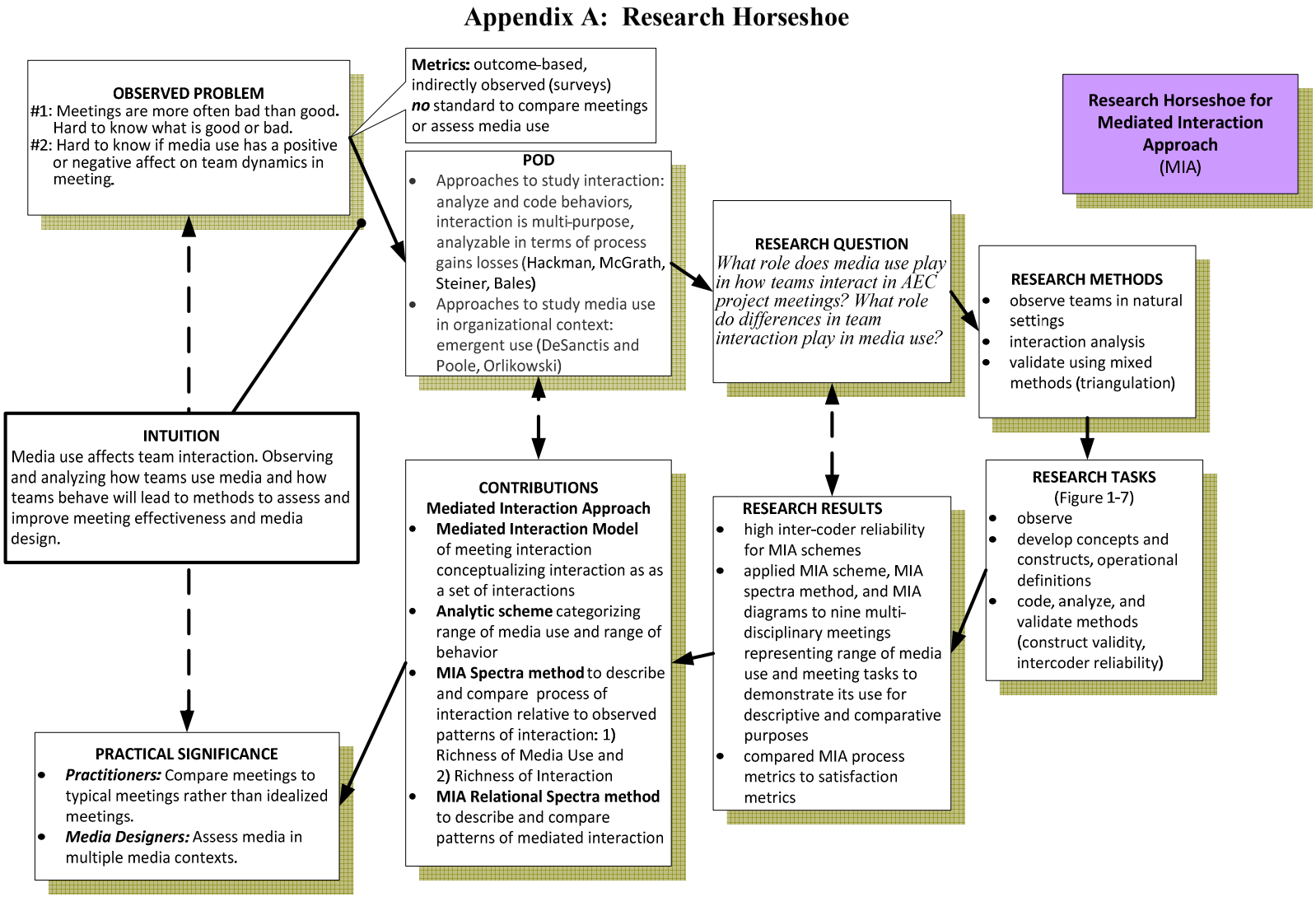



*Figure A-1: Research horseshoe summarizing the dissertation research process steps based on the Center for Integrated Facility Engineering (CIFE) horseshoe research method (Fischer 2006).*

# Appendix B: Acronyms, Glossary, and Symbols

## B.1 Acronyms

*Table B-1: List of acronyms used in the dissertation.*

| Acronym | Description |
|---|---|
| ADF | Activity Design Framework coding scheme (Section J.6) |
| AEC | Architecture, Engineering, and Construction |
| AIT | advanced information technology |
| AST | Adaptive Structuration Theory and Coding scheme (Section 0) |
| CDW | Collaborative Design Workflow coding scheme (Section K.1) |
| CF | Communicative Functions coding scheme (Section 2.5) |
| CWA | Collaborative Workflow Analysis coding scheme (Section K.1) |
| DEEP DEEP(AND) | Coding scheme with Describe, Explain, Evaluate, and Predict developed by Liston et al. and extended by Garcia et al. (Section K.6) |
| DFCS | Decision Function Coding System (Section J.2) |
| DRQ | Deep Reasoning Questions |
| CIFE | Center for Integrated Facility Engineering |
| FWA | Framework for Analyzing Workspace Activity (J.7) |
| GAI | Goals of Artifact Interaction (Section 2.5, 4.3) |
| GDSS | Group Decision Support Software |
| GWRCS | Group Working Relationship coding scheme (Section J.3) |
| IHF | Information Handling Framework (Section J.4) |
| IPA | Interaction Process Analysis coding scheme (Section K.3) |
| IPO | Input-Process-Output Model (See Chapter 2) |
| IR | Information Richness coding scheme (Section 2.4.1 and 4.3) |
| IRB | Institutional Review Board |
| ISM | Interaction Spectrum Method (Section 5.4) |
| LOA | Level of analysis |
| MIA | Mediated interaction Analysis coding scheme developed in this research (Section |
| MIM | Mediated Interaction Model (Section 4.2) |
| MIP | Media Instrumental Purpose (Section K.7) |
| MG | Meeting Gestures coding scheme (Section 4.3) |
| MMA | Multi-Modal Meeting Interaction (Section 4.3) |
| MUA | Media Use Access coding scheme (Section K.5) |
| MUI | Media Use Interactivity coding scheme (Section K.6) |
| MUT | Media Use by Type (Section K.4) |
| MRT | Media Richness Theory (Section 2.4) |
| PCS | Participation Coding Scheme (Chapter 3) |
| POP | Product, Organization, and Process coding scheme (Section J.8) |
| PP | Pointing coding scheme (Section 4.3) |
| RWA | Relational Workflow Analysis (Section K.2) |
| RCA | Relational Communication Analysis coding scheme (Section J.4) |
| RI | Richness of Interaction |
| RMU | Richness of Media Use |
| TEMPO | Time-by-Event-by-Member Pattern Observation (Section 2.2.3) |

## B.2 Glossary

**act (n):** the unit of interaction; input of a single group member and referenced to three axes: type of act, source of act, time of act, where type of act relates the act to the group's ongoing activity (McGrath 1991, p. 165)

**activity (n):** (see act).

**analytic focus (n):** orientations and ways into an observation (Jordan and Henderson 1995, p. 57).

**analytic scheme (n):** a collection of coding schemes associated with an analytic foci.

**behavior (n):** observable activity by a team member or team members.

**codes (also labels):** names given to concepts (Corbin and Strauss 1990, p. 66).

**coding scheme (n),** a collection of codes associated with an analytic category or analytic focus.

**concept (n):** basic unit of analysis; the names for unique categories of "recognizable, distinguishable phenomena" (Heath and Bryant 2000, p. 16); relate to one or more constructs.

**construct (n):** more precise definition of a concept; ways of elaborating upon an abstract concept (created or enhanced) in order to facilitate making observations that will support the theory under investigation (Black 1999, p. 36).

**event (n):** "are stretches of interaction that cohere in some manner that is meaningful to the participants" (Jordan and Henderson 1995, p. 57).

**intercoder reliability (same as interrater reliability):** a measure to assess the reliability of a coding scheme.

**interaction (n):** the unit of analysis for a meeting representing a discrete act of a team member.

**interaction process, meeting process, team interaction process (n):** participants' interdependent acts that convert inputs to outcomes though cognitive, verbal, and behavioral activities directed toward organizing task work to achieve collective goals (Marks et al. 2001).

**keyword (n):** the term used by Transana to refer to a code.

**media (n.):** an intermediate agency, instrument, or channel; a means; especially a means or channel of communication or expression (OED Online 2008).

**mediated interaction (n):** the collective set of meeting interaction behaviors that comprise team interaction behaviors and media use behaviors; the view of interaction in terms of how teams interact and how teams use media.

**media use (n):** the conceptualization of the process of interacting with the various media—how often teams use media, how many media they use and what type of media, how the teams physically interact with the media, and for what purpose.

**measure (v), process measure (n and v.)**: "the extent, dimensions, or amount of observed process phenomena, especially as determined by a standard"(Ragland 1995); to ascertain or appraise by comparing to a standard (OED online 2008).

**meeting interaction (n)**: the interdependent behaviors of the team as observed through the individual and collective acts of (a) team member(s).

**metric (n):** "a quantitative measure of the degree to which a system, component, or process possesses a given attribute. A calculated or composite indicator based upon two or more measures" (Ragland 1995).

**multi-categorical construct (n):** a construct made-up of two or more constructs.

**operational definition (n):** rulers or instruments that produce an acceptable way of measuring constructs (Black 1999, p. 36).

**Richness of Interaction (n):** the extent to which team interaction achieves synergy.

**Richness of Media Use (n):** the extent to which the team engages with media in meeting interaction.

**segment (n), interaction segment, interaction:** a portion of the meeting interaction representing an utterance, parallel conversation, or silence; segment boundary in the work and that the next stretch of meeting interaction will be of different character.

**sparklines (n):** "small, high-resolution graphics embedded in a context of words, numbers, images. Sparklines are data-intense, design-simple, word-sized graphics" (Tufte 2006).

**team (n):** a multi-disciplinary group of three or more individuals who are interdependent in their tasks, interact intensively to provide a 'built' product, plan, or service (Tannenbaum et al. 1992; Cohen and Bailey 1997; Devine et al. 1999; Liston et al. 2001).

**team interaction (n):** the inter-personal interactions that take place among team members. (Hackman 1987, p. 316); how teams act and react in relation to the systems within which they interact.

**utterance (n):** stretch of talk, by one person, before and after which there is silence on the part of that person" (Harris 1951, p. 14).

## B.3 Formula Notation: Symbols and Expressions

Several research papers inspired the symbol notation and equations used in this paper: (Lewin 1951; Arrow 1952; Blalock 1971; Kemeny and Snell 1978; Spivey 1989; Jovanovic 2003; McCowan 2005).

I distinguish between variables representing concepts and processes and variables representing number. I use italics to represent conceptual variables. I use capitalized variables to refer to a set of variables and the lowercase letter variable, with a sub-notation, for a specific instance of the variable. For example, $I$ represents the conceptual interaction process and $i_n$ represents a specific meeting interaction. Since all instance variables relate to a specific meeting interaction, I use the subscript notation of n, $_n$, to represent the nth instance of the variable, where N represents the total number of instances. I use the superscript notation of n, $^n$, to refer to the nth instance of the variable for variables that may have more than one value.

*Table B-2: List of symbols used in this dissertation including a description and example of the symbol in an expression.*

| Symbol | Denotes… | Example in expression |
|---|---|---|
| { ,} | the set of | $\{x_1 , \dots , x_n\}$ The set of variables containing n elements. |
| ⟨,⟩ | sequence of | |
| ∈ | member of | $a_x \in A$ Each $a$ is a member of $A$. |
| $\bar{x}$ | average | $\bar{x} = 20\%$ |
| **σ** | standard deviation | σ = .2 |
| $A$ | set of action behaviors for interaction process | $A = \{A_1,\dots, A_N\}$ |
| $A_n$ | set of action behaviors for a nth interaction | $a \in A$ |
| $B$ | set of behaviors | |
| $B_n$ | set of behaviors for nth interaction | $B_n = \{b_b , b_q, \dots\}$ |
| $b_x^n$ | individual behavior for category "x" for nth interaction | $b_x \in B$ |
| $C$ | set of communication behaviors for an interaction process | $C = \{C_1,\dots, C_N\}$ |
| $C_n$ | set of communication behaviors for an individual meeting interaction | |
| $d_n$ | duration for nth meeting interaction | |
| $D$ | Duration for meeting | |
| $f(X,Y)$ | a process is a function of X and Y processes | |
| $I$ | set of sequential meeting interactions | $I = \langle i_0,\dots, i_N\rangle$ |
| $I_N$ | number of meeting interactions | |
| $i_n$ | nth meeting interaction | $i_n \in I$ |
| $d_n$ | duration for nth meeting interaction | |

*Table B-2 (continued): List of symbols used in this dissertation including a description and example of the symbol in an expression.*

| Symbol | Denotes… | Example in expression |
|---|---|---|
| $G$ | set of conceptual contributions to project, meeting process, and interpersonal interaction systems | |
| $G_n$ | contributions for nth interaction | |
| $g_a^n$ | contributions of nth interaction from action processes to project, meeting process, and interpersonal interaction | |
| $g_c^n$ | Contributions of nth interaction from communication processes to project, meeting process, and interpersonal interaction | |
| | | |
| $g_r^n$ | contributions of nth interaction from reaction processes to project, meeting process, and interpersonal interaction | |
| $M$ | media use process | $M = \{M_1,\ldots, M_\mathrm{N}\}$ |
| $M_\mathrm{n}$ | set of media use behaviors for nth meeting interaction | $M_1 = \{b_c\ , b_\mathrm{e}, \ldots\}$ |
| $MI$ | media interacting | |
| $MP$ | media purposing | |
| $MU$ | media use process that includes the processes of utilizing and accessing | |
| N | total number of meeting interactions | |
| n | the nth meeting interaction | |
| $P$ | pattern of meeting interaction | $P \subseteq I$ |
| $R$ | reaction process | $R = \{R_1,\ldots, R_\mathrm{N}\}$ |
| $R_\mathrm{n}$ | set of reaction behaviors for nth meeting interaction | |
| RI | Richness of Interaction | |
| $\mathrm{RI_n}$ | Richness of Interaction for nth interaction | |
| RMU | Richness of Media Use | |
| $\mathrm{RMU_n}$ | Richness of Media Use for nth interaction | |
| t | time | |
| $T$ | set of team interaction processes | |
| $T_\mathrm{n}$ | set of team interaction processes for nth interaction | |

# Appendix C: Institutional Review Board Consent Form

Consent Form with Waiver of Signature for

PARTICIPATION IN STUDY ON THE USE OF PROJECT INFORMATION IN ARCHITECTURE, ENGINEERING, AND CONSTRUCTION MEETINGS

**FOR QUESTIONS ABOUT THE STUDY, CONTACT:** Martin Fischer, CIFE, Stanford University, Terman Engineering Center, MC: 4020, 380 Panama Mall, Stanford, CA 94305-4020, 650-725-4649). Only protocol directors or faculty sponsors whose names appear on application cover page may be listed here.

