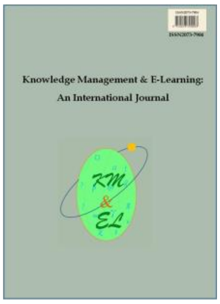
Knowledge Management & E-Learning



ISSN 2073-7904

Virtual team learning: The role of collaboration process and technology affordance in team decision making

Sean Cordes
Western Illinois University, IL, USA

Recommended citation:
Cordes, S. (2016). Virtual team learning: The role of collaboration process and technology affordance in team decision making. *Knowledge Management & E-Learning*, *8*(4), 602–627.

Knowledge Management & E-Learning, 8(4), 602–627

Virtual team learning: The role of collaboration process and technology affordance in team decision making

Sean Cordes*

Faculty of University Libraries
Western Illinois University, IL, USA
E-mail: CS-Cordes@wiu.edu

*Corresponding author

Abstract: The study examines two dimensions that impact virtual team decision making. One is the influence of collaboration process structure: the sequences, patterns, and routines participants use to interact and solve problems. The other is technology affordance: the strengths and weaknesses of technologies in terms of the usefulness they offer to teams when performing tasks. Some teams used a structured collaboration process with monitoring, coordination, and backup functions during a decision-making discussion. Other teams had no discussion process instructions. In addition, some teams possessed stronger technology affordance including both chat and an editable document. Other teams used chat technology alone, which offered fewer collaboration possibilities. The collaboration process and technology affordance factors were tested in an experiment in which four-person online teams worked as a personnel hiring committee. Information about four job candidates was distributed to create a hidden profile in which some information was shared across all team members, while other information was visible only to specific members. Two hundred and eight students, comprising fifty-two teams completed the study. Teams using the structured collaboration process made more accurate and higher-quality decisions. In addition, scores were higher when technology affordance included both chat and editable document tools, but this influence was not significant.

Keywords: eLearning; Information sharing; Collaboration; Decision making; Virtual teams; Hidden-profile

Biographical notes: Dr. Sean Cordes is currently an Associate Professor at Western Illinois University. He has performed numerous projects relating to instructional design and teaching with technology. His research interests include human-computer interaction and the development of 21st century information skills.

1. Introduction

1.1. Background of the study

The ability to adapt to virtual environments is critical for organizations in which work is increasingly performed online and success is dependent on team collaboration, development of flexible structures for virtual team work and knowledge acquisition strategies (Majchrzak, Rice, Malhotra, King, & Ba, 2000; Pfister & Oehl, 2009). Virtual teams are distributed members using communication technology to accomplish common goals or tasks (Majchrzak et al., 2000). These teams often make decisions using a range of processes to acquire, exchange, and apply information (Chiravuri, Nazareth, & Ramamurthy, 2011). Because of temporal differences, member distribution, and reliance on communication technology, teams work differently online (Grenier & Metes, 1995). Most notably, the communication technology that brings teams together also mediates the ability to share information, generate alternatives, and perhaps most importantly, to make decisions (Fuller, Hardin, & Davison, 2006; Wysocki & McGary, 2003).

Decision making occurs at all levels and areas of the organization. Therefore, decisions directly impact the quality and value of work outcomes (DuBrin, 2013). However, based on a review of 400 organizational management decisions, Nutt (2002) found that half of these failed to reach full potential. Decisions most often fail because of poor strategies that result in information and decision alternatives being overlooked. Regarding virtual teams, part of this shortcoming is likely due to insufficient training and experience in the online work setting. For instance, in addition to communication challenges, virtual teams often have little experience working with other members or training for online collaboration (Munkvold & Zigurs, 2007).

Collaboration is a key to effective teamwork because it provides a means for building understanding about how the team gets things done (Lin, Chiu, Joe, & Tsai, 2010). Tarmizi et al. (2007), suggest virtual teams may benefit from collaboration processes designed to increase team performance. For instance, Maznevski and Chudoba (2000) found effective collaboration was associated with the ability of virtual teams to adapt their interaction form, decision process, and work coordination. This suggests virtual teams need process methods for sharing and managing information in order to be successful (Dittman, Hawkes, Deokar, & Sarnikar, 2010). As Luery and Raisinghani (2001) notes, without effective processes and communication, technology itself cannot optimize outcomes.

For example, technology-mediated communication makes sequence and timing of virtual team interaction more difficult than for physical teams. Typing messages takes longer than talking, and team information in the virtual setting requires more effort to organize and manage. Furthermore, individual actions are hidden from others, so some members may not focus attention on the task (Martins, Gilson, & Maynard, 2004). Also, because visual cues are limited, virtual teams have difficulty coordinating activity. This is critical to effective collaboration. For example, Kopp, Hasenbein, and Mandl (2014) found teams that focused on coordination behaviors performed better than teams that focused on content activity. These unique characteristics of virtual work suggest that new approaches to team learning are needed since traditional methods do not effectively support virtual collaboration. Accordingly, organizations must develop training in new techniques for the distributed workplace.

1.2. Purpose of the study

With the trend toward online work, and the need for specialized skills and technology for virtual teams to collaborate effectively, there is value in designing effective techniques that are easy to implement and use. Supporting this, Rice, Davidson, Dannenhoffer, and Gay (2007) demonstrated that teams trained on technology use, work process, and task structure increased performance significantly.

The purpose of this research is twofold. First, using the context of a personnel selection task, the research proposes a collaboration process structure using coordination, monitoring, and backup functions to improve team decision accuracy and quality that can be implemented without formal training. Second, the research examines whether the amount of communication technology affordance influences team decision outcomes. Specifically, does the amount of communication technology methods available to the team impact its ability to exchange information and make better decisions?

Collaboration process structures are more effective when they contain cues about the interaction of team, task, and environment that provide details about how to act. Thus, developing structures to improve team decision making requires enhancing the patterned interaction of team members during the collaboration process (DeSanctis & Gallupe, 1987). However, technology mediation impacts team communication and information sharing. Affordance properties of specific communication technologies, such as text chat or shared collaboration tools, provide more or less support for information exchange during the decision process. Given these qualifications, the following hypotheses were tested:

Hypothesis 1*: Teams using a designed collaboration process structure will have greater decision accuracy.*

Hypothesis 2*: Team using a designed collaboration process structure will have higher decision quality.*

Hypothesis 3*: The degree of communication technology affordance will moderate the relationship between collaboration process structure and decision accuracy.*

2. Literature review

Drawing on the collaboration process framework of Dittman, Hawkes, Deokar, and Sarnikar (2010), three areas of research were used to provide theoretical and practical structure to this study. First, virtual team literature was reviewed to identify unique challenges of the virtual team process including communication, collaboration, and information sharing. Next, a review of collaboration research literature provided guidance in methods for designing a virtual team process to optimize decision making. Finally, because virtual team development requires an understanding of how knowledge is acquired and retained, relevant learning theory was reviewed and applied to build a conceptual framework for grounding the proposed collaboration process (Gould, 2012).

