Impact of process protocol design on virtual team effectiveness

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Impact of process protocol design on virtual team effectiveness

by

Christofer Sean Cordes

A dissertation submitted to the graduate faculty

in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

Major: Human Computer Interaction

Program of Study Committee:
Anthony Townsend, Major Professor
Stephen Gilbert
Brian Mennecke
Gerry McKiernan
Kevin Scheibe

Iowa State University
Ames, Iowa
2013

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DEDICATION

This work is dedicated to my family, friends, and colleagues that have made the quest for knowledge and understanding such a big part of my life. Particularly my family who supported and encouraged the many hours of academic effort over the years that led to this research, and especially my wife Jennifer who has been there at every turn of the dissertation process, including providing food on-the-fly, document formatting assistance, and technical support during the study trials. In addition, I would like to thanks my friends and colleagues who supported my exploration by listening and dialoging with me through many conversations and providing a sounding board for my thoughts, ideas, questions, and reflections on how the virtual environment impacts team behavior.
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I want to also offer my appreciation to those who helped support the project technology, including technology testing, providing user experience feedback on the navigation and design elements critical to performance of the task, and technical support during the task. In addition I want to thanks the departmental staff who kept project administration on track and moving forward. Perhaps most important, I would like to thank those who participated in the experiment. Signing up, scheduling, performing the tasks, and taking numerous surveys in the virtual environment can be a challenging experience, and the patience, flexibility, and enthusiasm of the teams that completed the study not only made the project possible, but rewarding beyond the work itself.
This dissertation examined the influence of action process dimensions on team decision performance, and attitudes toward team work environment and procedures given different degrees of collaborative technology affordance. The work provides insight into how team process impacts immediate and emergent outcomes in virtual work, and the extent that lean communication and collaborative technology supports or constrains effectiveness. The study is framed by theoretical perspectives fundamental to the study of virtual team interaction including: group member influence, patterned interaction, socio-technical dynamic, and groups as information processing systems. Process models were used to provide context for understanding team behavior in the experimental task, and clarify understanding of process influence on team performance and attitudes.

Two hundred-eight students completed the study comprising 52 four-member teams. Teams performed the same complex hidden profile task in a completely dispersed virtual work space using the online Google document application. The dynamic of the experimental task provided insight into how virtual teams share and exchange information leading to decision outcomes, the impact process has on team affective outcomes, and the role technology affordance plays in virtual team process and outcomes.

A 2x2 factorial design based on prescribed action processes and two degrees of collaborative information display structure was used to test predictions relating to communication process and display structure on team decision performance, climate, and procedural justice perceptions. The results showed that action process structure has a small but meaningful effect on decision performance, team climate, and procedural justice perceptions.
Tests for interaction effects were mixed. Collaborative display structure supports process influence in the predicted direction on performance and climate outcomes, but this effect was not significant. However, display structure had a differential moderating effect on procedural justice outcomes.

In addition, confirmatory factor analysis was performed to clarify relationships in the proposed model. The majority of indicators loaded significantly (11 of 13). However the majority of goodness of fit indicators, while approaching acceptability, did not meet established levels of fit. In addition, the squared multiple correlations across indicators was relatively weak with only 5 of 13 observed variable at or approaching the accepted 0.50 threshold. This indicated low ability of the latent construct to explain variance in the indicator variables, and high degree of residual error. Namely, findings from the confirmatory factor analysis implied other latent factors are operant in the relationship between process and performance, and refinements of the study design and sampling methods is suggested before the findings are generalized or substantiated.
CHAPTER 1

INTRODUCTION

Changes in business requirements and advances in technology have contributed to a shift in work structures. A response to these changes is the increasing use of virtual teams (Johnson, Bettenhausen, & Gibbons, 2009). It is estimated that over half of professional employees work in virtual teams (Kanawattanachai & Yoo, 2002). While debate over an exact definition of virtual teams remains elusive, these work units are generally defined by one or more non-collocated members, using synchronous and asynchronous technology to perform routine and complex tasks that may require a wide range of processes to acquire, exchange, and apply information (Suchan & Hayzak, 2001; Kossler & Prestridge, 1996; Townsend, 1998; Ananth, Nazareth, & Ramamurthy, 2011). While virtual teams are similar to physical teams in many ways, they are distinct on a number of dimensions, including configuration of team members across time and distance, communication processes, type and complexity of work performed, and the context in which the work occurs (Lurey & Raisinghani, 2001; Colquitt, 2001). Work configurations and communication structures unique to virtual teams have significant impact on skill requirements, member interaction, and communication methods (Guzzo & Dickson, 1996; Lojeski, Reilly, & Dominick, 2007).

The flexibility of virtual work can enable success by providing a way to bring together diverse expertise over time and distance, often employing audio and video technology to help approximate processes of the physical environment. In addition, unique technology affordances temper virtual team action and performance (Fuller, Hardin, & Davison, 2006), such as the ability to capture, share, and apply information to make decisions. Successful outcomes often depend on the ability of members to apply
communication technology to produce and use information to solve problems (Pont, 2001; Conference Board of Canada, 2006; Society for Human Resource Management and WSJ.com, 2008). However interaction of time, space, and technology make it more difficult to exchange knowledge, make decisions, and manage virtual teams (Berry, 2011; Hong & Vai, 2008, Mirakaj, 2010). Team effectiveness then can be thought as the successful structuring of dimensions of team, technology, task, and context (Mazmeki, 2000).

For instance, complex tasks such as planning, collaboration, and decision making may be more effective when performed in the virtual environment because of the ability of technology to foster interaction process. Likewise, computer mediation can enable timing and sequencing of activity, and shared representations of task information that keep members on the same page and provide a common ground that promotes participation (Marks, Mathieu, & Zaccaro, 2001). This is especially true when “team processes are adapted to the affordances of the CMC environment” (Rice, 2007, p. 579). As Rice demonstrated, when trained on technology use, work process, and task structure, virtual team performance can increase significantly (2007).

However, computer mediation can also limit information processes required for effective communication and collaboration. Virtual teams are generally successful performing low complexity task requirements that more closely approximate the process of face-to-face teams. However, higher complexity problems, such as the knowledge based work performed by most virtual teams, have less permeable boundaries and require a high degree of real-time interaction (Bell & Kowzloski, 2002; Kirkman & Matheiu, 2005). In addition, virtual team communication and collaboration functions are often independent, combining synchronous and asynchronous methods of interaction. This allows team
members to work across constraints of time and space. But it also alters the patterns, processes, and meaning of the work between team members. For example, military teams in the field operate under environmental conditions that can limit use of rich media; on the other hand, alternatives such as text chat may fall short in providing verbal and gestural communication cues that clarify meaning in face-to-face teams.

Given these configural, contextual, and task related variables, virtual team work is a complex concept that requires new research approaches to address inconsistencies in our understanding of virtual processes (Clear & MacDonell, 2011), tools, and techniques that can maximize effectiveness of distributed work (Stevens & Campion, 1994).

**Problem Statement and Purpose of the Dissertation**

**Problem statement**

Virtual teams are perhaps the fastest growing organizational work unit. But given the long history of small group and team research, empirical study of what makes virtual teams effective is relatively recent. Much of the virtual team research has focused on defining differences between virtual teams and their physical counterparts. Yet despite similarities to physical teams, the distribution of members and reliance on technology to communicate makes virtual teams distinctly different, especially in terms of the processes they use to perform work.

Because teamwork processes are interdependent acts that guide and coordinate the transformation of inputs to outcomes, the technology-action dynamic is critical for virtual teamwork success. However, while general understanding of virtual team effectiveness has grown the relationship between communication modalities and virtual team process remains less understood (Hollingshead, McGrath, & O'Connor, 1993). As Luery notes, without
“dependable processes and strong interpersonal relationships based on information and communications,” advanced technologies alone cannot optimize effectiveness (2000, p. 11).

Virtual teams work under technical conditions that can create uncertainty about the stability of the work environment. Exploring how computer mediated technology (CMC) can be best integrated through interactive processes such as monitoring, feedback, and coordination may lessen some of the negative impact of uncertainty on perceptions of team procedures. A key to this idea is that CMC can support greater interdependence and participation. Computer mediated collaboration can provide strong interdependence that leads to shared understanding and commitment to process and outcomes. Teams gain a sense of sharedness a number of ways, but at minimum this requires team interaction, mutual patterns of understanding, and norms for behavior. Team members must work together to complete tasks and this cooperation can lead to increased sense-making and social influence across the team (Cohen & Bailey, 1997; Colquitt, 2001). Accordingly, Bell and Kozlowski recommend further research on the “interaction between communication technology and task type on team processes and effectiveness,” particularly regarding dynamic, complex tasks (2002, p. 44) such as decision making.

Teams tend to create an understanding of their work that reflects their own unique circumstance. Technology appropriations are unique to the social structural context and the behaviors and perceptions of users; so when teams bring social structures to life, the outcomes may be not be consistent with the original intent of technology features and accompanying task and environmental structures. The alignment of interaction processes with the structural potential of technology and surrounding conditions can lead to outcomes that are more or less predictable and favorable (DeSanctis & Poole, 1993), suggesting that
process structures designed to foster effective interaction in the virtual environment can lead to improvements in performance, and provide insight into how teams will behave given their unique operating conditions.

Towards a better understanding of the relationship between team process and outcomes, and the role of mediating technology in this dynamic, this study addresses three main goals. First I will examine the impact of virtual team action process structure on effectiveness outcomes of decision performance, team climate and procedural justice climate using a taxonomical team process framework.

It is argued that an action process structure that is highly systematic, interdependent, and mutually supportive will increase decision performance by reducing individual and group level bias and sampling preference in the decision process. Namely teams using a structured action process that supports monitoring, backup, and coordination of task information (Marks et al., 2001), will make better decisions.

Second, research suggests action process can be structured to heighten engagement and develop a feeling of social presence (Aoki, 1995) that supports interdependence and interaction essential in building a sense of community among participants (Reid, 1994). Specifically, teams in the study using an action process structure that provides opportunities for interdependence, alignment with team tasks and goals, and dynamic to foster better alternatives will have more positive perceptions of the team work climate. Likewise, action process structures should also enable more accurate information representation, consistent procedures, and better opportunities to influence discussion and outcomes, which will positively impact team perceptions of procedural fairness.

Finally, I will examine potential moderating effects of communication technology
modality on the relationship between decision performance, and team climate and procedural justice measures. Specifically, when teams are provided with increased technology affordance that allows members to visualize and collaborate directly with decision information, participation, interdependence, information accuracy, and correctibility is amplified so that the influence of action process structure on decision performance, team climate, and justice climate perceptions increases.

Given this backdrop, the study will address the following research questions relative to the role of action process structure and communication technology affordance in virtual team work.

To what extent does action process structure influence perceptions of team climate?
To what extent does action process structure influence procedural justice perceptions?
To what extent does action process structure impact team decision performance?
To what degree does technology affordance moderate performance and attitudes?

**Purpose of the Dissertation**

The study adds to the growing body of interdisciplinary research on computer-mediated decision making in virtual team environments in some useful theoretical and practical ways. While there is a rich body of literature examining the relationship between team inputs and performance and attitudinal outcomes in both face-to-face and virtual settings, this dissertation is relatively unique because it adopts an intervention driven approach to examine virtual team effectiveness by varying task process structure in a completely open online work environment. Specifically, some teams will use an action process structure designed to improve decision making and perceptions of team climate and procedures, while other teams will not. Likewise, while many studies have examined the
impact of media richness (the degree to which technology can approximate communication in the physical environment) on team effectiveness, there is little current empirical knowledge on the impact of extending lean media (combining a collaborative text mode with text based communication) to improve team outcomes.

While teams increasingly use rich media technology, it is not always available or practical, so it is likely that virtual teams will continue to use a variety of rich, lean, synchronous, and asynchronous communication tools. As such, this study extends research on virtual team work practice by helping to identify needed adaptations to “business processes based on information and communications technologies that can foster success,” in flexible, distributed, demanding information environments (Grenier & Metes, 1995, p. 2).

Third, if the full potential of virtual teams is to be realized, there remains much to be understood regarding how virtual team processes can be maximized to generate productive decision outcomes (Townsend et al., 1998; Powell et al., 2004; Kirkman, et al., 2002). For instance, hidden profile research employs a number of interventions for improving decision accuracy including: listing and information structuring, cognitive priming, and preference advocacy (Greitemeyer & Schulz-Hardt, 2003; Mojszisch et al., 2004; Voigtlaender, Pfeiffer, & Schulz-Hardt, 2009). All of these techniques show merit for improving performance. However intervention strategies for improving virtual decision performance have not been thoroughly applied and examined in the virtual work team scenario.

A final goal is to further understanding of how computer-mediated communication impacts how team members feel about virtual work procedures. “The more people participate in decision-making through having influence, interacting, and sharing information,” West (1998) explains, “the more likely they are to invest in the outcomes of those decisions and to
offer ideas for new and improved ways of working” (p. 240). Yet while it is accepted that procedures that provide equality, consistency, and control can foster effective team effectiveness, a continued need for context-sensitive research regarding the impact of procedural rules on virtual team perceptions still exists (Colquitt, 2006).

In this dissertation, I intend to examine the impact of monitoring, backup, and coordination structures on how team members feel about the procedures used to make decisions. These structures help teams clarify goals, information, and progress through interdependent, collective action that is accurate and consistent. As such, it is reasonable that action process structure can be designed to support fairness rules, and teams using such a procedure should have more positive feelings about the procedures used.

Finally, I will explore the integral role of technology affordance in team decision process where potential for visualization and interaction with decision information is increased for some teams with the aid of collaborative text document, while other teams use a chat only communication protocol. This structural configuration provides insight into the influence of lean collaborative ability on the effectiveness of baseline chat communication processes. The relationships between structuring conditions and outcomes of decision performance, team climate, and justice perceptions are shown in the projected research model in Figure 1.
It is believed that team action process structure will impact the amount and quality of information made available to the team, and the ability of the team to effectively process this information to reach an optimal decision. In addition, the action process structure creates conditions that should foster perceptions of procedural fairness and shared team climate.

Assuming the use of a relatively standardized hidden profile research task, it is suggested that teams using an action process structure that enables greater participation, better information access and exchange potential and more equitable and regulated procedures, will make more accurate decisions, and have more positive attitudes of procedural fairness and team climate than those using ad hoc processes.

Finally, it is anticipated that the team action process structure and team effectiveness relationship is moderated by the way that decision information is made visible and collaborative. That is to say, teams using a protocol designed to structure decision information through document collaboration (e.g., novelty, valence, and rank of decision attributes and alternatives) are anticipated to demonstrate greater decision performance and stronger perceptions of team procedures and climate than teams with lesser affordance to visualize and manipulate information as a group.
The moderating and outcome variables in this study are congruent with dominant variable constructs used in the virtual team literature, including performance measures such as information sharing, decision accuracy and decision quality, and attitudes regarding work climate and procedures. However, examination of the impact of action process and information display structuring relative to these areas is currently the exception rather than the rule in the stream of research.

Towards greater understanding of these dimensions of collaborative decision making process, the dissertation will contribute to the virtual team literature by helping advance knowledge about the relationship between action process and information collaboration structures using text-based communication. Given this, the study uses a solvable, relatively complex task, and applies levels of process structure across conditional groups. It is felt that the knowledge from this experimental arrangement may contribute to both conceptual and practical understanding useful to researchers, team designers, and managers by offering practical, theory driven ways to maximize team work and provide insight into the development of virtual work structures.

The remainder of the dissertation is outlined as follows. Chapter two discusses the existing literature important to provide theoretical and empirical basis for the study. In chapter three, the research model, hypotheses, theoretical constructs, and processes for testing and measuring the projected study outcomes are detailed. Preliminary analysis of the data including data treatment, manipulation checks, data aggregation, and results of all hypothesis tests are presented in chapter four. Chapter five concludes the dissertation with a discussion of the research, including theoretical and practical assertions as well as limitations and avenues for extending the study to future virtual team process research.
CHAPTER 2

LITERATURE REVIEW

A review, examination, and critical analysis of existing scholarly literature (Gall et al., 2006; Hart, 1998) relevant to virtual team effectiveness was performed in order to delimit the research problem, distinguish areas of inquiry that would most benefit from further contribution, provide useful new perspective, and identify recommendations for further research. Because the area of team research has a long history and broad scope, the review centers primarily on the central study objectives, and less on peripheral aspects of the research topic (Biggam, 2008). Specifically, the review takes the filmmaking approach suggested by Rudestam and Newton (2005). A longshot of background material is presented to provide overview of the central theories and concepts of teams and team effectiveness. Then a mid-range view of literature focused on variables related to team effectiveness is developed to refine background concepts and summarize issues relevant to the orientation of virtual team study. Finally, a “careful examination” of literature having “the most direct relevance to the proposed research question(s),” provides a close-up view of the areas of study interest (2005, p. 62).

As such, the discussion opens by defining the concepts of groups, teams, and virtual teams, and describing the relationship between teams and team effectiveness. Next, I will outline the historical grounding for this study drawing from specific streams of group, team, and virtual team literature relating to the most salient aspects of this research. Focusing this, I examine the literature highlighting specific team inputs, processes and outcomes, with emphasis on studies that explore team member information sharing, communication, and process coordination on outcomes of team effectiveness. Specifically, an input-process-
output framework is used to describe the role action process and information display structuring play in cognitive, behavioral, and attitudinal outcomes.

A Working Definition of Groups, Teams, and Virtual Teams

Descriptions of collective units of people vary widely in the literature. For example, the idea of team is frequently used alongside similar connotations of groups, often depending on the researcher and field of study. Because of this, conventions of distinction between these definitions are not widely shared (Cohen & Bailey, 1997). Both groups and teams share a number of commonly examined dimensions such as configuration, type and degree of interaction, and performance. However there are distinct differences as well, especially as the study of teams advance. Accordingly, this literature review tends to use the terms group and team interchangeably in the narrative, except where referred to specifically in the research or when distinctions are needed. In addition, a working definition of groups, teams, and virtual teams is included to focus and clarify these distinctions as used in the dissertation.

Groups

Historically, the lines distinguishing groups from teams are blurry at best. Myers defines groups as “two or more people who interact with and influence one another”. Members perceive the group as a unique entity beyond the individual, and think of the whole in terms of “us” (1993, p. 305). However this perspective does not specify a shared understanding about goals or outcomes. From this, a distinction can be made between groups and teams in that teams share a collective purpose (Townsend, 1998).

But this is not always consistent in the experimental and theoretical literature. For example, Cordery, Mueller, and Smith (1991) studied the collective decision making process of small groups in the business setting, and Thibaut and Walker discuss fair group decisions
in terms of member agreement upon an outcome (1978). Likewise, Arrow, McGrath, and Berndahl’s theory treats small groups as complex, adaptive, dynamic systems represented by bounded, structured entities. These group systems influence and are influenced by the purposive, interdependent actions of individuals (2000).

**Teams**

There also remains ambiguity surrounding the definition of teams. For this study, teams are defined as collections of persons who are task interdependent, share responsibility for outcomes, and function as “as an intact social entity, embedded in one or more larger social systems” (Cohen & Bailey, 1997, p. 241) distinguished by the alignment of members with some common goal (Roberson & Colquitt, 2005; Hackman, 1987).

The goal-oriented focus of teams makes outcomes implicit. Team outcomes are typically described in terms of processes, products, strategies, attitudes, and behaviors (Lipnack & Stamps, 2000; Duarte & Snyder, 1999). To reach goals, teams are dependent on the availability of shared resources. Thus, one critical limitation for organizational teams is the inaccessibility of critical resources, especially information, without which even well designed teams may fail to achieve effective outcomes (Luery & Raisinghani, 2001).

**Virtual teams**

As with the group and team literature, there is a wide range of perspective for defining virtual teams. Virtuality is often a matter of degree that can confound precise definition. As Fiol and O’Connor posit “physical distance among team members, interrupted by only occasional face-to-face contact, is likely to pose a different set of barriers to member identification than a complete absence of face-to-face contact” (2005, p. 19).
In general, virtual teams are groups of geographically and/or organizationally dispersed coworkers that are assembled using a combination of telecommunication and information technologies and meet at varying distances, times and frequency (Townsend, 1998; Lipnack & Stamps, 1999). These elements are associated with the development of a multidimensional environment having different degrees of virtualness across dimensions (Cohen & Gibson, 2003). Towards clarification of the nature of virtual teams, work by Kirkman and colleagues (2004) help refine the orientation between group, team, and virtual team definitions. Namely, virtual teams are groups of people who work interdependently across space, time, and organizational boundaries using technology to communicate, collaborate and reach a common goal.

**Virtual Teams and the Conceptual Basis of the Research**

In this study, a functional perspective is adopted to examine the potential for process gains in team effectiveness by the structuring of action processes and collaborative display affordance to improve outcomes of team interaction. Poole and colleagues define functional perspective as one that examines “the inputs and/or processes that function to influence group effectiveness” (Poole, Hollingshead, McGrath, Moreland, & Rohrbaugh, 2004, p. 7). Towards the goals of this study, a functional perspective helps differentiate the actions and behaviors that promote effective performance, and those that impede it.

There are several established theoretical bases relevant to examination of action process and decision making in virtual teams. Arrow, McGrath, and Berdahl provide five particular orientations that help frame the basis for this study, including: the influence of teams on member attitudes, the patterned interaction of teams, teams as a mechanism for performing tasks, teams as information processing systems, and teams as sociotechnical
Teams as mechanism for member influence

Festinger’s social comparison theory posits individual opinion and ability cannot be evaluated against physical means alone. Although people bring distinct beliefs and attributes into the group setting, they tend to compare their opinions and abilities against similar others. The drive to evaluate and adapt individual attitudes and abilities is motivated by a dynamic interaction of minority and majority influences that have social impact on individuals. For example, as individual attitudes align with comparison group members, the influence between comparison group and individual group members increases (1954).

Similarly, Blau’s theory of social exchange (1986) provides insight into the interactive elements that lead goal driven behavior. As individuals weigh costs and benefits of interactions between groups and members, the degree to which individuals are satisfied changes. When someone receives help, it is expected they express appreciation. If he or she reciprocates, the social reward the other receives serves as inducement to extend mutual assistance as well which creates a bond between them.

In general, social influence is greater when effectors are high in status, close in immediacy, and when the number of people is greater (Latane, 1981). Likewise, leadership and expertise are critical inputs for team building, vision, and effectiveness. This can be especially important for virtual teams leaders who may need specialized skills not required in face-to-face settings (Staples, Wong, & Cameron, 2004; Webster & Wong, 2003).

Social exchange between team members also influences individual beliefs of fairness as group members gain knowledge of how others are treated (Milgram, 1974). Individual beliefs are shaped by the actions and attitudes of others. Therefore, team members need to be
close to “perceptions, attitudes, and behavior to be exposed to social influences” (Liang, Xue, Ke, & Wei, 2009, p. 301). As such, the proximal social environment provides vital information that individuals use to construct reality (were things fair, are my teammates of like mind, do we all understand what to do, can we do it?).

For example Liao and Rupp found when work group cohesion increases, there is greater likelihood that shared perceptions of the justice climate will develop as a result of these interactions (2005). Accordingly, the body of work regarding groups as member influence is important to this research because of its focus on member to member, and group to member interactive relationships, and the impact these relationships have on group and member attitudes, in particular attitudes towards the team work environment, and the procedures used to perform decision making tasks.

**Teams as a patterned interaction mechanism**

Bales research helped develop an empirical approach towards understanding small group work that continues to influence team study today (1950). The research is built on the principle that interaction systems are social in nature, and range from small groups to complete societies. His method, Interactive Process Analysis (IPA) was perhaps the first to provide a powerful, discrete way to examine small group interaction in real-time using a comprehensive measurement system. Designed to glean “the type of problem-solving relevance of each act for the total on-going process” (1950, p. 258), IPA was a major step in the development of process-centric methods for analyzing and classifying interaction behavior and member relationships in problem solving teams. Bales theoretical contributions were key to developing the concept of teams as human interaction systems with an “overarching problem-solving sequence of interaction between two or more persons” (1950,
and where effective problem solving outcomes are related to the ability of the members to develop status structures built on a “satisfactory set of social-emotional relationships to each other” (Bales, 1953, p. 21).

Bales original construct proposed six challenges related to communication and information processes that teams must address to solve problems effectively. These included: orientation, evaluation, control, decision, tension management, and integration with the group. These strategies have been applied successfully in the field to improve face-to-face team effectiveness. But developing effective interaction patterns between members can be more difficult in the virtual environment. Technology mediation over time and distance can impact the natural, regulated flow of information required for developing team communication, trust, coordination, and leadership structures. Successful information exchange is a primary factor for success in the virtual team environment; yet it remains difficult to approximate communication conditions of the physical task environment. Technologies used to perform group tasks can approximate the physical environment to some degree, but the quality and type of interaction patterns may often take a different form in the virtual setting.

For instance, matching the functionality of routine interaction, such as automating an online versus paper calendar is straightforward. Higher level processes, such as developing regulated structures for team discussion including who can speak, who they can speak to, the length of time a person can speak, and the order of turns, are not as easy to adapt. Thus, effective support for team decision making requires adapting in a positive way the interactive exchanges that happen as teams progress through the problem solving process (DeSanctis & Gallupe, 1987). It can be presumed then that the greater degree of change in communication
structures, the more dramatic the impact on team problem solving processes.

Interaction patterns can improve or impede team effectiveness, but the relationship between interaction patterns and effectiveness can be hard to unravel. Virtual interaction patterns may be more meaningful, useful, and effective to the degree they contain communication cues about the team members, task, and environment. Communication cues such as speed and frequency of data, tracking of team actions, and structure of information display provide details to the team about how to act. These factors interplay dynamically, so the combined impact may be difficult to determine.

For example, De Guinea, Webster, and Staples found virtualness was negatively associated with action process variables. In their meta-analysis of over 200 virtual team studies, high degree of virtualness was associated with decreased social presence, limited social cues, increased time and effort for communication, and less inhibited communication which led to higher conflict among team members. However, the overall impact of virtualness on quality, productivity, and team satisfaction was positive, suggesting there is more benefit gained than lost in overall performance despite the disconnect between team members (2005).