**DESCRIPTION:** You are invited to participate in a research study on the use of project information in architecture, engineering, and construction project meetings to compare the use of paper and electronic-based meetings. You will be asked to allow video and audio recording of the project meeting(s) you are participating in and to participate in an survey.

**RISKS AND BENEFITS:** The risks associated with this study are possible distraction of the team during the meeting due to the video and audio equipment. The benefits which may reasonably be expected to result from this study are analysis of the value of the project information currently used by the project team. The video recordings will be analyzed by the project team to classify activities of the team according to the use of information and interaction with project information artifacts such as drawings, electronic models, or whiteboards. No assignment of activities or recording of individual activities will be documented or recorded. All activities and transcript of the verbal activities will be recorded anonymously. All analysis results will be made available to participant organizations. We cannot and do not guarantee or promise that you will receive any benefits from this study. We cannot and do not guarantee or promise that you will receive any benefits from this study.

**TIME INVOLVEMENT:** Your participation in this experiment will take approximately 1-2 hours depending on the duration of the project meeting(s).

**PAYMENTS:** You will not receive any payment for participation in this research study.

**SUBJECT'S RIGHTS:** If you have read this form and have decided to participate in this project, please understand your participation is voluntary and you have the right to withdraw your consent or discontinue participation at any time by requesting stoppage of recording or decline participating in the survey. You have the right to refuse to answer particular questions. Your individual privacy will be maintained in all published and written data resulting from the study.

**Contact Information:**

- Appointment Contact: If you need to change your appointment, please contact Kathleen Liston at 650-274-4172.
- Questions, Concerns, or Complaints: *If you have any questions, concerns or complaints about this **research study**, its procedures, risks and benefits, or alternative courses of treatment, you should ask the Protocol Director. You may contact him/her now or later at fischer@stanford.edu.
- Emergency Contact: *If you feel you have been **hurt by being a part of this study**, or need immediate assistance please contact ***Teddie Guenzer*** **at 650-723-4945** or the Faculty Sponsor, Martin Fischer at 650-725-4649.
- Alternate Contact: If you cannot reach the Protocol Director, please page the research team at Kathleen Liston at 650-274-4172.
- Independent of the Research Team Contact: *If you are not satisfied with the manner in which this study is being conducted, or if you have any concerns, complaints, or general questions about the

research or your rights as a research study subject, please contact the Stanford Institutional Review Board (IRB) to speak to an informed individual who is independent of the research team at (650)-723-2480 or toll free at 1-866-680-2906. Or write the Stanford IRB, Administrative Panels Office, Stanford University, Stanford, CA 94305-5401. In addition, please call the Stanford IRB at (650)-723-2480 or toll free at 1-866-680-2906 if you wish to speak to someone other than the research team or if you cannot reach the research team.

As part of this research project, we will make a videotape recording of you while you participated in the experiment. We would like you to indicate what uses of this videotape you are willing to consent to by initialing below. You are free to initial any number of spaces from zero to all of the spaces, and your response will in no way affect your credit for participating. We will only use the videotape in ways that you agree to. In any use of this videotape, your name would *not* be identified. If you do not initial any of the spaces below, the videotape will be destroyed.

I give consent to be audiotaped during this study:

please initial: __Yes __No

I give consent to be videotaped during this study:

please initial: __Yes __No

The videotape can be studied by the research team for use in the research project.

please initial: __Yes __No

Results of analysis of the videotape can be used for scientific publications.

please initial: __Yes __No

I give consent for segments of the tapes or snapshots resulting from this study to be used for demonstration of the results of this study:

please initial: __Yes __No

**I have read the above description and give my consent for the use of the videotape as indicated above by responding to this email and waive the right for a signature to protect my anonymity in this research study.**

**The extra copy of this consent form is for you to keep.**

Protocol Approval Date: 9/29/06

Protocol Expiration Date: 9/27/07

Protocol Approval Date: 10/25/07

Protocol Expiration Date: 10/24/08

# Appendix D: Satisfaction Survey

**Please circle your answers**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | **1=Much** Less | | | | | | **7=Much More** |
| 1. | I got (less/more) from the meeting than I had anticipated. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 2. | I benefited (less/more) from this meeting than I expected. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 3. | I am (less/more) likely to attain my goals because of this meeting. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| | | **1=Strongly** Disagree | | | **4=Neutral** | | | **7=Strongly Agree** |
| 4. | I liked the way the meeting progressed today. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 5. | I feel good about today's meeting process. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 6. | I feel satisfied with the procedures used in today's meeting. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 7. | I liked the outcome of today's meeting. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8. | I feel satisfied with the things we achieved in today's meeting. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 9. | I am happy with the results of today's meeting. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

**Meeting Survey Part 2: Meeting Goals**

| | Please check all meeting types, goals that apply and indicate the primary goal of the meeting | Primary Goal | Secondary | Not a goal |
|---|---|---|---|---|
| | Information Briefing/Dissemination | | | |
| | Team Building | | | |
| | Brainstorming, Generating New Ideas, Alternatives | | | |
| | Strategic Planning | | | |
| | Commitment-Building | | | |
| | Program/Project Planning or Review | | | |
| | Decision-Making | | | |
| | Dispute Resolution | | | |
| | Problem Solving/Crisis Resolution | | | |
| | Coordination | | | |
| | Other:_____ | | | |

## D.1 Discussion and Analysis of Survey Data

A total of fifty-eight respondents from nine meetings are included in the survey data (Table D-1). Additional survey data are excluded due to missing data or poor reliability.

Questions 1-3 survey the individual net perceived goal attainment. The Cronbach's Alpha for these questions is .93 exceeding acceptable standards. The mean is 14.7 out of a maximum possible score of 21 with a standard deviation of 4.3 (combined value for three responses to question) and average was 4.9 for the three responses.

Questions 4-6 survey the satisfaction with the meeting process. The Cronbach's Alpha for these questions is .89 exceeding acceptable standards. The mean is 15.1 out of a maximum possible score of 21 with a standard deviation of 3.7 (combined value for three responses to question).

Questions 7-9 survey the satisfaction with the meeting outcome. The Cronbach's Alpha for these questions is .95 exceeding acceptable standards. The mean is 15.2 out of a maximum possible score of 21 with a standard deviation of 4.1 (combined value for three responses to question).

The satisfaction data show no relationship between type of media and satisfaction measures. Paper-based meetings had low (below 12) and high (above 15) satisfaction measures and digital-based meetings had low and high satisfaction measures.

*Table D-1: Survey results for eight meetings organized by survey construct: 1) individual satisfaction, 2) satisfaction with process, and 3) satisfaction with outcome. The table lists the number of respondents, Cronbach's Alpha, Mean value combining three questions for each survey construct, standard deviation, and average value. The data in gray are from meetings that are not included in the final analysis in Phase IV.*

| | | | Individual Satisfaction - Net Perceived Gain Q1-Q3 | | | | Satisfaction with Process Q4-Q6 | | | | Satisfaction with Outcome Q7-Q9 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Meeting | Media | Respondents | Alpha | Mean | Deviation | Average | Alpha | Mean | Deviation | Average | Alpha | Mean | Deviation | Average |
| Total | | 58 | **0.93** | 14.7 | 4.3 | 4.9 | **0.89** | 15.1 | 3.7 | 5.0 | **0.95** | 15.2 | 4.1 | 5.1 |
| MTNG90 | Paper | 8 | 0.88 | 12.5 | 2.8 | 4.2 | 0.9 | 14.25 | 2.4 | 4.8 | 0.55 | 13.1 | 2.02 | 4.4 |
| MTNG60 | Paper | 15 | 0.73 | 19.6 | 1.4 | 6.6 | 0.82 | 18.8 | 1.8 | 6.3 | 0.95 | 19.1 | 2.5 | 6.4 |
| MTNG80 | Mixed | 8 | 0.86 | 14.25 | 3.3 | 4.8 | 0.79 | 14.23 | 2.7 | 4.8 | 0.99 | 15.3 | 3.3 | 5.1 |
| MTNG50 | Digital | 7 | 0.91 | 15.8 | 3.04 | 5.3 | 0.96 | 15.3 | 3.2 | 5.1 | 0.96 | 15.7 | 3.7 | 5.2 |
| MTNG02 | Paper | 9 | 0.87 | 11.6 | 3.3 | 2.3 | 0.75 | 13.4 | 3.4 | 2.7 | 0.9 | 14.1 | 3.1 | 2.8 |
| MTNG06 | Digital | 7 | 0.8 | 9.7 | 2.7 | 3.2 | 0.94 | 11.4 | 3.6 | 3.8 | 0.93 | 10 | 3.4 | 3.3 |
| MTNG09 | Paper | 4 | 0.8 | 16.25 | 2.94 | 5.4 | -0.75 | 14.5 | 1.1 | 4.8 | 0.88 | 14.75 | 2.94 | 4.9 |

# Appendix E: Sample Portion of Raw Meeting Transcript

W001: ....landscaping<1334>

F002: Where does that fit in here? Is that item #2 (looking at paper))? <6825>

I003: (...) Is that what you have X? <13763>

G004: It's now outside of grid line A8 and up to grid line 4. That's structural steel.¤<19982>
F005: You're talking about BML labs?¤<23598>

G006: Umm.. the BML labs. The wash rooms. Those meeting rooms. All of that. <27189>

F007: That's steel. So all of that concrete topping on steel beams comes to that. <31410>

G008: Do we have to fireproof that? Or is that something we are looking at? <37406>

L009: No. That was from the get go it was already. <40961>

G010: And then, uhh. The landscaping if we are going to try and get some kind of confidence in that number. I know we've been talking to BWL and everybody, but we need a little bit more information on how that wetland is going to be developed. <58540>

F011: The latest drawings which are hot off the press show sections, all the planting materials, <65702>

G012: So we did produce those. <69286>

F013: Yeah. It's brand new. <70157>

J014: Got an email from (...) <73811>

C015: Those are posted. <75209>

J016: Posted. <75822>

Z017: *((no distinct talking))* <82767>

J018: I think the other (...) is coordination with wastewater treatment process. Wetland, there's no duplication there. We dropped some auxiliary costs. <93437>

F019: And that's basically that's all that I have in a nutshell.<98689>

Z020: Thank you very much. <104382>

J021: That's point 5. <108309>

G022: It seems that there some pressing...do people have to leave. <110577>

Z023: ((....))<112617>

G024: I keep getting the evil eye from you. <115167>

I025: no. No. I don't know I think that we had two different agendas. <121101>

G026: There's one agenda and you guys don't own it. <122991>

I027: That is the problem. <123914>

G028: That is my problem. I am very happy that they are here but you have to coordinate it because we are so many people. <130335>