2.1. Communication

The distribution of members and reliance on technology makes virtual team communication distinctly different, especially in terms of work process. One challenge is the diminished sense of co-presence in the virtual setting. Co-presence is the cognitive and affective perception that persons are on the same page, working together, and of like mind. But in the virtual setting, visual and verbal communication cues are reduced. Because of this, casual conversation that fills gaps in face-to-face settings is lacking. Thus, effective application of communication technology is required to create a shared sense of being during virtual team interaction (Daft & Lengel, 1986).

Additionally, research suggests that display of task-related information increases effective communication by helping teams maintain shared awareness of decision information (Mason & Mitroff, 1973). For example, representation of information using listing and structuring methods is associated with improved learning and solution rates in decision-making scenarios (Voigtlaender, Pfeiffer, & Schulz-Hardt, 2009).

Nonetheless, there is no single solution for representing team information. For instance, Remus (1984) found that both tabular and graphic displays improve decision making outcomes depending on environmental complexity. In low-complexity environments, a tabular display helps aggregate and weigh decision criteria. In the case of high-complexity settings, rules available in graphic displays prove better as a decision making aid (Remus, 1987). Consequently, virtual interaction patterns are likely to be more effective when they contain communication cues that provide details to the team about how to act (DeSanctis & Gallupe, 1987). Structuring the team collaboration process is one way to improve this fit (Koszalka & Wang, 2002). Majchrzak and colleagues (2000) assert that team interaction is improved by identifying changes to information, then assigning protocols to address these changes. Dialog structuring is another way to enhance collaboration. Hron, Hess, Cress, and Giovis (2000) found that teams directed to discuss topics critically and provide equal input were better able to work through key questions and provide greater focus on the information.

Perhaps the most important function of communication media in the collaboration decision environment is to enable interdependent teamwork. When communication processes are aligned with technology, outcomes are generally expected to be positive (DeSanctis & Poole, 1994). But it can be hard to match technology to a task because some media are more suitable for particular work than others (Figl & Saunders, 2011). For example, research on military training found that alternatives such as text-based chat may fall short in providing critical verbal and gestural communication cues such as uncertainty and urgency that are clearly available in face-to-face contexts (Budlong, Walter, & Yilmazelb, 2009). However, this distinction is not always clear. Dennis, Valacich, Speier, and Morris (1998) discovered that low-fidelity communication tools like text-based chat enabled more team ideas. Finally, research suggests that display of task-related information can increase communication effectiveness by helping teams maintain a shared awareness of decision information (Mason & Mitroff, 1973). For instance, using listing and structuring methods to represent information is associated with improved learning, memory performance, and solution rates in decision making scenarios (Voigtlaender, Pfeiffer, & Schulz-Hardt, 2009).

2.2. Information sharing

In terms of intellectual task performance, information sharing may have the greatest impact on virtual teams. DeChurch and Mesmer-Magnus (2010) highlight two dimensions-uniqueness and openness-that help define the information-sharing dynamic. Uniqueness represents how much teams recognize and apply distinct member information. Access to unique information expands the knowledge pool and potential for generating alternatives. Openness is a socio-emotional construct that describes a team's willingness to share information. While receptiveness to information sharing does not directly lead to more available knowledge, it may increase the depth of processing and opportunities for sharing unique information.

Much of the knowledge about information sharing is founded on Stasser and Titus's (1985) studies on information sampling bias. The authors learned that even when teams were given access to all information, the ability to exchange it and make the correct decision was extremely limited. Generally, groups tend to discuss (shared) information known by all more than (unshared) information unique to certain individuals. This results in individual and group-level bias that causes important information to be overlooked (Stasser & Titus, 2003).

Two key explanations have been offered for this effect. Specifically, individuals tend to prefer their initial choice regardless of additional information offered in discussion. At the team level, groups often weigh information incorrectly, or decisions are made prematurely before all information is revealed. This is attributed to placing higher value on information that is held by the majority or is presented more often during discussion. As such, there is a social cost for introducing new information, so individuals are less likely to bring new information forward and tend to agree with the opinion of others (Brodbeck, Kerschreiter, Mojzisch, & Schulz-Hardt, 2007).

Thus, effective decisions are enabled by a diversity of available information, and a willingness to exchange it. As information is revealed to decision makers, changes in the information set may make previously unacceptable options viable. However, in virtual teams the rules of order and task processes that are well known to physical teams must be clarified and the quality and type of interaction patterns may take different forms (Brandt, England, & Ward, 2011; Kozlowski & Ilgen, 2006). This requires teams to adjust information exchanges as they progress through the problem-solving process (DeSanctis & Gallupe, 1987). Because of this, teams must often adapt routines by performing alternate acts and revising their understanding of task-related cues and information (Wood, 1986).

For instance, indiviudals often align existing information with that of other team members rather than construct new knowledge. Therefore, teams often tend to reach consensus quickly (Shukor, Tasir, Van der Meijden, & Harun, 2014). This tendency towards consensus is a concern because high-level knowledge construction is predictive of meaningful learning. For example, Shukor, Tasir, Van der Meijden, and Harun (2014) showed that student learning teams demonstrate stronger knowledge construction when argumentation elements are introduced into team discussion prompting new alternatives.

2.3. Collaboration

Collaboration is the joint effort towards a goal and requires teammates to work together to support task and team interdependence. For example, one study of computer-mediated communication found that teams with high-quality exchange relationships, noted for strong coordination and information sharing, were able to reduce the negative impact of isolated members (Cogliser et al., 2013).

Nonetheless, much research shows that teams are challenged by tasks that require integration of unique information (Stasser & Titus, 1985). Collaboration creates value by coupling team expertise, insights, and resources to solve problems where individual efforts would fail. Yet team collaboration often falls short, costing time and resources. However, as De Vreede and Briggs (2005) explain, team collaboration can be improved by developing effective interaction structures based on group dynamics, process techniques, and technology.