One explanation for this difference is the impact of copresence which can foster interaction and understanding across the team. Copresence is the cognitive and affective perception that persons in the virtual environment are collocated, working together, and of a like mind. Communication cues enable copresence by creating a sense that people are actually there, and in turn foster increased performance and satisfaction (Daft & Lengel, 1986; Ma & Agarwal, 2007). Copresence can improve communication, but this does not always translate to improved performance. In particular, virtual communication cues may not
be as effective as those in the physical setting. Virtual teams do not have the opportunity to share information through casual conversation that can fill in gaps in the communication process. For effective information exchange to occur, team members must be steadily available. As such, virtual communication can be hindered by lengthy and confusing interactions (Short, Williams, & Christie, 1976; Beranek, Broder, Reinig, & Romano, 2005).

So while it may be possible to optimize virtual communication, it is likely virtual team interaction patterns and communication cues are unique, and may never fully match the dynamic of those in the physical setting. Thus, varying degrees of media richness and non-traditional means of information exchange in the virtual environment suggest need for specialized protocols for structuring communication and collaboration procedures. As such patterned interaction theory is important to this study for its emphasis on task communication and coordination, and for insight into the role of computer mediation technology on the flow of team information.

**Teams as task performance mechanism**

Teams often perform complex, knowledge-based tasks that require interdependent action, and involve cognitive behaviors such as planning, knowledge integration, performance management, decision making, and process improvement (Mohrman, Cohen, & Mohrman, 1995; Marks et al., 2001). Although, task performance is impacted by a number of variables, the most commonly studied are those relating to task type, task behavior, and task processes. Early group task research systematically identified three core task types: production, discussion, and problem solving (Hackman & Vidmar, 1970; Morris, 1966).

Different task types produce distinct types of interaction. Production tasks call for the construction and demonstration of concepts, descriptions, and arrangements, such as writing
a story, or describing techniques used in a painting. Production tasks are thought to be the most difficult to perform, because they demand divergent thinking. This implies a higher level of task complexity, requiring members to use diverse resources, and more innovative and interdependent solutions. However, working on production tasks in groups may also foster high levels of tension, and competition, creating mixed feelings about the team and task (Hackman, 1965).

Discussion tasks demand evaluation of controversial topics or situations, generally with the requirement of group agreement, for instance whether an activity should be legal or illegal. Hackman found (1970) discussion interchanges are more relaxed. But because of this groups sometimes lack initiative to follow through with tasks. Likewise, conflict and performance is generally low in discussion groups. Hackman suggests that because discussion is a typical activity for many people, the task format may not provide enough salience for groups to take it seriously.

Problem solving tasks require planning and action for solving a particular difficulty, for example how to determine the most efficient travel route given a set of road options and conditions. Problem solving teams must work well together to be effective. Problem solving tasks require members to prepare a set of actions to achieve a goal. While problem solving tasks require less divergent thinking than production tasks, conditions that lead to creative tension in production groups are not present in problem solving groups. As such, problem solving groups may lack benefits arising from constructive disagreement which leads to better alternatives.

Because task requirements vary, different types of tasks require, or at least inspire different patterns of member behavior that result in substantially different emphases in the
group interaction process. Long before the digital age, Sorenson identified five individual task behaviors central to virtual team decision making today: structuring, generating, elaborating, evaluating, and requesting (1971). Structuring behaviors focus attention on the main objective of the problem or ask for consideration of part of the problem. Generating behaviors bring new ideas to the group through the introduction of new ideas, or additional insight into existing information that requires further consideration. Elaboration behavior lets individuals explain and justify how information they have offered contributes to the task. Evaluations allow persons to compare, contrast, and clarify task information and actions, pointing out inconsistencies, and showing agreement or disagreement. Finally, individuals may make requests to the group for additional facts, a review of previous actions and information, or ask if other members have any additional information or suggestions about additional actions needed.

Group size is also a major factor in task performance (Hackman, 1970). As groups get larger, the ability to manage communication is challenged. Some individuals tend to dominate discussions more often, and others feel too inhibited to speak in the large setting group setting. In addition, there is a greater sense of competition in larger groups, which can lead to disagreement that obstructs task completion. On the other hand, large groups tend to benefit from increased amount and diversity of member skills and abilities. For instance, conflict in large groups can be reduced by providing central leadership and creating sub-groups that limit exposure of any individuals to the larger group. As such, large groups may offset coordination issues through benefits of greater, more diverse resources, and distinct group configuration.

In small groups, satisfaction is higher, but members can find the work load
overwhelming. Also, small groups may become overly intimate, preventing members from expressing disagreement that generates constructive conflict that can lead to better solutions. Given contraindications regarding the relationship between task and team, Hackman called for “further investigation of the means by which the interaction between task characteristics and performer characteristics takes place” (1970, p. 52). More recently, the task oriented literature has begun to focus on collective process elements that form the dynamic basis of task interaction, including: communication, coordination, task-technology fit, and monitoring.

Task coordination is important to maintain a logical, consistent flow of work activity. And based on a large body of research, Powell asserts that effective coordination is closely related to performance outcomes. But virtual teams face a number of challenges trying to coordinate tasks across time, space, technology structures, and individual characteristics. Given these difficulties, researchers have developed interventions to improve task coordination.

One approach that has shown success is use of introductory and periodic face-to-face meetings (Powell, Piccoli, & Ives, 2004; Majchrzak, Rice, King, & Malhotra, 1999). This gives opportunity for teams to fill-in-the- blanks of task understanding resulting in increased performance. However, face-to-face meetings may not be possible for all teams. Another less traditional method is the object-oriented approach which helps reduce process loss by standardizing inputs, processes, and outcomes. Ramesh and Dennis suggest that compartmentalized teams with highly structured work processes using media that provides contextual understanding may be more effective than tightly coupled teams using typical rich media coordination procedures (2002).
Technology is integral to virtual team function, and given the fact that they perform a wide variety of tasks, it is important to closely evaluate task-technology fit. Technology choice is based on available options, the requirements of the task, and the ability of individual members to interact with the team through the technology. However, even when limited options are available, members will work within technology constraints, or adapt the technology to meet their own needs. Team members adapt and restructure technologies to perform work by drawing on the affordance of the technology, and the social context the work occurs in.

Relative to tasks, adaptive actions comprise a series of generally positive appropriation moves which are response in part to the misalignment and malleability of technology, and the events that lead to changes requiring the team to adapt (Majchrzak, 2000). Typically, teams will initially alter their communication structure to match the features of available technology. But over time, team members adapt these technology structures to meet communication requirements as understood by the team. Thus, eventually teams are generally successful in adapting technology to meet communication and coordination needs regardless of the variety of options.

Finally, task performance is dependent on the understanding of team members about the purpose of the task, the progress the team is making, the responsibility of individual members, and the ability to interact timely and effectively. Towards addressing task performance challenges, Malhotra and colleagues recommend the following. First, clear objectives must be made and understood by all members, including subsequent deviations from original goals. Second, teams must bring forward or otherwise create a sense of shared understanding about the task. Third, team members must have sufficient time to interact,
including face-to-face meetings when possible. In addition, roles should be well defined upfront, but allow for flexibility should requirements change. Last, communication protocols should be established about what is communicated, to whom, when, and what for (Malhotra, Majchrzak, Carmen, & Lott, 2001).

Team task performance concepts inform this research because it frames the relationship between team member task requirements, and supporting technology. Of particular interest is the role of mediating technology on task processes used for decision making, and the impact of changes in task process on associated cognitive, behavioral, and attitudinal outcomes.

**Teams as a mechanism for information processing**

Drawn from the metaphor of the personal computer, a large pool of research has studied teams as information processing systems for “acquiring, processing, storing, exchanging and using information” (Arrow et al., 2000, p. 10). Teams process information to perform cognitive tasks such as planning, problem solving, and decision making. Information is shared among group members in mind and action, and the degree to which information is shared impacts individual and group outcomes. In the information processing view, performance is often measured in terms of the outcome of cognitive tasks. Performance varies between groups and effectiveness is based on a number of dimensions, including: uniqueness, convergence, and divergence of information, innovativeness of ideas, and variability of the cognitive process between groups and members.

Decision making is perhaps the most critical information task performed by teams. Because decision making requires the ability to use information effectively, the study of team information processing continues to be a critical stream in the team literature. This is
especially true in the case of virtual teams where members face communication and coordination challenges such as difficulty creating shared understanding, sporadic interaction, reliance on computer mediation, increased need for flexibility, and loose definition of communication protocols due to changing requirements (Malhotra et al., 2001).

In general, groups are found to be more effective than individuals at performing memory tasks, and there are three mechanisms thought to lead to the superiority of group information processes. First, groups have a greater pool of available information than individuals. Second, groups have the ability to monitor and provide feedback about information shared through the group that provides error correction. Last, groups have stronger decision making processes for evaluating information. For example, findings by Hinsz and colleagues support that groups have superior decision making processes partly because error correction leads to greater recall. This effect is more pronounced when members have high confidence, and are able to determine what can and cannot be recognized (Hinsz, Tindale, & Vollrath, 1997).

Performance outcomes in memory tasks are an integrative effect of information pooling, error correction, and decision making functions, as group members bring information into the discussion, recognize what is missing, and aggregate this information through combinatorial process. For example, Hinsz found that decision performance was a product of “the degree of consensus favoring a response alternative, the correctness of a response alternative, and the confidence members have in their responses” (1990, p. 717).

Decision alternatives that are easily proven correct are more likely to be accepted by the group. Alternatives that are less demonstrable require greater consensus before they are accepted. Supporting this idea, Stasser and Titus cite the hidden profile task, where some
information is shared across the team, while other critical information is initially possessed by only some members to confirm that individual preference and group bias mediates information exchange processes (2003). Individuals tend to stick to their initial choice. And even when all information is potentially available during discussion, groups are more likely to discuss common information first, discuss it more, and remember it more often. Further, there is social cost for introducing new information, so individuals are less likely to bring new information forward, or go against the will of the majority.

Decision processes tend to vary by the nature of the task (Davis, 1982), making development of performance interventions difficult. Laughlin (1980) notes that the apparent decision scheme for each task type varies as a function of how easy it is to demonstrate to group members that an alternative is the correct response. Accordingly, Cramton (1997) recommends that knowledge sharing in virtual teams be enabled by evenly distributing knowledge to all team members, and communicating knowledge of both content and context. For example, Voigtlaender and colleagues found marked improvement in hidden profile decision making when all information was made available, and listed by valence and novelty in a visual display format by the team (Voigtlaender et al., 2009).

In addition, a number of other strategies have been used to foster process gains in hidden profile problems, such as advocacy, priming for critical thinking, and full profile disclosure. Yet no intervention has been entirely successful. Explanations for failure to detect the solution in hidden profile problems have been attributed to dysfunctional individual process, (bias towards self-evaluated information), as well as group level processes (premature consensus, preference for shared information, and consistently presented information). Nonetheless, while process interventions generally improve performance by
addressing these challenges, a large percentage of groups still fail to select the best alternative (Greitemeyer, Schulz-Hardt, Brodbeck, & Frey, 2006; Brodbeck, Kerschreiter, Mojzisch, & Schulz-Hardt, 2007; Rentsch, Delise, Salas, & Letsky, 2010). In this study, the concept of groups as information processing systems highlights the critical role of information sharing behavior in the decision making process, in particular the role of process in information acquisition, exchange, and evaluation.

**Teams as sociotechnical systems**

The sociotechnical system perspective established the view of teams as open systems comprised of not only members, but the tools, resources, and technology available to them. The sociotechnical system perspective was developed from action research in real contexts, and emphasizes the dynamic relationship between workers, technology systems, and the organizational environment (Czaja & Sankaran, 1997). One key concept is that changes in technology impact existing group structures, and the tasks and technologies traditional to those structures (Arrow et al., 2000), including the design of work and organizational systems.

Sociotechnical systems are built on three interdependent components, a personnel subsystem consisting of group members, a technological subsystem, representing the technology available to the group, and a subsystem of external environmental factors that impact the group (Hendrick, 1997). The social and environmental systems impact member perceptions of the environment, while the technical element reflects the mediating factor of technology processes used to perform work (Karwowski, 2001). In a greater sense, these subsystems form a sociotechnical system representative of the resources and relationships of the work unit as a whole. Closer examination of sociotechnical systems reveal a complex set
of dynamically intertwined and interconnected elements, which include inputs, processes (throughputs), outputs, feedback loops, and the environment in which the system personnel operate and interact (Emery & Trist, 1960). Subsystems interact with each other, and the optimization of dynamics between social, technical, and environmental subsystems can lead to improved attitudes and performance.

In virtual environments, the technical subsystem that mediates communication and coordination may have greater impact on performance than in other team environments. In the collocated environment, interaction is transparent; members can see and react readily to what others are doing. In the virtual workspace this awareness is obscured, and communication and coordination of team work is often more challenging, impacting both performance and attitudes. This is due in part because computer mediated environments force a degree of abstraction or opacity on virtual interaction not found in physical settings. Opacity is a state of ambiguity and artificiality that shapes the interaction of the virtual environment (Fiore, Salas, Cuevas, & Bowers, 2003).

So in one sense, technical subsystems are effective to the degree they offer clear representations of the work. In the virtual team, work representations are clarified through the visual and verbal communication cues that approximate the physical team environment and the shared team and task resources that must be effectively acted upon (Anderson et al., 2000; Greenberg, 1991). However, technical subsystems in the virtual work space may not provide adequate communication and coordination cues. This limits availability of implicit strategies available to virtual teams. Therefore, opacity in the virtual work space can impede interactions that foster positive team attitude, performance, and continuance, especially under conditions of high task complexity, workload, and time constraint.
Alternately, Fiore and colleagues (2003) describe the sociotechnical system in the context of a distributed coordination space, a framework where attitudes, behaviors, and cognition occur during three phases of team interactivity. The pre-process interaction phase includes task planning and preparation, and the forming of shared expectations. For instance teams often clarify goals, determine available resources, and then set a course of action. The in-process phase is a period where task execution occurs, and the elements of coordination and communication are most critical. During task execution, teams employ the technical system to facilitate required actions, monitor progress, provide feedback to the team, and adjust direction. In the post-process phase team perceptions reflect shared feelings about task and outcome performance. For example, in the post-process, teams may more or less agree about whether goals were met, the ability of the team to meet standards, and whether or not the team should continue. In this study, the sociotechnical perspective highlights the relationship between technology mediation and the impact this has on member-to-member, member-to-technical and member-to-environmental system process interaction.

Framework for Understanding Team Effectiveness

This study adopts an input-process-output (IPO) model to provide clear description to the basic operations of virtual team decision making. Models help drive team research because they allow a concrete way to approach the investigation at the local level to gain deep knowledge of operational functions. Step based models are particularly useful in understanding tasks such as problem solving and decision making because they help clarify the objectives, means, and processes for selecting and implementing alternatives, and evaluating solutions (Emergency Management Institute (U.S.), 2002).

The input-process-output model offers a conceptual framework that has traditionally
provided central ideation for studying team effectiveness (Hackman & Morris, 1975). In general, inputs comprise tangible things that go into the system and allow outcomes to be achieved such as: materials, knowledge, human resources, tasks, technology, and climate. Inputs clarify individual, team, and organizational factors that can foster or inhibit interaction and so can be said to guide team processes at three levels (McGrath, 1964): individual factors (characteristics, skills, abilities, and traits), team-level factors (task structure and team size), and organizational and contextual factors (environmental complexity and team climate).

Processes represent dynamic interaction between group members and resources, and help define how teammates interact and work together to achieve task related goals. From a systems perspective, Lee, Espinosa, and Delone explain that rigor and consistency of related processes impact team ability to align with tasks. Process rigor is the adherence to highly structured, well-defined guidelines, clear definition of goals and responsibilities, formal processes of development, and accurate performance tracking. Rigorous process improves team coordination effectiveness, while process consistency enables commonality and uniformity of processes across groups. Consistent processes are critical to team functioning because they help members know what to expect. For example consistent processes can improve team communication by reducing uncertainty and variance between individual perceptions of information (2009).

Outcomes in the IPO model represent task and non-task consequences of a group’s functioning. Outcomes include performance measures such as quality, quantity, and efficiency, as well as affective and cognitive perceptions, such as satisfaction, trust, cohesion, climate, and fairness (Mathieu, Maynard, Rapp, & Gilson, 2008; Martins, Gilson, & Maynard, 2004; Anderson & West, 1994; Colquitt, 2001).
In the IPO model, process leads to alterations of the environment and to the group itself so outcomes become inputs for the next phase of activity forming a recurrent cycle of input, process, and output (McGrath, 1991). From this perspective, the interaction of inputs, process, and outputs, and the individual and shared behaviors and attitudes of team members lead to immediate and continued outcomes that reflect team effectiveness (McGrath, 1984; Hackman, 1987; Roberson & Colquitt, 2005). Most definitions of team effectiveness express the concept as a multidimensional construct, but there is no complete consensus about specific measurement criteria (Goodman, Ravlin, & Schminke, 1987). However broadly defined, there is sufficient overlap among definitions to assume that criteria for team effectiveness include: a clear understanding of goals, procedures, and required actions, effective and efficient production of outputs, attitudes about the team work experience, and the team’s potential to perform effectively in the future (Hackman, 1987; Cohen, 1994; Guzzo & Dickson, 1996). Many studies have focused on the relationship between inputs and outcomes, but less exploration of the effect of process on outcome has been undertaken. Towards this, Hackman and Morris suggested more complete description of the relationship between technology, task, and product in work groups is needed (1975).

Along this line, Baninajarian and Abdullah (2009) propose that team process structure (work context, team design, and team interaction dynamic), and the use of a team process facilitator (to provide task focus, evaluate performance and progress, and push tasks forward), may increase team effectiveness. Key to their concept is the idea that teams are effective to the extent that facilitators are skillful at the task, possess strong communication skills, and can provide useful information and feedback to the team. Likewise, team members are effective when there is a high degree of interdependence and coordination, and when the
task design ensures positive interaction in the group. This is similar to other process related applications of team research. For instance, team instruction designed to foster self-disclosure, clear communication, and increased interaction, has been shown improve outcome effectiveness and attitudinal development in conditions where high team diversity and strong individual attitudes disrupt performance (Powell, 2004). The dynamics of the input-process-output model provide a grounding point for the study of team effectiveness. A more focused review helps to clarify the role and impact of team inputs, outputs, and in particular process on team effectiveness.

**Team Inputs**

**Group size**

Group size is often cited in the literature as a primary variable of team performance (Steiner, 1972). Godar and Ferris (2004) explain that in general team size negatively impacts the ability to perform tasks. However, some research has shown performance increases with group size (Gallupe et al., 1992). Work by Hackman and Vidmar help clarify this discrepancy. In their research, large groups have ability to harness diverse resources, and consolidate member perspectives through sub-groups to increase performance. But members are often dissatisfied with process complications due to increased coordination demands across teammates.

And while small teams generally have greater coordination, and higher process satisfaction, they often lack sufficient resources to complete tasks. Thus small teams have closer member relations which increase satisfaction with team processes, but effectiveness is hampered by lack of resources to perform effectively. Large teams on the other hand have resources to generate stronger outcomes, but require stronger processes to manage diverse
The distance between members has a strong impact on the strength and disposition of team interaction. Physical and temporal dispersion reflects the dynamic of distance between members, and influences the amount and type of work performed with the team, the configuration of team members and technology, and the degree that technology is required. Geographically and temporally dispersed teams rely heavily on computer mediated technology to perform work. This increases uncertainty, and impacts group processes, relationships and the context in which the work occurs (Luery & Raisinghani, 2001). Owing to this, interactions required for task performance such as member interdependence, communication, and coordination are unique in the less structured collaborative workplace (Scheibe, Mennecke, & Zobel, 2006).

In general, the more proximal the members, the more members interact, and thus the more member perceptions converge (Salancik & Pfeffer, 1978). Miller argued that members rarely interact with others who are not close to them in physical space (1989). This is consistent with arguments by Newell and Simon (1972), who suggested that greater distance between system members reduces bond strength. As such, larger teams are characterized by less social interaction and greater physical distance between members (Hare, 1992). Given this, member dispersion can pose challenges to virtual team effectiveness. For instance, lower performance and satisfaction perceptions are associated with the configuration of team members, team technology, and team interaction. Schweitzer and Duxbury in one case, found team performance and satisfaction was negatively impacted by distance between team
members, proportion of virtual team members, and by the time spent working online with the team (2010).

**Task Type**

Task type can be classified on a number of dimensions. Early group research outlined four demonstrable task types that serve as a general reference point. Production tasks, involve the development of a presentation, idea, or other tangible, meaningful product. Discussion tasks entail the evaluation of an issue. And problem solving task require designing a plan for action to eliminate some challenge or dilemma. Early research by Hackman & Morris found task type influences group performance and attitudes. Groups performing production tasks felt more coordination strain and conflict among members. However members felt they had greater ability to be creative and provide input. Groups performing discussion tasks experienced less conflict, but had lower quality outcomes in general. Similarly problem solving groups were more comfortable, and felt the team worked well together as a whole. For instance, group members contributed more openly to the task, and managed work time better (1975).

Research suggests task type interacts with team other team inputs, but the relationship is not always clear. For example, Hackman and Morris (1975) found no interaction between group performance and task type. However, more recent research suggests process strategies that are effective for small groups, such as turn-taking, member identification and contribution, and tracking of conversational flow, diminish as team size increases. However, there is evidence this impact can be reduced through interventions such as learning protocols that provide a scripted referent point. For example, Pfister and Oehl found that when group size increased from three to four members, a protocol using chat communication and a
referencing and listing function improved learning on a problem solving task, offsetting process losses due to team size increase (2009).

The nature of the task reflects levels of complexity, whereby some tasks are easier to perform than others. For example tasks involving factual knowledge are typically less complex than those that require solving a problem, or making a decision. As such, task demands impact team process in terms of interaction, and the behavior of the team as they perform the task. For example, a given task complexity may require adoption of appropriate strategies to reach effective outcomes. Gruenfeld and Hollingshead, for example, found teams with strong ability to differentiate between viewpoints and integrate conceptual similarities were more effective at solving problems than groups with low integrative complexity strategies (1993). However, while task type may guide the group towards adopting a more or less complex strategy, team behavior may still be constrained by outcome requirements (Sorenson, 1971). However this impact may be more or less favorable depending on the type of task performed and the conditions surrounding the team. For instance, complex tasks generally require greater coordination and take longer to perform particularly in distributed teams (Powell, 2004). Nonetheless, delays caused by computer mediated communication may provide more time for teams to develop quality outcomes (Straus & McGrath, 1994).

**Technology**

Because technology mediates all virtual team communication and coordination actions, the type of technology used is perhaps the most important input for these groups. For example, media richness, the ability of media to reproduce the original information (Daft & Lengel, 1984) has been found to positively impact team effectiveness, efficiency, amount of
communication, (Carlson & Zmud, 1999; Hinds & Kiesler, 1995; Jarvenpaa, Rao, & Huber, 1988) the relationships among team members (Pauleen & Yoong, 2001), and team commitment (Workman, Kahnweiler, & Bommer, 2003). Equally, research indicates the addition of video resources results in significant improvements to the quality of a team’s decisions (Baker, 2002) and increased levels of performance and trust (Burgoon et al., 2002).

One reason for these benefits is that technology in the virtual setting offers a degree of anonymity that may reduce the effects of production blocking and process loss found in collocated teams. This may be in part due to the deindividuation of personnel, which lessens the impact of role, status, and individual dominance of action processes (Arrow et al., 2000). In contrast, technology mediated communication can also pose challenges to team effectiveness. For instance, technology reduces modalities of communication which impacts group process, task performance, and member satisfaction (Hollingshead, McGrath, & O’Connor, 1993). In terms of virtual team effectiveness, diminished non-verbal and visual cues are associated with longer decision time, less effective interaction, and weaker ability to make inferences about member knowledge and anticipate other member responses (Cramton, 2001; Hollingshead, 1998; Sproull & Kiesler, 1986; Riopelle et al., 2003).

Team Process

According to Marks and colleagues the process construct centers on the interaction of the team, and different forms of process describe these interactions depending on the nature and outcomes of team goals. In general, team process can be defined as collective “interdependent acts that convert inputs to outcomes through cognitive, verbal, and behavioral activities directed toward organizing task work to achieve collective goals” (Marks et al., 2001, p. 357). This includes both social interaction and task related activity of
the team (Guzzo & Dickson, 1996), which comprises a dynamic changing system where processes unfold and evolve over time. As a result, current processes are part a product of past group activity, and an indicator of future outcomes (Arrow et al., 2000). For instance, Ilgen, Hollenbeck, Johnson, and Jundt (2005) note that phenomena such as “knowledge, attitudes, and behaviors are both inputs and process in a developmental sequence that impacts team performance” (p. 519).

**Planning processes**

Taxonomically, processes are often categorized by three dimensions: planning, action, and interpersonal. Planning processes are periods where teams plan and evaluate activities that move the team forward to complete goals and objectives. These activities include goal, task, and resource identification, as well as forming strategies for evaluating team action and guiding future activity (Martins, Gilson, & Maynard, 2004).

**Interpersonal processes**

Interpersonal processes help regulate team activity influence cognitive and affective perceptions of the team. This includes strategies for managing conflict and disagreement, fostering helping and contributive behaviors, and regulating team emotions during task performance. For example, interpersonal communication and interaction processes can help foster positive socio-emotional perceptions of trust, motivation, and confidence in virtual teams (Marks et al., 2001).

Interpersonal relationships develop through formal and informal interaction that occurs during team activity such as planning, strategy development, and task performance. The relative strength of interpersonal process and interpersonal member relationships is
dependent on distance, duration, frequency, and intensity of interaction, and member interpersonal skill. This suggests benefits of interpersonal processes to support team motivation, conflict, and trust might only be realized over time, where teams have experienced significant interdependence (Nah, Schiller, Mennecke, Siau, & Sattayano, 2011).