# Appendix F: Sample Portion of Transcript

| ID | Segment Transcript | Time Stamp (milliseconds) |
|---|---|---|
| X001: | *((nothing going on - watching 4D model))* | 76168 |
| A002: | You can see the roofing being installed now. | 78481 |
| X003: | *((watching 4D model))* | 91945 |
| A004: | Man lift will come up in this area right here and we'll do an interior model and show balustrades and that sort of thing and we'll show the manlift in the model. | 103939 |
| Z005: | (question is asked but not heard) | 106843 |
| A006: | That's a great question. We'll cover that in that in other model. | 114594 |
| B007: | What was the question? I didn't hear it. | 116583 |
| A008: | Wanted to know if we needed an opening in the roof to get ductwork in? | 122642 |
| A009: | To answer his question, the large duct, there is some 54" duct up in the trusses and we'll try to erect those trunklines as they erect the steel. | 136841 |
| B010: | I just stepped it up to every other day now just to get it going faster. | 145279 |
| X011: | *((review of 4D model))* | 192733 |
| B012: | This is the last piece of steel that goes in right here off of Street X. | 195904 |
| A013: | B, now uhm...since we're now at this point can we go to Place X now. | 201440 |
| B014: | Sure. | 203260 |
| A015: | So all we're going to do now try to break down the building by components. This element right here is called Place X and just walk through how that goes together and what's in the Place X and some of the challenges that we face. | 221049 |
| A016: | We're going to try to break it down and at then at the end we'll talk more about how they interact with one another. | 234329 |
| X017: | ((watching 4D model)) | 241105 |
| B018: | So,...the uuh...again the code is pretty similar, but we have some different new kind of activities coming in here. One is purple for mechanical, blue is for interior finishes, see some pink activity for secondary support steel, studs, things like that, uuhm...(… ) | 269563 |
| X019: | *((watching model))* | 278659 |
| B020: | We're looking at Place X from the north right now and the steel on the left there is part of the box. | 289120 |
| A021: | Are you still at 2 days? | 290618 |
| B022: | Uuuhh. No, I'm at one day. | 293285 |
| A023: | Okay, same thing...( ) Steel is ( ) being aligned-bolted-welded there. | 305717 |
| Z024: | ( ) question asked, is that a box? | 313116 |
| X025: | *((watching 4D model))* | 322883 |
| Z026: | How does that box get there before the support? | 326120 |
| E027: | You guys have to figure that out. (Laughing) | 328720 |
| A028: | That's the trick part of this. | 331429 |
| B029: | I guess I have it coming in a couple of days early, but it's not too early. It needs to come in because the steel comes in right above it right there. | 341336 |
| A030: | That should be air handler unit xx? Is that what it is? | 344879 |
| B031: | Uuh. Yes, that's air handler xx and that's one. | 354045 |
| A032: | Okay. So for Company Y what The plan is and anybody has any better ideas certainly you know speak up, but because of the weight and size of those units we were looking at bringing them in as we erected the steel and setting them on the steel and then erect over the top of them and then hang them, pull them up to the upper steel with light coil rods so we can get the deck even and there's an isolation slab underneath this because it's difficult to get close enough with the big rig later on. | 392181 |
| F033: | A, Do we take the steel above the X deck? | 395026 |
| A034: | Yes, they're not that heavy. It's something we need to look at and we are going to rig them. | 402380 |
| K035: | Can you go back to those dates? | 404056 |
| A036: | Absolutely. | 408403 |

# Appendix G: Transcription and Coding Process Using Transana Coding Software

In Phase IV, I performed the following tasks on ten meeting observations using the Transana software:

1. I imported the video data into Transana and created a 'Series' object, e.g., 'MTNG1' in Figure G-2, and an 'Episode' object. In the meetings that had multiple video I had multiple 'Episode' objects.
2. I created a 'Transcript' object for the 'Episode'.
3. I transcribed the video using the playback features in Transana and a three pedal foot mouse. This allowed me to rewind a few seconds, stop, and insert a time stamp with foot pedals and type simultaneously. At the end of each segment I inserted a time stamp in the transcript.
4. Created 'Clips' representing each of the segments. I added a feature to the Transana software to automate the generation of clips using the 4-digit labels I created. Each clip is an object in the Transana database and is associated with a start time, end time, and transcript text. The 'Clips' are the unit of analysis and are equal to an interaction (segment). Transana organizes clips in 'Collections'.
5. I exported the 'Clip' data to a comma-delimited file to import into Excel. I modified the Transana software to export the raw clip data, including the start time, clip identifier, and transcript text for the clip. I also modified the Transana data to export some analytic data based on the raw clip data, including Participation analysis (Appendix H).

The transcription process is labor intensive and it is often cited as the challenge or barrier to use interaction analysis (Fairhurst 2004). For every minute of video data, this process took approximately ten minutes. An hour of video took approximately ten hours to transcribe and create the clips. This does not include the time I spent programming to automate the generation of the clips from my transcription. Other researchers, e.g., Futoran et al. (1989) and Milne (2005), who developed an instrument approach to capture and analyze group behavior, report similar amounts of time required to follow this approach.

*Figure G-1: Example of raw data exported from the Transana software. The raw data include a unique identifier for each clip, the duration of the clip in milliseconds, and the transcribed text.*

| Clip Num | Clip ID | Duration | Text |
|---|---|---|---|
| 726 | W001-A1 | 359876 | Meeting setup - need to remove this time from analysis |
| 727 | A001-A2 | 22013 | A001: Let's go ahead and start with the hopefully the final sign-off for 4th floor, C. Sure. And uh, Let's go ahead and start with umm. . Let's see. Mainly. Let's go over our last hits. There's only 6 or 7 of them? |
| 728 | C002-A3 | 693 | C002: Yeah. |
| 729 | A003-A4 | 1281 | A003: All right. |
| 730 | X004-A5 | 6454 | X004: *((switching to view))* |
| 731 | B005-A6 | 946 | B005: Cable tray is cut. |
| 732 | A006-A7 | 261 | A006: Okay. |
| 733 | A007-A8 | 2173 | A007: Stop |
| 734 | B008-A9 | 5166 | B008: We're supposed to find out if shaft is going to get bigger. |

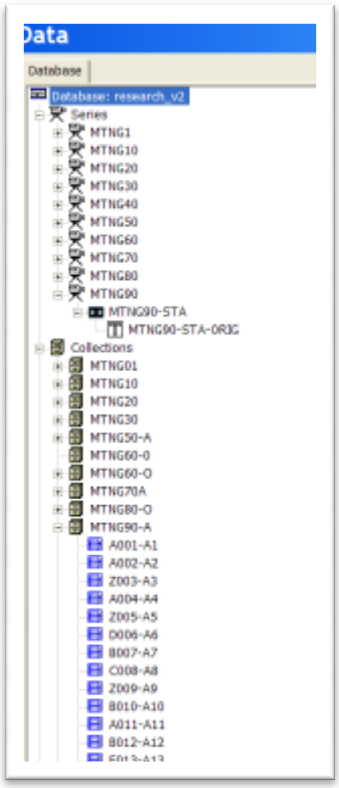



*Figure G-2: Snapshot of the Transana database hierarchy showing the meeting observations as 'Series'. Each 'Series' contains at least one 'Episode' and 'Transcript'. 'Collections' represent the set of 'Clips' associated with a 'Series' and represent the segments.*

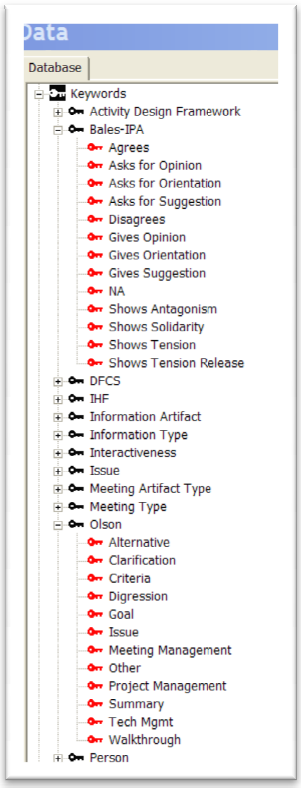



*Figure G-3: Snapshot of the Transana database showing the 'Keyword' objects and the various 'Keyword' schemes (Transana refers to these as 'Keyword groups') that I applied to the observational data.*

In Phase III, the coders initially used the Transana software to code the meeting observations. Figure G-4 shows the interface to assign coding categories or 'keywords' to segments or 'Clips'. Transana supports assignment of multiple keywords from a single coding category (keyword group), e.g., Bales' IPA 'agrees' and Bales' IPA 'Gives Orientation'. This allows users to assign multiple keywords when a segment meets the definition of two keywords in a single category. This is particularly useful when a segment is lengthy or the topic or nature of the segment shifts. However, this introduced problems with comparing coder data. We also discovered that the keyword assignment feature in Transana was more labor intensive than using Microsoft Excel to code the segments. The trade-off is that Excel does not allow for multiple assignments of keywords to a single segment of data. I chose to impose the restriction of a single keyword assignment for each coding scheme to a segment.

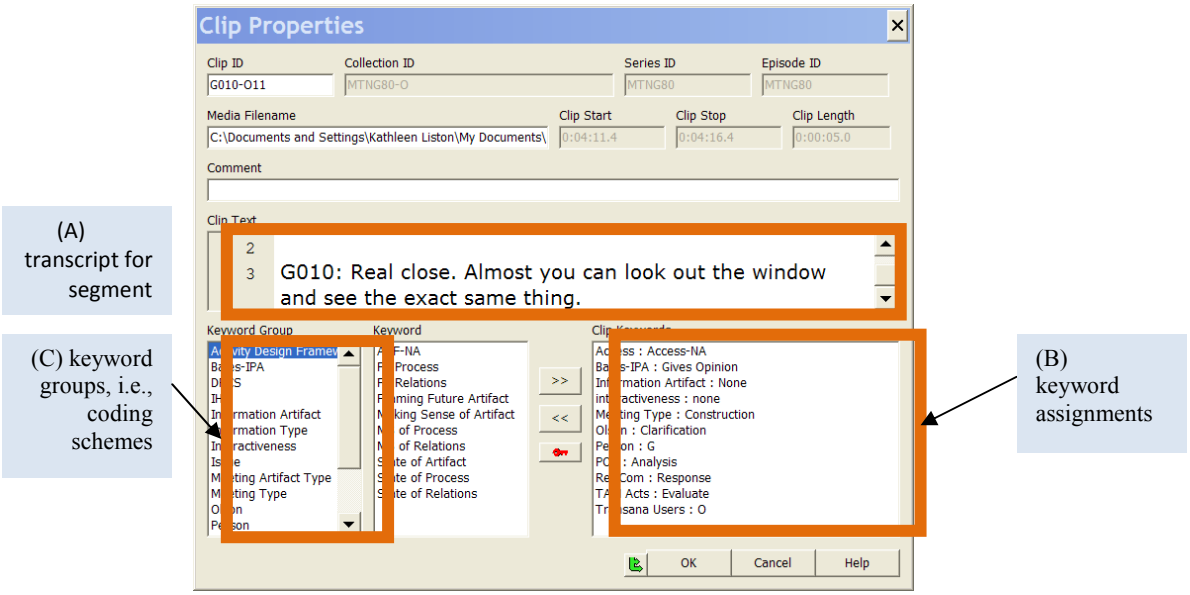



*Figure G-4: Snapshot of a 'Clip' object representing a segment of a project meeting. The 'Clip' has the following properties: a unique ID, start time, stop time, length, (A) text, and (B) keywords. The Clip dialog box allows users to assign keywords to a clip object by selecting a (C) keyword group and then selecting the keyword.*

*Figure G-5: Example of coding worksheet in Excel used in Phase III. Multiple coding schemes were applied to the observation data. Coding categories were assigned to a list so coders could select from the list for quick entry.*

| Clip Nu | Clip ID | Duration | Seconds | Minutes | Text | Project Workflow | Relational Workflow | Interaction Process analysis | Media Type | Interacti vity | Access | Media Information |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 726 | W001-A1 | 359876 | 359.876 | 5.997933 | Meeting setup - need to remove this time from analysis | | | NA | | | | |
| 727 | A001-A2 | 22013 | 381.889 | 6.364817 | A001: Let's go ahead and start with the hopefully the final sign-off for 4th floor, C. Sure. And uh, Let's go ahead and start with umm. . Let's see . Mainly. Let's go over our last hits. There's only 6 or 7 of them? | Meeting Managem | Initiation | Gives suggestion | Digital | viewing | Shared | Describe |
| 728 | C002-A3 | 693 | 382.582 | 6.376367 | C002: Yeah. | Meeting Managem | Continue | Agrees | Conceptual | viewing | Access-I | Evaluate |
| 729 | A003-A4 | 1281 | 383.863 | 6.397717 | A003: All right. | Meeting Managem | Response | Agrees | Conceptual | none | Access-I | Evaluate |
| 730 | X004-A5 | 6454 | 390.317 | 6.505283 | X004: ((switching to view)) | Walkthrough | Communicatio | NA | Digital | changing | Shared | Describe |
| 731 | B005-A6 | 946 | 391.263 | 6.52105 | B005: Cable tray is cut. | Clarification | Initiation | Gives orientation | Digital | viewing | Shared | Describe |
| 732 | A006-A7 | 261 | 391.524 | 6.5254 | A006: Okay. | Clarification | Response | Agrees | Digital | viewing | Shared | Describe |
| 733 | A007-A8 | 2173 | 393.697 | 6.561617 | A007: Stop | Meeting Managem | Order | Gives suggestion | Digital | changing | Shared | Describe |
| 734 | B008-A9 | 5166 | 398.863 | 6.647717 | B008: We're supposed to find out if shaft is going to get bigger. | Issue | Initiation | Gives suggestion | Digital | viewing | Shared | Evaluate |
| 735 | A009-A10 | 3454 | 402.317 | 6.705283 | A009: Yep. I Still don't have answer on that. | Clarification | Response | Agrees | Conceptual | none | Access-I | Evaluate |
| 736 | B010-A11 | 8335 | 410.652 | 6.8442 | B010: That's going to be broken in 2 | Issue | Communicatio | Gives orientation | Digital | viewing | Shared | Predict |
| 737 | A011-A12 | 3857 | 414.509 | 6.908483 | A011: Did you note that anywhere on yours, D? | Clarification | Initiation | Asks for orientation | Digital | viewing | Shared | Describe |
| 738 | D012-A13 | 197 | 414.706 | 6.911767 | D012: I didn't. | Clarification | Continue | Gives orientation | Digital | viewing | Shared | Describe |
| 739 | A013-A14 | 1885 | 416.591 | 6.943183 | A013: Okay. | Other | Response | Agrees | None | none | Access-I | TAM-NA |
| 740 | D014-A15 | 4134 | 420.725 | 7.012083 | D014: There's a lot of those that are going to be broken. and I can't draw it.XXXX | Criteria | Communicatio | Gives orientation | Digital | viewing | Shared | Explain |
| 741 | A015-A16 | 4471 | 425.196 | 7.0866 | A015: You can't.... | Criteria | Initiation | Gives opinion | None | none | Access-I | Explain |

*Figure G-6: Sample of the raw coded data in Excel. Each segment in the raw data, e.g., the segment with 'Clip Num' 726, includes a unique 'Clip ID', Duration in milliseconds, seconds, and minutes, text, and keyword assignments, e.g., Project Workflow, Relational Workflow, Interaction Process analysis, media type, Interactivity, Access, and Media Information (DEEP). In total, there were 4,759 segments produced.*

# Appendix H: Participation Rate Analysis

We (myself and a research assistant) wrote an analysis tool for Transana to calculate the proportion by participant and to calculate the Gini coefficient for each observation. The formula for the Gini coefficient ($G$) is:

*Formula H-1: The formula for the Gini coefficient. The symbol notation does not follow the notation used throughout this dissertation.*

$$G = |1 - \sum_{k=1}^{k=n-1} (X_{k+1} - X_k)(Y_{k+1} + Y_k)|$$

Where $n$ is the number of participants, $X$ is the equal participation rate, i.e., for n participants, 1/n, and $Y$ is the participation rate for each participant.