Collaboration processes reflect the methods and activities that groups use to take action and achieve goals. There are potential benefits to implementing well-designed team collaboration process structures, but there are limits too. First, expert facilitation and design can be expensive. In addition, professionally-designed process tools can be difficult for beginners to understand. Finally, while there are many techniques and tools for facilitating collaboration, teams are often not trained to use them (Dittman, Hawkes, Deokar, & Sarnikar, 2010). Central to collaboration design are patterns that provide the basis for developing detailed process instructions. A collaboration process conceptualizes *what* steps teams must do to reach goals including: defining problems, developing and selecting alternatives, taking action, and evaluating outcomes (Kolfschoten & De Vreede, 2007). Collaboration patterns also prescribe *how* work will be done through activities that create effective interaction, transporting teams through the process. In order to support effective collaboration, interaction patterns must account for how teams access, organize, and use information to solve problems. A description of patterns for designing collaboration processes is shown in Table 1 (Tarmizi et al., 2007).

Table 1
Collaboration pattern concepts

Pattern	**Description**
Generate	Shift from fewer to more concepts
Clarify	Shift from less to more shared meaning of concepts
Reduce	Shift from having many concepts to fewer concepts for consideration
Organize	Shift from less to more understanding of concept relationships
Evaluate	Shift from less to more understanding of the usefulness of concepts toward goals
Build Consensus	Shift from more disagreement to having less disagreement actions to take

Collaboration processes can be made more effective by defining the actions that teams use to perform tasks. Marks, Mathieu, and Zaccaro (2001) developed an empirically-based taxonomy of team process using three dimensions: transition, action, and interpersonal. The taxonomy was developed to be broadly applied to different types of situations, but easily understandable so that it could be applied readily to team development.

Planning processes are periods during which teams develop activities that move them forward to complete goals and objectives, form strategies for evaluating actions, and guide future activity (Martins, Gilson, & Maynard, 2004). Interpersonal processes help regulate activity and act as strategies for managing conflict, promoting helping behavior, and regulating team emotions. Most important to this research, action processes are functions that contribute directly to task performance, teamwork, and goal achievement. This includes monitoring system resources and team progress towards goals, providing behavioral monitoring and backup assistance, and coordinating the timing and sequencing of the work (Powell, Piccoli, & Ives, 2004).

Because action processes are closely tied to team interdependence, these dimensions are critical to information sharing and exchange, forming the basis for collaboration. Monitoring goal progress is the process of self-regulating the action towards outcomes and “captures the transactional nature of decision making, identifying the key choices called for by a decision maker as the decision process unfolds” (Nutt, 1993, p. 228). Nutt (1993) contends one effective strategy for goal progress monitoring is reframing the problem to focus on problems, answers, or new rules or practices that expand alternatives and clarify whether action is needed. Teams that reframe problems effectively demonstrate new ways to address performance problems, and revise actions to meet goal requirements.

Systems monitoring involves tracking and reviewing team information resources to identify previously known information or changes to information. When high reliability is required, systems monitoring provides a way to understand information and make careful judgments in time-sensitive, high-intensity situations (Waller, Gupta, & Giambatista, 2004). Monitoring and backup responses are functions that support interdependence by giving direction, seeking help, or performing tasks for teammates (Marks, Mathieu, & Zaccaro, 2001). Yet in a study of MBA consulting teams Lewis (2004) found that knowledge workers may have limited ability to access and exchange information effectively without face-to-face contact. Thus, while monitoring and backup responses provide a mechanism for regulating the action of team members, without shared understanding these behaviors can also restrict collaboration (Burtscher, Kolbe, Wacker, & Manser, 2011). However, there is evidence that training can improve team monitoring and backup processes. For instance, research on military teams found that process training increased monitoring, feedback, and back-up behaviors which led to increased performance (Morgan, Glickman, Woodward, Blaiwes, & Salas, 1986).

Finally, coordination process regulates the sequence and timing of interdependent activity, supporting information exchange and adjustment of team action (Brannick, Roach, & Salas, 1993). But this requires more cognitive effort in the virtual setting in order to approximate the dynamic of face-to-face interaction. Specifically, Whittaker and O'Conaill (1997) posit that effective information sharing in virtual teams is a collective function that requires coordination of technology, process, and content between team members.

3. Learning theory and goals

The collaboration process structure in this study was designed to teach virtual teams how to exchange information effectively leading to better decisions. It follows that the goals of the process be grounded in learning theory that matches task, technology, and context. In this case, the principles of cognitive flexibility theory served as a framework for the collaboration process structure.

Cognitive flexibility theory was developed in response to challenges faced when learning with networked technology (Spiro, Coulson, Feltovich, & Anderson, 1988). The theory focuses on knowledge exchange in complex environments. Explicitly, research on using cognitive flexibility theory to improve learning is built on reducing bias toward significant contextual information by providing: 1) sufficient information complexity to avoid reductive bias, 2) multiple representations and flexible schema, 3) detailed knowledge of contextually relevant cases, 4) connections between structural relationships, and 5) support for active participation and exchange of information (Spiro, Feltovich, Jacobson, & Coulson, 1992).

In this study, cognitive flexibility theory was used to facilitate collaboration process conditions so that teams learn to better categorize and revise information, see connections between pieces and the whole, and transfer knowledge. The relationship between concepts used in the proposed collaboration process structure is shown in Table 2.

Table 2
Relationship between concepts in the collaboration process structure

Action Process Dimensions (Marks et al., 2001)	**Collaboration Process Supports (Tarmizi et al., 2007)**	**Theoretical Framework (Spiro et al., 1988)**
Monitoring progress toward goals	Reduce, Organize, evaluate, build consensus	Sufficient information complexity, multiple representations and flexible schema
Systems Monitoring	Generate, clarify, reduce	Sufficient information complexity, multiple representations and flexible schema, connections between structural relationships
Team Monitoring and Backup Responses	Generate, clarify, evaluate, and build consensus	Sufficient information complexity, multiple representations and flexible schema, detailed knowledge of contextually relevant cases, connections between structural relationships
Coordination	Generate, clarify, reduce, organize, evaluate, build consensus	Sufficient information complexity, multiple representations and flexible schema, connections between structural relationships, support for active participation and exchange of information

4. Methods

This section outlines the research methods used to test the proposed collaboration process for improving decision making, including the participants, research design, decision task, independent variables, and outcome measures.