**Action processes**

Action processes are activities that relate to the performance of tasks contributing to goal achievement. This includes monitoring team progress and resources, reviewing team member actions, providing help when needed, and coordinating the timing and sequencing of the work. Action processes have a strong task orientation, and often are tied closely to dimensions related to team interaction like communication, task technology fit, and adaptation to changing conditions (Powell, 2004). Considering decision making, action processes are especially critical as they directly impact the information sharing and exchange activities needed to determine the best outcome. Action processes for performing effective task work include: monitoring progress toward goals, systems monitoring, team monitoring and backup responses, and coordination activities.

**Monitoring goal progress**

Monitoring progress toward goals is the process of self-regulating action towards desired outcomes. Team members assess task progress by identifying performance gaps between the current team state and desired goals, and this information is relayed to the team as a whole. Performance gaps are triggers of decision making activity. The identification of performance gaps lead to choices that initiate the gathering and application of information to clarify needs, develop strategies, and implement and test solutions.
Nutt’s framework for effective decision making prescribes monitoring as essential to capture the “transactional nature of decision making, identifying the key choices called for by a decision maker as the decision process unfolds” (1993, p. 228). Extending this idea, progress monitoring keeps teams on track by helping members adjust to changing perceptions of information as teammates interact. For example, in Nutt’s research, effective decision formulation is built on the ability to reframe the problem as it develops, carefully justifying and demonstrating the need to act. One reframing tactic is solution intervention. Team members demonstrate potential new ways that address performance problems then carefully study options for goal fit. Ideas in the solution intervention are not imposed, but remain open to modification throughout the process. Thus monitoring goal progress by openly reframing the problem across the task process may foster more effective decision making.

**Systems monitoring**

Systems monitoring refers to tracking internal resources such as personnel, equipment, information that is generated or contained within the team, and external environmental conditions like technology functioning and outside organizational influences. Systems monitoring behavior allows team members to track required resources and the work environment to make certain the team has what it needs to perform tasks and reach goals. Meta-analytic research of 138 team effectiveness studies by Lepine and colleagues (2006) showed system monitoring was a strongly correlated to other action processes, and was significantly related to team effectiveness. This suggests that system monitoring provides a framework for maintaining team awareness of information and resources that works in coordination with additional processes related to coordination and collaboration.
Monitoring in the decision making process is an interdependent information sharing and exchange activity “that requires coordination of both process and content between speakers and listeners” (Whittaker & O’Conaill, 1997, p. 25). This requires team members to be aligned in terms of team information, procedures, and goal progress (Whittaker & O’Conaill, 1997).

For instance, some research suggests that the display of task related information can increase performance effectiveness by helping virtual teams maintain shared awareness of decision system information (Mason & Mitroff, 1973; Zmud, 1979). In addition, external information representation using listing and structuring methods is associated with improved learning, memory performance, and solution rates in problem solving and decision making scenarios (Voigtländer et al., 2009).

Effectiveness is influenced by problem complexity and displays that reduce the complexity of information can minimize this effect. Yet, there is still no one-size-fits-all solution for representing team information. Remus (1984) found both tabular and graphic displays improve decision making outcomes depending on level of environmental complexity. In low complexity environments, tabular display helps operators’ better aggregate and weigh decision criteria. However, in the case of intermediate environmental complexity, composite rules available in graphical displays prove better as a decision making aid than tabular counterparts (Remus, 1987).

Conversely, Watson and Driver found no significant difference between the ability of graphic and tabular displays to improve decision making, determining that there was no improvement in recalled information by subjects presented with information using both display types (1983). Nonetheless, there is evidence that the visual representation of team
resources can help members adapt to rapidly changing, complex environments (Chen, Thomas, & Wallace, 2005).

Along these lines, work by Schilling, McGarity, and ReVelle (1982) suggests clear representation of the decision space, such as the visual display of relationships between alternatives, provides insight that leads to more accurate choices by providing richer representation and more objective screening of criteria. In discrete decision scenarios, like determining ambulance base sites given the amount of existing coverage and temporal requirements, graphic representation of the interrelatedness of all stated alternatives fosters efficient choices. Likewise, in a continuous decision space, such as found when determining the amount of new students an institution can reasonably handle in a given year, visual display can reveal the salience of varying levels of criteria such as geographic location, academic quality and need for financial aid.

**Team monitoring and backup behavior**

Team monitoring and backup responses are primarily cognitive functions that provide assistance to members either by giving instruction and direction, seeking help from a teammate, or by performing a task for a teammate. Team members need to be informed about the role of others on the team to understand how the team will address the task. On effective teams, members watch what the others are doing, provide feedback, and step in when (Marks et al., 2001).

Leadership plays a critical role in the monitoring process. Mulvey and Veiga (1996) advise team leaders hold responsibility for monitoring team process to determine if self-limiting actions occur and to provide feedback to team members. However, other research posits team success is dependent on the monitoring and back up responses of all team
members. In the case of successful teams, Ilgen notes that monitoring behavior is accepted practice where all must members must have opportunity to provide feedback. Further, teams will fail if any individual fails to perform monitoring and backup behaviors (1999).

Monitoring and backup processes are often critical to effective performance because they allow gaps and inconsistencies in the work to be identified and adjusted. For example, co-pilots must closely watch pilot actions and be able to detect, communicate, and correct errors (Marks et al., 2001), and air traffic controllers develop a mental model to “maintain an accurate and complete picture of the traffic situation in order to provide needed monitoring and separation functions” (Endsley, 1997, p. 1). Similarly, Chen and colleagues (2005) learned teams in a helicopter combat simulation increased performance by employing regulatory monitoring, and exchanging systems information such as ammunition depletion and team helicopter damage. Given this evidence, monitoring practices likely have influence on the ability of teams to establish a shared view of team information that impacts effectiveness. For instance, in a study of anesthesiology teams, the similarity between participants’ mental models moderated the relationship between team monitoring and performance. Interestingly, high monitoring behavior in the absence of shared understanding had negative effect on performance (Burtscher, Kolbe, Wacker, & Manser, 2011). Thus for teams to benefit from monitoring, adequate interdependence may be required to active collective understanding about what is required to perform the task effectively.

To address this challenge, research shows training can improve team monitoring and backup processes. For example Morgan and associates (1986) found that process trained military teams displayed more performance monitoring, feedback, and backing-up behaviors than teams without process training. Over time, training activity cultivated a greater
perception of these behaviors, and this was accompanied by increased performance. Nutt explains that inclusion of monitoring in decision making prescriptions “captures the transactional nature of decision making, identifying the key choices called for by a decision maker as the decision process unfolds” (1993, p. 228).

Coordination

Coordination process is strongly correlated with team effectiveness in a number of work scenarios including military, research and development, and sales teams, as well as team studies of college students. Coordination processes regulate the sequence and timing of synchronous and simultaneous interdependent events, often involving information exchange and mutual adjustment of team actions. Coordination requires teams to maintain clear communication, and the ability to stay in synchronized with each other (Brannick, Roach, & Salas, 1993; Marks et al., 2001, p. 368). Because of the dispersed nature and reliance upon communication technology, coordination may be more challenging for virtual teams. Distance between team members may limit communication cues, and the ability to develop collective experiences that leads to positive outcomes.

However, process structure may foster better coordination. For instance, in a study of learning teams, Kienle and Hermann (2003) found coordination structure was required for effective collaborative learning and development of shared understanding. Participants expressed desire for a single facilitator to control discussion and outcome determination, and called for the implementation of special contextual structures to manage organizational and member content contributions that support the coordination of the communication process (2003).
Team Outcomes

Team performance outcomes are typically measured by the quantity and/or quality of products, the consequences that teamwork has for members, and the potential for teams to perform effectively in the future (Guzzo & Dickson, 1996; Hackman, 1987; Sundstrom, De Meuse, & Futrell, 1990). From this view, effectiveness can be viewed as a set of dynamic functions carried out before, during, and after work sessions to help teams collaboratively achieve its outcomes and tasks (Baninajarian, 2009). Performance measures often describe quantifiable relationships between groups or individuals, and task they perform, such as the amount of coal a team of miners’ processes in a day, a target shoot rating, or a committee selecting a job candidate (Cohen & Bailey, 1997; Stasser & Titus, 2003). Numerous studies have generated a range of widely accepted outcome variables for measuring team effectiveness. In general, team outcomes can be described across three dimensions: performance, attitudes, and behaviors (Lurey & Raisinghani, 2001; Mohrman, Cohen, & Mohrman, Jr., 1995).

Affective outcomes

Attitudes like cohesion, trust, commitment, and satisfaction have been widely studied, particularly at the individual level. Cohen posits that individual inputs such as interpersonal skill, self-efficacy, and team size impact attitudes of team members (1994). Researchers have also studied effect of process on outcomes. For instance, researchers have tried a number of techniques to improve perceptions of procedural justice, defined as the fairness of decision making procedures.

Procedural justice, research has typically centered on impact from two areas, the control persons have over process and decisions outcomes, and the degree that rules related
to fair process are present in team decision processes, such consistency, accuracy, correctability of errors, and the suppression of bias. These elements were identified and supported empirically in numerous studies on team and individual perceptions (Leventhal, 1980; Thibaut & Walker, 1975; Colquitt, 2004).

When justice perceptions are high, team members are more likely to contribute helping behaviors to team activity. For example, in a study of banking teams, Naumann and Bennett concluded that when processes generate strong team cohesion and leaders demonstrate fair procedures to the team, justice climate is improved significantly (2000). This suggests justice climate is fostered when people feel they are equal to others in the process, and this effect is stronger when their input is considered by leaders.

In addition, Korsgaard and colleagues (1995) studied management teams in Fortune 500 companies to see how control over process and decision had on justice perceptions. The study found when input was strongly considered by leaders, perceptions of procedural fairness were high, and teammates had greater attachment to the team, trust in leaders, and commitment to leader decisions, even when members had little control over actual outcomes. The findings demonstrate that consideration of team input and the ability of teams to influence decisions can have immediate and long term impact on performance and attitudes. When consideration of member input is low the quality of outcomes can suffer from limited input, such as expertise, or innovative ideas. In addition, low influence groups have less commitment to leader decision, and may not follow through with or support the team outcome (1995).

Work by Colquitt helped clarify the role procedural justice in teams. Two studies showed that individual perceptions align with perceptions of team treatment. Positive
perceptions of team justice increased individual attitudes about team procedures, increased
corporation, and role performance. Further, the interaction of own and other justice
perceptions were stronger when task interdependence was high (2004).

These findings were also supported by additional research by Colquitt and Jackson
(2006) which compared individual and team level justice climate perceptions. Results
confirmed that procedural consistency and the ability to influence outcomes were more
salient for teams than individuals, while no significant difference was found between teams
and individuals in terms of the amount of control over process. The results demonstrate that
when procedures are consistent, teams are less concerned about the ability to voice their
views during team process, than the ability to influence the final decision. However, as
Thibaut and Walker argue, the salience of process control may still be useful as an ancillary
means of exerting decision control when outcomes are determined by forces outside the team
(1975), such as when resources are restricted, or conditions are uncertain. Impact of
procedural justice can be particularly great for virtual teams because inputs of dispersion,
diversity impact team communication that leads to positive shared understanding of justice
(Roberson & Colquitt, 2006). For example, in one of the few studies of procedural justice in
virtual teams, Hakonen and Lipponen (2008) found that justice perceptions were moderated
by geographic dispersion and the number of face-to-face meetings of virtual teams. As teams
grow farther part, sensitivity to justice perceptions becomes stronger as a means of
identification that reduces uncertainty.

Team climate is a framework for understanding the team context in terms of
individual perceptions, attitudes, and behaviors. While there is a rich body of literature
exploring attitudes of individual team members, there has been less research at the collective
Towards understanding the broad impact of team climate at the collective level, the Team Climate Inventory provides four key constructs for measuring shared perceptions of team climate innovation, these include: participative safety, support for innovation, team vision; and task orientation (West & Farr, 1990). Together the four constructs provide a broad measurable description of team functioning at both individual and group levels. For example, on teams where participative safety is high, members feel free from reprisal, and are more likely to participate, contribute to, and take risks for the team, including inclination to contribute new ideas. Likewise, when support for innovation is high, team members are more likely to express verbal and written support for new ideas and make practical efforts to make resources available and bring new ideas forward.

Team vision is the shared group perspective of team members that goals are worthwhile and achievable. Members participate in team activities because they believe the group is more likely to succeed than any individual. Effective teams need a clear vision to move ideas forward (West, 1994). Finally, strong task orientation enables effective monitoring, and critical review of team actions. The task orientation dynamic provides a feedback-loop that helps team adapt and improve (Burch & Anderson, 2004).

As such, measures of team climate can be used to understand team feelings and functions, and help develop strategies to improve work conditions. In a study of 84 four-person teams of graduate students, Loo and Lowen (2003) used clustering methodology and the team climate inventory to designate a typology of team climates with the goal of developing team building and climate interventions. They found that team climate outcomes are representative across all four climate constructs. That is to say a team low in team climate
is low on all subscales, and teams with strong climates are high on all subscales. In addition, there is evidence that low and moderate team climate can improve over time with training intervention.

Perhaps most important to this study, overall perceptions of team climate can impact team ability to share information and acquire knowledge. Using a sample of 650 management information systems students, Xue and colleagues found that individual perceptions of team climate was positively related to information and knowledge sharing among team members. The researchers concluded that influence of team climate on the sharing and exchange of knowledge was brought about by member attitudes about the team, and by external climate forces, including facilitation and empowerment from leadership. Knowledge was shared more often and more effectively when individuals had higher levels of trust, cohesion, and innovativeness. Further teams high in these qualities were more open to information sharing, reasonable risk taking and cooperation (Xue, Bradley, & Liang, 2011).

Performance outcomes

Research regarding virtual team performance outcomes is mixed. Some research has found face-to-face teams perform better than virtual teams (Andres, 2002; Straus & McGrath, 1994). However, in numerous studies comparing performance outcomes between virtual and other teams, there is little significant evidence of difference between them (Hiltz, Johnson, & Turoff, 1986; Archer, 1990; Chidambaram, 1996; Chidambaram & Bostrom, 1993).

Studies exploring brainstorming by Gallupe and colleagues found that virtual groups are as good as or better at generating ideas than face-to-face groups (1994; 1992). One explanation is the generative effect of computer mediated technology opens the door to ideas by reducing communication blocks such as listening, or waiting for a turn.
In addition, Potter and Balthazard’s study of corporate managers performing a desert survival scenario task found that the performance and process outcomes of online teams were comparable to those of their face-to-face counterparts (2002). And a meta-analysis of 13 studies by McLeod found that using electronic decision support systems led to higher decision quality, task focus, and equality of participation. Interestingly, the studies showed that while computer mediated teams made better decisions, members were less satisfied with the process and decision, and took longer to make a decision (1992). This dynamic between performance and attitudes is also noted in research by Hiltz and colleagues which showed that face-to-face groups reached stronger agreement than computer mediated groups, but no differences between the two types of groups in the quality of decisions was found (1986).

Finally, Hollinshead and McGrath (1995) reviewed 50 team studies and found that in general computer mediated teams had less interaction and information exchange behaviors, and took longer to perform tasks than collocated teams. And although computer mediated groups excelled at generating ideas, they were less effective than face-to-face groups at problem solving tasks, and tasks requiring conflict resolution. The authors note that beyond the characteristics of the technology itself, technology use alters the structuring of tasks which impacts virtual group function. Still, in some cases, action processes in virtual teams may be more effective than physical exchanges. For instance asynchronous communication, such as email, can reduce production blocking present in physical settings, adding potential for increased participation and more reflective responses (Berry, 1997).

From the extant literature over the past 50 years, a number of key considerations for understanding team effectiveness are evident. First, there is consistent evidence that virtual teams take longer to complete tasks then face-to-face teams. The increased time is likely due
to reliance on technology to communicate and coordinate team activity. This raises questions about the degree to which electronic communication benefits or hinders virtual team effectiveness. Virtual teams may be required to perform actions to communicate online not required when communicating face-to-face. For example it may take longer to communicate through typing. Likewise it may take longer to sort and organize team information using tools in the virtual space than in the physical space. In addition, because physical actions are often hidden from the team, team members in the virtual environment may divide attention between the online team and other tasks (Martins, 2004).

Second, there are inherent differences in team communication and coordination protocols between online and physical teams that impact performance (Berry, 2011). While there are well-established communication routines in physical teams, computer mediated teams often must re-establish what and what not to do to process information and perform procedures. For instance, rules of order and task processes that are well known in physical teams must be clarified in virtual teams (Brandt, England, & Ward, 2011; Kowzloski & Ilgen, 2006). Also, while there is uncertainty present in all teams that must be addressed for effective performance to occur (Walther, 1995), computer mediation can create a greater degree of uncertainty in virtual communication, so development of processes leading to effective performance may be harder to establish. For example, computer mediation in virtual teams can result in less information exchange, poor process structuring, ineffective communication, and lack of understating about what do to achieve goals (Dittman, Hawkes, Deokar, & Sarnikar, 2010). These challenges have important implication for team task performance where information sharing and exchange are critical. Stasser and Titus initial hidden profile research (1985) concluded that teams make decisions in large part based on
the appraisal of available information. In addition, quality decisions are enabled by the diversity of available information and the preference of members. As the number of alternatives increase across the group the greater the chance that an optimal alternative will surface (Shulz-Hardt et al., 2006). Likewise, the preference of majority and influential group members has strong impact on decision outcomes (Mojzisch & Shulz-Hardt, 2010). However weakly structured communication in the virtual workspace can limit the availability of alternatives and member preference input, resulting in the weighting of some alternatives and opinions over others, and some to not be mentioned at all.
CHAPTER 3
RESEARCH AND DESIGN METHODOLOGY

The primary goal of this study is to determine the role of action process structure to promote or constrain decision performance, and influence perceptions of team work climate and procedural justice in virtual decision making teams. The study attempts to build upon foundational elements of previous studies of team decision performance, team climate, and procedural justice. As such it was felt reasonable to draw from similar populations, study designs, procedures, measurements, and test methods.

Participants

The study population was graduate and undergraduate students at two Midwestern universities. Recruitment emails were distributed at both universities. In addition classroom visits were made to 23 classes. Participants from these classes were offered a small extra credit bonus by the instructor. Finally, participants were entered into a raffle for an iPad 3 device as incentive. After removal of partial teams, where less than four participants arrived online at the time of the assigned trial, the final sample was 208 participants assigned to 52 complete teams across four treatment conditions.

Participant recruitment

Participants were recruited for the study during the 2012 to 2013 academic year. Recruitment methods were approved by the institutional review board at both universities. Students were invited to participate using a number of recruitment methods including flyers, mass email, and through in-class presentations to students. The recruitment materials and in-class presentations provided students with a description of the study including: the purpose, task, benefits of participation, compensation, confidentiality measures, and a link to the study
sign-up calendar. Flyers were also distributed on campus bulletin boards. In addition, scheduled recruiting visits were made to 23 classes. Instructors in these classes offered extra credit for participation. In these cases, students that did not wish to participate in the study were given the option of an alternate extra credit option. Participants informed the researcher through email the name of the course where extra credit was offered, and participation confirmation was forwarded to the instructor at the end of the semester.

An online scheduling tool was used to sign up participants. On the schedule site, students were given a series of available study dates and times, and self-assigned themselves to periods when they would be available. In addition, the sign up calendar requested email contact information. This was used to deliver information to participants about the study including: login information, a link to the informed consent document, and the date and time of the study session. Personal identifiers were only used to coordinate study participation and were not attached to any survey information. After all communication was complete, the email addresses and online schedule were destroyed. Five participants were contacted for each trial to increase likelihood a minimum four participants would be present for the study. After a date and time had at least five participants available, an email was sent to each participant with the date and time of the study trial, the web link to Google Docs where the study trial was conducted, and the username and password for individual team member accounts. In the event more than four participants arrived, additional participants were asked to reschedule for a later date. Likewise, when less than four participants arrived participants were asked to reschedule as well.

To clarify individual characteristics of participants, data for six demographic measures were collected. These included 1) age, 2) gender, 3) ethnicity, 4) prior personal
relationship with other team members, 5) previous group work with other participants, and 6) comfort level using internet technologies. Women were more represented than men in the sample. Ethnic groups were most strongly represented by White/Caucasians, with African American, Hispanic, and Asian participants roughly equal in representation. Copies of all recruitment materials and the informed consent document are included in Appendix A.

**Study Design**

The experiment used a two factor design with two levels. The within-subject factor was the exclusive decision information set given to each team member. The between-groups factors were two independent variables, action process structure and information display structure, used to test the hypotheses. The action process structure variable had two levels, high action process structure (an experimental action process designed to foster team effectiveness) and low action process structure (an ad hoc action process agreed upon by the teams without formal action process structure guidelines). The second independent variable was an information display structure also with two levels, high information display structure, (teams were able to collaborate using a Google document), and low collaborative display (teams saw basic instructions in the document, but could not add or manipulate content). Participants were assigned to one of the four conditions based on the order of indicated availability, and trials were performed in order of conditions one through four (High/High, High/Low, Low/High, Low/Low).

**Variables and Measurements**

**The hidden profile task**

All participants performed the same hidden profile task (Schulz-Hardt, Brodbeck, Mojzisch, Kerschreiter, & Frey, 2006). Ranking of candidate attributes was done individually
and as a team. As is standard in hidden profile tasks, candidate profile attributes were varied so members had some unique and some shared task information in their individual profile sets. Attributes in the candidate profile sets were designed to be plainly positive or negative. Positive attributes included characteristics such as, “has excellent depth perception”. Negative attributes were statements like, “is sometimes unorganized” (Schulz-Hardt et al., 2006).

The complete information set contained 40 attributes with ten attributes for each candidate in the complete profile set. However, at the start of the study, each team member received only a partial set of profile information containing 24 attributes, six for each candidate. Some of these attributes were unique to the individual; other attributes were shared among one or more team members. Each individual hidden profile sheet had four positive and two negative attributes for candidates A, B, and D, while the profile for candidate C contained three positive and three negative attributes. The clear-cut designation of positive and negative attributes and the distribution of these attributes across candidate profile makes an information set where no clear choice was available at the individual level, but an optimal choice could be made when all information was aggregated at the team level. Therefore during the individual pre-discussion task, candidate C appears to be the least desirable choice, while candidates A, B, and D, contained an equal number of positive and negative attributes that suggest each was more suitable for the position than candidate C.

When individually held attributes were pooled from each team member, the complete set of information showed candidates A, B, and D had six negative and four positive attributes, while candidate C had seven positive and three negative attributes. Thus given complete information sharing, candidate C could be clearly identified as the strongest choice.
As such, the successful exchange of hidden information between members results in different decisional implications. Thus, performance gains can occur when team members integrate all relevant information into the discussion (Gretimeyer et al., 2002), however quite often studies have found that unshared information is overwhelmingly salient, and teams often overlook critical information need to make optimal decisions (Wittenbaum & Stasser, 1996).

The hidden profile task was suitable for assessing the effect of process structure on team performance for a number of reasons. First it has been widely used to evaluate decision making in teams (Gretimeyer & Schulz-Hardt, 2002; Schulz-Hardt et al., 2006). Second, because the problem scenario is fairly complex, and there is a single objective answer, the task offers an effective way to examine the role of process in the decision making activity. Decision scores can be easily determined, the shift potential for candidate preference before and after discussion allows for measuring decision strength, and the task scenario is sufficiently interdependent as to provide evidence of impact of process on team climate and procedures. Finally, while the task is only an approximation of how teams behave during online decision making, it is nonetheless empirically representative of actual decision making problems virtual teams may encounter in the workplace.

Independent Variables

Based on the literature, two independent factors were created. These variables were manipulated to represent high and low conditions of each factor. The experimental conditions are described below.

Action process structure

Communication norms are needed for virtual teams to exchange information effectively, maintain cohesive communication, and integrate the work of the team. Structured
discussion supports information exchange, and keeps all team members aligned with the task and moving forward (Malhotra, Majchrzak, & Rosen, 2007). In this study, an action process structure variable was used to foster systematic team interaction that was felt would lead to better decisions, and more positive feeling about the team environment and procedures. The process protocol was based on a turn-taking structure using a single communication channel (chat message system) within Google documents.

Turn-taking strategies influence subject speaking behavior. Research on digital conversation (ver Mat, Truang, & Heylen, 2011), shows pausing for reflection between turns can make communication more congenial, less forceful, and gives the impression of greater closeness. In the high action process structure used in this study, all team members are asked to monitor and report on teammate input and actions. In addition, backup actions are encouraged between members during discussion. Likewise, a consensus appointed leader coordinates team input, and teams are directed to advocate for clarity of decision information by arguing positive and negative traits, and by highlighting redundancy and novelty of information irrespective of their individual belief (Greitmeyer, Schulz-Hardt, Brodbeck, & Frey, 2006).

Backup, monitoring, and coordination behaviors are felt to support effective observation and adaptation of team member behavior (O'Dea & U.S. Army Research Institute for the Behavioral and Social Sciences, 2006). Monitoring enables decision makers to identify alternatives, and make more informed choices. Effective teams monitor the performance of other team members to keep apace of how they are performing and progressing, and offer assistance when needed. Further, interventions that contain a process components can help teams identify choices, recognize types of information that should be
collected, engage in interdependent actions, and adapt to changing conditions in the information environment (Nutt, 1999).

**Information display structure**

Task performance is impacted by complexity; number of required actions component interdependence and dynamic changes to inputs and outputs over time impacts performance behaviors. As requirements change, teams must adapt by performing alternate acts, and revising understanding of task related cues (Wood, 1986). An information display structuring variable was operationalized with a tabular configuration for analyzing decision information using a shared Google document to support interdependence and reduce the complexity of decision information. Namely, team members can post their individual information into a shared space, and add, edit, delete and markup content together.