Gini Coefficient: **0.716237**

Total number of persons: 12

| Participation Rates relative to all activities | | | Participation Rates between meeting participants | | |
|---|---|---|---|---|---|
| PERSON | TIME | RATE | PERSON | TIME | RATE |
| Person D | 3719568 | 0.050719 | Person D | 3719568 | 0.05474 |
| Person I | 1986347 | 0.027086 | Person I | 1986347 | 0.029232 |
| Person G | 120250 | 0.00164 | Person G | 120250 | 0.00177 |
| Person H | 1631760 | 0.02225 | Person H | 1631760 | 0.024014 |
| Person F | 1712298 | 0.023349 | Person F | 1712298 | 0.025199 |
| Person A | 40505036 | 0.55232 | Person A | 40505036 | 0.596099 |
| Person C | 1894871 | 0.025838 | Person C | 1894871 | 0.027886 |
| Person Y | 15670 | 0.000214 | Person B | 12154626 | 0.178876 |
| Person B | 12154626 | 0.165739 | Person W | 1199316 | 0.01765 |
| Person W | 1199316 | 0.016354 | Person M | 2519132 | 0.037073 |
| Person X | 5251572 | 0.07161 | Person L | 44480 | 0.000655 |
| Person M | 2519132 | 0.03435 | Person E | 462450 | 0.006806 |
| Person L | 44480 | 0.000607 | | | |
| Person Z | 118781 | 0.00162 | | | |
| Person E | 462450 | 0.006306 | | | |

*Figure H-1: Example of participation analysis data exported from Transana using a custom participation analysis script developed in this research. The analysis includes frequencies (rates) across participants and the Gini coefficient.*

# Appendix I: Reliability Measure Formulas

This appendix compares and discusses the three intercoder reliability methods employed in the research: percent agreement, Cohen's Kappa, and Krippendorff's Alpha.

## I.1 Percent Agreement

The simplest measure is percent agreement or percent fit, where:

*Formula I-1: Formula for percent agreement:*

$$\textit{Percent Agreement} = P_a = \frac{O_a}{U_t}$$

$$O_a = \text{total number of times coders agree}$$

$$U_t = \text{total number of units analyzed}$$

and is "the proportion of units with matching descriptions on which two observers agree" (p. 80, Hayes and Krippendorff 2007). For example, the percent agreement for the example in Figure I-1 is .67.

| Unit 1 | Unit 2 | Unit 3 |
|---|---|---|
| Category A | Category B | Category A |
| Category A | Category C | Category A |

**Categories: 3**
Category A
Category B
Category C

| | | |
|---|---|---|
| 1 | 2 | 1 |
| 1 | 3 | 1 |
| 1 (agree) | 0 (disagree) | 1 (agree) |

$U_t = 3$
$O_a = 2$
$P_a = .67$

*Figure I-1: Example of percent agreement variables applied to three coding units with two coders and three coding keywords.*

Most researchers, including Tinsley and Weiss (1975), Carletta (1996), and Hayes and Krippendorff (2007) do not recommend this as an appropriate measure since $P_a$ does not account for the likelihood that two coders would agree by chance. Two reliability measures that account for likelihood by chance are Cohen's Kappa (κ) (Cohen 1960) and Krippendorf's Alpha (α) (Krippendorff 1980; Krippendorff 2004).

## I.2 Cohen's Kappa

Cohen's Kappa is the most commonly cited measure found in the studies applying interaction analysis to group interaction. Cohen's Kappa coefficient (κ) is:

*Formula I-2: Cohen's Kappa for assessing reliability:*

$$Cohen's\ Kappa = \kappa = \frac{P_a - P_e}{1 - P_e}$$

where $P_a$ is the percent observed agreement,
and $P_e$ is number of agreements expected by chance for each category.

For example, $P_a = 2$, Pe is the sum of the expected frequencies for each code or the sum of the row and columns of the codes in the contingency table in Figure I-2.

$$P_e = \frac{(2*2)}{3} + \frac{(0*1)}{3} + \frac{(1*0)}{3} = 1.33$$

$$\kappa = \frac{2 - 1.33}{1 - 1.33} = .4$$

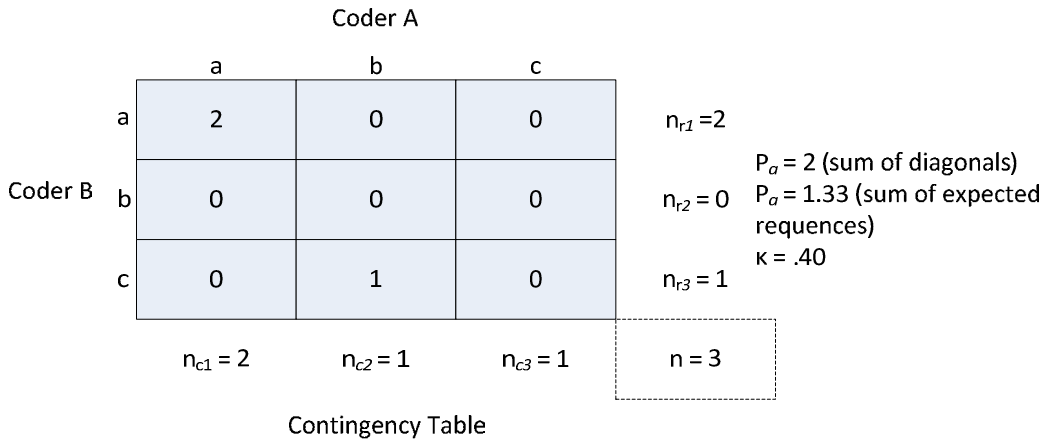



*Figure I-2: Contingency table to calculate Cohen's kappa.*

The criteria for acceptance is κ > .4 for moderate intercoder reliability and κ > .8 for high intercoder reliability.

## I.3 Krippendorff's Alpha

Krippendorff argues that Cohen's Kappa does not account for X and proposes Krippendorf's Alpha coefficient as a better measure of reliability:

*Formula I-3: Krippendorf's Alpha coefficient:*

$$\boldsymbol{\alpha} = 1 - \frac{D_o}{D_e} = \frac{\text{Observer Disagreement}}{\text{Expected Disagreement}}$$

$$D_O = \frac{1}{n}\sum_c \sum_k n_c n_{k\ metric\ \delta_{ck}^2}$$

$$D_e = \frac{1}{n(n-1)}\sum_c \sum_k n_{k\ metric\ \delta_{ck}^2}$$

For the example in Figure I-1, $the\ contingency\ table\ for\ n_c n_{k\ metric\ \delta_{ck}^2}\ is\ shown\ in\ Figure\ I-2.,\ such\ that\ n_0 = 4, n_1 = 1, and\ n_2 = 1$, n = 6, and:

$$\boldsymbol{\alpha} = 1 - \frac{D_o}{D_e} = \frac{(n-1)\sum_c o_{cc} - \sum_c n_c(n_c-1)}{n(n-1) - \sum_c n_c(n_c-1)}$$

$$\boldsymbol{\alpha} = \frac{(6-1)(4) - (4(4-1) + 1(1-1) + 1(1-1))}{6(6-1) - (4(4-1) + 1(1-1) + 1(1-1))} = .44$$

| | a | b | c | |
|---|---|---|---|---|
| a | 4 | 0 | 0 | $n_1 = 4$ |
| b | 0 | 0 | 1 | $n_2 = 1$ |
| c | 0 | 1 | 0 | $n_3 = 1$ |
| | $n_1 = 4$ | $n_2 = 1$ | $n_3 = 1$ | n = 6 |

Coincident Matrix

*Figure I-3: Coincident matrix to calculate Krippendorf's Alpha.*

Krippendorff (2004) states that an α > .667 is sufficient to make tentative conclusions and α > .8 is sufficient for scholarly arguments.

## I.4 Acceptable Standards

I chose to apply each measure to the data based on review of prior methods to apply intercoder measures (

Table I-2) and established the acceptance criteria summarized in Table I-1. I developed a macro in Excel to calculate each of these measures for each coding scheme using coded data from two coders. This macro is show in Figure I-4. I used data samples provided by Krippendorff to validate the calculations. The development of this macro tool greatly facilitated the process of reliability measures throughout the latter phases of the research.

*Table I-1: Summary of intercoder reliability measures used in this research. Three measures of agreement were applied in Phase IV, including Percent Agreement, Cohen's Kappa, and Krippendorf's Alpha. The table lists the method to calculate the reliability and the thresholds for meeting high intercoder agreement and acceptable intercoder agreement.*

| Intercoder Reliability Measure | Method | High Intercoder Agreement | Acceptable Intercoder agreement |
|---|---|---|---|
| Percent Agreement | $P_a = \frac{O_a}{U_t}$ | ➢ .8 | ➢ .7 |
| Cohen's Kappa (κ) | $\kappa = \frac{P_a - P_e}{1 - P_e}$ | ➢ .8 | ➢ .4 |
| Krippendorff's Alpha (α) | $\alpha = 1 - \frac{D_o}{D_e} = \frac{\text{Observer Disagreement}}{\text{Expected Disagreement}}$ | ➢ .8 to make scholarly arguments | ➢ .667 to make tentative conclusions |

*Table I-2: Sampling of reliability criteria in research.*

| Published Research | Coding Scheme | Segment Method | Reliability Method | Reported Measures |
|---|---|---|---|---|
| (Bekker et al. 1995) | | counts | κ, counts | .72 |
| (Kelly and Spoor 2007) | Bales IPA, LAP, coded survey | | P(A), κ | .71 and .56 respectively, used coded consensus methods to resolve issues |
| (Kuhn and Poole 2000) | GWRCS coding scheme, thematic segmentation | theme | κ | .95 |
| (Nyerges 1998) | multiple | interval | P(A), κ | 71 and 81<br>.66 and .79 |
| (Yates and Orlikowski 2002) | genre coding scheme | theme | κ, theme | .8 and .1 |
| (Parent et al. 1997) | custom coding scheme | interval | κ, interval | .91 |
| (Veinott et al. 1999) | Multiple:<br>Olson code (Boyle et al. 1994) | turns | K | .77 |
| (Jovanovic et al. 2005) | utterances | utterances | κ and α | Similar values |
| (Stephens 2005) | media type | sentences | Scott's pi, Holsti CR (Holsti 1969) | Ranged from .5 to .8, used consensus and review to reach reliability |

## I.5 Reliability Process Using Macro

I developed an Excel macro to calculate the three measures for intercoder reliability. Figure I-4 shows the interface for this macro. It supports the calculation for a specified number of units (segments) and specified number of categories.

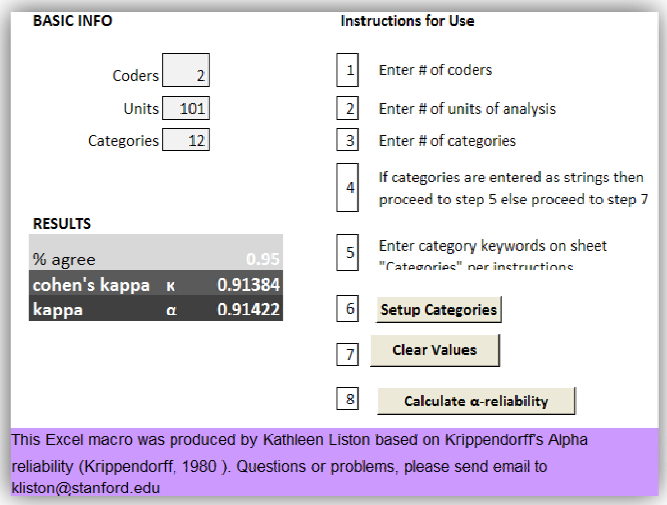



*Figure I-4: Snapshot of Intercoder Reliability Excel Macro developed in the research to quickly calculate three inter-coder reliability measures: Cohen's Kappa, Krippendorf's Alpha, and Percent Agreement (% agree).*

# Appendix J: Phase III Code Book

In Phase III, three coders applied the following coding schemes to portions of the meeting data:

| Section | Acronym | Coding Scheme | Developed by |
|---|---|---|---|
| J.1 | AST | Adaptive Structuration Coding Scheme | (DeSanctis and Poole 1994) |
| J.2 | DFCS | Decision Function Coding Scheme | (Poole and Roth 1989) |
| J.3 | GWRCS | Group Relational Working Coding Scheme | (Poole and Roth 1989) |
| J.4 | RCA | Relationship Communication Analysis | (Rogers and Farace 1975) |
| J.5 | IHF | Information Handling Framework | (Baya 1996, p. 11) |
| J.6 | ADF | Activity Design Framework | (Minneman 1992) |
| J.7 | FWA | Framework for Analyzing Workspace Activity | (Tang 1989) |
| J.8 | POP | Production, Organization, and Process | (Fischer and Kunz 2004) |
| J.9 | IT | Information Type coding scheme | |

The following sections list the codes for each of the coding schemes along with a brief description of the code. The codes are included here as reference for the discussions in Chapters 2 and 4. The cited papers for each coding scheme provide further detail for the rationale of the coding scheme, examples of the coding scheme, and findings from using the coding schemes.