4.1. Participants

Two hundred and eight students completed the study. One hundred and twelve females (53.8%) and ninety-six male students (46.2%) participated. The subjects were all undergraduates. The age range for participants was between 18 and 44 years old. Participants signed up for the study based on their availability using an online calendar.

Each team had four members. Teams were created by randomly assigning participants to one of four groups representing high and low conditions of two factors: collaboration process structure and degree of technology affordance. After removal of partial teams, the final sample was two hundred and eight participants assigned to fifty-two complete teams across four treatment conditions.

4.2. Research design

The research design was a 2 x 2 factorial model. Independent variables included: 1) the collaboration process structure used during the team discussion, and 2) the degree of technology affordance-chat only versus chat and an editable team document space-that could be used for reviewing and interacting with decision information.

One way to test the effectiveness of a team process is to evaluate decisions using a common problem-solving context. In this study, participants acted as committee members assigned to choose an airline pilot from four candidates. Each pilot candidate had a set of ten personality attributes, some positive and some negative. Positive attributes included characteristics such as, “has excellent depth perception”. Negative attributes were statements like, “is sometimes unorganized” (Schulz-Hardt, Brodbeck, Mojzisch, Kerschreiter, & Frey, 2006).

No individual team member had complete information. Candidate information sets were distributed so that each team member had some unique information about each candidate, as well as some candidate information that was shared with other members. The distribution of positive and negative attributes across profiles creates an information pool in which no clear choice is available at the individual level, but a clear solution is available when all information is aggregated by the team. Initially, candidate C appears weakest with only three positive qualities, while candidates A, B, and D have four. With complete sharing, candidate C has seven positive and three negative attributes, while all others have four positive and four negative attributes. Given this, C is clearly the strongest choice. As such, learning gains occur when team members integrate all relevant information into the decision (Greitemeyer, Schulz-Hardt, Brodbeck, & Frey, 2006).

4.3. Decision task

Text-based chat and shared documents such as Google Documents are one of the most widely-used organizational communication formats. These tools are frequently used by both professional and student learning teams. To perform the task in this research, participants logged in to individual Google accounts. Each team member had a document with information for four pilot candidates, and access to a shared document which provided task instructions and a way to collaborate with the team. All teams used the chat feature to communicate using text, and the body of the document was available for members of high technology affordance teams to input and view task information. There were two phases to the study. In the first phase, members were asked to read the candidate attributes and individually choose a pilot based on the available information. In addition, they were asked to rate suitability of each candidate on a scale of 1 through 5 (1 being not suitable at all to 5 being very suitable) as show in Appendix A. A representation of the individual decision process performed in phase one is shown in Fig 1.

Second, participants assembled online as a team by opening a shared Google document. This document included instructions for conducting the team discussion based on one of the four factorial conditions, as described in Appendices B through E. Half of the teams used the collaboration process structure designed to improve decision making. Teams using this process structure had defined monitoring, backup, and coordination instructions for conducting the discussion. These teams were also asked to appoint a team monitor to guide task activity. Starting with Candidate A, each member input the attributes from their individual data set one-at-a-time for group review. Team members discussed whether they noted duplicate attributes, attributes not seen before, and whether attributes were positive or negative in the candidate profile being reviewed. All team members were instructed to discuss each individual candidate and had the right to dispute and clarify the meaning of information during any part of the decision process as shown in Fig 2.

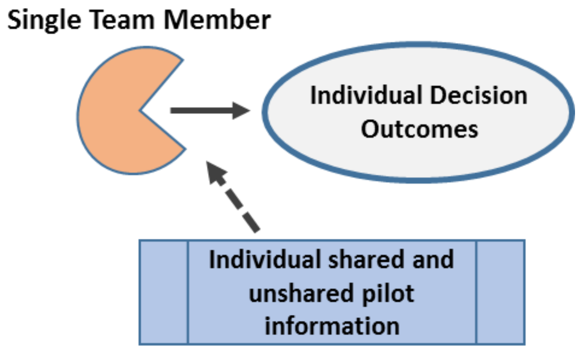


Fig. 1. Phase 1-Individual decision

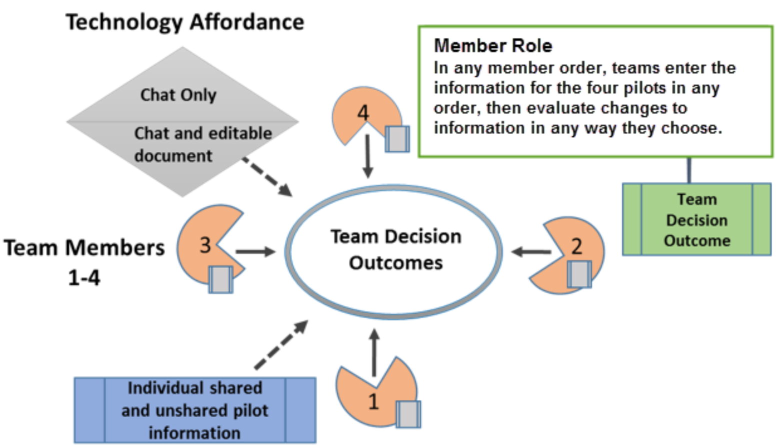


Fig. 2. Phase 2-Team decision using collaboration process

In the “ad hoc” process structure, members submitted information in any order, at any time, and used text-based chat to discuss the information any way they chose. Like the experimental groups, each member was asked to tell the group whether they noted specific candidate information. However, there were no guidelines for discussion or how to reach decisions. A description of the ad hoc process is shown in Fig 3.