The literature suggests that the structure of information, and the way it is displayed can improve understanding of complex information sets. In one instance, Remus (1984) found tabular display improved managerial decision making. Also, Goeller and colleagues used a similar type of tabular score card method to evaluate biological conditions (1977), and Pardee, Philips, and Smith found it effective to use rank-ordered attribute levels to quantity the value of information (1970). Information display structure improves performance because it allows participants to screen information and make alternatives visible. “Presentation in decision space,” Schilling and colleagues propose, “aids the decision maker in assessing an alternative's performance with respect to unstated or hidden objectives” (1982, p. 237).

Finally, while display structure may enable some behaviors associated with effective performance, it may not be enough by itself to ensure success. For instance, Fischer and Mandal’s (2005) study of visual representation and knowledge convergence offers additional
insight on the role of information display structure to support decision making. The authors found that teams using a content-specific display that allowed shared representation and greater interactive capability increased effective pooling of information, but did not foster effective information exchange in an evaluative task.

**Dependent Variables**

All scale constructs are measured with a five-point likert scale using endpoints of “strongly agree” and “strongly disagree”. Slight modifications of scale items were made only when necessary to ensure validity and reliability relative to task context. Three scaled dependent variables were measured including: the team climate for innovation index, the procedural justice index, two measures for information sharing (shared and unshared), and a measure for decision quality based upon the perceived suitability of job candidates before and after discussion. Finally, the dependent variable for decision accuracy was an objective measure coded 1 for correct and 0 for incorrect decisions. All measures and original scales from which items were derived are provided in the Appendix C.

**Team climate**

The Team Climate Inventory (Anderson & West, 1994) was designed to measure the overall team work environment in four areas: participative safety, group vision, task-orientation, and support for innovation. The original inventory developed by Anderson and West contained 44 items. To reduce survey time and increase likelihood of response, this study uses the 14 question short form of the inventory adapted by Kivimaki and Elovainio (1999). The authors compared internal homogeneity, reliability and normality for both short and long scales across two large independent samples. Compared to the original Team Climate Inventory, an acceptable predictive validity of the shortened version was
demonstrated. Bivariate correlations within each scale of the four core dimensions suggested predictive validity of both long and short constructs. In addition, high cross-scale correlation between the long and short scales indicated that the shortened version had acceptable coverage of the core areas of the original construct.

In the shortened construct, four team vision items measured perceptions of agreement with the purpose, clarity, and value of task objectives. Chronbach’s alpha for the four question team vision scale was .85. Five participative safety items measured team perceptions of participation, information sharing, collective understanding, and unity when performing tasks. Internal consistency for the participative safety scale was .85. Three items in the task orientation scale measure team ability to align task work with effective process strategies. The task orientation questions addressed member willingness to question team actions, evaluation of strategies towards goal progress, and the degree that members build upon the ideas of others to achieve goals. Cronbach’s alpha for the task orientation scale was also .85. Finally, the support for innovation scale used three items to measure perspectives about how actively the team sought out new information and ideas, whether the team took adequate time to develop ideas, and how well members cooperated to apply them. The internal consistency in this case was .81. Given high correlation between the original and revised scales, and the relatively strong internal consistency of the shortened scale, the abridged format was felt adequate to measure team climate in the experiment.

**Procedural justice**

The procedural justice construct measures team perceptions about the fairness of procedures used to make decisions. The measurement for procedural justice perceptions was taken from a seven-item construct drawn from the constructs outlined and tested in Colquitt’s
dimensions of organizational justice (2001). Two scale items in Colquitt’s construct are based on Thibaut & Walkers (1975) criteria for measuring process control (the ability to voice one’s opinion) and decision control (the ability to influence outcomes). Five additional items reflect Leventhal’s procedural rules (1980). These items measured participant feeling of procedural bias, the accuracy and consistency of procedures, whether members had influence over outcomes, and whether they could appeal decisions. As a whole, the measures serve to determine an overall impression of the fairness of team procedures. The procedural justice scale in this study was unmodified and was validated in two separate studies (Colquitt, 2001) with a reliability of Cronbach’s alpha ranging from .78 and .93. All items in the construct are measured on a five point scale ranging from (1-strongly disagree) to (5-strongly agree).

**Decision performance**

Decision performance outcomes were measured in three ways, team accuracy in choosing the best candidate from four alternatives, individual perceptions of value placed on shared and unshared information in making the team decision, and individual perceptions of candidate suitability before and after discussion.

**Decision accuracy**

Decision accuracy was an objective measure of the team’s decision outcome (Stasser & Titus, 1985; Greitemeyer et al., 2006) based on the selection of the optimal candidate. In this case the manifest profile attributes designated candidate C as the optimal choice (coded 1) over alternative candidates A, B, and D (coded 0). Data was collected on this variable from individuals before discussion, and again after the team discussion with each team
member instructed to make the same final decision.

**Information sharing**

The performance measure for information sharing compared members perception of the value of candidate attributes towards making the team decision. Participants individually ranked all 40 candidates attributes on a five-point scale (1-not important at all to 5-very important) according to how valuable each characteristic was in making the team decision. The measures were used to generate the average value (Postemes, 2008) of shared attributes (items available to all members), and the average value for unshared attributes (those items hidden from one or more members but available when pooled during discussion).

**Decision quality**

Perceived suitability of the optimal candidate (C) and those that appeared equally best before discussion (A, B, and D) was measured using a five-point scale (coded 1-very unsuitable to 5-very suitable). Individual participants were asked to respond to the question "To what extent did you find candidate (A, B, C or D) suitable for the job" before and after discussion to determine whether individual preference for candidates shifted when teams had potential for pooling all information (Postemes, 2008, p. 922).

**Decision Task Procedures**

Prior to the study, participants received an introductory message with the time and date of the study trial, login instructions for accessing the study space, a team and team member number, and a link to the online consent form containing a statement of their rights as a participant to confidentiality and anonymity, and the right to terminate the study process at any time.

At the beginning of the task, team members logged in and were presented with four
documents which included: 1) the study instructions, 2) a document with partial attributes for four candidates, 3) a document to make an individual decision about the pilot candidate and, 4) a document for making the team decision. Participants were directed to read the study instructions first.

The instructions described, 1) information about how to use the chat tool for communicating with teammates and if technical support was needed, 2) description of the study scenario for a personnel committee asked to hire a pilot from a pool of candidates, 3) a list of available materials and what these contained, and 4) steps for performing three tasks: an individual decision, a team decision, and a final survey. Finally, a link was included to the consent form, and participants were asked to complete this if they had not already done so when the login information was sent.

Next, participants were asked to read the candidate attributes and perform the pre-discussion decision task. Individuals were given ten minutes to read the candidate attribute document and select a pilot based on the traits available about each candidate. Participants were asked to be able to explain to the team why they chose a particular candidate. This individual decision was recorded using an online survey and participants were asked for the team and team member number, and the candidate the participant selected. In addition, they were asked to rate the suitability of each candidate on a scale of 1-5 (coded 1-not suitable at all to 5-very suitable).

The assigned team member numbers helped ensure that candidate profiles were distributed correctly so that each participant only had access to candidate information with a particular profile set. Similarly, the team number provided a way to make sure that teams were separated into the correct treatment condition, and members only saw instructions that
reflected the treatment condition associated with that team number.

After recording individual decisions, the participants were alerted to assemble with the other team members by opening the shared team decision document. This document included instructions for conducting the team discussion based on one of four treatment conditions representing the factors of action process and information display structure. To ensure sufficient time was given for reviewing and discussing all candidate information thoroughly, no time limit was set, but teams were informed it should not take longer than 45 minutes to make a decision. At this point, team members reviewed and discussed the candidate attributes in the manner prescribed in the team decision process instructions designed to reflect the four factorial conditions. Materials used to perform the experimental task are found in Appendix B.

After the team decision was reached, all team members were asked to enter the same pilot candidate selection into a team decision survey, and all team members again individually ranked the suitability of each candidate. Following this, participants filled out a survey with questions for gathering demographic data, and recording outcome perceptions for team climate, procedural justice, and information sharing variables. Finally, participants met in the chat of the team discussion document for debriefing where they were informed about the goal, purpose, and benefits of the study, asked if they had questions or concerns, and given appreciation for their time. Appendix C contains instruments for collecting individual and team decisions and scaled measurements.

**Treatment Conditions**

The research design included two treatment conditions with two levels for a 2 x 2 factorial model. These treatment conditions included, 1) the action process structure applied
during the team discussion, 2) the degree the collaborative Google document could be used for reviewing and interacting with decision information. In the high action process structure, teams applied designated monitoring, backup, and coordination protocol to the group discussion. This included a discussion monitor that coordinated input of candidate attribute information from each team member, and allowed feedback from other members regarding the information. Each member was asked to tell the others whether they saw duplicate attributes, new attributes not seen before, and whether attributes were positive or negative.

Next, the monitor reported back any duplicate attributes to the team, clarified any new attributes entered into the discussion, and gave the final number of positive and negative attributes for the candidate as agreed upon by the team. Team members were asked to provide backup assistance by advocating for or against the valence of decision information, the presence of extraneous information, and attribute novelty (unshared information). After the team reached agreement they were asked to make a final team decision about which candidate was chosen for the pilot job.

In the low action process structure, each member was asked to tell the group whether they noted any duplicate attributes, new attributes not seen before, and whether attributes were positive or negative. But there was no required facilitator to coordinate discussion. Members could submit any information into the discussion at any time, and the team was told they could discuss the information in any order or way they chose. As in the experimental condition, after the team reached agreement they were asked to make a team decision about which candidate was chosen for the pilot job.

The second factor was the affordance of information display structure. Half the teams were assigned to a task space that allowed team members to directly input individual
candidate attributes into a Google document. All candidate attribute information could be visually reviewed and edited as a group. This provided an increased collaborative technology affordance for these teams that was felt to improve team decision performance. For instance, results of a hidden profile experiment by Voigtlaender et al. (2009) suggest that the ability to access and interact collectively with complete decision information can enhance recognition of task relevant information leading to more accurate decisions.

Teams in the control condition did not have the same affordance of listing and structuring candidate information. In the control condition, participants could not edit the shared document, so opportunity to pool and organize individual candidate attributes into a complete information set were constrained. Because the collaboration feature was not available, the ability to list and structure the decision information was limited by the linear format of the chat conversation. Even if team members pasted in candidate information intact, redundant information could not be deleted, and information could not be moved from one point in the chat discussion to another.

**Proposed Hypotheses**

Figure 2 represents the hypothetical construct model. It displays the influence action process structure is expected to have on outputs of team climate, procedural justice, and decision performance. Also depicted in the model is the predicted moderating relationship of information display structuring on the association between team action process and outcome variables. The rationale for each relationship is based on the research outlined in Chapter 2. The remainder of this section will discuss the proposed relationships between these variables and derive specific hypotheses based on the conceptual model.
The relationship between action process structure and team climate outcomes

It is predicted that individual attitudes toward the team climate will be influenced by the structure of action process in the team discussion. Team climate reflects perceptions of the patterns of behavior members experience while working interdependently to reach a shared goal. For positive team climate to be established there must be interaction, a reachable goal that requires some sort of collective effort, and enough required interdependence so shared understanding and patterns of behavior about the work can be established (Anderson & West, 1998; Katzenbach & Smith, 2001).

Action process structures can increase participation, provide direct support for interdependent work, and synchronize the activity of teams (Marks, et al., 2004). Given this, an action process structure with monitoring, backup, and coordination rules should enable greater team interdependence, and foster stronger shared perceptions of team participation, task orientation, and the ability to generate viable alternatives (Anderson & West, 1998).

Hypothesis 1: Action process structuring will be positively related to perceptions of team climate.
The relationship between action process structure and justice perceptions

Positive justice perception is associated with effective team process behaviors such as cooperation, helping, and task performance (Colquitt, 2001). Justice perceptions are positive when individuals have voice in the decision making process, and when they feel their ideas are considered and have influence over outcomes. These feelings are even more salient when complexity is high and outcomes are uncertain (Van den Bos & Lind, 2002; Thibaut & Walker, 1975). Further, justice rules afford a regulatory framework where procedures are consistent, information is accurate, and team members have power to appeal procedures and make corrections, reducing the tendency towards bias and dominance of the discussion (Leventhal, 1980).

Therefore the justice and team literature suggests action processes can support the development of positive justice perceptions in a number of ways. Specifically, monitoring provides a means for teams to maintain information accuracy; backup functions allow members to provide input into the decision and influence team progress and outcomes; and coordination processes help maintain consistency of procedures by segmenting and programing activity (Marks & Panzer, 2004). As such, it is hypothesized that:

Hypothesis 2: Action process structuring will be positively related to perceptions of procedural justice.

The relationship between action process structure and decision performance

In general, process impacts team ability to make good decisions. Participation in the decision process is enabled and members have a shared responsibility for task quality and ongoing evaluation of performance. One key element is interactive participation. High interdependence promotes effective performance (Kellett, 1993), and strengthens group
norms allowing teams to operate in ways that are appropriate for the team and task (Hackman, 1992) leading to better decisions. Effective teams use decision procedures that allow diverse thinking, team member input, and open attitude for change. In addition, the procedures for decision making are enhanced when they represent clear norms for communication, and all member perspectives are included so decision quality is ensured (Mohrman et al., 1995).

In distributed teams, leadership can also play a critical role in decision making process. For example, in highly dispersed teams performing innovative tasks, frequent leader communication grounds team members in the decision process, and when communication with leaders is positive, members feel greater influence on outcomes (Gajendran & Joshi, 2012).

Specific to information sharing tasks, research points to a number of reasons at the individual and group level that challenge decision makers. At the individual level, members tend to stick to their initial preference (Greitemeyer & Schulz-Hardt, 2003). This preference is supported when shared information that supports an individual’s best initial alternative is presented during team during discussion (Greitemeyer & Schulz-Hardt, 2003).

Reinforcement for biased alternatives reflects the salience of persistent information at the group level, and the impact this has on individual perceptions of the team. For instance, persons holding shared information are viewed as more task-capable because their information validates the findings of others (Wittenbaum, Hollingshead, & Botero, 2004). Thus, at the group level, the more members that have the information, the more likely it is to be recalled, discussed, and given greater value (Stasser & Titus, 2003; Postmes, Spears, &
Cihangir, 2001), and the less likely individuals are to change their opinion about an alternative.

From these ideas, it is posited that structured monitoring, backup, and coordination processes will help increase performance on the decision task by addressing challenges to team information exchange and validation. First, monitoring and backup process should encourage highlighting of novel information, and reduce salience of shared information by removing redundant items. Second, coordinated review of each candidate attribute set by all members during discussion should help generate more accurate profiles, reducing preference for initial alternatives, and clarifying the optimal choice. It is felt that the interdependent review of candidate attributes will sensitize team members to counterfactual element as the process unfolds promoting the seeking of disconfirmatory information that leads to better solutions (Kray & Galinski, 2003). Specifically, a turn-taking decision process where all members voice all attributes should support the advocacy of each candidate equally resulting in greater exchange of unshared information (Greitmeyer et al., 2006).

Finally, Wittenbaum and colleagues argue that information sharing bias is part a matter of individual goal attainment. Self-directed member interests influence decision outcomes in part by determining who information is given to, what is shared, and how it will lead to meeting goals (2004). Thus using a regulated action process structure providing systematic regulation of team input and shared outcomes should minimize individual member influence on the team decision. Namely, prescribed action process should minimize bias influences of social comparison and self-interest in the decision process by enabling an interaction dynamic that will increase the meta-knowledge base of the team members, (Van Ginkel & Van Knippenberg, 2009), and form a stronger team identity where the collective
body takes on the responsibility for the process (Zambosk, Kyne, Kile, & Klinger, 1992). This stated, the following hypotheses regarding decision performance are speculated.

Hypothesis 3: Action process structure will be positively related to team decision performance.

Hypothesis 3a: Action process structure will be positively related to perceptions of optimal candidate suitability after team discussion.

Hypothesis 3b: Action process structure will be positively related to the value placed on shared versus unshared decision information.

Hypothesis 3c: Action process structure will be positively related to decision accuracy.

**Potential moderating effects of information display structure on action process influence**

The visual representation of information can be critical to decision making (Mason & Mitroff, 1973; Zmud, 1979). Visual channels reduce disruption to turn taking, and minimize the length of messages needed to communicate meaning (Munzer & Borg, 2008) suggesting that graphic representation of decision information provides a way to approximate verbal communication by providing cues that confirm whether information is received and understood (Boyle, Anderson, & Newlands, 1994).

Visual representation of central task elements and characteristics provide contextual support that influences the ability to solve problems (Ertl, Fischer, & Mandl, 2008). As task representations change, the subjective interpretation changes as well. Thus in the team setting, visual representation can allow team members to more easily revise their interpretations of problem solving information (Zhang & Norman, 1994). When information
is made visible, the attributes and temporal order become more salient, and decision makers
may be more likely to attend to it (Jarvenpaa, 1990). One explanation may be that
representations of information may reduce mental overhead by enabling visual perception
channels, and freeing other cognitive resources to be used in the problem solving process
(Lohse & Wharton School, 1996).

This is consistent with previous studies on memory tasks demonstrating that listing
and other forms of external representation of information improves learning, performance,
and problem solving (O’Donnell, Danserau, & Hall, 2002; Corter & Zahner, 2007; Newell &
Simon, 1972; Woods et al., 1997).

In addition, information display structure can positively influence performance
related behaviors such as the extraction, discussion, and sharing of group knowledge
(Mohammed & Dumville, 2001). For example, listing and structuring of information
improved detection rates of hidden attributes in the group setting by reducing individual
preference effects (Voigtlendaer, Pfeiffer, & Schulz-Hardt, 2009). Subsequently, the way
information is organized and represented to the team provides cognitive process support for
individual decision makers, and makes a more collective view of decision information
available to the team. It is expected then that collaborative display of decision information
will enhance action process leading to improved decision performance.

Further, because team climate represents a shared perception of the types of
behaviors, practices, and procedures that are supported in a specific setting (Schneider,
White, & Paul, 1998), it is reasonable that an additional collaborative information channel
will enhance team interdependence and understanding enhancing the effects of action process
and thus strengthening positive team climate perceptions. Specifically, collective information
structuring should enhance team ability to clarify objectives, respond to change, build on the ideas of others, and reach an effective decision (Loo & Loewen, 2003) which should increase positive feelings about team participation, competence, and ability to work together.

Increased information display affordance should also influence the role of action process on perceptions of procedural justice. Working collectively with information should provide greater of interdependence which likely will strengthen feelings about the degree of participation and influence on outcomes. For instance, teams using an action process have should have more equitable participation, and when used with a collaborative information display, procedures should be more consistent, and contributions of individual team members should be more recognizable, and have greater chance of consideration. In addition, the ability to collectively review and edit information with equal participation should help teams clarify and correct the information set leading to a more accurate representation of decision information than if using the chat tool alone.

Given this, it is felt that using information display structuring will provide a richer opportunity for team member participation, and reduce uncertainty about task-relevant information, leading to stronger perceptions of procedural fairness (Lind & Van den Bos, 2002). Given the theoretical and empirical relationship between information display structure, action process structure, and the outcomes variables of decision performance, team climate and procedural justice, it is hypothesized that that:

Hypothesis 4: Information display structure affordance will moderate the relationship between action process structure and team climate perceptions so that influence of action process will be more or less effective.

Hypothesis 5: Information display structure will moderate the relationship between
actions process structure and procedural justice so that influence of action process will be more or less effective.

Hypothesis 6: Information display structuring will moderate the relationship between action process structuring and decision performance so that influence of action process will be more or less effective.
CHAPTER 4
RESULTS AND ANALYSIS

The major subject addressed in this study was whether structured team action process fosters team effectiveness outcomes including the ability to make accurate, high quality decisions, and attitudes towards team procedures and work climate. In addition, the study proposed that increased collaborative affordance using a shared document would enhance the relationship between team action process and outcomes.

Chapter four is structured in two main parts. The primary analysis section presents an overview of descriptive information about the study population, and assessment of data required for hypothesis testing including: data treatment, manipulation checks, appropriateness of aggregation, and scale reliability. Following this, the chapter presents the primary analysis with the results of hypothesis tests, and outcomes of confirmatory factor analysis of the fit of variables to the proposed model.

Preliminary Analysis

Descriptive data

Two-hundred eight participants successfully completed the study for a total of fifty-two intact teams of four members each. In twelve trials only two or three participants logged into the study space which was less than the required number of participants needed. When this happened, participants were asked to sign up for a future study time, and asked whether they would be available on an on-call basis. Also, in these cases the trial for that period was cancelled and no data collected. In addition, five complete teams participated, but one or more members failed to complete one or more measurement instruments. In these instances, the complete case for each team was removed from the data.
Basic demographic data was collected from each participant. There were 112 female participants (53.8%) and 96 male participants (46.2%) in the study. The age range for participants was between 18 and 44 years old. The participant pool strongly reflected the traditional undergraduate population with (154, 74.0%) of participants between the ages of 18 and 24. Ethnicity of participants showed diversity typical of the university study population as well. Caucasian/White subjects represented the majority group (121, 58.2%), followed by African Americans (37, 17.8%), Hispanic (19, 9.1%), Asian (20, 9.6%), and other ethnic groups (11, 5.3%).

In addition, to gauge prior familiarity between persons in the population, participants were asked whether they knew any teammates well, and whether they had worked previously in a group with any teammates. Of 208 participants, six (2.9%) responded that they knew one or more teammates well prior to the study. Four participants had performed group work with at least one teammate prior to the study (1.9%). Finally, participants were asked about individual comfort level using internet communication technologies. Most participants felt very comfortable using internet technologies (103, 50.0%). However, nearly as many felt only somewhat comfortable, (98, 47.1%), and a few persons (7, 3.4%) expressed they were not comfortable at all.

Data treatment

Initial data from the individual decision, team decision, and final questionnaires were collected during the experiment and recorded using Qualtrics survey software. The data from the three surveys were downloaded as comma-separated value (.csv) files. The three files were consolidated into the SPSS statistical software version 20 using the merge files command. The merge files command allowed data for all variables to be consolidated by
matching the three separate files on the key variable of team number. This allowed all study variables to be included in a single SPSS data file corresponding to each case. Following this, non-instrumental data such as survey instructions that appear as string variables and IP addresses, were removed from the imported data set. In addition, the following actions were taken to insure the integrity of the data and the integrity of the data analysis. First, master file information was maintained in the Qualtrics survey bank, and cross-checked with the SPSS data to maintain data integrity. Second, after each study trial an examination of the descriptive data was conducted to ensure that all team numbers were recorded properly so each case corresponded to the correct treatment condition, and that all teams submitted the same final candidate choice.

In addition, individual measurement items for team climate and procedural justice were recoded into composite variables to represent the complete measurement constructs, as were the items measuring shared and unshared information. Also, individual and team decision variables were recoded so values reflected a dichotomous variable representing a correct (1) or incorrect (0) decision. Finally, the individual hypotheses tests were conducted multiple times to validate result outcomes. Using the procedures above it was verified that the data set and statistical analysis was complete and accurate.

**Manipulation checks**

Manipulation checks were performed to determine if the two independent conditions (action process structure and information display structure) were successfully manipulated. First, the experimental action process included a protocol for a team monitor. To determine whether action process conditions were manipulated, participants were asked whether the team had “appointed a monitor” during the exercise. Response options included 1 = “Yes, we
had a team monitor” or 0 = ”No, we did not have a monitor”. Chi-square test of independence was used to verify whether participants recognized the action process condition they were in. Nearly all participants (N=204, 98.0%), correctly identified the action process condition they experienced, indicating the conditional groups were distinct, \( \chi^2 (1, N = 208) = 200.126, p < .001 \). Four persons failed to identify the condition correctly. In addition, chat logs from study trials were inspected to ensure the proper feedback and monitoring process was reflected in the pattern of team discussion. Based on this, manipulation for action process structure condition was considered successful.

A check was also performed to confirm manipulation of the information display structure condition. In the study, some teams had the ability to view and edit decision information in a shared display document, while other teams did not. To help ensure the information display condition was in place, participants were asked whether the team had “cut and pasted” decision information into the team decision document (an instruction for teams in the experimental information display structure condition). Response options for this question were 1 = “Yes, we cut and pasted our attributes into the shared document” or 0 = “No, we did not paste our attributes into the shared document”. In addition, team shared documents were inspected after each trial to see if participants listed and structured the attribute information according to instructions. The chi-square test result showed most participants (206, 99.0%) correctly identified the information display condition and only two persons did not, \( \chi^2 (1, N = 208) = 173.50, p < .001 \). Based on this, it was felt the manipulation was successful. Because most participants correctly identified both independent conditions, faults on the manipulation check were felt to be due to participant error in filling out the questionnaire, and not an indication that the conditions failed to manifest. Given this,
data for all teams was retained in the dataset for inclusion.

Finally, a check was performed to test the manipulation of the hidden profile condition. It was expected that participants would prefer an initial suboptimal choice prior to discussion of the full attribute set. Likewise, a stronger preference for the optimal candidate following discussion would suggest that the hidden profile manipulation was successful. A manipulation check using the chi-square test to detect differences between individual and team decision choice was done. Results showed the initial choice was independent of the choice made after the team discussion, \( \chi^2 (1, N = 208) = 8.93, p = .003 \). This indicated that beliefs about the candidates shifted when additional information was made available. Accordingly, it was felt the hidden profile manipulation was also successful.

**Data aggregation**

Because this was a between group study, aggregate scores for team measures were computed for team climate and procedural justice by averaging individual scores on each measure. To ensure reliable aggregation at the team level, all members were informed that this was a team decision exercise. Further, all scale items reflected participation at the team level. Finally, several analyses were done to justify that aggregated scores reflected team level attributes, including reliability analysis, within-team agreement, and intra-class correlation.