## J.1 Adaptive Structuration Coding Scheme (AST)

DeSanctis and Poole (1994) developed Adaptive Structuration Theory and developed the AST coding scheme to analyze team interaction with a Group Decision Support System (GDSS). This coding scheme was difficult to apply to meeting interactions as it requires examining and analyzing features of the media and its use for each meeting interaction. Additionally, the coding scheme does not easily apply to non-digital media. The analytic scheme consists of three coding schemes. The first captures the source of the structure:

*Table J-1: Summary of coding categories for AST scheme for sources of structure for the meeting interaction, i.e., the structure comes from either the technology, the tasks, or the environment.*

| Structure Source | Definition | Examples |
|---|---|---|
| AIT (A) | advanced information technology (AIT) including hardware, software, and procedures | keyboard input devices, voting modules, decision models |
| AIT outputs (AO) | data, text or other results produced by the AIT | displays of group votes, lists of ideas, opinions, graphs |
| Task (T) | task knowledge or rules, facts figures | a budget task, customary ways |
| Task (O) | task data or procedures | budget calculations |
| Environment (E) | social knowledge or rules of action drawn | implications of corporate spending policies |
| Environmental outputs (EO) | Results of applying knowledge or rules drawn from the environment | implications of corporate spending |

The second coding scheme captures the instrumental use of the technology:

*Table J-2: Coding categories for instrumental uses of an Advanced Information Technology (AIT).*

| Instrument Use | Definition |
|---|---|
| Task | facilitate substantive work |
| Process | to manage communication |
| Power | to influence others' thinking or to move them forward |
| Social | to establish or maintain social relationships among members, such as to joke, laugh, or tease one another |
| Individualistic | for private reasons |
| Fun/Exploratory | no goal, to play, see how system works |
| Confusion | during a period of disorientation |

The third coding scheme captures the "appropriation moves" or how teams use features and structures of technologies in practice. This coding scheme consists of thirty-two separate appropriation moves relating to four high-level appropriation moves (DeSanctis and Poole 1994, p. 135):

1. Direct use where structure is preserved
2. Relate to other structures and structure may be blended with another structure.
3. Constrain the structure and structure is interpreted or reinterpreted.

Express judgments about the structure.

4.

## J.2 Decision Function Coding System (DFCS)

DFCS (Poole and Roth 1989) is a modified extension of Bales' Interaction Process Analysis coding scheme (1950) (see Appendix K.3) and Fisher's decision-making coding scheme (1970) and describes phases of decision-making.

*Table J-3: Decision Function Coding System categories developed by Poole and Roth (1989) to describe phases of decision-making.*

| Category Grouping | Category | Description of Category |
|---|---|---|
| Problem Activity | (PA) Problem Analysis | statements that define or analyze the problem |
| | (PC) Problem Critique | statements that support or criticize problem analysis |
| Executive Activity | (OO) Orientation | statements that direct the group's process or help the group to do its work |
| | (PR) Process Reflection | solutions or proposals |
| Solution Activity | (SA) Solution Analysis | review of issues to date, review of the design or schedule, restatement of issues, alternatives, criteria |
| | (SD) Solution Design | statements that propose solutions |
| | (SD) Solution Elaboration | statements that alter or amend solutions |
| | (SC) Solution Evaluation | statements that support (+), criticize (-), or offer evaluation (/) of solutions. |
| | (CF) Solution Confirmation | votes or offer final confirmation of decisions |
| | (DIS) Other | disorganized or non-focused discussion. |
| (NN)Tangents | | moving to an unrelated subject |
| Simple agreement | | statements that express agreement |
| Simple disagreement | | statements that express disagreement |

## J.3 Group Working Relationship (GWRCS)

The GWRCS coding scheme developed by Poole and Roth (1989) describes patterns of conflict reflecting different working relationships in groups. The scheme as listed in Table J-4 includes three high-level categories, low, moderate and high conflict, and seven categories. Poole and Roth applied the scheme to groups in the lab, achieving .85 intercoder reliability. The scheme mixes social and action perspectives of team interaction.

*Table J-4: Group Working Relationship Coding Scheme (GWRCS) categories listed and organized by high-level categories. The GWRCS coding scheme describes patterns of conflict, from low to high.*

| High-Level Category | Category | Description |
|---|---|---|
| Work Focused Relationship (Low Conflict) | (FW) Focused Work | Periods when members are task-focused and do not disagree with one another |
| | (RI) Relational Integration | Periods when the group is not task-focused; these exhibit tangents, joking, and positive socio-emotional behavior. |
| Moderate Conflict | (CW) Critical Work | Periods when members disagree with each other, but the disagreements are centered on ideas and no opposing sides have been differentiated. |
| | (OD) Open Discussion | A third mode of opposition resolution that involves problem solving<br>discussions, negotiation, or compromise. |
| High Conflict | (OD) Opposition | Periods in which disagreements are expressed through the formation of opposing sides; conflict is personalized during these periods. |
| | Accommodation | One of three modes of resolution of oppositions in which one side gives in. |
| | Tabling | A second mode of resolution of oppositions in which no resolution occurs, but the subject is dropped. |

## J.4 Relational Communication Analysis (RCA)

The relational communication analysis coding scheme examines the control or dominance aspect of communication (Rogers and Farace 1975). It examines the relational and processual aspects of interpersonal communication. The following codes represent the original codes that Rogers and Farace (1975) developed. I modified this coding scheme to capture the relational aspect of communication and refer to the modified scheme as RWA (Appendix K.3). The coding scheme applies three codes to each interaction. The first coding scheme is a code for the speaker (similar to the participant code I use, see Chapter 3). The second code is a description of the format of the message. The third code is the response mode of the speech.

*Table J-5: Relational Communication Analysis coding categories developed by Rogers and Farace (1975), describing the format of the message and response mode of the message.*

| **Format of Message** | |
|---|---|
| assertion | A completed referential statement in either declarative or imperative form |
| question | Any interaction that takes an interrogative grammatical form |
| talk-over | An interruptive manner of entering an ongoing utterance by another participant |
| non-complete | Any interaction that is initiated but not expressed in a complete format |
| other | Any interaction that is unclassifiable as to their form |
| **Response mode** | |
| support | giving and seeking of agreement, assistance, acceptance, approval |
| nonsupport | denote disagreement, rejection, demands, and challenges |
| extension | continues flow of preceding message |
| answer | response to a question which has substance or commitment, definitive |
| order | unqualified command |
| disconfirmation | refers to a response in which one interactor requests a response and the other interactor ignores the request |
| topic change | an exchange in which a second message has no theme in common with the first message, but also that no response commonality was requested by the first message |
| initiation-termination | begins or ends an interaction |
| 0ther | |

## J.5 Information Handling Framework (IHF)

*Table J-6: Information handling and design framework developed by (Baya 1996, p. 11). This framework focuses on specific domain-specific information activity differentiating between the type of informational activity at a generic level, the level of abstraction, what the information describes, the format of the information, and level of detail of the information.*

| Information Handling Framework | | | | | |
|---|---|---|---|---|---|
| Informational Activity | Level of Abstraction | Design Information Framework (DIF) | | | |
| | | Descriptor | Subject Class | Medium | Level of Detail |
| Generate | Unlabeled | Alternative | Assembly | Audio | Conceptual |
| Access | Labeled | Assumption | Component | Video | Configurational |
| Analyze | Associative | Comparison | Connection | Text | Detail |
| | Qualitative | Construction | Feature | Graphic | |
| | Quantitative | Location | Requirement | Gesture | |
| Information Fragment Duration | | Operation | Design-Concept | | |
| Quantitative measure in seconds | | Performance | Other | | |
| | | Rationale | | | |
| Design Information Measures (dim) | | Relation | | | |
| Quantitative measure: takes integer values (1,2,3) | | Requirement | | | |
| | | Miscellaneous | | | |

*Table J-7: Description of generic informational activity categories defined by Baya (1996).*

| Informational Activity | Description |
|---|---|
| generate | an action which adds new information to the information space from an unidentified source, e.g., writing, drawing, talking |
| access | an action which references information within or outside the information space from an identifiable source, e.g., read, recall |
| analyze | an action which changes an attribute of the information fragment, e.g., interpret, organize, calculate |

## J.6 Activity Framework for Considering Design Communication (ADF)

The Activity Design Framework examines the process of design in relation to past, present, and future states and in relation to the artifact, process, and relations (Minneman 1992).

*Table J-8: Framework to analyze design communication developed by Minneman (1992). These coding categories make explicit the temporal nature of the activity and differentiate activities based on the topic.*

| Trajectories/Facets | An Artifact | A Process | A Relation |
|---|---|---|---|
| State of | current understanding of artifact | current process | relations |
| Making sense of | explanations of how artifact came to be | explanation of how process came to be | explanations of relations |
| Framing futures of | framing future state of artifact | framing future state of process | framing future state of relations |

## J.7 Framework for Analyzing Workspace Activity (FWA)

Tang (1989) built on the work by Bly (1988) to examine the physical actions of design activity and the purpose of those actions.

*Table J-9: Framework for analyzing workspace activity developed by Tang (1989). The framework looks at how team performs activity and what the activity accomplishes. This coding scheme distinguishes between different physical actions and the purpose of those actions in the context of mechanical design.*

| | **Action** | | |
|---|---|---|---|
| **Function** | List | Draw | Gesture |
| Store information | | | |
| Express ideas | | | |
| Mediate interaction | | | |

## J.8 Product, Organization, and Process (POP)

POP is a coding scheme to analyze the informational content of an utterance and is adapted from (Fischer and Kunz 2004). The scheme acts as a check for the Workflow, DEEP and Media Type coding schemes. If the content fits any of these definitions, then the team is discussing something related to the project. Multiple codes may be applied to each meeting interaction, e.g., Product-Process.

*Table J-10: The Product, Organization, and Process (POP) coding scheme developed by Fischer and Kunz (2004) to analyze the content of the interactions.*

| **Code** | **Definition** |
|---|---|
| Product | information describing the physical project artifact and its scope |
| Organization | Information describing the organization carrying out the design and construction of the project |
| Process | Information describing the activities and steps to design or construct the project artifact, e.g., schedule |

## J.9 Information Type (IT)

IT is a coding scheme to elaborate the different types of media the team employs or type of information referenced in an interaction, e.g., schedule, 4D model, etc.

*Table J-11: The Information Type coding scheme to classify interactions in terms of the information referenced in the interaction.*

| Code | Definition |
|---|---|
| 2D drawing | interaction referencing a 2D description of the project artifact or components related to the project artifact |
| 3D model | interaction referencing a 3D model of the project artifact or components related to the project artifact |
| 4D model | interaction referencing a digital 4D model of the project schedule or portion of the project schedule |
| RFI | interaction referencing a request for information |
| Clarification | interaction referencing a request for clarification |
| Change Order | interaction referencing a change order |
| Contract | interaction referencing a contract document |
| Estimate/Budget | interaction referencing an estimate or budget or cost data |
| Item Log | interaction referencing the item log |
| Meeting minutes | interaction referencing the meeting minutes |
| Schedule | interaction referencing the project schedule |

# Appendix K: Mediated Interaction Analytic Scheme Code Book

The Mediated Interaction Analytic (MIA) scheme captures dynamic mediated interaction. The seven coding schemes reflect perspectives of meeting interaction related to social and functional behavior and to media use. The code book describes each coding scheme and the coding categories for the coding scheme (see Figure 4-4 for the Mediated Interaction Analytic schemes in one figure).

| Section | Acronym | Coding Scheme | Developed by |
|---|---|---|---|
| K.1 | CWA | Collaborative Workflow Analysis | modified CDW (Olson et al. 1992) |
| K.2 | RWA | Relational Workflow Analysis | modified RCA (Rogers and Farace 1975) |
| K.3 | IPA | Interaction Process Analysis | (Bales 1950) |
| K.4 | MUT | Media Use by Type | |
| K.5 | MUA | Media Use Accessibility | |
| K.6 | MUI | Media Use Interactivity | |
| K.7 | MIP | Media Instrumental Purpose | modified DEEP (Liston et al. 2001) and DEEP(AND) (Garcia et al. 2003) |

## K.1 Collaborative Workflow Analysis Coding Scheme (CWA, modified CDW)

The Project Activity coding scheme is based on research by Olson et al. (1992) to analyze collaborative activities of software design. Olson's research looked at the collaborative design workflow and also identified issues as a useful concept to structure collaborative design workflow. Olson categorized meeting activities into the following four categories:

- ***Coordination activities***: verbal actions to manage the meeting or the project.
- ***Design-focused activities:*** verbal or non-verbal interactions focusing on identification and resolution of project issues, clarifying the issue or a characteristic of the project artifact, communicating the rationale of the current object artifact, or creating new alternative designs of the object artifact.
- ***Taking stock activities:*** verbal or non-verbal interactions summarizing project issues or walking through the current state of the object artifact as a user, i.e., contractor, client, etc.
- ***Digression or other activities:*** verbal and non-verbal interactions unrelated to the project or project issues, e.g., sidebar conversations, parallel conversation, meeting breaks, or off-topic conversation.