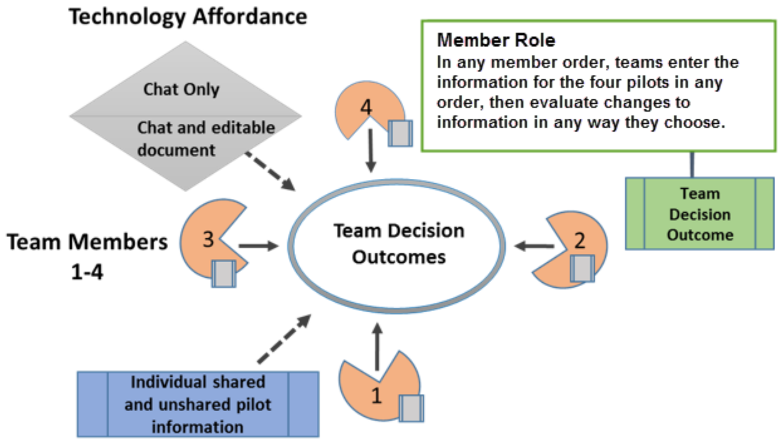


Fig. 3. Phase 2-Team decision using ad hoc process

In addition, while some teams used only text-based chat for discussion, other teams could input individual candidate attributes into the document, and visually review and edit the information as a group. This provided increased collaboration technology affordance for these teams. For example, results of a hidden profile experiment by Voigtlaender, Pfeiffer, and Schulz-Hardt (2009) suggest the ability to access and interact collectively with relevant information can enhance recognition of cues leading to more accurate decisions. Conversely, teams in the control condition could not edit the shared document, so opportunity to pool and organize candidate attributes into a complete information set were constrained to the chat. Even if team members copied and transferred candidate information exactly, redundant information could not be deleted, and information could not be moved from one point in the chat discussion to another.

After reaching agreement, teams in all conditions made a decision about which candidate was chosen for the pilot job. All teams were advised to base their arguments on all the decision information in the discussion, not just on the individual information held. In addition, each individual again ranked the suitability of all of the candidates, and all members entered the same team decision for the selected pilot into a final decision form.

4.4. Independent variables

The role of process structure and technology affordance in virtual collaboration work was examined using two independent factors. These variables were manipulated to represent high and low conditions of each factor.

4.4.1. Collaboration process structure

Communication norms are necessary for virtual teams to exchange information, maintain cohesive communication, and integrate teamwork. Structured collaboration supports information exchange, and keeps members aligned with the task and moving forward (Malhotra, Majchrzak, & Rosen, 2007). In this study, a collaboration process structure variable was used to foster team collaboration, hopefully leading to more accurate, higher quality decisions. The process was based on a turn-taking structure using a single communication channel (chat message system) within Google documents. Research on digital conversation shows turn-taking strategies influence interaction behavior by allowing pauses for reflection between turns making communication seem closer, more congenial, and less forceful (Ter Maat, Truong, & Heylen, 2010).

Likewise, backup, monitoring, and coordination behaviors help support effective observation and adaptation of team member behavior (O'Dea et al., 2006). Monitoring enables decision makers to identify alternatives, and make more informed choices. Effective teams monitor the performance of team members to keep apace of how they are performing and progressing, and offer assistance when needed. Further, interventions that contain a process component can help teams identify choices, recognize types of information that are needed, engage in interdependent actions, and adapt to changing conditions in the environment (Nutt, 1999).

In this study, team members in the experimental collaboration process groups were asked to monitor and report on teammate input and actions. In addition, backup actions were encouraged between members during discussion. Likewise, a consensus-appointed leader coordinated team input, and team members were 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 initial individual belief (Greitemeyer, Schulz-Hardt, Brodbeck, & Frey, 2006).

4.4.2. Technology affordance

Task performance is impacted by complexity, including the number of required actions, component interdependence, and dynamic changes to inputs and outputs over time. As requirements change, teams must adapt by performing alternate acts, and revising their understanding of task related cues (Wood, 1986). In this study, a technology affordance variable was operationalized by providing experimental teams with a shared Google document to support interdependence and reduce the complexity of decision information. Specifically, teams in the experimental condition could post their individual information into the shared document space and edit, organize, and review content together. It was felt that providing these teams with a higher degree of collaboration technology affordance would allow members to better manage decision information as it changed over time, leading to stronger decision outcomes.

Research suggests that the ability to display and structure information can improve the understanding of complex information sets. In one instance, Remus (1984) found managers using a tabular display improved decision making. Along these lines, Pardee, Philips, and Smith (1970) found it effective to use rank-ordered attribute levels to quantify the value of information. Schilling, McGarity, and ReVelle (1982) propose that information display structure improves performance because it allows participants to screen information and make alternatives visible by providing the ability to assess "an alternative's performance with respect to unstated or hidden objectives" (p. 237). However, while display structure enables some behaviors associated with effective decisions, it may not be enough to ensure success. For instance, Fischer and Mandal (2005) found that visual representation and knowledge convergence in teams using a content-specific display that allowed shared representation and greater interactive capability increased the effective pooling of information, but did not foster effective information exchange in an evaluative task.

4.5. Measures

Two measures were used to examine the potential impact of the collaboration process structure and degree of available technology affordance on team decision outcomes. Team decision accuracy was measured by the ability of teams to choose the optimal job candidate from four alternatives. Alternately, decision quality was measured by the degree of change in individual perceptions of the optimal candidate's suitability before and after discussion.

4.5.1. Decision accuracy

Decision accuracy was an objective measure of the team's decision outcome (Stasser & Titus, 1985; Greitemeyer, Schulz-Hardt, Brodbeck, & Frey, 2006) based on the selection of the optimal candidate. In this case the complete 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 after the team discussion with each team member instructed to report the same final decision.

4.5.2. Decision quality

Perceived suitability of the optimal candidate C, who had the fewest positive qualities before discussion, and candidates A, B, and D, who appeared equally best before discussion, was measured using a five-point scale coded 1 through 5 (1 being not suitable at all to 5 being very suitable). Given complete information exchange after discussion, candidate C had the most positive qualities, while candidates A, B, and D were clearly less desirable. Decision quality was measured by the amount of change in perceived suitability of candidate C using pretest and posttest measures. Individual participants were asked to respond to the question "To what extent did you find candidate C suitable for the job" before and after discussion to determine whether individual preference for candidates shifted when teams had potential for pooling all information (Postmes, Spears, & Cihangir, 2001).

5. Results

Binary logistic regression was used to test for differences in decision accuracy between conditions. The test statistic supported hypothesis one, indicating that collaboration process structure had a predictive effect, (β=.848, χ^2= 8.54, p=.006 with df =1). Collaboration process structure teams picked the optimal candidate more often (73.1%) than teams in the control condition (54.0%). The effect size of this difference was moderate (OR=2.34). Specifically, teams using the collaboration process structure were twice as likely to make the correct decision as those using an ad hoc process.