In two cases, aggregation was not performed. Aggregation measures such as factor analysis, correction for attention, and intra-class correlation assume a relationship between individual items measuring facets of a concept based on the assumption that individual factors share distinct patterns (Rummel, 2000; Hopkins, 2006). As such, two variables were in the study were not aggregated. The variable for decision accuracy was an objective measure of group
performance. Similarly, the measure for decision quality represented a single item measure based on difference in perceptions of the optimal candidate before and after discussion. Because these variables were un-scaled, and held no potential patterns between items in a construct, aggregation tests were not felt useful in these instances.

**Scale reliability**

Cronbach’s alpha coefficient scores were computed to assess internal reliability of the scaled dependent variables for team climate and procedural justice. An acceptable threshold for item and scale reliability in the literature is $\alpha = .70$ (Nunnally, 2001). The team climate construct had four sub-scales comprising 14 total items. The overall reliability estimate for the team climate construct was acceptable at $\alpha = .861$, demonstrating the items combined as a whole were statistically representative of the construct.

The procedural justice construct contained seven items. Considering all individual observations, reliability of the procedural justice scale was considered adequate with $\alpha = .725$. The reliability analysis showed that deleting the fifth item, “Have you been able to appeal outcomes” would have improved the reliability of the construct to $\alpha = .739$. However, the construct met the threshold for reliability with all measures included, and the increase in reliability would be fairly small if the item was deleted, so the construct was felt to be adequate without adjustment. Finally, test statistics for the information sharing variables showed both constructs were reliable. Cronbach’s alpha for the 16 unshared information items was $\alpha = .880$ and $\alpha = .815$ across the 24 shared information items.

**Within-team agreement**

Within-team agreement was tested for scaled variables using the $\text{rgw}(j)$ measure to determine fit for aggregation of measures to the team level. The $\text{rgw}(j)$ index reflects the
degree of within-team alignment of construct measures by comparing the observed variance of the group to the predicted random variance. Acceptable inter-coder agreement using rwg(j) is satisfied if the mean test scores are equal to or greater than .70 (James, Demaree, & Wolf, 1984). For each study variable the total rwg(j) index measures averaged across all team showed satisfactory agreement between members. The scores ranged from .711 to .962, which was adequate to infer reliability for all scales across all participants. Following this qualification, intra-class correlation statistics were assessed for measure reliability.

**Measure reliability**

Inter-class correlation statistics were calculated to determine appropriateness of aggregating the measures to the team level based on the variance between and within teams in the study. Intra-class correlation, ICC(1), and ICC(2) statistics are perhaps the most common method for aggregation of data to higher levels of analysis (Shrout & Fleiss, 1979). For this study, ICC(1) scores were computed first to assess member agreement with scores for the categorical independent variables. Then the ICC(2) values were used to determine reliability based on group mean average. Recommended ICC values for group level measurement found in the literature are designated for ICC(1) as a value of .12 (James, 1982), and .60 for ICC(2), (Glick, 1985). Testing of ICC(1) and ICC(2) indicated acceptable value for all measures. Results for scale reliability and aggregation suitability for all variables used are shown in table one.
Table 1

Results for Reliability Tests for Variables Used in the Study

<table>
<thead>
<tr>
<th>Construct</th>
<th>Cronbach’s alpha</th>
<th>Rwg(j)</th>
<th>ICC(1)</th>
<th>ICC2(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Team Climate</td>
<td>.861</td>
<td>.962</td>
<td>.251</td>
<td>.876</td>
</tr>
<tr>
<td>Procedural Justice</td>
<td>.725</td>
<td>.875</td>
<td>.180</td>
<td>.624</td>
</tr>
<tr>
<td>Information Sharing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shared Information</td>
<td>.880</td>
<td>.711</td>
<td>.213</td>
<td>.837</td>
</tr>
<tr>
<td>Unshared Information</td>
<td></td>
<td>.784</td>
<td>.140</td>
<td>.790</td>
</tr>
<tr>
<td>Decision Accuracy</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Decision Quality</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>

Power analysis

Power analysis was used to generate sample sizes and determine effect sizes for hypothesis tests. Sample size was figured using pre-established alpha level, effect size, and power, based on the type of statistical test performed. A typical level of power at .80 with an alpha level .05 was used as benchmarks. Conventional effect sizes were selected to detect small, medium, and large effects depending on the type of statistical test performed and the number of variables included (Cohen, 1988). In this study several types of hypothesis tests were performed. The sample size requirements for small, medium, and large effects for each test performed are displayed in table 2. Given the study sample size of N = 208, medium and large effects were detectable given the variables and tests used in the study.

Table 2

Sample Size Requirements by Effect Size Based on Statistical Model

<table>
<thead>
<tr>
<th>Statistical Model</th>
<th>Effect Size $f$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi-Square</td>
<td></td>
</tr>
<tr>
<td>ANOVA</td>
<td></td>
</tr>
<tr>
<td>ANCOVA</td>
<td></td>
</tr>
<tr>
<td>Logistic Regression</td>
<td></td>
</tr>
<tr>
<td>Small (.10)</td>
<td>616</td>
</tr>
<tr>
<td>Medium (.25)</td>
<td>788</td>
</tr>
<tr>
<td>Large (.40)</td>
<td>800</td>
</tr>
<tr>
<td></td>
<td>780</td>
</tr>
</tbody>
</table>
Effect size gives clarification about the magnitude of relationships beyond the idea of significant association in that it shows how far the predicted hypothesis diverges from the null hypothesis. Practically, it gives a metric for understanding how much teams in each condition differ from each other. Also, standardization of effect size provides a grounding point for the integration of meta-analytic data so that meaning can be clarified across different statistical tests. Because effect size reflects the proportion of variance and degree of correlation between variables, conversion is required to adjust for differences in statistical model.

In this study, effect size indexes established by Cohen were used for determining the relationship magnitude between variables shown in table three. In addition, Chinn’s method for converting effect size of odds ratios was also used for closer examination of logistic regression tests. It is acknowledged this measure is not as well established as those of Cohen, and results were treated with caution. However it adds to the existing indexes, has shown some history of reliability, and allows effects sizes to be compared across the study (Cohen, 1992; Cohen, 1988; Chinn, 2000).

### Table 3

*Magnitude of Effect Summaries for Effect Size Indexes Used in Power Analysis*

<table>
<thead>
<tr>
<th>Statistical Model</th>
<th>ES Index</th>
<th>Small</th>
<th>Medium</th>
<th>Large</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi-Square</td>
<td>$\chi^2$</td>
<td>.10</td>
<td>.30</td>
<td>.50</td>
</tr>
<tr>
<td>ANOVA/ANCOVA</td>
<td>$n^2$</td>
<td>.01</td>
<td>.06</td>
<td>.14</td>
</tr>
<tr>
<td>Logistic Regression</td>
<td>OR</td>
<td>1.44</td>
<td>2.47</td>
<td>4.25</td>
</tr>
</tbody>
</table>
Control variables

Factors observable before the study with potential impact on outcomes were controlled for during hypothesis tests. Holding control variables constant improves test accuracy and clarifies the relationship between independent and outcomes variables (Committee for Proprietary Medicinal Products, 2003). Control variables often represent a pattern or configuration of individual characteristics participants bring to the team. In this study, team effectiveness is considered an emergent configuration in that it is borne from the complex aggregation of individual traits and experience (Klein & Kowlowski, 2000). To account for the impact of these elements, a number of configurable variables were examined to determine if association existed with the dependent variables. These included age, gender, and ethnicity, relationships with other participants prior to the study, and individual comfort level using internet technology. When these variables were examined, internet technology comfort level was positively correlated with team climate and procedural justice scores. In addition, the variable for ethnicity was positively correlated with procedural justice, and the variable for age was positively correlated with team climate. Because of this, the variables for internet comfort level, age, and ethnicity were controlled for in the regression tests.

Primary Analysis

Given the study design and variable configuration a series of tests were used to examine the hypotheses. Main testing of the hypothetical model was done using regressions analysis. The study used two categorical variables, action process structuring, and information display structuring. Dependent variables included scaled and binary measures. The dependent measures for team climate and procedural justice were treated as interval level variables (coded 1 through 5), and the decision accuracy outcome variable was a binary
variable (coded 0 and 1). Because of this, analysis of variance was used to examine main and interaction effects for the categorical outcomes variables (H1, H2, H4, H5), and logistic regression used to test main and interaction effects for the binary decision accuracy measure (H3c, H6). In addition, hypothesis three also used repeated measures (H3a), and one-way analysis of variance (H3b) tests to more closely examine the relationship between decision performance variables.

Finally, as an addition to hypothesis testing, confirmatory factor analysis, a form of structural equation modeling, was conducted to test the validity of the hypothesized measurement model by specifying and evaluating relationships among aggregated variables (indicators) and their unobserved (latent) constructs (Shah & Goldstein, 2006). A two-step process was performed to conduct the confirmatory factor analysis. First, a measurement model was specified and assessed, followed by a test of the model structure to examine relationships between constructs (Panuwatwanich, Stewart, & Mohamed, 2008). Model fit was evaluated at both steps in the procedure using a set of commonly used tests: normed Chi-Square, goodness-of-fit index, comparative-fit index (CFI); incremental-fit index (IFI); and root mean square error of approximation (RMSEA). The following thresholds were used to determine adequate model fit: $x^2/df$, 3.00; GFI, CFI, and IFI, 0.90; and RMSEA, 0.08 (Hair et al., 2006).

**Experimental conditions and related outcomes**

The study used a 2 X 2 Factorial design. Table four shows the means and standard deviation of each factorial condition for each outcome variable. With exception of measures for procedural justice and information sharing, the descriptive data demonstrates a trend
where scores on dependent outcomes are greatest in teams where both experimental conditions are present, and lowest where ad hoc process were used.

Table 4

*Means and Standard Deviations for Outcomes for Experimental Factor Conditions*

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>High Action process, High Information Display</th>
<th>High Action process, Low Information Display</th>
<th>Low Action process, High Information Display</th>
<th>Low Communication Display, Low Information Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>Team Climate</td>
<td>3.95 (.561)</td>
<td>3.80 (.520)</td>
<td>3.68 (.573)</td>
<td>3.52 (.520)</td>
</tr>
<tr>
<td>Procedural Justice</td>
<td>4.00 (.590)</td>
<td>3.70 (.561)</td>
<td>3.55 (.672)</td>
<td>3.70 (.532)</td>
</tr>
<tr>
<td>Decision Accuracy</td>
<td>.807 (.410)</td>
<td>.673 (.473)</td>
<td>.635 (.470)</td>
<td>.462 (.480)</td>
</tr>
<tr>
<td>Decision Quality</td>
<td>3.80 (1.34)</td>
<td>3.50 (1.30)</td>
<td>3.50 (1.40)</td>
<td>3.27 (1.23)</td>
</tr>
<tr>
<td>Information Sharing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shared</td>
<td>3.70 (.512)</td>
<td>4.01 (.433)</td>
<td>3.70 (.620)</td>
<td>3.94 (.388)</td>
</tr>
<tr>
<td>Unshared</td>
<td>3.67 (.661)</td>
<td>3.67 (.734)</td>
<td>3.40 (.844)</td>
<td>3.61 (.734)</td>
</tr>
<tr>
<td>Teams</td>
<td>52</td>
<td>52</td>
<td>52</td>
<td>52</td>
</tr>
</tbody>
</table>

**Tests for main effects**

Hypotheses one and two predicted that teams using high action process structure were expected to report stronger team climate and procedural justice scores than teams under an ad hoc action process condition. To test hypotheses one and two, a one-way multivariate analysis of variance (MANOVA) was used to test for main effects of action process and information display structure on the dependent variables of team climate and procedural justice controlling for the covariates of internet confidence, age, and ethnicity.

Multivariate analysis of covariance was chosen over other regression methods to account for the configuration of variables based on testing assumptions suggested by Meyers, Gampst, & Guarino (2006). Specifically, moderate significant correlation was present (.20 - .60) between the dependent variables. In this case, the study variable for team climate and
procedural justice were positively correlated with $r = .590$.

The MANOVA gives a multivariate F statistic that measures effect on the combined dependent variables, namely how much impact the independent variables have on the combined dependent measure, and which dependent variable is most affected. If the multivariate test of all factors on dependent variables is significant, follow-up tests can be used to determine if there are differences among population means for independent variables and combinations of the dependent variable (Meyers et al., 2006).

The test was performed by entering control variables for internet technology confidence, age, and ethnicity in step one, followed by the independent variable in step two. If the calculated values for the main factors are $p < 0.05$, the null hypothesis is rejected, acknowledging the alternative hypothesis that differences among groups exist. Preliminary examination found the model met qualifications for the MANOVA test. Box’s Equality of Variance Matrices was non-significant indicating the vector of the combined dependent variables followed a normal multivariate distribution and that the homogeneity of variance-covariance matrix assumption was not violated (.328). In addition, Levene's Test of Equality of Error Variances was non-significant for the team climate (.111) and procedural justice (.160) dependent variables.

A test of all covariates on the combined dependent variables rejected the omnibus null hypothesis indicating mean differences between action process structure groups existed on at least one linear combination of the team climate and procedural justice variables, Wilks’ $\lambda = .941$, $F(2, 194) = 6.09$, $p = .003$. The estimated effect size showed that 6% of the overall variance in the derived dependent variable was accounted for by action process condition, $\eta^2 = .060$, which was a medium effect given the test and sample size.
Univariate analysis was used to closer examine the strength of the relationship of the action process factor on each dependent variable. To account for the covariance between dependent variables, and control for Type I error, Bonferroni correction was used on tests for between-subjects effects. Test statistic indicated hypothesis one was supported. Pairwise comparison with Bonferroni correction showed main effect of action process condition on team climate scores, \( F(1, 205) = 11.03, p = .001 \). The effect size was medium, \( \eta^2 = .064 \). The test statistics were supported by stronger scores for teams using high action process structure (\( M = 3.90, SE = .091 \)) than those in the control group (\( M = 3.20, SE = .091 \)).

Hypothesis two, which examined the influence of action process structure on procedural justice was also supported. Examination of group means provided evidence of a positive relationship between the variables. Specifically, high action process teams (\( M = 3.93, SE = .100 \)) had stronger procedural justice perceptions than ad hoc action process teams (\( M = 3.71, SE = .100 \)). A significant univariate test statistic and moderately strong F score, \( F(1, 205) = 7.10, p = .008 \) indicated a difference in justice perceptions between groups. The effect size statistic however was smaller than observable given the sample size, \( \eta^2 = .03 \).

To summarize, multivariate and univariate analysis supported a meaningful relationship between action process and feelings about team climate (H1) and between action process and procedural justice perceptions (H2). However, the strength of significance, higher test statistic, and stronger effect size indicated action process structure had more influence on team climate scores than on procedural justice outcomes. The results for the univariate tests are presented in table five.
Table 5

Results of Regressing Team Climate and Procedural Justice on Action Process

<table>
<thead>
<tr>
<th>Source</th>
<th>Dependent Variable</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Team Climate</td>
<td>1.551</td>
<td>3</td>
<td>.517</td>
<td>1.809</td>
<td>.027</td>
</tr>
<tr>
<td></td>
<td>Procedural Justice</td>
<td>.781</td>
<td>3</td>
<td>.260</td>
<td>.764</td>
<td>.012</td>
</tr>
<tr>
<td></td>
<td>Internet Confidence</td>
<td>Team Climate</td>
<td>1.624</td>
<td>2</td>
<td>.812</td>
<td>2.840</td>
</tr>
<tr>
<td></td>
<td>Procedural Justice</td>
<td>2.644</td>
<td>2</td>
<td>1.322</td>
<td>3.884</td>
<td>.038</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>Team Climate</td>
<td>1.134</td>
<td>4</td>
<td>.283</td>
<td>.991</td>
<td>.017</td>
</tr>
<tr>
<td></td>
<td>Procedural Justice</td>
<td>2.189</td>
<td>4</td>
<td>.547</td>
<td>1.607</td>
<td>.032</td>
</tr>
<tr>
<td>Action process</td>
<td>Team Climate</td>
<td>3.837</td>
<td>1</td>
<td>3.837</td>
<td>13.44**</td>
<td>.064</td>
</tr>
<tr>
<td></td>
<td>Procedural Justice</td>
<td>2.336</td>
<td>1</td>
<td>2.336</td>
<td>6.861**</td>
<td>.034</td>
</tr>
<tr>
<td>Error</td>
<td>Team Climate</td>
<td>56.311</td>
<td>207</td>
<td>.286</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Procedural Justice</td>
<td>67.070</td>
<td>207</td>
<td>.340</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**p < 0.01

Main effects of action process on decision performance (H3a, H3b, H3c)

Hypothesis three posited that action process structure is positively related to decision performance. Prior to discussion candidates A, B and D, had equally positive attributes (4 positive, 2 negative). Candidate C had fewer positive attributes initially (three positive and
three negative attributes). On the basis of the incomplete profile, three candidates, A, B or D, would potentially seem the best choice at first. In the study, teams in the high action process condition were expected to select the best candidate more often after discussion, and this improvement would be reflected by a shift in individual perceptions of candidate suitability and a higher value placed on unshared information indicating better information exchange.

**Decision quality (H3a)**

Hypothesis 3a tested decision quality by measuring the perceived suitability of the optimal candidate (candidate C) at the time of the individual decision when only partial information was available, and at the time of the team decision after the complete information set was made available during discussion. It was thought that teams using high action process structure during discussion would exchange and evaluate information more effectively, and this would be reflected by higher post discussion suitability scores for candidate C.

Using a repeated measures analysis of variance, quality ratings for candidate C before and after discussion were entered first as within-subject variables. Then, the variable for action process was added as a between subjects factor. The test statistic showed support for hypothesis 3a, with a meaningful relationship between action process and decision quality indicated between measurement times, $F(1, 206) = 14.43, p < .001, \eta^2 = .065$. Pairwise comparisons between high and low condition groups supported this finding, $F(1, 206) = 9.20, p < .003$. But the amount of effect size, could not be confirmed, $\eta^2 = .043$.

In addition, examination of the estimated marginal means showed teams using high action process structure rated candidate C as significantly more suitable after discussion ($M = 3.50, SE = .085$) than those in low action process teams ($M = 3.12, SE = .085$). The
findings suggest that teams in the high action process condition gained a complete understanding of candidate profiles leading to stronger decision quality, but the degree of effect should be treated with caution.

**Information sharing (H3b)**

Results did not support hypothesis 3b. Hypothesis 3b was examined using a one-way analysis of variance to compare group means between high and low action process groups on the perceived value of shared and unshared candidate attributes. It was expected that teams in the high action process condition would place lower value on shared information and greater value on unshared information than teams in the control condition. First, the variables for shared and unshared attributes were entered as dependent variables. Next, the independent variable for action process structure was designated as the grouping factor. Significance between groups was determined by calculated at $p < 0.05$.

The predicted relationship between action process condition and the value of shared information was non-significant. Teams in the high action process groups value shared information similarly ($3.85, SE = .499$) to teams in the low action process condition ($M = 3.82, SD = .528$). In addition, while teams in the high action process teams valued unshared information ($M = 3.70, SD = .686$) more than teams in the control condition ($M = 3.55, SD = .777$), there was no significant distinction between group value perceptions of candidate attributes.

**Regression test for decision accuracy (H3c)**

Hypothesis 3c used logistic regression to determine the impact of action process on decision accuracy outcomes while controlling for age, ethnicity, and internet comfort level.
To perform the test, the dependent variable for decision accuracy was entered in step one. Next and control and independent variables were entered together in step two. Preliminary examination found the Hosmer and Lemeshow goodness-of-fit statistic was non-significant (.094) indicating adequate fit with no statistical difference between predicted and observed values in the model. In addition, Nagelkerke’s $R^2$ test statistic (.588) showed a moderately strong relationship between predictors observed outcomes. In logistic regression, the Wald chi-square is used to determine significance. If the P-value is < 0.05, the null hypothesis is rejected, indicating meaningful difference between groups. In addition, the odds ratio value predicts the likelihood of an outcome for each one unit increase in the independent variable and so is considered an indicator of effect size.

The results of the logistic regression supported the argument that action process structure impacts decision accuracy (H3c). Action process had an independent predictive effect on decision accuracy, ($\beta = .848, \chi^2 = 8.54, p = .005$ with df = 1). The odds-ratio effect size was moderate (OR=2.34), implying that for each additional team using the experimental action process structure, the odds of choosing the optimal pilot candidate increased 2.3 times.

A test of the full regression model against a constant only model was significant, $\chi^2 = 11.34, p = .039$ with df = 10, indicating a combined effect of the variables in the model on decision outcomes. The constant only model predicted outcomes, 63.5% of the time however, the full model was slightly more predictive. After the addition of all variables outcomes were classified 64.4% of the time (80% of correct decisions and 37% of incorrect team decisions).

This finding was further supported by descriptive data which showed high action process teams made more accurate candidate decisions than those in the control condition. Teams using the action process structure protocol were significantly more likely to detect the
optimal candidate (73.1%) compared to teams in the control conditions (53.8%), $\chi^2 = 8.54, p = .006$ with df =1. A summary of test statistics for logistic regression of action process on decision accuracy outcomes is in found in table six.

Table 6

Results of Regressing Decision Accuracy on Action Process

<table>
<thead>
<tr>
<th>Predictor</th>
<th>B</th>
<th>Wald</th>
<th>Sig.</th>
<th>Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>2.491</td>
<td>.477</td>
<td>.276</td>
<td>2.084</td>
</tr>
<tr>
<td>Age (1)</td>
<td>.734</td>
<td>1.187</td>
<td>.863</td>
<td>.915</td>
</tr>
<tr>
<td>Age (2)</td>
<td>-.089</td>
<td>.030</td>
<td>.998</td>
<td>1.002</td>
</tr>
<tr>
<td>Age (3)</td>
<td>.002</td>
<td>.000</td>
<td>.931</td>
<td>.915</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>3.080</td>
<td>.544</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethnicity (1)</td>
<td>-.855</td>
<td>1.060</td>
<td>.303</td>
<td>.425</td>
</tr>
<tr>
<td>Ethnicity (2)</td>
<td>-1.167</td>
<td>1.778</td>
<td>.182</td>
<td>.311</td>
</tr>
<tr>
<td>Ethnicity (3)</td>
<td>-.910</td>
<td>.931</td>
<td>.335</td>
<td>.402</td>
</tr>
<tr>
<td>Ethnicity (4)</td>
<td>-.283</td>
<td>.086</td>
<td>.770</td>
<td>.754</td>
</tr>
<tr>
<td>Internet Comfort</td>
<td>1.605</td>
<td>.448</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internet Comfort(1)</td>
<td>1.407</td>
<td>1.578</td>
<td>.209</td>
<td>4.082</td>
</tr>
<tr>
<td>Internet Comfort(2)</td>
<td>.103</td>
<td>.099</td>
<td>.753</td>
<td>1.108</td>
</tr>
<tr>
<td>Action process</td>
<td>.848</td>
<td>8.540</td>
<td>.006**</td>
<td>2.340</td>
</tr>
</tbody>
</table>

**p < 0.01

Secondary Analysis

Tests for moderating effects

Regression analysis was performed to examine the potential moderating effects of information display structure on the relationship between action process and team outcomes. Moderating variables influence relationship between an independent and dependent variable. The degree of interaction between the moderator and independent variables strengthens or weakens the relationship (Baron & Kenny, 1986). It was expected that the structure of the team information display would make the impact of team action process more or less influential on team climate (H4), procedural justice perceptions (H5), and team decision accuracy (H6). For all tests the control variables were regressed first, followed by the
independent and moderating variables, and then the interaction term. The predictor and moderating variables in the regression were centered and dummy coded. Centering the independent variables reduces multicollinearity in the interaction term, and aids with result interpretation. The action process structure and information display structure variables were centered by subtracting the overall mean of the variable from the existing value from each data point in the data set. Both variables were dummy-coded with low condition designated as -1, and high condition as 1. Next, a variable for the interaction term was calculated from the cross product of the independent variable and moderating variables. Finally, hypothesis tests were conducted.

Test for moderating effects of information display on impact of action process structuring on team climate (H4) and procedural justice (H5) perceptions

Hypotheses four and five predicted that technology affordance of the information display would moderate the relationship between action process structuring and outcome variables for team climate and procedural justice. Specifically, it was felt that the relationship of action process structuring between team climate (H4) and procedural justice (H5) would be more or less enhanced if information display structuring (richer information representation and collaborative affordance) was provided during the group’s decision meeting.

Statistics showed the multivariate test met the required assumptions for the individual hypothesis tests. Box’s Equality of Variance Matrices test statistic indicated normal multivariate distribution of the combined dependent variables (.895), and Levene's Test of Equality of Error Variances was non-significant for team climate (.075) and procedural justice (.550). The interaction of information display and action process factors on the
canonical multivariate variable was significant, Wilks’ $\lambda = .940$, $F(2, 201) = 6.70$, $p = .002$, suggesting the conditional factors interacted to increase the response on any or all combinations of the team climate and justice outcomes. The multivariate test also confirmed a main effect of action process structure on the canonical dependent variable, Wilks’ $\lambda = .939$, $F(2, 201) = 6.54$, $p = .002$.

Hypothesis four predicted information display structuring would moderate the relationship between action process structuring and team climate measures. A non-significant post hoc univariate test, and low F score indicated hypothesis four was not confirmed. In this case, the interaction of information display and action process had no apparent meaningful effect on team climate outcomes. Interesting enough, results indicated main effects on team climate for each independent factor suggesting action process and information display structure supported team climate development individually. The main effect on team climate scores for action process was significant at, $F(1, 207) = 13.93$, $p = .001$, $\eta^2 = .067$, and the test for effect of information display structure was also significant, $F(1, 207) = 1.27$, $p = .036$, $\eta^2 = .022$.

Test statistics did show hypothesis five was supported. Information display significantly moderated the relationship between action process structure and procedural justice outcomes although the effect size was close to medium size but was not confirmed, $F(1, 207) = 3.38$, $p < .009$, $\eta^2 = .051$. An examination of means between conditional groups supported the moderation finding. Accordingly, teams where action process and information display structuring were both present had slightly stronger procedural justices scores ($M = 3.94$, $SE = .102$) than teams where only action process structure was present ($M = 3.81$, $SE = .102$). In addition, results from the regression for hypothesis five noted there was also
significant main effect for action process on justice perceptions, $F(1, 207) = 2.35, p < .004, \eta^2 = .036$.