Olson elaborated each of these high-level categories into 11 coding categories listed in Table B-2. Olson used this coding scheme to analyze software design teams and measure the amount of time teams spent performing the various types of project activities. For example, Olson found that teams spend 40% of the time spent focusing on design-related activities, 30% taking stock, and the remainder of the time coordinating or digressing. Olson did not use the coding scheme to correlate patterns of activities with other process measures; or to evaluate artifact use.

The Olson coding scheme analyzes issue-centered design meetings. I made minor changes to the definitions of Olson's coding scheme to broaden its application to project meetings ranging from brainstorming through planning and scheduling of a building. For example, Olson defined the 'walkthrough' activity as walking through the design as a user. We extended the concept of walkthrough to include a broad set of users, e.g., client, contractor, or subcontractor; walking through the design or construction of an object artifact. For example, the teams in the MEP coordination meetings spent a significant amount of time walking through the design to identify potential installation problems.

*Table K-1:The collaborative workflow coding scheme based on (Olson et al. 1992).*

| High-Level Category Grouping | Code | Code Description |
|---|---|---|
| coordination | project management | interactions not directly related to content of design but to project process or organization |
| | meeting management | interactions having to do with orchestrating meeting time's activity |
| | goal | interactions discussing purpose of group's meeting |
| design-focused | issue | Interactions initiating major questions, problems or aspects of the design object that need to be addressed |
| | alternative | Interactions discussing solutions or proposals |
| | criterion | Interactions discussing reasons, arguments, opinions that evaluate an alternative solution or proposal |
| | clarification | questions or answers to clear up misunderstandings |
| taking stock | summary | review of state of design in list format, if it is ordered by steps it is a walkthrough |
| | walkthrough | gathering of design so far in sequential steps |
| other | digression | discussion of non-project-related topics |
| | other | time not attributed to other categories |
| technology management | technology management | Interactions using technology |

## K.2 Relational Workflow Analysis Coding Scheme (RWA)

RWA modifies RCA. It focuses on the relational communication aspect of the meeting interaction. It makes the following modifications to RCA:

- Splits the "response-initiation" code into two separate codes, "initiation" and "response" to examine the relationship between initiations and responses. It keeps the "initiation-response" code for interactions that act as both a response and initiation.
- RWA removes the "topic change" code since "initiation" refers to interactions that initiate a new issue or topic.
- RWA removes the "supports" and "non-support".
- RWA removes the "answer" code since IPA examines the question/answer aspect of the interaction.
- RWA keeps the codes "disconfirmation"
- RWA adds a code "communication" to refer to interactions that are neither initiations or responses, or continue from a previous initiation.

*Table K-2: Description of codes for Relational Communication Analysis coding scheme based on (Rogers and Farace1975)*

| Code | Description |
|---|---|
| initiation | an interaction that initiates a new issue, idea, or topic; an exchange in which a second message has no theme in common with the first message, but also that no response commonality was requested by the first message |
| continue | continues flow of preceding interaction |
| order | unqualified command |
| disconfirmation | refers to a response in which one interactor requests a response and the other interactor ignores the request |
| communication | an interaction that is neither an initiation, continuation, response, order, or disconfirmation; an interaction that communicates project information, e.g., a goal, summary, or statement |
| initiation-termination | begins or ends an interaction |
| other | An interaction that does not fit any of the RWA coding descriptions |

## K.3 Interaction Process Analysis Coding Scheme (IPA)

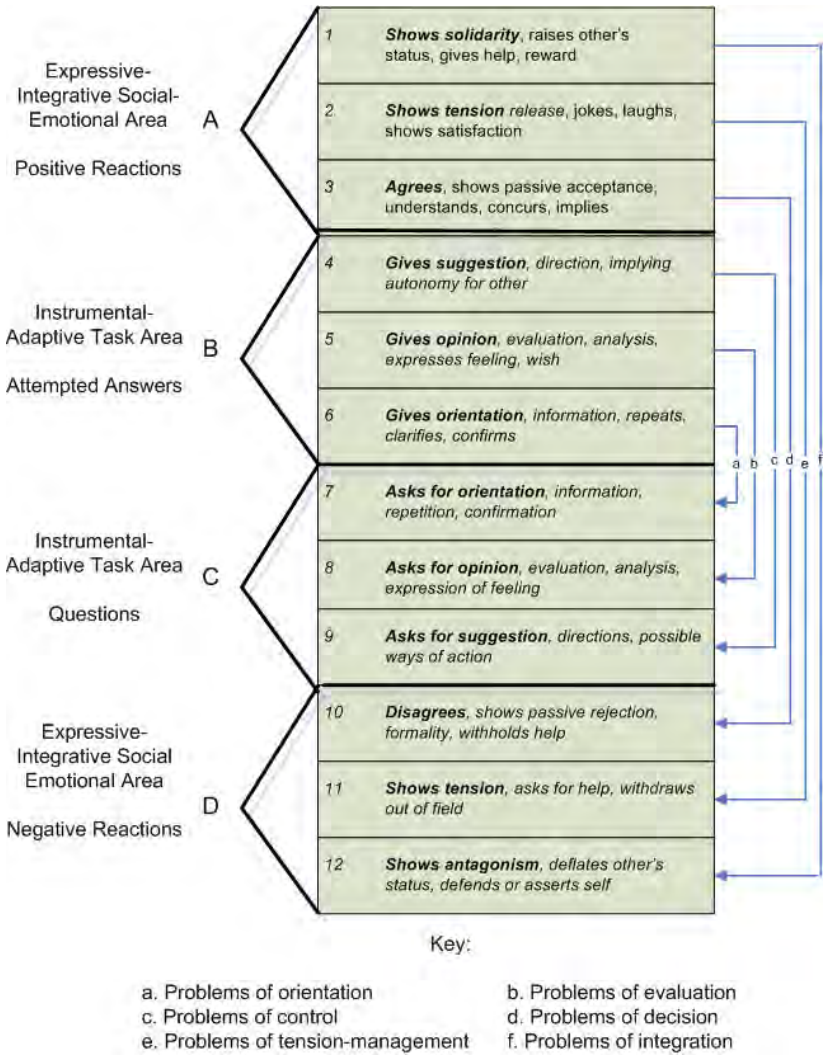



*Figure K-1: Bales' Interaction Process analysis categories (Bales 1950).*

## K.4 Media Use by Type and Accessibility Coding Schemes (MUT and MUA)

*Table K-3: Coding schemes for media use (type) (MUT) and media accessibility (MUA).*

| Media Type coding keywords | Description | Examples |
|---|---|---|
| **Media Type** | | |
| digital | an interaction with a digital representation of an information artifact | electronic display of information including 2D, 3D, schedule, documents, etc. |
| paper | an interaction with a paper representation of an information artifact | 2D drawings, schedules, agendas, activity logs |
| whiteboard | an interaction with an information artifact on a whiteboard or similar physical writing display | participant uses whiteboard to draw a detail or points to information on a whiteboard |
| physical | an interaction with a physical model of the 'object' artifact | scale model of the project, submittal sample |
| conceptual | an interaction that involves no interaction with media use, but the content of the interaction involves the exchange of project information | a participant discusses their knowledge of an electrical code |
| none | an interaction involving no media and no discussion of project information | these are typically associated with Olson activities such as "digression" or "other" |
| **Accessibility** | | |
| shared | medium is available to all participants | projected display |
| semi-shared | medium is available to a small group of participants | set of drawings |
| private | medium is available only to an individual, but there are multiple copies of the medium | a copy of the schedule distributed to each meeting participant |
| single | Medium is available to only one person | sketch on a paper |

## K.5 Media Use Interactivity (MUA)

*Table K-4: Coding scheme for describing level of interactivity.*

| Interactivity code | Description | Type | Examples |
|---|---|---|---|
| viewing | an interaction that involves one or more participants directing their attention towards an information artifact, physically or verbally; interaction involves no direct contact with the information artifact | unidirectional | viewing a static snapshot of a 2D drawing, digital or paper |
| pointing | an interaction involving a participant physically gesturing to an information artifact manually or with an instrument, i.e., mouse, laser pointer | unidirectional | physically pointing to a wall or coordination issue |
| annotating | an interaction involving annotation of an information artifact | bidirectional | drawing, mark up, notes |
| changing | an interaction involving changes to the representation of the information artifact | bidirectional | moving views in 3D, adjusting value in a schedule |

## K.6 Media Instrumental Purpose – MIP

Media Instrumental Purpose coding scheme modifies DEEP(AND) (Liston et al. 2001; Garcia et al. 2003). It adds the code 'generate' to account for the generation of project information.

*Table K-5: Description of Media Purpose coding scheme.*

| MUP code | Activity description | Temporal Frame | Output | |
|---|---|---|---|---|
| | | | Conceptual | Shared |
| **Grounding Activities** | | | | |
| describe | interactions involving requests to describe or the description of project information. | existing or prior state | none or modification to model form | none |
| explain | interactions involving requests to explain or the explanation (rationale) of the 'form' of the product, organization, or process. | existing or prior state | relationship between requirement and model form | none |
| **Action Activities** | | | | |
| generate | interactions generating a new form, requirement, or analysis | future state | new project model form information or new requirement | |
| predict | interactions involving requests to analyze the model form or interactions performing an analysis | existing and future state | new analysis | |
| evaluate | interactions involving requests to assess or choose model alternatives or involving evaluation of alternatives in the context of requirements | future state | deletion or no change | |

# Appendix L: Sample Coded Observation Using MIA

*Table L-1:Sample coded data using MIA analytic scheme. The coded data represents a five-minute portion of a meeting.*

| Duration | Min. | Text | Process Workflow | Relational | IPA | Use | Interactivity | Access | Model Workflow |
|---|---|---|---|---|---|---|---|---|---|
| 2.50 | 2.50 | setting up for meeting. All right , so, XXXXX (introducing research) .... | Meeting Management | Other | Gives Orientation | None | none | NA | NA |
| 0.03 | 2.53 | A001: X, I don't know if you know who X is. X is the principal now at X? | Project Management | Initiation | Asks for Orientation | None | none | NA | Describe |
| 0.03 | 2.56 | D002: Yes. Has been. | Clarification | Response | Gives Orientation | None | none | NA | Describe |
| 0.30 | 2.86 | A003: Has been? He is the principal engineer for X engineers. X's boss. So if you have any questions..feel free | Clarification | Communication | Gives Orientation | None | none | NA | Describe |
| 0.10 | 2.96 | B004: This is your chance to string him out to dry, too, if he's going to cause any trouble around here. | Digression | Communication | Shows Tension Release | None | none | NA | NA |
| 0.08 | 3.04 | A005: No, man X is our budy around here. Y on the other hand is the problem. | Digression | Communication | Shows Tension Release | None | none | NA | NA |
| 0.64 | 3.68 | A006: Today, too. for Z. This is an interesting meeting to come to. Today we are talking about a floor where we didn't do the MEP process the way we've beeing doing it the rest of the building. You know, I felt pretty confident speaking on the behalf of everyone that it's been a pain in the rear end because of it. The other floors were much easier when we followed our process and signed everything off and agreeing on routes before we got started. So anyway this has been a learning tool for me to say for sure what we have been doing on the rest of the building was certainly the best we could do for this process. | Meeting Management | Communication | Gives Orientation | Conceptual | none | NA | Describe |
| 0.44 | 4.12 | A007: So, umm, so one of our dilemmas so I understand right. Everyone's drawing that has been uploaded recently is an attempt to show as-built conditions in the field. Right? An awful lot of the electrical stuff was kind of routed in the field by our superintendents and then as-builted afterward. Right? | Issue | Initiation | Asks for Orientation | Conceptual | none | NA | Describe |
| 0.02 | 4.14 | G008: Correct. | Clarification | Response | Gives Orientation | Conceptual | none | NA | Describe |
| 0.05 | 4.19 | A009: How close do you think we are to be right on the money? | Issue | Initiation | Asks for Opinion | None | none | NA | Evaluate |
| 0.08 | 4.27 | G010: Real close. Almost you can look out the window and see the exact same thing. | Clarification | Response | Gives Opinion | None | none | NA | Evaluate |
| 0.03 | 4.30 | Z011: (laughter) | Digression | Other | Shows Tension Release | None | none | NA | NA |
| | | A012: There are really only a couple of areas I want to make sure we | | | | | | | |