In addition, a repeated measure analysis of variance (ANOVA) test provided evidence that hypothesis two was also confirmed. Perceptions of candidate C after discussion were significantly stronger in teams using the collaboration process structure, $F(1, 206) = 14.43$, $p < .001$, η^2= .065. Suitability perceptions of these teams reflect more complete information exchange and greater shared understanding about the decision (M = 3.50, SE = .085) than those in control groups (M = 3.12, SE = .085).

Finally, hypothesis three posited that increased technology affordance would moderate the relationship between collaboration process structure and decision outcomes.

However, the test statistic indicated no meaningful interaction, thus hypothesis three was not confirmed, $p > .01$. The descriptive data demonstrated a trend where scores were greatest in teams when both collaboration process structure and increased technology affordance were present, and lowest where ad hoc process was used and technology affordance was limited. Descriptive data for all team outcomes by condition are shown in Table 3.

Table 3
Means and standard deviations for conditions and tested outcomes

Dependent Variable	***High CPS, High TA***	***High CPS, Low TA***	***Low CPS, High TA***	***Low CPS, Low TA***
Decision Accuracy	.807 (.410)	.673 (.473)	.635 (.470)	.462 (.480)
Decision Quality	3.80 (1.34)	3.50 (1.30)	3.50 (1.40)	3.27 (1.23)
Teams	52	52	52	52

6. Discussion

Collaboration process structure teams made more effective decisions than ad hoc process teams, regardless of available technology affordance. An increased capability to address individual and group level bias may explain this influence. Collaboration process structure teams voiced information equally to the group, and had equal opportunity to negotiate meaning regarding decision information. This may have promoted greater focus on the features of alternatives and less on personal preference. In short, as members discussed options, these teams were better at identifying differences in the candidate profiles, and generated better connections between cases (Schulz-Hardt et al., 2006).

Making sense of complex information requires strong coordination by members contributing equally at specific times (Spiro, Feltovich, Jacobson, & Coulson, 1992). Collaboration process structure teams presumably used coordination, monitoring, and backup actions more consistently, which helped them to better determine the value of candidate information (Tarmizi et al., 2007). Thus the results suggest that there is learning value in the collaboration experience beyond content, and prior to outcomes (Shukor, Tasir, Van der Meijden, & Harun, 2014).

A second consideration was the potential interaction of collaboration process structure and technology affordance on decision outcomes. Although no meaningful relationship was found, teams had greater success overall when using the collaboration process structure along with increased technology affordance. Given this finding, the ability to view and edit the information as a group did improve decision outcomes to some extent. In this case, it is possible that greater technology affordance reduced the communication constraints that typically limit team cognition. For instance, Jefferson, Ferzandi, and McNeese (2004) found that chat communication had a negative impact on hidden profile solutions because inconsistent communication reduced a team's ability to develop an adequate representation of decision information.

Similarly, Van den Haak, de Jong, and Schellens (2004) found that information display reduced cognitive effort, which allowed members to see evolving information more clearly, and provided more time to perform knowledge building acts. Accordingly, similar research discovered that listing techniques can clarify the value of decision variables, allowing for better screening of alternatives (Voigtlaender, Pfeiffer, & Schulz-Hardt, 2009). In the current study, the collaboration document separated data from discussion content, perhaps putting more focus on the information set. It may also have provided a clearer view of the decision information, that helped teams to clarify the meaning and value of candidate profiles as redundant data was removed, and unique information was highlighted.

Yet despite encouraging results, there were limitations to the study. The research context was a single scenario, so results may be different in other contexts and settings. And although teams in the control groups used ad hoc processes, some of them did make the correct decision. This suggests that these teams developed effective collaboration processes on their own, although is no way to tell what strategy was used. Additional research using a qualitative component may help clarify other potentially useful techniques. Finally, because this was a distributed study where participant location and setting was unknown, there may have been confounding influences. For example, it cannot be said whether additional supports were used, such as listing and structuring information using a notepad and pencil. Likewise, it is unknown if participants were in the same room at the time of the experiment, which could lessen typical communication constraints found in the virtual work environment. Establishing protocols that provide tighter control while maintaining authenticity of the virtual work environment will need to be considered.

7. Conclusions and implications

The study offers insight about the relationship between collaboration process, technology affordance, and teams in the virtual environment that can inform future research and practice. For instructional designers, training on the use of collaboration technology and process structure to perform online work is valuable to ensure virtual team learning and organizational success. Virtual teams must often hit the ground running yet team orientation is rarely mentioned in the literature. This is particularly important in organizations in which members may lack experience performing virtual work. Teaching team members to understand the dynamic between collaboration tools and process actions might reduce uncertainty about task performance and allow more time for teams to focus on the work at hand.

References

Brandt, V., England, W., & Ward, S. (2011). Virtual teams. *Research Technology Management, 54*(6), 62–63.

Brannick, M. T., Roach, R. M., & Salas, E. (1993). Understanding team performance: A multimethod study. *Human Performance, 6*(4), 287–308.

Brodbeck, F. C., Kerschreiter, R., Mojzisch, A., & Schulz-Hardt, S. (2007). Improving group decision making under conditions of distributed knowledge: The information asymmetries model. *Academy of Management Review, 32*(2), 459–479.

Budlong, E. R., Walter, S. M., & Yilmazelb, O. (2009). Recognizing connotative meaning in military chat communications. In *Proceedings of the Evolutionary and Bio-Inspired Computation: Theory and Applications III* (Vol. 73470). Orlando, Florida: International Society for Optics and Photonics.