Finally, although not predicted, results indicated a reliable association between internet comfort level and procedural justice, $F(2, 207) = 2.722, p = .017$. The power statistic indicated less than medium effect size, $\eta^2 = .041$. A univariate contrast with Bonferroni correction for all levels of the variable showed participants that were very comfortable (coded 3) using the internet differed significantly in procedural justice perceptions from those that were somewhat comfortable (coded 2), $p = .004$. Persons that were comfortable using internet technology, had significantly stronger procedural justice perceptions ($M = 3.90, SE = .070$) than participants that were somewhat confident ($M = 3.67, SE = .070$), and those who were not confident at all ($M = 3.74, SE = .207$). A summary of the results for moderation tests on team climate and procedural justice measure is described in table seven.
Table 7

Regression Results for Interaction of Action Process and Information Display

<table>
<thead>
<tr>
<th>Source</th>
<th>Dependent Variable</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Team Climate Procedural</td>
<td>1.728</td>
<td>3</td>
<td>.576</td>
<td>2.043</td>
<td>.030</td>
</tr>
<tr>
<td></td>
<td>Justice</td>
<td>.843</td>
<td>3</td>
<td>.281</td>
<td>.865</td>
<td>.013</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>Team Climate Procedural</td>
<td>.844</td>
<td>4</td>
<td>.211</td>
<td>.748</td>
<td>.015</td>
</tr>
<tr>
<td></td>
<td>Justice</td>
<td>2.524</td>
<td>4</td>
<td>.631</td>
<td>1.942</td>
<td>.038</td>
</tr>
<tr>
<td>Internet</td>
<td>Team Climate Procedural</td>
<td>1.672</td>
<td>2</td>
<td>.836</td>
<td>2.965</td>
<td>.030</td>
</tr>
<tr>
<td>Confidence</td>
<td>Justice</td>
<td>2.722</td>
<td>2</td>
<td>1.361</td>
<td>4.190**</td>
<td>.041</td>
</tr>
<tr>
<td>Action process</td>
<td>Team Climate Procedural</td>
<td>3.930</td>
<td>1</td>
<td>3.930</td>
<td>13.93**</td>
<td>.067</td>
</tr>
<tr>
<td></td>
<td>Justice</td>
<td>2.353</td>
<td>1</td>
<td>2.353</td>
<td>7.30**</td>
<td>.036</td>
</tr>
<tr>
<td>Information</td>
<td>Team Climate Procedural</td>
<td>1.263</td>
<td>1</td>
<td>1.263</td>
<td>4.480</td>
<td>.022</td>
</tr>
<tr>
<td>Display</td>
<td>Justice</td>
<td>.327</td>
<td>1</td>
<td>.327</td>
<td>1.006</td>
<td>.005</td>
</tr>
<tr>
<td>CPS x IDS</td>
<td>Team Climate Procedural</td>
<td>.078</td>
<td>1</td>
<td>.277</td>
<td>.413</td>
<td>.002</td>
</tr>
<tr>
<td></td>
<td>Justice</td>
<td>3.376</td>
<td>1</td>
<td>10.40</td>
<td>12.90**</td>
<td>.051</td>
</tr>
<tr>
<td>Error</td>
<td>Team Climate Procedural</td>
<td>54.978</td>
<td>205</td>
<td>.282</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Justice</td>
<td>63.342</td>
<td>205</td>
<td>.325</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p < 0.05  **p < 0.01

Tests for moderating effects of information display structure on the impact of action process on decision accuracy (H6)

Hypothesis six posited information display structuring would moderate the relationship between action process structuring and decision performance. Namely, teams using a structured action process in conjunction with collaborative display would make more accurate decisions than any other condition. Somewhat surprisingly, the regression test for moderating effects of information display on the impact of action process on decision
accuracy failed to demonstrate the predicted moderating relationship. While test results did indicate action process had significant main effect on decision outcomes, $\beta = 1.08$, $\chi^2 = 6.40$, $p = .011$), there was no evidence of interaction between action process and information display. The odds ratio values indicated a medium effect for the relationship of action process and decision accuracy, OR = 2.94. However, it was noted that after the addition of the information display factor, the full model was slightly more predictive than the single factor (action process structure) only model, successfully classifying outcomes 66.8% of the time (87% of correct decisions and 34% of incorrect team decisions). The results for hypothesis six are shown in table eight.

Table 8

Regression Results for Interaction of Action Process and Information Display

<table>
<thead>
<tr>
<th>Predictor</th>
<th>B</th>
<th>Wald</th>
<th>Sig.</th>
<th>Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>2.442</td>
<td>.486</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (1)</td>
<td>.833</td>
<td>1.505</td>
<td>.220</td>
<td>2.300</td>
</tr>
<tr>
<td>Age (2)</td>
<td>.029</td>
<td>.003</td>
<td>.956</td>
<td>1.029</td>
</tr>
<tr>
<td>Age (3)</td>
<td>.086</td>
<td>.023</td>
<td>.879</td>
<td>1.090</td>
</tr>
<tr>
<td>Ethnicity</td>
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<td>.706</td>
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</tr>
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<td>Ethnicity (1)</td>
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<td>.401</td>
<td>.498</td>
</tr>
<tr>
<td>Ethnicity (2)</td>
<td>-.977</td>
<td>1.240</td>
<td>.265</td>
<td>.376</td>
</tr>
<tr>
<td>Ethnicity (3)</td>
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<td>.862</td>
<td>.353</td>
<td>.417</td>
</tr>
<tr>
<td>Ethnicity (4)</td>
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<td>.068</td>
<td>.794</td>
<td>.778</td>
</tr>
<tr>
<td>Internet Confidence</td>
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<td>.203</td>
<td>4.249</td>
</tr>
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<td>Internet Comfort(1)</td>
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<td>.089</td>
<td>.766</td>
<td>1.103</td>
</tr>
<tr>
<td>Internet Comfort(2)</td>
<td>.849</td>
<td>7.629</td>
<td>.010**</td>
<td>2.338</td>
</tr>
<tr>
<td>Action process</td>
<td>.328</td>
<td>2.409</td>
<td>.121</td>
<td>1.388</td>
</tr>
<tr>
<td>Information Display</td>
<td>.230</td>
<td>.540</td>
<td>.462</td>
<td>.794</td>
</tr>
</tbody>
</table>

**p < 0.01

**p < 0.01
Confirmatory Factor Analysis

Model design and definition

Sample size requirement for factor analysis is somewhat unclear. Recommendations in the literature based on number of indicators typically suggest 10 to 20 subjects per variable (Nunnally, 1978; Hair et al., 2006). Alternately, Kline suggests a range of acceptable size is from 100 to 200 subjects if the model is not too complex (2005). Given the variables in this study, there were a total of 26 original indicators. Using the subject per indicator rules of thumb, the sample size (N = 208) was adequate for confirmatory factor analysis (CFA).

The CFA model was designed by creating three latent unobserved variables, one for decision performance, a second to represent team climate, and a third for procedural justice. Measurement items were aggregated into factors which were treated as “reflective indicators of their respective constructs” (Panuwatwanich, Stewart, & Mohamed, 2008, p. 415). Indicators in the model included the four aggregated team climate subscales, seven procedural justice item indicators and two unidimensional indicators for decision accuracy and decision quality to represent decision performance. Cronbach’s alpha coefficients for all scales ranged from .701 to .775, sufficiently above the 0.70 cutoff for scale reliability. Individual variables were mapped from the data set to respective indicators in the model. Finally, error terms were created for each individual indicator variable. Last, a line of covariance was drawn between the latent constructs.

Measurement model assessment

The CFA was done with AMOS 21 software using maximum likelihood estimation (MLE) method. The tested measurement model with latent variables, indicators, and error terms is shown in figure 3.
Figure 3: Measurement Model for Confirmatory Factor Analysis

Six widely used goodness-of-fit criteria were examined to determine overall alignment of the hypothesized to observed model. These included measures for chi-square goodness of fit, normed Chi-Square, goodness-of-fit index (GFI), and root mean square error of approximation (RMSEA). In addition, two incremental measures were used to evaluate the fit of the predicted model to the null or independent model which assumes the unobserved variables are completely uncorrelated. These measures include comparative fit index (CFI) and incremental-fit index (IFI).

Models are typically assumed to have adequate fit when chi-square is non-significant, and fit index measures meet or exceed the following values: $\chi^2/df > 3.00$; RMSEA < 0.08; and GFI, CFI, and IFI > 0.90 (Panuwatwanich et al., 2008; Hair et al., 2006). While these are commonly accepted values, they reflect rules-of-thumb that should be treated with caution.
As such it is recommended model assessment should be interpreted relative to substantive and theoretical issues unique to the study (Hu & Bentler, 1999).

In confirmatory factor analysis, a low, non-significant chi-square value is desirable to show no real difference exists between the observed and proposed models. The chi-square goodness-of-fit statistic in this case was significant, and the normed chi-square was slightly above the threshold of 3.00 suggesting inadequate model fit, ($\chi^2=201.94$, df= 63, $x^2/df$, 3.20). However, it is well documented that factors such as sample size and multivariate normality of indicators in the model can inflate the chi-square statistic, and so additional fit indices were examined (Ho, 2006). Additional absolute fit measures lent support to unacceptable model fit as well.

The Real Mean Square Error of Approximation was above the criteria, RMSEA=.103, again indicating the measurement model lacked fit to the observed outcomes. Likewise, the GFI value was 0.88, slightly below the accepted threshold 0.90. Finally, incremental fit measures were examined to judge the model fit to the null model where observed variables are considered uncorrelated. Values for the incremental fit index were lower than acceptable with the CFI =0.82 and the IFI =0.82 (Panuwatwanich et al., 2008). However it is noted the comparative fit indices did approach the acceptable level with possible improvement to the model fit ranging from (0.18 to 0.12) which would be of modest importance given the open nature of the study environment.

In addition to fit indices, measurement model assessment requires examination of factor loadings estimates and squared multiple correlations of indicators to ensure that indicators significantly represent the unobserved variables, and are sufficiently reliable (Ho, 2006).
Estimates for most factors (11 of 13) loaded significantly ($p < .001$) on their associated latent constructs with acceptable factor loadings represented by standardized regression weights above 0.50. Two procedural justice indicators, P6 (ability to appeal) and P7 (ethical and moral standards) were non-significant. This showed that the majority of indicators were sufficiently characterized by their respective latent constructs.

Explained variance of the measured variables is determined by examining the squared multiple correlation (SMC) of each indicator. Squared multiple correlations express how much of the variable is determined by the latent construct, and are a measure of how reliable the construct is at predicting the variable outcome. R-Square values for all indicators but three were less than the recognized multiple correlation coefficient level of 0.50. The range of variance explained across all 13 indicators extended from 0.01 or 1% (PJ7) to 0.64 or 64% (TC2). The data showed the model had relatively low explanatory power on a number of indicators, and subsequently a large amount of residual error. Results for assessment of the measurement model are given in table nine. Based on the model fit indexes, inconsistent factor loadings across indicators, and low degree of explained variance, the default model was felt to lack adequate convergent validity and so full structural assessment of the model was not performed. Namely, the results suggest team climate, procedural justice, and decision performance constructs were not the only latent variables influencing the 13 measured variables. However, it is noted that preliminary examination of modification indices suggested that adjusting for within-construct error covariance between residual terms $e_1$ (TC1) and $e_3$ (TC3), and between-construct error covariance between residual terms $e_1$ (TC1) and $e_6$ (PJ2), would significantly improve model fit to acceptable levels.
Table 9

*Result of Model Measurement Tests for Confirmatory Factor Analysis*

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Loadings</th>
<th>t-value</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Team Climate</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TC1: Participative safety</td>
<td>0.69</td>
<td>f.p.</td>
<td>0.48</td>
</tr>
<tr>
<td>TC2: Support for innovation</td>
<td>0.80</td>
<td>9.50</td>
<td>0.64</td>
</tr>
<tr>
<td>TC3: Team vision</td>
<td>0.61</td>
<td>7.65</td>
<td>0.37</td>
</tr>
<tr>
<td>TC4: Task orientation</td>
<td>0.65</td>
<td>8.04</td>
<td>0.42</td>
</tr>
<tr>
<td><strong>Procedural Justice</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PJ1: Process control</td>
<td>0.65</td>
<td>f.p.</td>
<td>0.42</td>
</tr>
<tr>
<td>PJ2: Outcome control</td>
<td>0.43</td>
<td>5.40</td>
<td>0.18</td>
</tr>
<tr>
<td>PJ3: Procedural consistency</td>
<td>0.70</td>
<td>8.22</td>
<td>0.49</td>
</tr>
<tr>
<td>PJ4: Freedom from bias</td>
<td>0.76</td>
<td>8.67</td>
<td>0.50</td>
</tr>
<tr>
<td>PJ5: Information accuracy</td>
<td>0.71</td>
<td>8.25</td>
<td>0.57</td>
</tr>
<tr>
<td>PJ6: Correctability/appeal</td>
<td>-0.15</td>
<td>-1.99</td>
<td>0.02</td>
</tr>
<tr>
<td>PJ7: Ethical/moral standards</td>
<td>0.12</td>
<td>1.55</td>
<td>0.01</td>
</tr>
<tr>
<td><strong>Decision Performance</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DP1: Decision quality</td>
<td>0.59</td>
<td>f.p.</td>
<td>0.35</td>
</tr>
<tr>
<td>DP2: Decision accuracy</td>
<td>0.58</td>
<td>7.70</td>
<td>0.34</td>
</tr>
</tbody>
</table>

Notes: Model fit indices: ($\chi^2=201.94$, df= 63; $\chi^2$/df, 3.20; GFI=0.88; CFI =0.82; IFI=0.82; RMSEA=.103; f.p., Parameter is fixed for estimation purpose; *All t-values are significant at p< 0.001.

**Summary of Study Results**

Six hypotheses were tested in the study. After controlling for effects of age, internet comfort level, and ethnicity, hypotheses one and two were supported. The type of action process structure teams used influenced how they felt about team climate (H1) and perceptions of the fairness of team procedures (H2), and this was evidenced by significant test statistics, and estimated marginal mean scores in the predicted direction. Hypothesis 3 used three measures to examine influence of action process on decision performance, and this relationship was supported by two of three tests. Teams in the high action process condition showed a greater shift towards the optimal candidate after discussion (3a), suggesting the experimental action process structure led to greater sharing and exchange of decision information. However, counter to prediction, teams in the experimental action process condition did not place meaningfully greater value on unshared information. This implies
that hidden information was not integrated significantly more effectively into the decision process by high action process teams than teams using ad hoc process (H3b). Finally, a binary logistic regression test for action process structure on decision accuracy after partialling out covariate effects was significant. Teams in the high action process conditions made substantially more accurate decisions than those in the control groups.

Hypothesis tests for the moderating effect of information display structure on the relationship between action process structure and team outcomes were mixed. First, there was no significant interaction between information display structure and action process when regressed on team climate scores (H4). However, the analysis of covariance detected simple main effects for the two independent factors, implying a linear influence of each independent variable which contributed to the variance in outcome scores. Both factors influenced how team members felt about the operational climate and procedures they experienced, however action process had a slightly stronger impact.

The test for moderation of action process effect on procedural justice scores by information display structure was confirmed (H5), suggesting that the interaction of action process and information display structures had a dynamic effect on justice perceptions. Interestingly, this effect was accompanied by a main effect for internet comfort level. It was found participants with a high level of confidence using the internet had more positive perceptions of procedural justice than persons with lower confidence levels. Finally, the regression test for moderating effects of information display on the impact of action process on decision accuracy failed to demonstrate the predicted outcome (H6). Action process and information display did not interact to improve decision accuracy. Action process alone significantly influenced decision accuracy, but this effect was modest. Nonetheless, the
addition of the information display factor did help account for more variance in scores, successfully classifying outcomes 66.8% of the time (87.0% of correct decisions and 34.0% of incorrect team decisions). A review of the significance for all hypothesis tests is shown in table ten.

Table 10

Findings for Testing Hypothesis One Through Six

<table>
<thead>
<tr>
<th>Hypothesis Tested</th>
<th>Supported</th>
<th>P-Value</th>
<th>Effect Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypothesis 1: Action process structuring will be positively related to perceptions of team climate.</td>
<td>Yes</td>
<td>.001</td>
<td>η²=.049</td>
</tr>
<tr>
<td>Hypothesis 2: Action process structuring will be positively related to perceptions of procedural justice.</td>
<td>Yes</td>
<td>.008</td>
<td>η²=.036</td>
</tr>
<tr>
<td>Hypothesis 3a: Action process structuring will be positively related to perceptions of optimal candidate suitability after team discussion.</td>
<td>Yes</td>
<td>.003</td>
<td>η²=.045</td>
</tr>
<tr>
<td>Hypothesis 3b: Action process structuring will be positively related to the value placed on shared versus unshared decision information.</td>
<td>No</td>
<td>.582 .108</td>
<td>η²=.001 η²=.012</td>
</tr>
<tr>
<td>Hypothesis 3c: Action process structuring will be positively related to decision accuracy.</td>
<td>Yes</td>
<td>.006</td>
<td>OR=2.34</td>
</tr>
<tr>
<td>Hypothesis 4: Information display structuring will moderate the relationship between action process structuring and team climate.</td>
<td>No</td>
<td>.535</td>
<td>η²=.001</td>
</tr>
<tr>
<td>Hypothesis 5: Information display structuring will moderate the relationship between action process structuring and procedural justice.</td>
<td>Yes</td>
<td>.009</td>
<td>η²=.042</td>
</tr>
<tr>
<td>Hypothesis 6: Information display structuring will moderate the relationship between action process structuring and decision accuracy</td>
<td>No</td>
<td>.462</td>
<td>OR=.794</td>
</tr>
</tbody>
</table>
CHAPTER 5
DISCUSSION AND CONCLUSIONS

Summary
This chapter provides a review of the study topic, purpose, methods, and findings. Following this, the meaning of the results is interpreted, and explanation for the findings is offered, including limitations and delimitations of the study. Last, recommendations for theoretical and practical applications of the research are offered.

Purpose of the study
Virtual work happens under specialized conditions and the inherent qualities of virtual teams create a unique climate and procedural structure that make requirements for effective performance distinct from other work units. A foundation for understanding team behavior is modeled on team inputs, process, and outputs. Inputs such as dispersion, communication technology, and task type impact how teams interact and the quality of outcomes they achieve.

Teams use interactive processes to perform tasks, and the way these processes are enacted impact team performance and perceptions about the work. Performance outcomes describe the immediate results of task work, for instance the time it takes to reach a decision, and the quality of the decision. Emergent outcomes like team climate, and procedural justice perceptions describe attitudinal and cognitive characteristics of the team. Because performance and affective outcomes are shaped through team interaction, a reasonable strategy for improving team effectiveness is by structuring team work processes. Towards this goal, some important overarching questions in this study included:

To what extent does action process structure influence perceptions of team climate?
To what extent does action process structure influence procedural justice perceptions?

To what extent does action process structure impact team decision performance?

To what degree does technologyaffordance moderate performance and attitudes?

To examine these questions, six hypotheses were tested. Two hypotheses tested for positive main effects of action process structure on attitudes toward team climate and procedural fairness. In addition, a series of three inferential tests were used to examine influence of action process on overall decision accuracy, decision quality, and information sharing. Finally, three hypotheses were tested for potential moderating impact of technology affordance on action process influence.

**Relation of study to literature**

Teams interact to perform tasks, produce outputs, and support member needs (Cohen & Bailey, 1997; McGrath, Arrow, & Berdahl, 2000). A fundamental way of understanding team performance is the input-process-output model (de Guinea, Webster, & Staples, 2005), where inputs such as member characteristics, task type, and technology configuration provide resources teams operate on to generate outputs (McGrath, 1984).

As such, the interaction of members in the virtual workspace shapes how work is performed, and this dynamic is reflected in the quality of outcomes (Martins, Gilson, & Maynard, 2004). For instance, Siedbrat and colleagues found dispersion was related to performance based on levels of task-related teamwork and communication. The author’s found high levels of task effort and coordination were critical to performance, but interpersonal processes played no significant role (2008) suggesting task process was a primary enabler of performance outcomes.
The way tasks are performed impact virtual team outcomes. Complex tasks such as decision making for instance are highly interdependent, require greater collaboration and information sharing, and have challenging sequencing and timing requirements (Bell & Kozlowski, 2002). Virtual teams use a variety of technology to communicate and do task work. Media rich technology such as audio and video are found to improve effectiveness, efficiency, and relationships of team members (Daft & Lengel, 1984; Strauss & McGrath, 1994; DeSanctis & Gallupe, 1987). Nonetheless, technology mediation can restrict non-verbal cues and information flow that minimize feedback effects critical for clear communication. For instance, in some cases lean media such as chat may be preferable when well-timed, dependable, and accurate communication is needed for coordinating activity (Budlong, Walter, & Yilmazel, 2009).

Because teams actively shape the work dynamic, the structure of team process is extremely important to effective outcomes (Powell, 2004). Well-designed process structure can increase team effectiveness. But this can be difficult to design and implement as strategies may impact one area of effectiveness but not another; and the relative advantages of one process structure over another are not well-established (Cohen, 1993; DeSanctis & Gallupe, 1987) especially in the virtual setting.

Action processes are dynamic structures instrumental to task performance. These processes are tied to the efficiency and quality of work outcomes (Marks et al., 2001) suggesting that action process structures can be designed to support team effectiveness. For example, Marks and Panzer found teams with high monitoring, feedback, and coordination had greater performance because they were able to better align team information and goals with member action (2004). Action process can influence emergent outcomes as well. As
Kahai found, team leader feedback positivity influenced member perceptions of satisfaction, cohesion, and group efficacy in teams using instant messaging (2013).

In recent years research has begun to focus on team level understandings such as climate perceptions of the team, and beliefs about fairness of team procedures. Climate is a facet-specific, collective understanding of team activities, norms, and behaviors (Anderson & West, 1998). This understanding allows members to make sense of work by enabling actions that lead to successful performance (Figl & Saunders, 2011). For example, strong climate for innovation reflects qualities that lead to positive team outcomes such as shared objectives, critical analysis of team activity, and a high degree of interdependence. Similarly, strong procedural justice feelings reflect consistent actions, accurate information, and member control over process and outcomes which generate positive team attitudes that impact immediate and long term performance (Colquitt, Noe, & Jackson, 2002; Hakonen & Lipponen, 2008).

**Methodology**

In the study, participants performed a hidden profile decision making task where some information was shared and some was unique to individual members. The task scenario was a hiring committee responsible for choosing an airline pilot from four candidates with differing personal characteristics. The experiment occurred in a completely dispersed virtual environment using configured process inputs and measured outputs. A chat tool was used for all team communication, and some teams used a shared collaborative document for organizing decision information.

Two between subject factors were considered. One factor was a structured action process. In this condition, all team members participated systematically in the discussion
activity. A team appointed monitor helped coordinate the sequence and timing of team activity, and all team members were asked to take an unbiased advocacy position when discussing decision information. The second factor was a higher degree of technology affordance provided by a collaborative document. The technology let members transfer their individual information to the team document, and the information could also be manipulated collectively.

During the study, participants performed three related tasks. First, candidate attributes were reviewed and an individual decision and candidate suitability ranking was made. Following this, teams gathered to discuss candidate qualifications under one of four factorial conditions. After discussion, teams selected a job candidate. Finally, participants filled out surveys containing questions related to demographic information, perceptions of the team climate and procedural justice, and the perceived value of candidate attributes in reaching the team decision.

**Study findings**

Teams using the experimental action process structure had stronger team climate and justice scores, and made more accurate decisions on the hidden profile task. These teams also showed a greater shift towards the optimal candidate after discussion indicating stronger decision quality. However, teams in the high action process condition were not significantly more effective at evaluating the importance of decision information critical to the decision than teams using nominal process. Teams in both conditions favored shared information more than unshared information, and in the case of hidden information, high action process structure teams felt unshared information was only slightly more useful than other teams.

Results for moderating effects were mixed. Information display structure did not
moderate action process effects on team climate outcomes. But there was significant interaction between information display structure and effect of action process on procedural justice perceptions. It was also found that participants who were very comfortable using internet technologies had more positive perceptions of procedural justice than persons with lower confidence levels. In addition, moderation between action process and information display on decision accuracy was not supported, although teams using the collaborative information display along with high action process structure made more accurate decisions than teams in all other conditions.

Finally, a confirmatory factor analysis was performed to establish whether the measured variables in the model reliably reflected impact on the latent constructs of team climate, procedural justice, and decision performance. Based on results of absolute and incremental indices, factor loadings, and $R^2$ values, it was determined the model lacked convergent validity and so structural testing of the model was not performed.

**Conclusions**

Process is an integral part of team function, and the structure of team action process can influence team performance effectiveness. There is evidence teams have stronger perception of the work climate when monitoring, backup and coordination processes support interdependence, and shared understanding of tasks, goals, and outcomes. Action process structure may also provide a way to regulate team activity that leads to favorable perceptions of team procedures by creating an environment where member participation is equal and valued, information is accurate, and procedures are consist. There is also evidence that monitoring, backup, and coordination support interaction leading to more accurate and higher quality decisions. But the manner and extent that action process influences information
sharing and exchange is remains unclear. Further, while action process can have significant influence on team effectiveness measures, the impact may be small as shown by the modest effect size indicators.

There is also some evidence that information display structure influences team climate independent of action process structure, but to a lesser degree. Action process and information display structure had separate influence on team climate suggesting additional communication channels can offer distinct advantages in addition to process structure alone. In addition, the increased technology affordance was found to moderate action process impact on justice climate. This implied that the ability of action process structure to influence perceptions of process control, information accuracy, and procedural consistency vary to the degree that teams have ability to structure the information and visualize it together in complete form. Finally, when action process structure is enhanced with increased display affordance, teams make more accurate decisions than when action process structure is used alone. But this effect is not interactive, suggesting information display structure can provide enhanced support of decision making, but action process structures are more salient towards facilitating effective performance of the task.