# Appendix M: Correlation Analysis

| | *Doing* | *Grounding* | *Expressing* | *Structuring* | *Coordinating* | *Explaining* | *Initiating* | *Responding* | *Producing* | *Acting* | *Initiate Rate* | *Response Rate* | *Issue Rate* | *Initiate/ Issue* | *Response/ Issue* | *Question Rate* | *Answer Rate* | *Agr Rat* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Doing | 1.00 | | | | | | | | | | | | | | | | | |
| Grounding | 0.75 | 1.00 | | | | | | | | | | | | | | | | |
| Expressing | -0.52 | -0.38 | 1.00 | | | | | | | | | | | | | | | |
| Structuring | 0.29 | -0.24 | -0.15 | 1.00 | | | | | | | | | | | | | | |
| Coordinating | 0.18 | 0.22 | -0.07 | 0.41 | 1.00 | | | | | | | | | | | | | |
| Explaining | -0.20 | -0.06 | 0.49 | -0.44 | -0.70 | 1.00 | | | | | | | | | | | | |
| Initiating | -0.74 | -0.66 | 0.00 | -0.25 | -0.18 | 0.10 | 1.00 | | | | | | | | | | | |
| Responding | -0.40 | -0.62 | -0.30 | 0.09 | -0.05 | -0.33 | 0.78 | 1.00 | | | | | | | | | | |
| Producing | 0.14 | -0.48 | -0.35 | 0.56 | -0.22 | -0.33 | 0.09 | 0.58 | 1.00 | | | | | | | | | |
| Acting | 0.24 | -0.07 | -0.24 | 0.60 | 0.54 | -0.61 | -0.11 | 0.38 | 0.42 | 1.00 | | | | | | | | |
| Initiate Rate | -0.52 | -0.30 | 0.27 | -0.01 | 0.07 | 0.36 | 0.51 | -0.02 | -0.44 | -0.40 | 1.00 | | | | | | | |
| Response Rate | 0.15 | 0.04 | 0.37 | 0.37 | 0.09 | 0.47 | -0.28 | -0.55 | -0.24 | -0.11 | 0.48 | 1.00 | | | | | | |
| Issue Rate | 0.58 | 0.32 | 0.07 | 0.46 | -0.01 | 0.34 | -0.56 | -0.61 | -0.03 | -0.15 | 0.18 | 0.76 | 1.00 | | | | | |
| Initiate/ Issue | -0.77 | -0.44 | -0.02 | -0.26 | 0.14 | -0.19 | 0.82 | 0.57 | -0.21 | -0.07 | 0.56 | -0.38 | -0.68 | 1.00 | | | | |
| Response/ Issue | -0.79 | -0.46 | 0.07 | -0.28 | 0.22 | -0.25 | 0.76 | 0.57 | -0.19 | 0.09 | 0.38 | -0.37 | -0.82 | 0.93 | 1.00 | | | |
| Question Rate | -0.22 | 0.30 | -0.07 | -0.41 | 0.22 | -0.19 | 0.13 | -0.01 | -0.57 | -0.08 | 0.18 | -0.49 | -0.39 | 0.56 | 0.43 | 1.00 | | |
| Answer Rate | 0.16 | -0.12 | 0.40 | 0.37 | -0.06 | 0.47 | -0.23 | -0.44 | 0.01 | -0.27 | 0.37 | 0.88 | 0.79 | -0.49 | -0.51 | -0.69 | 1.00 | |
| Agree Rate | 0.31 | 0.06 | 0.17 | 0.36 | 0.10 | 0.40 | -0.09 | -0.25 | -0.08 | -0.09 | 0.45 | 0.76 | 0.81 | -0.36 | -0.48 | -0.40 | 0.81 | |
| Disagree Rate | 0.22 | 0.17 | 0.09 | -0.03 | -0.13 | 0.29 | -0.25 | -0.53 | -0.15 | -0.70 | 0.27 | 0.47 | 0.57 | -0.34 | -0.45 | -0.39 | 0.70 | |
| Positive Rate | 0.05 | -0.10 | 0.41 | 0.23 | 0.31 | 0.02 | -0.10 | -0.21 | -0.11 | -0.25 | 0.31 | 0.31 | 0.47 | -0.14 | -0.27 | -0.12 | 0.56 | |

*Figure M-1: The correlation table for all team interaction process measures. The analysis shows no significant correlations between team interaction process measures, except measures that should measure the same aspect of the team interaction, e.g."responding" to "response/issue".*

| | | Team Interaction Process Measures | | | | | | | | | | Media Use Measures | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Doing | Grounding | Expressing | Structuring | Coordinating | Explaining | Initiating | Responding | Producing | Acting | Using | Supporting | Communicating | Directing | Integrating | Transitioning | Coordinating | Sharing | Changing | Producing | Performing |
| Team Interaction Process Measures | Doing | 1.00 | | | | | | | | | | | | | | | | | | | | |
| | Grounding | 0.75 | 1.00 | | | | | | | | | | | | | | | | | | | |
| | Expressing | 0.55 | 0.43 | 1.00 | | | | | | | | | | | | | | | | | | |
| | Structuring | 0.29 | -0.24 | 0.07 | 1.00 | | | | | | | | | | | | | | | | | |
| | Coordinating | 0.18 | 0.22 | 0.04 | 0.41 | 1.00 | | | | | | | | | | | | | | | | |
| | Explaining | -0.20 | -0.06 | -0.46 | -0.44 | -0.70 | 1.00 | | | | | | | | | | | | | | | |
| | Initiating | -0.74 | -0.66 | -0.07 | -0.25 | -0.18 | 0.10 | 1.00 | | | | | | | | | | | | | | |
| | Responding | -0.40 | -0.62 | 0.20 | 0.09 | -0.05 | -0.33 | 0.78 | 1.00 | | | | | | | | | | | | | |
| | Producing | 0.14 | -0.48 | 0.28 | 0.56 | -0.22 | -0.33 | 0.09 | 0.58 | 1.00 | | | | | | | | | | | | |
| | Acting | 0.24 | -0.07 | 0.03 | 0.60 | 0.54 | -0.61 | -0.11 | 0.38 | 0.42 | 1.00 | | | | | | | | | | | |
| Media Use Process Measures | Using | 0.29 | 0.23 | 0.42 | 0.22 | 0.07 | -0.36 | -0.04 | 0.17 | 0.27 | 0.38 | 1.00 | | | | | | | | | | |
| | Supporting | 0.01 | 0.41 | 0.22 | -0.15 | 0.23 | -0.20 | 0.03 | -0.10 | -0.40 | 0.11 | 0.73 | 1.00 | | | | | | | | | |
| | Communicating | 0.51 | 0.65 | 0.43 | 0.02 | 0.16 | -0.22 | -0.30 | -0.21 | -0.15 | 0.24 | 0.87 | 0.84 | 1.00 | | | | | | | | |
| | Directing | -0.02 | 0.12 | 0.55 | -0.12 | 0.42 | -0.76 | 0.20 | 0.33 | 0.06 | 0.07 | 0.36 | 0.36 | 0.25 | 1.00 | | | | | | | |
| | Integrating | -0.32 | 0.00 | 0.23 | -0.45 | -0.26 | 0.10 | 0.26 | 0.14 | -0.26 | -0.36 | -0.43 | -0.05 | -0.32 | 0.07 | 1.00 | | | | | | |
| | Transitioning | 0.14 | -0.39 | 0.28 | 0.32 | -0.13 | -0.37 | 0.23 | 0.71 | 0.90 | 0.48 | 0.28 | -0.36 | -0.10 | 0.21 | -0.32 | 1.00 | | | | | |
| | Coordinating | 0.21 | 0.33 | 0.21 | 0.27 | 0.77 | -0.76 | -0.16 | 0.08 | -0.10 | 0.68 | 0.60 | 0.67 | 0.62 | 0.54 | -0.28 | 0.01 | 1.00 | | | | |
| | Sharing | 0.30 | 0.14 | 0.22 | 0.31 | 0.11 | -0.32 | -0.10 | 0.12 | 0.33 | 0.45 | 0.95 | 0.60 | 0.78 | 0.25 | -0.68 | 0.36 | 0.57 | 1.00 | | | |
| | Changing | 0.27 | -0.33 | 0.32 | 0.63 | -0.16 | -0.34 | -0.03 | 0.42 | 0.94 | 0.43 | 0.52 | -0.17 | 0.13 | 0.08 | -0.48 | 0.82 | 0.04 | 0.59 | 1.00 | | |
| | Producing | 0.30 | -0.25 | 0.45 | 0.52 | -0.09 | -0.42 | 0.09 | 0.58 | 0.91 | 0.53 | 0.59 | -0.08 | 0.23 | 0.21 | -0.42 | 0.90 | 0.17 | 0.63 | 0.95 | 1.00 | |
| | Performing | 0.42 | -0.08 | 0.40 | 0.48 | -0.14 | -0.32 | -0.09 | 0.35 | 0.81 | 0.45 | 0.72 | 0.05 | 0.41 | 0.15 | -0.58 | 0.78 | 0.19 | 0.78 | 0.94 | 0.95 | 1.00 |

*Figure M-2: Correlation table for team interaction process measures and media use process measures. The analysis shows no significant correlations between any team interaction process measure and media use process measures.*

# Appendix N: Mediated Interaction Profiles and Charts

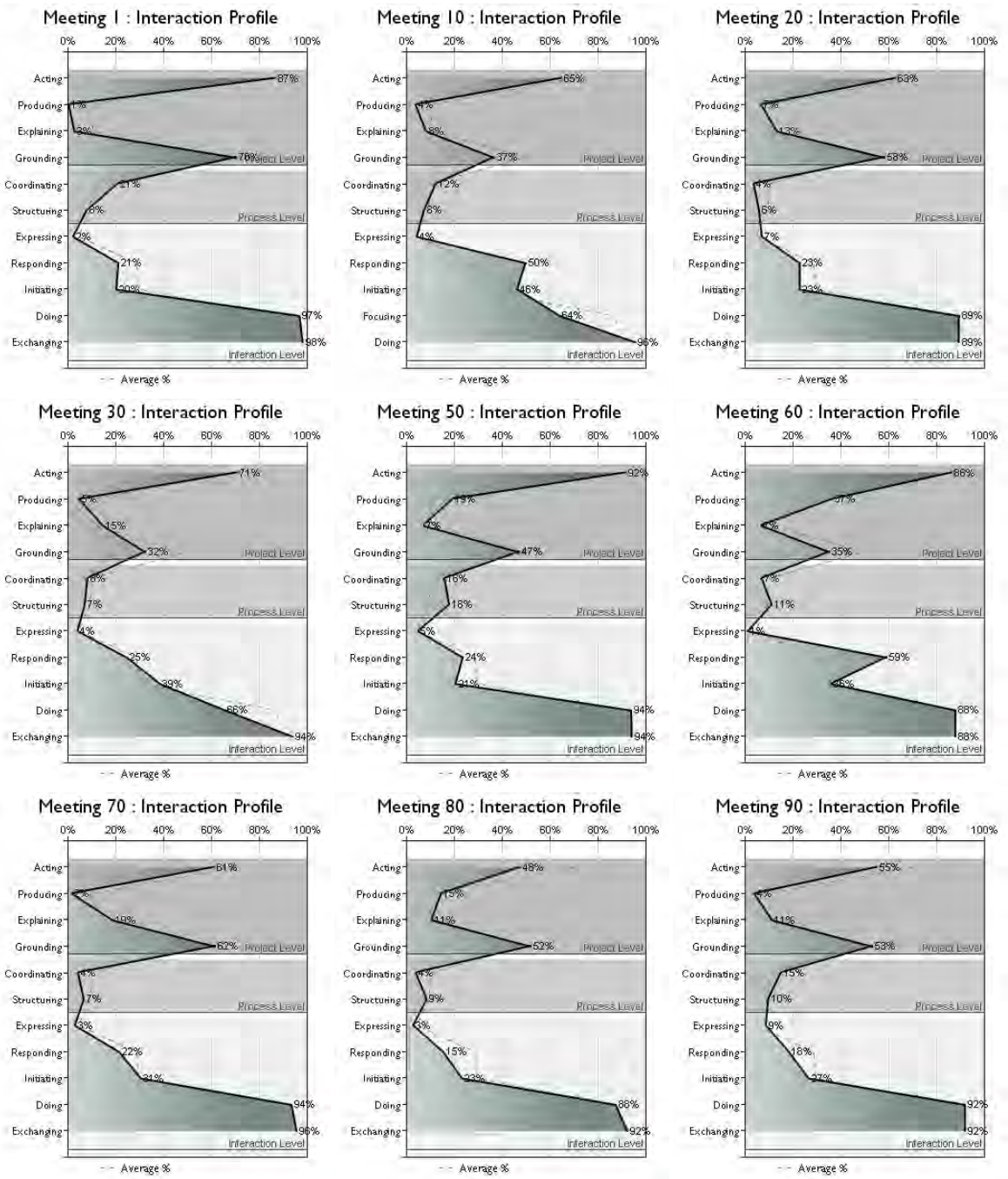



*Figure N-1: Team Interaction Profiles for all nine meetings comparing the proportional time spent communicating, reacting, and acting relative to the different level of analysis. This shows the same general profile for all meetings with variations in "producing" and "acting" at the project level and "coordinating" at the process level.*