Burtscher, M. J., Kolbe, M., Wacker, J., & Manser, T. (2011). Interactions of team

mental models and monitoring behaviors predict team performance in simulated anesthesia inductions. *Journal of Experimental Psychology: Applied, 17*(3), 257–269.
Chiravuri, A., Nazareth, D., & Ramamurthy, K. (2011). Cognitive conflict and consensus generation in virtual teams during knowledge capture: Comparative effectiveness of techniques. *Journal of Management Information Systems*, *28*(1), 311–350.
Cogliser, C. C., Gardner, W., Trank, C. Q., Gavin, M., Halbesleben, J., & Seers, A. (2013). Not all group exchange structures are created equal: Effects of forms and levels of exchange on work outcomes in virtual teams. *Journal of Leadership & Organizational Studies*, *20*(2), 242–251.
Daft, R. L., & Lengel, R. H. (1986). Organizational information requirements, media richness and structural design. *Management science*, *32*(5), 554–571.
De Vreede, G. J., & Briggs. R. O. (2005). Collaboration engineering: Designing repeatable processes for high-value collaborative tasks. In *Proceedings of the Hawaii International Conference on System Science (HICSS)* (Vol 9). Big Island, HI. Washington: DC: IEEE Computer Society Press.
DeChurch, L. A., & Mesmer-Magnus, J. R. (2010). The cognitive underpinnings of effective teamwork: A meta-analysis. *Journal of Applied Psychology*, *95*(1), 32–53.
Dennis, A. R., Valacich, J. S., Speier, C., & Morris, M. G. (1998). Beyond media richness: An empirical test of media synchronicity theory. In *Proceedings of the 31st Hawaii International Conference on System Sciences* (pp. 48–57).
DeSanctis, G., & Gallupe, R. B. (1987). A foundation for the study of group decision support systems. *Management Science, 33*(5), 589–609.
DeSanctis, G., & Poole, M. S. (1994). Capturing the complexity in advanced technology use: Adaptive structuration theory. *Organization Science, 5*(2), 121–147.
Dittman, D. R., Hawkes, M., Deokar, A. V., & Sarnikar, S. (2010). Improving virtual team collaboration outcomes through collaboration process structuring. *Quarterly Review of Distance Education, 11*(4), 195–210.
DuBrin, A. J. (2013). *Fundamentals of organizational behavior: An applied perspective*. Oxford, UK: Elsevier.
Figl, K., & Saunders, C. (2011). Team climate and media choice in virtual teams. *AIS Transactions on Human-Computer Interaction, 3*(4), 189–213.
Fischer, F., & Mandl, H. (2005). Knowledge convergence in computer-supported collaborative learning: The Role of external representation tools. *The Journal of the Learning Sciences, 14*(3), 405–441.
Fuller, M. A., Hardin, A. M., & Davison, R. M. (2007). Efficacy in technology-mediated distributed teams. *Journal of Management Information Systems*, *23*(3), 209–235.
Gould, J. (2012). *Learning theory and classroom practice in the lifelong learning sector*. Exeter, UK: Learning Matters LTD.
Greitemeyer, T., Schulz-Hardt, S., Brodbeck, F. C., & Frey, D. (2006). Information sampling and group decision making: The effects of an advocacy decision procedure and task experience. *Journal of Experimental Psychology, Applied, 12*(1), 31–42.
Grenier, R., & Metes, G. (1995). *Going virtual: Moving your organization into the 21st century*. Saddle Brook, NJ: Prentice Hall.
Hron, A., Hesse, F. W., Cress, U., & Giovis, C. (2000). Implicit and explicit dialogue structuring in virtual learning groups. *The British Journal of Educational Psychology, 70*(1), 53–64.
Jefferson, T., Ferzandi, L., & McNeese, M. (2004). Impact of hidden profiles on distributed cognition in spatially distributed decision-making teams. In *Proceedings of the Human Factors and Ergonomics Society 48th annual meeting*. New Orleans, Louisiana. Santa Monica, CA: Human Factors and Ergonomics Society.
Kolfschoten, G. L., & De Vreede, G. J. (2007). The collaboration engineering approach

for designing collaboration processes. *Lecture Notes in Computer Science, 4715*, 95–110.

Kopp, B., Hasenbein, M., & Mandl, H. (2014). Case-based learning in virtual groups – Collaboration problem solving activities and learning outcomes in a virtual professional training course. *Interactive Learning Environments, 22*(3), 351–372

Koszalka, T. A., & Wang, X. (2002). Integrating technology into learning: A summary view of promises and problems. *Educational Technology & Society, 5*(1), 179–183.

Kozlowski, S. W. J., & Ilgen, D. R. (2006). Enhancing the effectiveness of work groups and teams. *Psychological Science in the Public Interest, 7*(3), 77–124.

Lewis, K. (2004). Knowledge and performance in knowledge-worker teams: A longitudinal study of transactive memory systems. *Management Science, 50*(11), 1519–1533.

Lin, C.-P., Chiu, C.-K., Joe, S.-W., & Tsai, Y.-H. (2010). Assessing online learning ability from a social exchange perspective: A survey of virtual teams within business organizations. *International Journal of Human-Computer Interaction, 26*(9), 849–867.

Luery, J. S., & Raisinghani, M. S. (2001). An empirical study of best practices in virtual teams. *Information & Management. 38*(8), 523–544.

Majchrzak, A., Rice, R. E., Malhotra, A., King, N., & Ba, S. (2000). Technology adaptation: The case of a computer-supported inter-organizational virtual team. *MIS Quarterly, 24*(4), 569–600.

Malhotra, A., Majchrzak, A., & Rosen, B. (2007). Leading virtual teams. *Academy of Management. Perspective, 21*(1), 60–70.

Marks, M. A., Mathieu, J. E., & Zaccaro, S. J. (2001). A temporally based framework and taxonomy of team processes. *Academy of Management Review, 26*(3), 356–376.

Martins, L. L., Gilson, L. L., & Maynard, M. T. (2004). Virtual teams: What do we know and where do we go from here? *Journal of Management, 30*(6), 805–835.

Mason, R. O., & Mitroff, I. I. (1973). A program for research in management information systems. *Management Science, 19*(5), 475–487.

Maznevski, M. L., & Chudoba, K. M. (2000). Bridging space over time: Global virtual team dynamics and effectiveness. *Organization science, 11*(5), 473–492.

Morgan, B. B., Jr., Glickman, A. S., Woodward, E. A., Blaiwes, A., & Salas, E. (1986). *Measurement of team behaviors in a Navy environment* (NTSC Report No. 86-014). Orlando, FL: Naval Training System Center.

Munkvold, B. E., & Zigurs, I. (2007). Process and technology challenges in swift-starting virtual teams. *Information & Management*, *44*(3), 287–299.

Nutt, P. C. (1993). The formulation processes and tactics used in organizational decision making. *Organization Science, 4*(2), 226–251.

Nutt, P. C. (1999). Surprising but true: Half the Decisions in Organizations Fail. *The Academy of Management Executive*, *13*(4), 75–90.