Discussion

Action process structuring and team climate

There was reliable association between action process structure and how members felt about the overall strength of team climate. One rationale for the outcome is that high action process teams conducted the discussion in a way that supported stronger interdependence, information sharing, and collective understanding (West, 1990; Kivimaki, 2004). Interaction, interdependence, and shared goals are needed for shared climate
perceptions to develop (Figl & Saunders, 2011). The action process structure involved a minimum of 16 systematic turn-taking episodes where all members participated in the review of information. Monitoring and feedback during these turns likely helped focus task activity, clarifying the meaning and value of information as the team operated on the decision information collectively. This may have created a higher level of interdependence, shared understanding of task and decision information, and confidence in the group to perform well.

High level interdependence through action process structuring may also have increased familiarity among team members that lead to feelings of team safety. Safety is a measure of affiliation represented by a sense of togetherness, attraction to team members, and a force that binds teammates together. Safe team climates predict team cohesiveness, higher levels of member commitment and trust, information sharing, and helping behavior (Colquitt, 2001). For example, knowledge coordination requires trust in teammate ability, and team members are more likely to share information when relationships are trusting (Xue, 2011). But cohesion can take time to develop and may lead to over familiarity that can hinder productivity through group think. However, teams in this study met only once, so a question remains whether time was sufficient for cohesion to develop and the role it may have played in climate beliefs.

Alternately, monitoring, backup, and coordination processes may help build confidence which lead to more positive perceptions of the team climate. Confident teams are more likely to explore new strategies, alternatives, and risks (Fuller, Hardin, & Davison, 2007). The discussion procedures using action process structure were systematic, consistent, and reiterative. As members repeated the process for each candidate, they may have gained confidence in the team’s ability to work together, developed new ideas about the value of
each decision option, and thus explored alternatives more effectively. In addition, higher interdependence in the structured process may led to greater shared team understanding that compensated for diminished communication capacity of the lean media used to perform the task (Alge, Wiethoff, & Klein, 2003). As such teams in this study seemed to use communication more effectively when members had a collective understanding about the relationship of technology, context, and task (Carlson & Zmud, 1999).

In addition, the communication dynamic between the team monitor and members in the study may have influenced team climate perceptions. The team monitor was responsible for helping ensure all members were able to contribute information, coordinating activity across members, and providing feedback to the team about task related information. This may have created an impression among members about the team climate that information was collectively shared, tasks and objectives well clarified, and ideas built upon so that goals were effectively accomplished. The managerial role of the team monitor reflects a transformational leadership style that may have enhanced positive perceptions about the team, and increased team ability to work together. Transformational leadership promotes teamwork by encouraging task engagement, acknowledging member contributions, and encouraging receptivity to other member ideas. In turn, team members are more likely to feel valued, safe, and willing to participate. Transformational leadership that focuses on individual contribution, while centering on the team as whole can increase perceptions of adaptive performance. For example, Charbonnier-Voirin and Vandenberghe (2010) found transformational leadership impacts the ability for teams to innovate, manage new tasks, and solve problems creatively given uncertain conditions. Finally, leadership effects may have been influenced by media used in the study. Under lean media conditions transformational
leadership promotes teamwork and feedback by focusing on tasks and objectives, and by fostering team identity. This leads to improved group interaction and more cooperative climate. But research suggests the effect occurs only when media richness is low, and cues about individuals are limited (Huang, Kahai, & Jestice, 2010; Kahai, Haung, & Jestice, 2012).

This is consistent with team climate findings in this study. All teams used lean media (chat) for discussion, but team climate perceptions were stronger for teams where the team monitor was prescribed. Figl and Saunders posit low media richness can lead to simplification of communication because inadequate feedback and a low degree of personal contact make it difficult to develop a common understanding (2011). Given this, teams with a designated leader may have been able offset some of the constraints low media richness has on team communication by providing coordination that fostered interdependence during the discussion.

**Action process structuring and procedural justice**

Action process structure had a main effect on procedural justice perceptions, which were stronger when collaborative affordance was also available. Justice scores were strongest when action process was accompanied by collaborative display, but interestingly, justice scores were nearly as strong for teams using no prescribed discussion method. The study results support previous findings. For example, the degree of direct influence team members have on process and outcomes influences justice perceptions. Philips for example (2011) found significant pairing between both process control and decision control that had independent effects on justice perceptions in online decision making. Inequities in determining outcomes can lead to some members being viewed as having lower status which
causes those members to feel they were treated unfairly. In this study, teams in the high action process had opportunity to provide considered input throughout the decision process, and equal input into decision outcomes which may have enhanced feelings of process and decision control that resulted in stronger justice score perceptions.

In addition, justice perceptions are supported in part by the accuracy of information and the consistency of procedures which provide mutual alignment of team perceptions of fairness (Cropanzano, Byrne, Bobocel, & Rupp, 2001). This may partly explain higher justice scores for team using the action process structure in the study. This finding is important to virtual teams where the number of members is often likely to be small. Colquitt and Jackson (2006) found procedural accuracy may be more important in small teams where errors can have more serious impact. Smaller teams can lack capacity to process large amounts of information. Further, given small team size, and a relatively large and complex data set, teams without processes in place to foster information accuracy may lack ability to support meaningful representation of decision information.

Consistency is considered a major factor in justice perceptions as well. Consistency rules are more important in formal, task oriented settings, and the degree of consistency impacts justice perceptions, particularly when interdependence is high. Colquitt (2004) for instance found team members had higher role performance when justice perceptions were consistent across the team. To build effective justice climates, procedures must be uniform across people, time, and context (Leventhal, 1980).

The results in this study suggest action process structure supports systematic team interaction which may lead to stronger feelings about procedural consistency and overall justice scores. An interesting finding in the study was teams in the nominal condition had
significantly stronger justice scores than teams using only action process or information display structures. One reason may be that nominal teams operated under more uncertain procedural conditions than other groups. When people are initially uncertain about team procedures, they rely more on available procedural heuristics as a grounding point, leading to stronger fair-process effects (Van den Bos & Lind, 2002).

In this dissertation, teams in the nominal condition had limited procedural guidance at the start of the task, requiring these teams to develop their own methods. Lacking authoritative guidelines, team members may have fostered positive justice perceptions based on team designated procedures because these mutually agreed upon rules reduced uncertainty among members. Also, research suggests procedural justice perceptions and helping behaviors are mutually supportive. Member justice perceptions tend to align with the perceptions of others, and team context provides a means for social comparisons to be made between individual justice levels and the justice levels of the team. For instance, Collquitt (2004) found higher levels of role performance when member justice perceptions were consistent with each other and similarly, Neumann and Bennett found justice attitudes predicted helping behavior (2007).

Because process was initially uncertain for teams in the control condition, individuals may have at first perceived the justice level of other team members as low. However helping and creative behaviors required for performing the task may have fostered justice perceptions in these teams (Du, Choi, & Hashem, 2012). Hogg and Terry note that high task interdependence predicts stronger group identity that leads to greater feelings about the group, and stronger salience of procedural justice (2000). In effect every team used some type of procedure regardless of condition. It is possible that control teams could have
developed procedures that promoted interdependence and helping behavior, thus generating stronger justice perceptions.

**Action process structuring and decision performance**

Action process structure had some meaningful impact on team ability to make accurate decisions in the hidden profile task. Teams using high action process had significantly better decision scores, and this was supported by positive shift in preference for the optimal candidate after participating in the team discussion. However, the relationship between action process structure and value perceptions about shared and hidden information is inconclusive. Teams in both high and low action process conditions valued shared information nearly the same, and while high action process teams did place a higher value on unshared information, the difference between groups was non-significant.

Overall the results suggest action process structure helps address individual and group level challenges that hinder hidden profile solution (Mojzisch & Schulz-Hardt, 2011). One explanation is that individual preference at the start of discussion may have been reduced in high action process teams because members were encouraged to voice opinions about the valence of attributes, and the state of the information set. This may have prompted members on these teams to focus more on the decision information and less on personal preference. Similarly, research by Schulz-Hardt and colleagues (2006) found that groups primed for dissent were more likely to solve hidden profile problems than teams in a consensus mode. In the current study, the members of high action process teams were directed to provide monitoring and backup consistently during discussion which may have fostered less-biased interchanges and greater divergent thinking leading to better solution rates.
Action process structures may also have reduced technology constraints that inhibit communication process and limit team cognition. Jefferson, Ferzandi, and McNeese found teams using chat technology had difficulty solving hidden profile problems in part because inconsistent information and communication reduced team ability to develop an adequate mental model of the problem (2004). Also, Dennis (1996) found teams using a group support system (GSS) exchanged more information than face-to-face teams. However, they were not able to apply hidden information to solve the problem effectively. One reason speculated for poor solution rate in Dennis’s research was that information in the group support system moved too fast, causing important information to be overlooked. Another challenge was that the system chat technology required extensive scrolling to find information, which may have limited the ability of teams to locate and use it.

Nutt (1992) recommends that including a team monitoring component supports transaction in the decision process because it allows key alternatives to be identified as the decision process plays out. Morgan and colleagues also found teams were more effective when they monitored performance, provided meaningful feedback to the team, and communicated in a way that confirmed messages were received and understood (Morgan et al., 1986). In this study, monitoring, and backup processes may have provided opportunity for team members to reflect on decision information and develop a shared sense about the problem that facilitated the development and evaluation of viable alternatives (Van Ginkel & Van Knippenberg, 2009), minimizing the constraints of the mediating technology.

It was curious however that while high action process teams made more accurate decisions, they did not value hidden information much more than shared information. One explanation is that both types of information were important to forming the profile leading to
a final decision. This is consistent with findings by Reimer and colleagues who found both shared and unshared information figure in hidden profile detection in teams where predissent bias was minimized (Reimer, Reimer, & Hinsz, 2010).

Likewise, in this study, the mean for unshared information for teams using nominal process was greater than teams using information structure display only, and nearly as strong as teams using action process structuring. One possibility is that teams in the control groups used processes that led to longer discussion time resulting in greater information pooling. This may have led to the discovery of more unique hidden items than if time had been restricted, increasing the value of these attributes. Yet despite pooling more information, these teams may have lacked adequate structures for assembling the information so that it provided clear, common comparison between all candidate alternatives (Reimer et al., 2010).

**Tests for interaction effects**

Tests were done to determine if the addition of a collaborative display mode moderated the influence of action process structure on team climate, procedural justice climate, and decision accuracy scores.

**Test for interaction of information display structuring on effects of action process structuring on team climate perceptions**

The test for interaction on team climate was non-significant. Yet results showed team climate scores were influenced independently by both factors, with action process having the strongest effect, and this was reflected in the outcomes across conditions. Specifically, teams using the action process structure alone had greater scores than those using the display structure alone. And while there was no moderating effect, team climate scores were highest when action process structure was supported with collaborative display, and lowest in teams
where no experimental structures were used. The results imply that both factors supported team climate development, with action process having the most impact.

A simple reason for the finding is action process teams had more opportunity to develop a positive climate. Team building elements of monitoring and backup structures were embedded throughout the discussion process for these teams, and this may have allowed the action process structure to activate climate perceptions to a greater extent. However, the collaborative display was used only for viewing and structuring information, and so action process elements felt to build team climate were less apparent in the display than in the chat function.

Another reason may be that information display structure fostered team climate perceptions on some dimensions, but was less effective at supporting the full range of climate dimensions than the action process structure. For example, working as a group with decision information through the display may have increased participation that led to stronger feelings of team togetherness and ability to share information. But coordination, monitoring, and backup processes had greater ability to support the full range of team climate dimensions (such as task orientation, goal clarification, and idea generation), and so the climate building potential of action process was more prominent during the structured chat discussion.

Test for interaction of information display structuring on effects of action process structuring on procedural justice perceptions

Significant interaction between information display structure and action process indicated the influence of action process on justice perceptions was dependent on the level of information display structuring. It was proposed that action process structure would offer broad support for justice elements, such as representativeness, procedural consistency,
correctability, and bias suppression. The results supported this idea. The findings indicated collaborative display amplified this influence by offering enhanced support for representing individual perspectives, and providing greater ability to support the accuracy of information and consistency of procedures related to the review and of organization of decision information.

Tabular display structures such as the collaborative document used in this study can increase the comprehensibility of decision information, suggesting that information display structuring in conjunction with the action process structure enhanced better accuracy of decision information, but display itself did not foster perceptions of the other procedural elements, which were supported more strongly through action process elements used to structure the discussion.

Similar to this, Remus (1987) found that information display can enhance consistency by providing cognitive (information about performance) and outcome feedback (details about the weighting of information). In this study, the display structure supported accuracy of decision data by allowing teams to easily highlight novel and remove redundant information which likely led to more cohesive attribute sets.

This may help explain why justice scores were strongest when information display affordance was available to action process teams. More accurate data may have enhanced salience of procedural factors, especially given the hidden profile task where success hinges on the ability to clearly and consistently represent decision information. A review of justice scores across all conditions supported this. Teams where both factors were present had significantly stronger means than those where only action process or information display structure was present. Interesting enough, there was no meaningful difference between teams
using both action process and information display structuring, and teams in the nominal condition. Teams with no process intervention factors had mean justice scores similar to teams where both factors were present, and the fully structured and unstructured teams both had greater justice perceptions than teams using either structure alone.

It was discussed earlier the possibility that teams in the nominal structure conditions had greater uncertainty surrounding task work. Guidance for performing the team discussion was limited, and in cases where teams have limited heuristics, the importance of procedural guidelines becomes more important (Hakonen, 2008; Van den Bos & Lind, 2002). Along these lines, lack of collaborative affordance on these teams may have created uncertainty about justice elements such as participation, information accuracy, consistency, and correctibility.

This explanation is supported by Stager and Muter (1971). The authors found that pictorial modes of instruction offered a performance advantage by reducing task uncertainty. Participants trained on an analogue radar display using pictorial instructions gained performance advantage by using display redundancy to minimize information overload, and were more effective than participants trained with verbal descriptions. Likewise, monitoring digital records of team activity (Leventhal, 1980) can improve fairness perception. For example, Malhotra, Majchrzak, and Rosen (2007) determined that annotating team knowledge and comparing these instances over time provided guidance towards what direction the team should take.
Test for interaction of information display structuring on effects of action process structuring on decision accuracy

A review of means across conditions showed that teams had the highest accuracy rates when action process structuring was combined with information display structuring. But the test for interaction between factors on decision accuracy failed to reach significance. A possible explanation for higher accuracy scores when both factors were present is that the information display structure reduced load on team memory processes and allowed members to focus more on information sharing and exchange, and less on clarifying the information set. Teams with no designated communication and display process structures made the fewest correct choices, and the mean for these teams was significantly different than for teams where both factors were present. In addition, teams in the action process only condition were more accurate than those using the collaborative display used alone. That considered it is reasonable to posit that while the information display was able to provide a clear representation of the information set, the display alone lacked the facilitating elements included in the action process structure required to process the information effectively.

Research on hidden attributes and the display of decision information is consistent with this finding. In some cases visual processing alternatives, such as rank-ordering and tabular display can clarify the value of decision variables, which allows for better screening of alternatives (Voigtländer et al., 2009). However, while this additional clarity may help to eliminate clearly poor alternatives, (Schilling, McGarity, & ReVelle, 1982) individual sampling preference may be a stronger predictor of decision quality. For instance, Greitemeyer and colleagues found individual preference a significant factor in decision outcomes, regardless of whether information was hidden or complete decision information (a
manifest profile) was made available for all candidates prior to discussion (Greitemeyer et al., 2006).

Technology constraints may have played a role in decision accuracy as well. The collaborative document allowed information to be more easily organized, but there were limits based on the form factor and features of the application. The document had a finite amount of space that could be accessed without having to scroll down the page. For example, one team member could place all the attributes they had for candidate A in the table, but as additional members added their candidate A attributes, the document grew longer and more complex, making it difficult to attend to all alternatives at the same time (although not as difficult as tracking information in the chat tool). This may have limited the effectiveness of the display to provide a decision space where redundant information could easily be removed, and viable alternatives evaluated.

In addition, some groups had no guidelines for entering information into the document. Lacking systematic method for organizing the data may have limited team ability to clarify the meaning of the displayed information. The representation of displayed information impacts what and when information is used. Thus teams without effective methods for structuring information may not benefit from the ability to see it, worse, what they see may not be useful in solving the problem. For instance, decision makers select probable alternatives based on the information as it is given (Aschenbrenner, 1978). Similarly, Slovic posited (1972) that decision makers only use information that is explicitly displayed in the problem space, and only in the form that it is displayed. Or as Payne observes, “any information that has to be stored in memory, inferred from the display, or transformed will be discounted or ignored” (1982, p. 390). Thus lacking effective processes
in place to organize information, the visual representation may bias members towards faulty alternatives.

**Study Limitations and Delimitations**

There are a number of important qualifications about the study design that are suggested. First, the study took place in a completely dispersed virtual environment. This is beneficial for the study of virtual work, because quite often team members cannot be ensured of using the same equipment, or participating from the same time or place. However, this open environment may have impacted ability to address the research questions.

While there was some evidence in the study that action process structure can lead to increased team effectiveness, the protocol was somewhat challenging to operationalize in the virtual setting. Process elements were built fairly explicitly into the guidelines, but how closely the prescription was followed is uncertain. For example, participants may have been collocated when they were presumed to be separate. Given the information sharing component used to assess decision making, face-to-face interaction could have affected decision results. Likewise, some teams with no designated action process were effective. Without doubt these teams employed some useful process structures in the decision process, but the study design did not capture this aspect.

The information display construct also posed challenges to the experiment. Depending on how teams entered information into the collaborative display, there could be too much information on the screen to manage. Alternately, it cannot be said for certain that some members in the non-information display condition were not creating tabular representations, or other notes about the data that helped them clarify the information.
Also, because participants used their own technology and internet connection, consistency of mediating technology across persons could not be completely controlled. This resulted in occasional dropped connections, and hardware or software failures which disrupted the team work flow. While this is likely to occur in the real setting, the impact of technical complications was not entirely accounted for in the study.

Conceptual limitations may also have impacted effectiveness of the research strategy. First, the concepts of procedural justice and team climate are distinct in the literature. But analysis found the two measures were moderately correlated. This may be due to similarities between questions in the separate constructs. For example both constructs examine issues relating to team participation. This study used a shortened 14 question version of the team climate index due to time limitations. Future studies testing both concepts may benefit from using the longer 44 question version of the Team Climate Index which offers more diverse coverage of the four team climate dimensions, and so may provide more distinction between the constructs.

However increasing the length of the measurement instruments may not be advisable; the current bank of surveys used in the study contained 77 individual questions. Recent research has shown that after 20 minutes, participants become fatigued, task attention is reduced, and response speed increases, which can leads to loss of data integrity (Cape, 2012).

In fact while it cannot be said for certain, given the length of the task and following surveys, fatigue effects may have influenced participant response in this study. For example, satisficing answers (doing just enough to complete), and responding before fully considering the question may have affected responses on some items leading to measurement error. For example, this effect suggested by measurements for the long set of 40 information sharing
questions which was taken last. This section was where most participants dropped out, and may also help explain why the outcomes for information sharing variables were so similar between groups.

A final concern is self-selection of participants. Some participants participated for extra credit in a course they were currently taking, while others participated with no guaranteed reward. While this likely helped to increase the study population size, participants who were explicitly rewarded may have been more motivated to perform the task.

**Recommendations for Future Study**

**Recommendations for practice**

Because action process structures and collaborative technology affordance impact team performance and attitudes, managers should examine how these structures can be implemented into team work designs with consideration towards the unique nature of the team, task, available technology, and virtualness of the work environment. Namely, team designers should investigate ways to develop protocols that enhance task related performance through processes that promote interdependence, monitoring of team behavior and progress, and coordination of team task work. In addition virtual team environments should incorporate clear display of team information, particularly when tasks involve complex problems or information sets. Finally, team members should be trained on how to apply action process techniques towards a variety of team, task types, and technology configurations.

**Recommendations for further research**

A major goal of this study was to explore the impact of composite action process structures on team climate, procedural justice, and decision performance outcomes. However,
additional studies may provide better understanding how the benefits of individual action process elements can be applied to the virtual team performance by examining these process variables more discretely. For example, determining the amount, frequency, and quality of monitoring, backup, and coordination behaviors that occur may shed light on which process actions are more salient in determining effective team outcomes.

Likewise, some elements of procedural justice and team climate may be more salient under some conditions than others. The results of this study found that the some justice indicators, (process control), were much stronger than others (ethicality, bias suppression) suggesting justice perceptions vary along a dimension given the task, technology, and processes used. Likewise, virtual team qualities and team climate may also interact. For example, Kivimaki et al. found that dimensions of team climate construct varied given high and low. Low complexity tasks had better fit with the four original scales. But high complexity tasks were more reliably represented when a fifth factor for degree of interaction was added (1998).

Also, decision making gains in virtual teams remain elusive. While interventions have shown to improve information sharing and accuracy, little research on combinations these tools, such as, turn taking, listing, and critical priming, have been done. In addition, although team perceptions are carried forward as inputs in the next activity, this study only examined climate perceptions and decision outcomes that occurred in a single session. Longitudinal study of team climate and procedural fairness attitudes may generate better understanding of how action process and display structuring impact team performance over time.

Finally, while the study design approximated the technology mediated environment and task complexity virtual decision making teams, the task and teams were nonetheless
The findings of this study might be extended if a variety of both strictly controlled experiments and research conducted in real-life environments were compared and contrasted for similarities and differences.
REFERENCES


APPENDIX A

RECRUTING MATERIALS
Greetings:

My name is Sean Cordes. I am a doctoral candidate in the Human Computer Interaction program here at Iowa State University. You are receiving this invitation to participate in a research study because you are identified as a current student in a program where communication and decision making is critical for academic and job success.

This study might be a good fit if you:

- Want experience working with online tools
- Want experience working in a team setting
- Want to improve decision making skills
- Want to improve communication skills

Purpose of Project: The goal of the study is to learn how to improve decision making in the online team environment. Specifically, the research project looks at computer-mediated communication in work teams. The purpose of the study is to gain a better understanding of how team design impacts internal team processes and performance. Your participation will help inform organizations on how to structure teams to facilitate higher performance and member satisfaction outcomes.

Compensation: First, each participant will be eligible for a drawing to receive an iPad3. Second, persons on the team with the best performance will receive $20 each.

What is asked of you: To be eligible to participate, you must be at least 18 years of age and have a computer and Internet connection. If you are willing to participate, you will be asked to attend a session where you will be assigned to a team and responsible for collectively completing a collaborative decision making task. Following this activity you will be asked to complete an online survey. This survey asks participants about their experiences on the team and perceptions about the team environment and procedures used in the activity. The entire study should take no longer than 60 minutes to complete.

To sign up for the project:
Please visit the following link and select the times and days you are available.

http://www.doodle.com/85x69gh53s6mqzs4

After you have designated times and days you are available, an email will be sent to you giving you access to the project site with a short set of instructions for logging in to the site, and for participating in the study exercise. If you have any questions or concerns about this request, please contact:

Sean Cordes
Ph.D. Candidate
Human Computer Interaction
Iowa State University
scordes@iastate.edu
Participant Recruitment Flyer

Calling all students!
Help us learn more
about online team decision making!
Would the study be a good fit for me? What are some possible benefits?

This study might be a good fit if you:

- Want experience working with online tools
- Want experience working in a team setting
- Want to improve decision making skills
- Want to improve communication skills

What would I do if I took part in the study?

If you decide to take part in the study, you would:
- Meet online with your team in a collaborative work space
- Review information about fictional job candidates
- Make an individual decision about who to hire
- Make a team decision about who to hire
- Fill out an online survey describing your experience

What else could I get for participating!
Participants who take part have a chance to win an iPad 3 to thank them for their time. The people on the team with the best performance will be awarded $20 each!
The principal researcher for this study is Sean Cordes, scordes@iastate.edu

To sign up for the project:
Please visit the following link and select the times and days you are available.
http://goo.gl/gQz3L or for more information, please contact cs-cordes@wiu.edu
This research is always voluntary and confidential!
APPENDIX B

EXPERIMENT TASK MATERIALS
Study Instructions

General Instructions
Communication
You can use the chat tool to communicate in documents like this one, where more than one person can see it, like this page. To chat click VIEWING tab at the top right of the page, and then chat at the bottom right). We will use the chat tool in these instructions for these things.

Communicate with your team.
The Task 2 page will let you communicate with your team using the chat tool for making your team decision.

The Study Problem
The Scenario
You will determine the best job candidate for an airline pilot position first individually, then as a group using a basic version of the human resources decision making process. Your airline is a main service specializing in international flights and requires pilots with extensive professional flight experience to fill the schedule. The airline recently posted an internal job announcement on the employee bulletin board system. You are one of four search committee members that will come together to choose a pilot to fly globally for the airline company. The job is intensive and requires expert skill and experience. After reviewing the applications a total of four potential candidates are eligible for the promotion. All the pilots have the same amount of flight time experience, and have flown many of the same planes and flight routes.

Materials
You should see you should see 4 documents in your Google docs list that provide information and procedures for performing the tasks.

1. Start Here - These general instructions are where we will meet in the chat tool before, after, and during the activity for questions.

2. Candidate Attributes document - Contains information about each job applicant you are reviewing. Use this information to help make your individual and group decisions.

3. Task 1-Individual Decision document-Contains instructions for reviewing the candidates and making your individual decision. The document also contains a link to the Individual Decision form.

4. Task 2 & Task 3-Team Decision & Final Survey document-Contains instructions for performing the team decision and final survey, with links to 2 forms for recording your answers, (Team Decision, and the Final Survey).
Performing the study (Three Tasks)
Using documents in your in Google Docs list you will complete 3 tasks.
1) Task 1 is an individual decision
2) Task 2 is team decision and final survey about your experience.
3) Task 3 is a final survey about your activity experience. There is no time limit to complete the tasks, but the entire process should never take longer than 90 minutes.
Tasks 2 and 3 are on the same document, and there are links to 2 forms at the bottom.

Make sure you filled fill out the consent form.
Follow this link to review your rights as a participant, and confirm that you are aware of these rights and agree to participate in the study, http://bit.ly/xjeWcp. After submitting the informed consent form, you will see a link that will take you back to the Google Docs list.

Thanks so much for your participation!
Task 1: Individual Decision Instructions

Read the information for the four pilots in the Candidate Attributes document in your Google Docs Space. The Candidate Attributes document contains information about each candidate (A-D). These attributes reflect the candidate’s job related behavior, skills and attitudes taken from employee review documents, and interviews with supervisors, and peers. The organization feels these things would be a good indicator of the pilots ability to perform well in the new position.

Based on the candidate attributes, select the candidate that you feel is best suited for the position. In the next task you will discuss your choice to come to a group decision. Be able to explain to your team why you chose the candidate you did.

Please go to the form here goo.gl/8TkVe and submit your individual decision about who gets the job.

You will have 10 minutes to review this information and prepare for the discussion.
Task 2: Team One Decision Instructions

In Task 2 of this activity three other team members will be joining you to take part in a group discussion about the job candidates. When you begin the session make sure all four team members are viewing the Task 2 Team Decision document, and then proceed with the team’s assignment. To chat click VIEWING tab at the top right of the page, and then chat at the bottom right. If no one is viewing, chat will not open.

During Task 2 your team will determine the best applicant to hire for the pilot position based on information team members report. To perform the group discussion, use the Candidate Attributes document you reviewed in Task 1. Note that on the basis of the total information available to you as a group, one of the four applicants is unambiguously the best according to expert opinion.

It is therefore your job as a group to determine who that applicant is based on the information that is shared during your group conference. This may or may not be the same person that you selected in Task 1.

Read the following instructions carefully before your team begins.

Decide as a group which one of the four pilots is the most suitable candidate for the new pilot position. There is no time limit, but the activity should not take more than 45 minutes.

Decision Process. Each team will assign one team member as the monitor to guide the task. Each team member will contribute to discussion of each individual candidate, and has the right to call an appeal during any part of the decision process.

Report on the Attributes
Starting with Candidate A each member copies and pastes the attributes from their individual Candidate Attributes document into the Attribute Work Area table below these instructions so team members can see each other’s information.

Using the chat tool, the team monitor asks for feedback from each person one at a time about attributes for Candidate A. Each member tells the group whether they see duplicate attributes, new attributes they not seen before, and whether attributes are positive or negative. Base your arguments on the ALL decision information in the discussion, not just on the individual on information you have.

Next, the monitor highlights new and duplicate information, and organizes the attribute information from all members into one set for the candidate discussed. Then the monitor lists the number of positive and negative attributes, and the new attributes found for the candidate discussed into the Decision Table. After any disagreements about the information for Candidate A are settled, the process continues with next candidate B.
Choose a Candidate
After all candidates are reviewed, make a team decision about which candidate gets the pilot job, based on the information found for each candidate in the discussion. Your team can take as much time as needed to reach agreement but the task should take no longer than 45 minutes to complete.

Attribute Work Area. Place pilot attributes here to discuss each candidate one at a time in order. You can make the box bigger if you need to.

<table>
<thead>
<tr>
<th>Decision Table</th>
</tr>
</thead>
<tbody>
<tr>
<td>Candidate A</td>
</tr>
<tr>
<td>Candidate B</td>
</tr>
<tr>
<td>Candidate C</td>
</tr>
<tr>
<td>Candidate D</td>
</tr>
</tbody>
</table>
**Enter Your Team Decision**
Each team member should fill out the team decision survey [http://goo.gl/h0rB4](http://goo.gl/h0rB4). Each team member should select the same candidate to hire, but may have different answers for the other questions. This concludes Task 2, please go to Task 3 and complete the Final Survey.

**Task 3**
**Final Survey:**
Finally, you will need to fill out a short online questionnaire related to your experiences on this team. This survey will take 10-15 minutes to complete. Fill out the Final Survey here, [http://goo.gl/MTUV8](http://goo.gl/MTUV8)

Thanks again for your time and participation!
Task 2: Team Two Decision Instructions

In Task 2 of this activity three other team members will be joining you to take part in a group discussion about the job candidates. When you begin the session make sure all four team members are viewing the Task 2 Team Decision document, and then proceed with the team’s assignment. To chat click VIEWING tab at the top right of the page, and then chat at the bottom right). If no one is viewing, chat will not open.

During Task 2 your team will determine the best applicant to hire for the pilot position based on information team members report. To perform the group discussion, use the Candidate Attributes document you reviewed in Task 1. Note that on the basis of the total information available to you as a group, one of the four applicants is unambiguously the best according to expert opinion.

It is therefore your job as a group to determine who that applicant is based on the information that is shared during your group conference. This may or may not be the same person that you selected in Task 1.

Read the following instructions carefully before your team begins.

Decide as a group which one of the four pilots is the most suitable candidate for the new pilot position. There is no time limit, but the activity should not take more than 45 minutes.

Decision Process
Each team will assign one team member as the monitor to guide the task. Each team member will contribute to discussion of each individual candidate, and has the right to call an appeal during any part of the decision process.

Report on the Attributes
Starting with Candidate A each member copies and pastes the attributes from their individual Candidate Attributes document into the Attribute Work Area table below these instructions so team members can see each other’s information.

Using the chat tool, the team monitor asks for feedback from each person one at a time about attributes for Candidate A. Each member tells the group whether they see duplicate attributes, new attributes they not seen before, and whether attributes are positive or negative. Base your arguments on the ALL decision information in the discussion, not just on the individual on information you have.

Next, the monitor posts a summary of new and duplicate information, and number of positive and negative attributes for the candidate discussed. After any disagreements about the information are settled, the process continues with next Candidate B.

Choose a Candidate
After all candidates are reviewed, make a team decision about which candidate gets the pilot job, based on the information found for each candidate in the discussion. Your team can take as much time as needed to reach agreement but the task should take no longer than 45
minutes to complete.

**Enter Your Team Decision.**
Each team member should fill out the team decision survey [http://goo.gl/h0rB4](http://goo.gl/h0rB4). Each team member should select the same candidate to hire, but may have different answers for the other questions. This concludes Task 2, please go to Task 3 and complete the Final Survey.

**Task 3**
**Final Survey:**
Finally, you will need to fill out a short online questionnaire related to your experiences on this team. This survey will take 10-15 minutes to complete. Fill out the Final Survey here, [http://goo.gl/MTUV8](http://goo.gl/MTUV8)

Thanks again for your time and participation!
Task 2: Team Three Decision Instructions

Task 2: Team Decision
In Task 2 of this activity three other team members will be joining you to take part in a group discussion about the job candidates. When you begin the session make sure all four team members are viewing the Task 2 Team Decision document, and then proceed with the team’s assignment. To chat click VIEWING tab at the top right of the page, and then chat at the bottom right). If no one is viewing, chat will not open.

During Task 2 your team will determine the best applicant to hire for the pilot position based on information team members report. To perform the group discussion, use the Candidate Attributes document you reviewed in Task 1. Note that on the basis of the total information available to you as a group, one of the four applicants is unambiguously the best according to expert opinion.

It is therefore your job as a group to determine who that applicant is based on the information that is shared during your group conference. This may or may not be the same person that you selected in Task 1.

Read the following instructions carefully before your team begins.
Decide as a group one of the four pilots is the most suitable candidate for the new pilot position. There is no time limit, but the activity should not take more than 45 minutes.

Decision Process
Each team member copies and pastes their individual Candidate Attributes for the pilots into the Attribute Work Area below these instructions so team members can see each other’s information.

Report on the Attributes. Using the chat tool discuss the attributes of each candidate. Each member tells the group whether they see duplicate attributes, new attributes they not seen before, and whether attributes are positive or negative. Enter the total positive and negative attributes new information found new for each candidate in the Decision Table below these instructions.

Choose a Candidate
After all candidates are reviewed, make a team decision about which candidate gets the pilot job, based on the information found for each candidate in the discussion. Each team member should select the same final candidate!

Attribute Work Area. Place pilot attributes here to discuss each candidate. You can make the box bigger if you need to.
<table>
<thead>
<tr>
<th>Candidate A</th>
<th>Positive</th>
<th>Negative</th>
<th>New</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Candidate B</td>
<td>Positive</td>
<td>Negative</td>
<td>New</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Candidate C</td>
<td>Positive</td>
<td>Negative</td>
<td>New</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Candidate D</td>
<td>Positive</td>
<td>Negative</td>
<td>New</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Enter Your Team Decision**
Each team member should fill out the team decision survey [http://goo.gl/h0rB4](http://goo.gl/h0rB4). Each team member should select the same candidate to hire, but may have different answers for the other questions. This concludes Task 2, please go to Task 3 and complete the Final Survey.

**Task 3- Final Survey:**
Finally, you will need to fill out a short online questionnaire related to your experiences on this team. This survey will take 10-15 minutes to complete. Fill out the Final Survey here, [http://goo.gl/MTUV8](http://goo.gl/MTUV8)

Thanks again for your time and participation!
Task 2: Team Four Decision Instructions

Task 2: Team Decision
In Task 2 of this activity three other team members will be joining you to take part in a group discussion about the job candidates. When you begin the session make sure all four team members are viewing the Task 2 Team Decision document, and then proceed with the team’s assignment. To chat click VIEWING tab at the top right of the page, and then chat at the bottom right). If no one is viewing, chat will not open.

During Task 2 your team will determine the best applicant to hire for the pilot position based on information team members report. To perform the group discussion, use the Candidate Attributes document you reviewed in Task 1. Note that on the basis of the total information available to you as a group, one of the four applicants is unambiguously the best according to expert opinion.

It is therefore your job as a group to determine who that applicant is based on the information that is shared during your group conference. This may or may not be the same person that you selected in Task 1.

Read the following instructions carefully before your team begins.
Decide as a group which one of the four pilots is the most suitable candidate for the new pilot position. There is no time limit, but the activity should not take more than 45 minutes.

Decision Process
Using the chat tool discuss the attributes of each candidate. Each member tells the group whether they noted any duplicate attributes, new attributes not seen before, and whether attributes are positive or negative.

Choose a Candidate
After all candidates are reviewed, make a team decision about which candidate gets the pilot job, based on the information found for each candidate. Each Team member should select the same final candidate!

Enter Your Team Decision.
Each team member should fill out the team decision survey http://goo.gl/h0rB4. Each team member should select the same candidate to hire, but may have different answers for the other questions. This concludes Task 2, please go to Task 3 and complete the Final Survey.

Task 3
Final Survey:
Finally, you will need to fill out a short online questionnaire related to your experiences on this team. This survey will take 10-15 minutes to complete. Fill out the Final Survey here, http://goo.gl/MTUV8

Thanks again for your time and participation!
Candidate Attributes

Team Member One

Candidate Profiles
Please review the following qualities about the pilot job candidates and use the information to make your individual decision about who should get the job. You will also use these same attributes in your team discussion and decision.

Candidate A:
1. has a very good feeling for dangerous situations
2. is at times not good at taking criticism
3. can assess complex situations well
4. has excellent depth perception
5. is sometimes unorganized
6. has very good leadership qualities

Candidate B:
1. maintains composure even in crisis situations
2. is regarded as grumpy
3. is highly reliable
4. is able to assess weather conditions very well
5. is regarded as not very cooperative
6. has very good computer skills

Candidate C:
1. is resistant to stress
2. is not verbally skillful
3. is able to make the right decisions very quickly
4. is regarded as egocentric
5. fosters a good atmosphere within the crew
6. has a poor diet

Candidate D:
1. is able to react to unforeseen events adequately
2. is considered arrogant
3. is able to concentrate very well over long periods of time
4. commands a high problem solving ability
5. is not very suitable for leading a team
6. has a very good sense of responsibility
Team Member Two

Candidate Profiles
Please review the following qualities about the pilot job candidates and use the information to make your individual decision about who should get the job. You will also use these same attributes in your team discussion and decision.

Candidate A:
1. has a very good feeling for dangerous situations
2. is regarded as a show-off
3. can assess complex situations well
4. has excellent depth perception
5. is regarded as not being open to innovations
6. has very good leadership qualities

Candidate B:
1. maintains composure even in crisis situations
2. has below average memorization skills
3. is highly reliable
4. is able to assess weather conditions very well
5. makes nasty remarks about his colleagues
6. has very good computer skills

Candidate C:
1. is able to make the right decisions very quickly
2. is very conscientious
3. is not verbally skillful
4. has a poor diet
5. is very skillful in dealing with complicated technology
6. is regarded as egocentric

Candidate D:
1. is able to react to unforeseen events adequately
2. is regarded as a ‘know-it-all’
3. is able to concentrate very well over long periods of time
4. commands a high problem solving ability
5. is hot-headed
6. has a very good sense of responsibility
Team Member Three

Candidate Profiles
Please review the following qualities about the pilot job candidates and use the information to make your individual decision about who should get the job. You will also use these same attributes in your team discussion and decision.

Candidate A:
1. has a very good feeling for dangerous situations
2. is unfriendly
3. can assess complex situations well
4. has excellent depth perception
5. has very good leadership qualities
6. takes part in further education only reluctantly

Candidate B:
1. maintains composure even in crisis situations
2. is regarded as arrogant
3. is highly reliable
4. is able to assess weather conditions very well
5. adopts the wrong tone sometimes
6. has very good computer skills

Candidate C:
1. puts the security of persons he is responsible for above everything
2. is able to make the right decisions very quickly
3. is regarded as egocentric
4. is not verbally skillful
5. has a poor diet
6. fosters a good atmosphere within the crew

Candidate D:
1. is able to react to unforeseen events adequately
2. is considered moody
3. is able to concentrate very well over long periods of time
4. commands a high problem solving ability
5. is regarded as a loner
6. has a very good sense of responsibility
Team Member Four

Candidate Profiles
Please review the following qualities about the pilot job candidates and use the information to make your individual decision about who should get the job. You will also use these same attributes in your team discussion and decision.

Candidate A:
1. has a very good feeling for dangerous situations
2. is unfriendly
3. can assess complex situations well
4. has excellent depth perception
5. has very good leadership qualities
6. takes part in further education only reluctantly

Candidate B:
1. maintains composure even in crisis situations
2. is regarded as arrogant
3. is highly reliable
4. is able to assess weather conditions very well
5. adopts the wrong tone sometimes
6. has very good computer skills

Candidate C:
1. puts the security of persons he is responsible for above everything
2. shows very good performance with regard to attention
3. is regarded as egocentric
4. is not verbally skillful
5. has a poor diet
6. fosters a good atmosphere within the crew

Candidate D:
1. is able to react to unforeseen events adequately
2. is considered moody
3. is able to concentrate very well over long periods of time
4. commands a high problem solving ability
5. is regarded as a loner
6. has a very good sense of responsibility
Complete Candidate Profile Set

Pilot A
has a very good feeling for dangerous situations
can assess complex situations well
has excellent depth perception
has very good leadership qualities
is at times not good at taking criticism
is sometimes unorganized
is regarded as a show-off
is regarded as not being open to innovation
is unfriendly
takes part in further education only reluctantly

Pilot B
maintains composure even in crisis situations
is highly reliable
is able to assess weather conditions very well
has very good computer skills
is regarded as grumpy
is regarded as not very cooperative
has below average memorization skills
makes nasty remarks about his colleagues
is regarded as arrogant
adopts the wrong tone sometimes

Pilot C
is not verbally skillful
is regarded as egocentric
is able to make the right decisions very quickly
is resistant to stress
fosters a good atmosphere within the crew
is very conscientious
is very skilful in dealing with complicated technology
puts the security of persons he is responsible for above everything
has a high attention to detail
has a poor diet

Pilot D
is able to react to unforeseen events adequately
is able to concentrate very well over long periods of time
commands a high problem solving ability
has a very good sense of responsibility
is considered arrogant
is not very suitable for leading a team
is regarded as a ‘know-it-all’
is hot-headed
is considered moody
is regarded as a loner
APPENDIX C

MEASUREMENT INSTRUMENTS
Individual Decision Form

Read the information for the four pilots in the Candidate Attributes document in your Google Docs Space. The Candidate Attributes document contains information about each candidate (A-D). These attributes reflect the candidate’s job related behavior, skills and attitudes taken from employee review documents, and interviews with supervisors, and peers. The organization feels these things would be a good indicator of a pilot ability to perform well in the new position.

Based on the candidate attributes, select the candidate that you feel is best suited for the position.

In the next task you will discuss your choice to come to a group decision. Be able to explain to your team why you chose the candidate you did.

Based on the attributes in the candidate profiles which candidate did you select? [A,B,C,D]

[1=Very Unsuitable, 2=Unsuitable, 3=Neutral, 4=Suitable, 5= Very Suitable]

How suitable was Candidate A for the job?
How suitable was Candidate B for the job?
How suitable was Candidate C for the job?
How suitable was Candidate D for the job?
Team Decision Form

Based on the attributes in the candidate profiles which candidate did your team select? [A, B, C, D]

[1=Very Unsuitable, 2=Unsuitable, 3=Neutral, 4=Suitable, 5= Very Suitable]

How suitable was Candidate A for the job?
How suitable was Candidate B for the job?
How suitable was Candidate C for the job?
How suitable was Candidate D for the job?
Information Sharing Measurement

Directions: After your team discussion, on a scale of 1 (not valuable at all) to 5 (very valuable) how valuable were the following attributes in making your team decision

- Has a very good feeling for dangerous situations
- Can assess complex situations well
- Has excellent depth perception
- Has very good leadership qualities
- Is at times not good at taking criticism
- Is sometimes unorganized
- Is regarded as a show-off
- Is regarded as not being open to innovation
- Is unfriendly
- Has a poor diet
- Maintains composure even in crisis situations
- Is highly reliable
- Is able to assess weather conditions very well
- Has very good computer skills
- Is regarded as grumpy
- Is regarded as not very cooperative
- Has below average memorization skills
- Makes nasty remarks about his colleagues
- Is regarded as arrogant
- Adopts the wrong tone sometimes
- Is not verbally skillful
- Is regarded as egocentric
- Takes part in further education only reluctantly
- Is able to make the right decisions very quickly
- Is resistant to stress
- Fosters a good atmosphere within the crew
- Is very conscientious
- Is very skillful in dealing with complicated technology
- Puts the security of person he is responsible for above everything
- Shows very good performance with regard to attention
- Is able to react to unforeseen events adequately
- Is able to concentrate very well over long periods of time
- Commands a high problem solving ability
- Has a very good sense of responsibility
- Is considered arrogant
- Is not very suitable for leading a team
- Is regarded as a ‘know-it-all’
- Is hot-headed
- Is considered moody
- Is regarded as a loner
Procedural Justice Measurement

Directions: The questionnaire focuses on how you feel about your team procedures. Please read the following statements carefully and respond with your own feelings and beliefs. There are no right or wrong answers. Please make sure to answer all questions. Thank you very much!

To what extent:

1 Strongly Disagree  2 Agree  3 Undecided  4 Disagree  5 Strongly Agree

Have you been able to express your views and feelings during those procedures?

Have you had influence over the (outcome) arrived at by those procedures?

Have those procedures been applied consistently?

Have those procedures been free of bias?

Have those procedures been based on accurate information?

Have you been able to appeal the (outcome) arrived at by those procedures?

Have those procedures upheld ethical and moral standards?
Team Climate Measurement Instrument
Directions: The questionnaire focuses on how you feel about the work climate of your team. Please read the following statements carefully and respond with your own feelings and beliefs. There is no right or wrong answer. Please make sure to answer all questions. Thank you very much!

1 2 3 4 5
Strongly Disagree Disagree Neutral Agree Strongly Agree

Participative Safety
People keep each other informed about work-related issues with the team.
There are real attempts to share information throughout the team.
People feel understood and accepted by each other.
We have a “we are together” attitude.

Support for Innovation
People in this team are always searching for fresh, new ways of looking at problems.
In this team we take the time needed to develop new ideas.
People in the team cooperate in order to help develop and apply new ideas.

Team Vision
How far are you in agreement with the task objectives?
To what extent do you think your team’s objectives are clearly understood by other team members?
To what extent do you think your team’s objectives were actually be achieved?
How worthwhile do you think these objectives are to the team?

Task Orientation
Are team members prepared to question the basis of what the team is doing?
Does the team critically appraise potential weakness in what it is doing in order achieve the best possible outcome?
Do members of the team build on each other’s ideas to achieve the best possible outcome?
VITA

Sean Cordes

Professional Profile
- Accomplished library faculty professor with comprehensive blend of hands-on academic technology management, and teaching experience.
- Innovative teacher devoted to student learning and development, committed to empowerment and student growth.
- Dedicated information scientist who is passionate about the potential and impact of information concepts and skills.
- Published author and national and international professional presenter.

Education
- MLS, University of Missouri-Columbia, May 2004
- MEd Educational Technology, University of Missouri-Columbia, December 2003
- BA English, Technical Writing, University of Missouri-Rolla, May 2000
- BA Psychology, Industrial/Psychology/Human Factors, University of Missouri-Rolla, May 2000

Teaching Interests
- Technology for Information Work
- Architecture of Information Systems
- Management of Library Systems and Services
- Knowledge Management and the Learning Organization
- Access and Presentation of Digital Content

Highlights of Teaching Experience
Assistant Professor, Western Illinois University 2007- Present
- Developed and teach General Honors course “Exploring Modern Information” including a variety of online interactive critical thinking experiences.
- Teach Library 201 “Introduction to Information Resources” course, incorporating hands-on information access, evaluation, and management activities using open and proprietary database and web information tools.
- Teach research information search, retrieval and evaluation instruction for a range of disciplines and lesson plans with 250+ classroom hours from 2007-2013.

Assistant Professor, Iowa State University 2004-2007
- Taught 2 online WebCT sections of the required 1/2 credit course Library 160 “Library Instruction” each semester from fall 2004 through spring 2007 with an average class size of 150 students per semester.

Highlights of Professional Experience
Instruction Service Coordinator, Western Illinois University 2007- Present
- Coordinated strategic planning, policy and program development, evaluation and assessment, and marketing of library instruction services.
- Manage day-to-day operations of large scale (350) sessions per year instruction program.
- Design and implement virtual reference systems
Develop and manage integrated library instruction scheduling and calendaring systems
Develop online instruction session evaluation technologies and processes
Design and manage records management system for library instruction program
Create digital instruction class guides and web pages to support face-to-face and online learning using a wide range of tools and platforms
Work with university and library web and computing services to develop web presence and increase usefulness and usability of the libraries instruction site.
Coordinate the library multimedia studio.
Coordinate seven member library faculty instruction team.
Supervise instruction unit media development staff, including digital project planning design and review.

Instructional Technology Librarian, Iowa State University 2004-2007
- Used the classroom environment in innovative ways to engage learners including the use of split screen video and background soundtracks.
- Assisted with the publishing (creating, editing, and formatting) of course content to the WebCT and online Library web sites each semester.
- Created pilot for distributing podcasts to multiple WebCT courses.
- Designed and implemented innovative materials and processes for a large scale WebCT online learning environment with minimal negative impact to existing service.
- Streamlined student test attendance processes by using direct data input into WebCT via laptop at test time.
- Developed multimedia tutorials that resolved 100% of existing usability issues and added value improvements related to design, usability and manageability.
- Wrote grant documents resulting in the upgrade of instruction facilities including complete redesign of the library classroom (hardware, furniture and fixtures), acquisition of classroom control system software, a presentation and conferencing room and podcasting equipment, and the library Multimedia Production Studio.
- Responsible for direct instructional support for students developing projects in the Multimedia Production Studio.

Research Assistant-Consultant, University of Missouri-Columbia, Columbia, Missouri 1999-2004
- As team leader developed and implemented distributed cataloging and internal circulation system for the Missouri Department of Transportation Library.
- Developed multimedia learning activities and information architecture for the Harry S. Truman Presidential Library and Museum web site.
- Developed and web mastered three sites for the Office of the Vice Provost for Minority Affairs, International Programs, and Faculty Development, including: the main Vice Provost MAIPFD site, University Black Studies web site, University Disability Services, the Martin Luther King Memorial site, and the ADA web site.

Scholarly and Professional Activities

Publications (**Refereed)
**Cordes, S., Georges, J., & Young, A. (2012). Riffing the tube: Developing and promoting viral instruction videos for mobile teaching projects. *Journal of Mobile Teaching*, (1)2.


**Refereed Conference Proceedings**


Grant Activity

National Network of Libraries of Medicine Technology Improvement Award, Midwest User Video Health Experiences (MUV-HE) 2011. Fully funded: $4500


National Library of Medicine, Building the Future with Community Health Information, Fully Funded: $38,829.


Iowa State University Library Computing Advisory Committee Grant 2005, Fully funded: $985.

Iowa State University Library Computer Advisory Committee Grant 2004 Fully Funded $12,395.

Selected Professional Service Activities

Desire2Learn Transition Advisory Team Group
12/5/11-8/20/12

Internet Technology Advisory Council
9/10/11-1/10/12

Desire2Learn Train the Trainer Group
9/16/11-Present

Committee Chair of the Provost's Award for Excellence in Teaching with Technology Committee 2009-2013

Committee Member Library Services Model Working Group, Technical Support and Technology
7/21/10-Present

Committee Member Library Services Model Working Group, Instruction and Online Learning
6/23/10-7/13/10
Member, myWIU Portal Beta Review Team
4/2/10-Present

Committee Member, University Technology Advisory Group
2/23/10-1/20/2012

Member LibQual+ Library Quality Assurance Assessment Group
9/11/09-3/3/10

Member University Mobile Computing Task Force, Sub-committee chair, research and development sub-committee
8/15/08-1/27/2013

Professional Organizations

American Library Association, Library Information Technology Association, Member Education Committee
6/1/09-Present

International Federation of Library Associations, Corresponding Member Information Literacy Committee
8/24/08-Present