Nutt, P. C. (2002). *Why decisions fail: Avoiding the blunders and traps that lead to debacles*. Oakland, CA: Berrett-Koehler Publishers.

O'Dea, A., Rose, K. G., McHugh, A., Phillips, J. K., Throne, M. H., McCloskey, M., & Mills, J. A. (2006). *Global Teams: Enhancing the performance of multinational staffs through collaborative online training.* Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Pardee, F. S., Phillips, C. T., & Smith, K. V. (1970). *Measurement and evaluation of alternative regional transportation mixes: Vol. II, methodology.* Santa Monica, CA: The Rand Corporation.

Pfister, H. R., & Oehl, M. (2009). The impact of goal focus, task type and group size on synchronous net-based collaboration learning discourses. *Journal of Computer Assisted Learning, 25*(2), 161–176.

Postmes, T., Spears, R., & Cihangir, S. (2001). Quality of decision making and group norms. *Journal of Personality and Social Psychology, 80*(6), 918–930.

Powell, A., Piccoli, G., & Ives, B. (2004). Virtual teams: A review of current literature and directions for future research. *ACM SIGMIS Database: the DATABASE for Advances in Information Systems, 35*(1), 6–36.

Remus, W. (1984). An empirical investigation of the impact of graphical and tabular data presentations on decision making. *Management Science, 30*(5), 533–542.

Remus, W. (1987). A study of graphical and tabular displays and their interaction with environmental complexity. *Management Science, 33*(9), 1200–1204.

Rice, D. J., Davidson, B. D., Dannenhoffer, J. F., & Gay, G. K. (2007). Improving the effectiveness of virtual teams by adapting team processes. *Computer Supported Cooperative Work (CSCW), 16*(6), 567–594.

Schilling, D. A., McGarity, A., & ReVelle, C. (1982). Hidden attributes and the display of information in multiobjective analysis. *Management Science, 28*(3), 236–242.

Schulz-Hardt, S., Brodbeck, F. C., Mojzisch, A., Kerschreiter, R., & Frey, D. (2006). Group decision making in hidden profile situations: Dissent as a facilitator for decision quality. *Journal of Personality and Social Psychology, 91*(6), 1080–1093.

Shukor, N. A., Tasir, Z., Van der Meijden, H., & Harun, J. (2014). Exploring students' knowledge construction strategies in computer-supported collaborative learning discussions using sequential analysis. *Educational Technology & Society, 17*(4), 216–228.

Spiro, R. J., Coulson, R. L., Feltovich, P. J., & Anderson, D. K. (1988). *Cognitive flexibility theory: Advanced knowledge acquisition in ill-structured domains* (Technical Report No. 441). Champaign, IL: University of Illinois, Center for the Study of Reading.

Spiro, R. J., Feltovich, P. J., Jacobson, M. J., & Coulson, R. L. (1992). Cognitive flexibility, constructivism, and hypertext: Random access instruction for advanced knowledge acquisition in ill-structured domain. In T. M. Duffy & D. H. Jonassen. (Eds.), *Constructivism and the Technology of Instruction: A Conversation* (pp. 57–76). Hillsdale, NJ: Erlbaum.

Stasser, G., & Titus, W. (1985). Pooling of unshared information in group decision making: Biased information sampling during discussion. *Journal of Personality and Social Psychology, 48*(6), 1467–1478.

Stasser, G., & Titus, W. (2003). Hidden profiles: A brief history. *Psychological Inquiry, 14*(3/4), 304–313.

Tarmizi, H., Payne, M., Noteboom, C., Zhang, C., Steinhauser, L., De Vreede, G. J., & Zigurs, I. (2007). Collaboration engineering in distributed environments. *e-Service Journal, 6*(1), 76–97.

Ter Maat, M., Truong, K. P., & Heylen, D. K. J. (2010). How turn-taking strategies influence users' impressions of an agent. *Lecture Notes in Computer Science, 6356*, 441–453.

Van den Haak, M. J., de Jong, M. D. T., & Schellens, P. J. (2004). Employing think-aloud protocols and constructive interaction to test the usability of online library catalogues: A methodological comparison. *Interacting with Computers. 16*(6), 1153–1170.

Voigtlaender, D., Pfeiffer, F., & Schulz-Hardt, S. (2009). Listing and structuring of discussion content: As a means of improving individual decision quality in hidden profiles. *Social Psychology, 40*(2), 79–87.

Waller, M. J., Gupta, N., & Giambatista, R. C. (2004). Effects of adaptive behaviors and shared mental models on control crew performance. *Management Science, 50*(11), 1534–1544.

Whittaker, S., & O'Conaill, B. (1997). The role of vision in face-to-face and mediated communication. In K. E. Finn, A. J. Sellen, & S. B. Wilbur (Eds.), *Videomediated Communication* (pp. 23–49). Mahwah, NJ: Erlbaum.

Wood, R. E. (1986). Task complexity: Definition of the construct. *Organizational Behavior and Human Decision Processes*, *37*(1), 60–82.

Wysocki, R. K., & McGary, R. (2003). *Effective project management: Traditional, adaptive, extreme* (3rd ed.). Indianapolis, Indiana: John Wiley & Sons.

Appendix A. *Phase 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.

Appendix B. *Phase 2: Team One Decision Instructions*

In Phase 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 Phase 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 Phase 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.

Decision Table

Candidate A	**Positive**	**Negative**	**New**
Candidate B	**Positive**	**Negative**	**New**
Candidate C	**Positive**	**Negative**	**New**
Candidate D	**Positive**	**Negative**	**New**

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.

Thanks again for your time and participation!

Appendix C. *Phase 2: Team Two Decision Instructions*

In Phase 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 Phase 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. Each team member should select the same candidate to hire, but may have different answers for the other questions.
Thanks again for your time and participation!

Appendix D. *Phase 2: Team Three Decision Instructions*

Task 2: Team Decision
In Phase 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 Phase 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 Phase 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.

Decision Table

Candidate A	**Positive**	**Negative**	**New**
Candidate B	**Positive**	**Negative**	**New**
Candidate C	**Positive**	**Negative**	**New**
Candidate D	**Positive**	**Negative**	**New**

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.

Thanks again for your time and participation!

Appendix E. *Phase 2-Team Four Decision Instructions*

Phase 2: Team Decision

In Phase 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 Phase 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 Phase 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 Phase 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.

Thanks again for your time and participation!