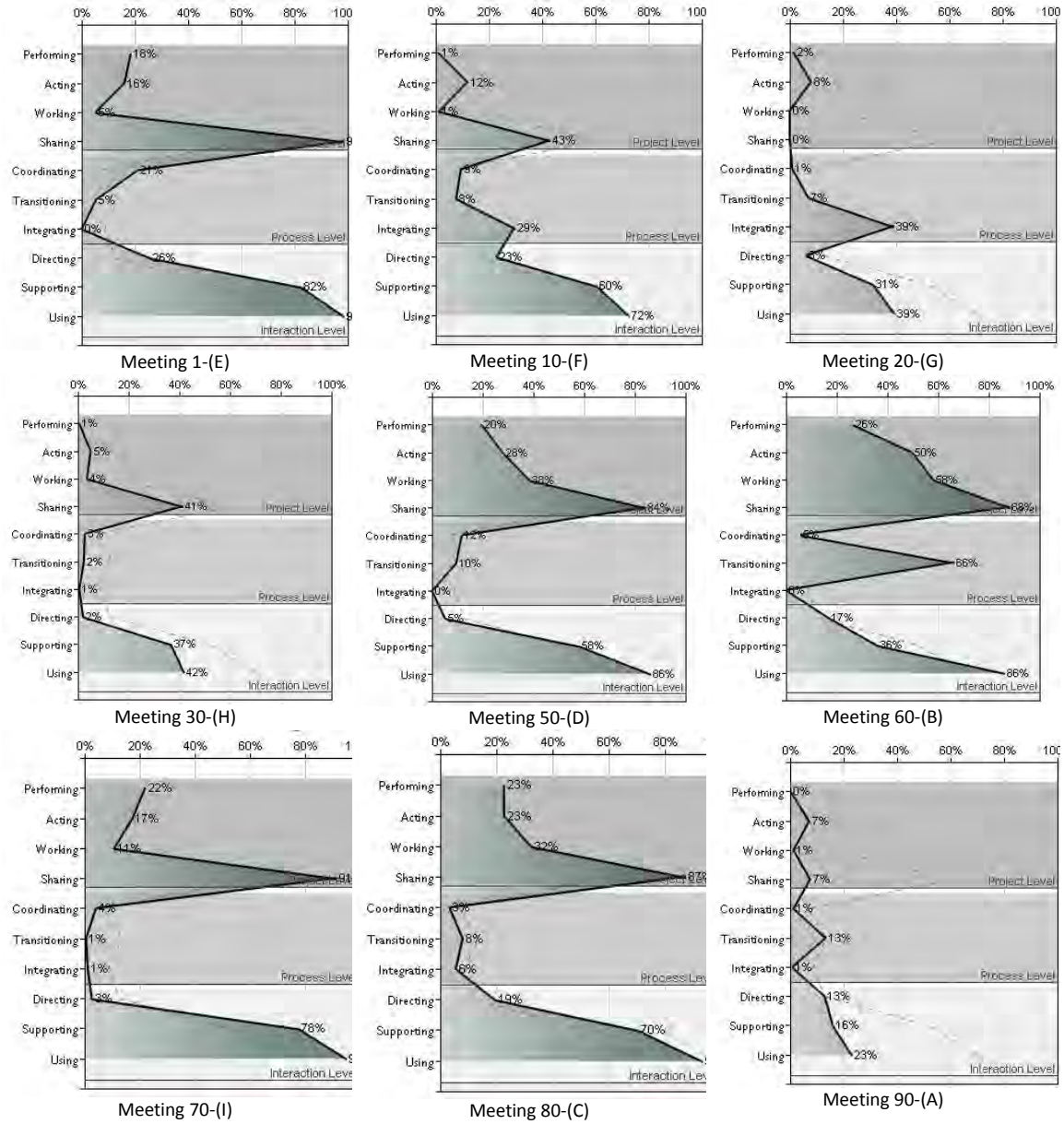



*Figure N-2: Media Use Profiles for the nine meetings analyzed in this research showing different patterns of media use relative to the levels of analysis and processes analyzed.*

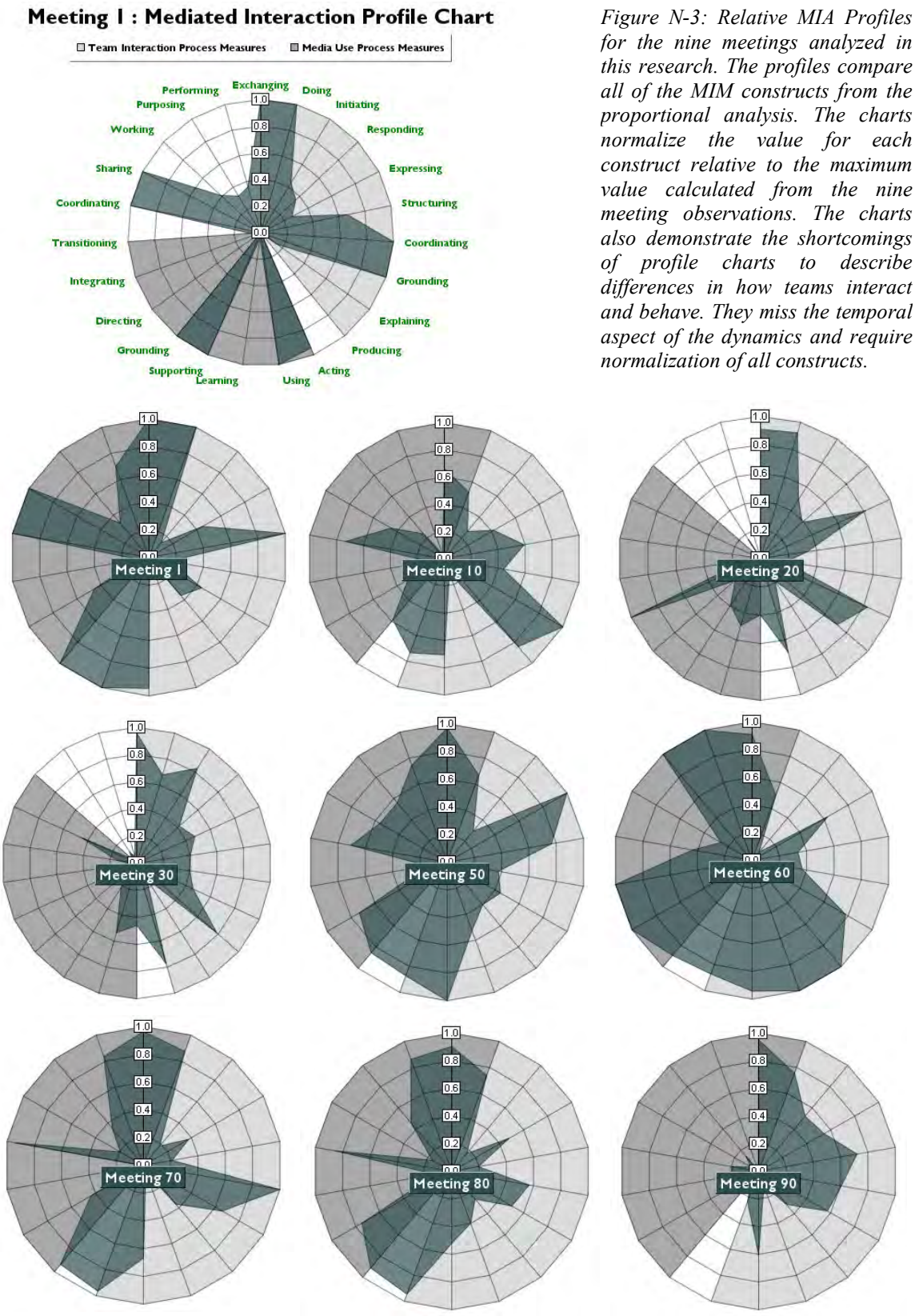
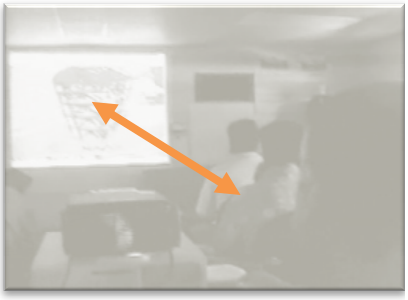
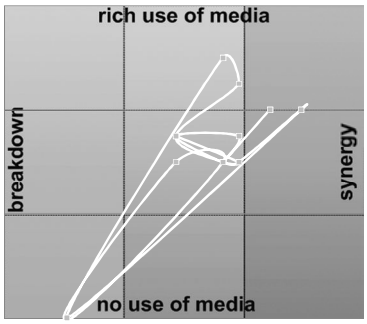


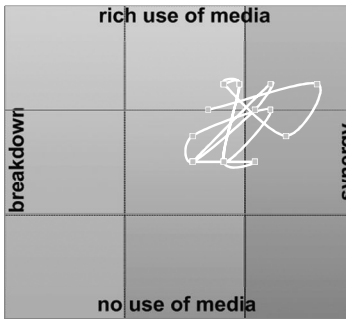

*Figure N-3: Relative MIA Profiles for the nine meetings analyzed in this research. The profiles compare all of the MIM constructs from the proportional analysis. The charts normalize the value for each construct relative to the maximum value calculated from the nine meeting observations. The charts also demonstrate the shortcomings of profile charts to describe differences in how teams interact and behave. They miss the temporal aspect of the dynamics and require normalization of all constructs.*

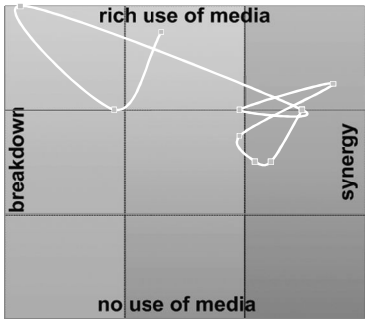
# Appendix O: Patterns of Mediated Interaction

*Figure O-1: Media as Communicator, Performer, Explainer, and Integrator characterized by cyclical, balanced patterns of mediated interaction (Meeting 1)*





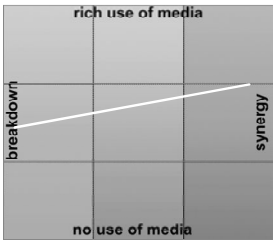




(A) The team uses media constantly throughout the meeting. The few periods of no media use are when the team is joking and laughing. This is a common pattern in synergistic teams that balance periods of communication and action with reaction and take breaks from using media.

(B) The most common pattern in this meeting is a cyclical pattern towards synergy and rich media use. The team watches the media, communicates, identifies issues, and adequately responds to one another using the media to support the interaction

(C) The team uses the media to describe complex project issues and moves between periods of communication and periods of exploration of features of the media.

The team uses media to communicate and uses the features of the media to structure the schedule review process. The team successfully uses the media to communicate project issues and engage participants.



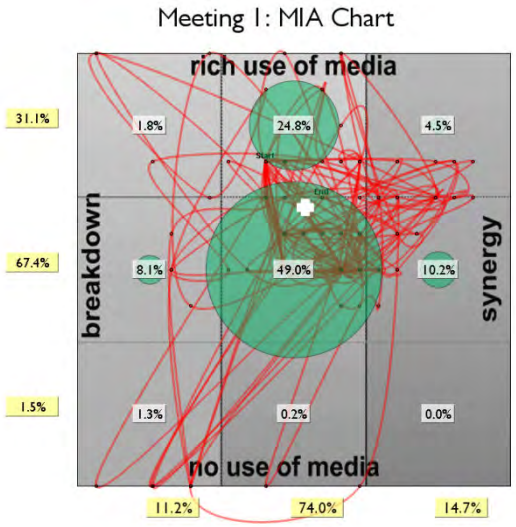
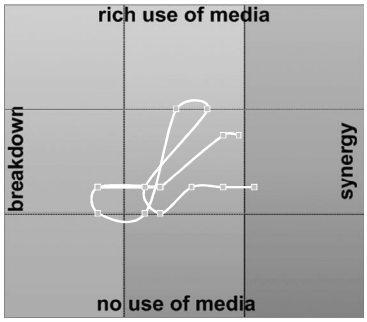
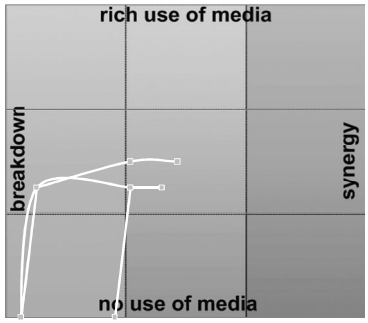



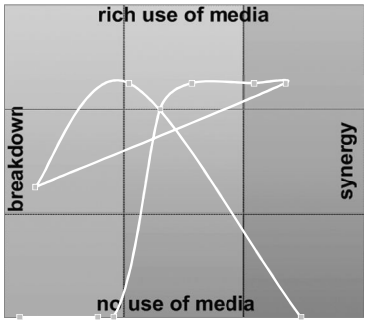
*Figure O-2: Media in Transition, Mixing Old and New ("Transitioning" and "Learning") characterized by transitions from cyclical, status quo to irregular, wide range of mediated interaction. (Meeting 10)*




(A) The team maintains status quo, using semi-shared media to support communication.

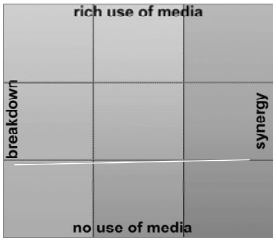



(B) The team explores new media and moves between status quo and towards breakdown. One meeting participant facilitates the use of the media, but the unfamiliarity of the tool and lack of direct interaction result in low media use and below status quo interaction.




(C) As the team explores additional features of the new media, the team gradually relates the media to the process and project issues.

The team maintains status quo through process facilitation. However, the team does not actively interact or engage with media use and limits media use to the sideline predominantly. When they use media to communicate, the media are semi-shared which limits engagement by all meeting participants.



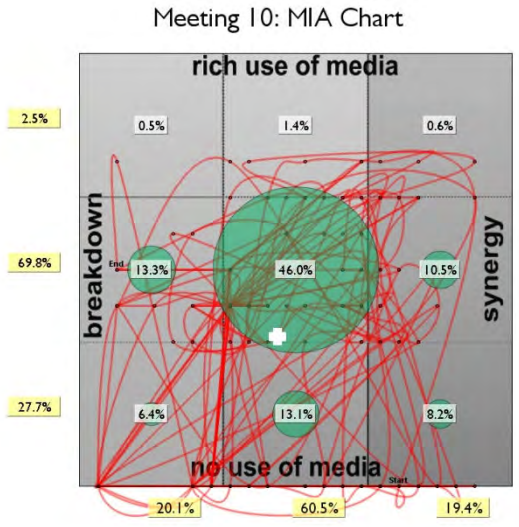
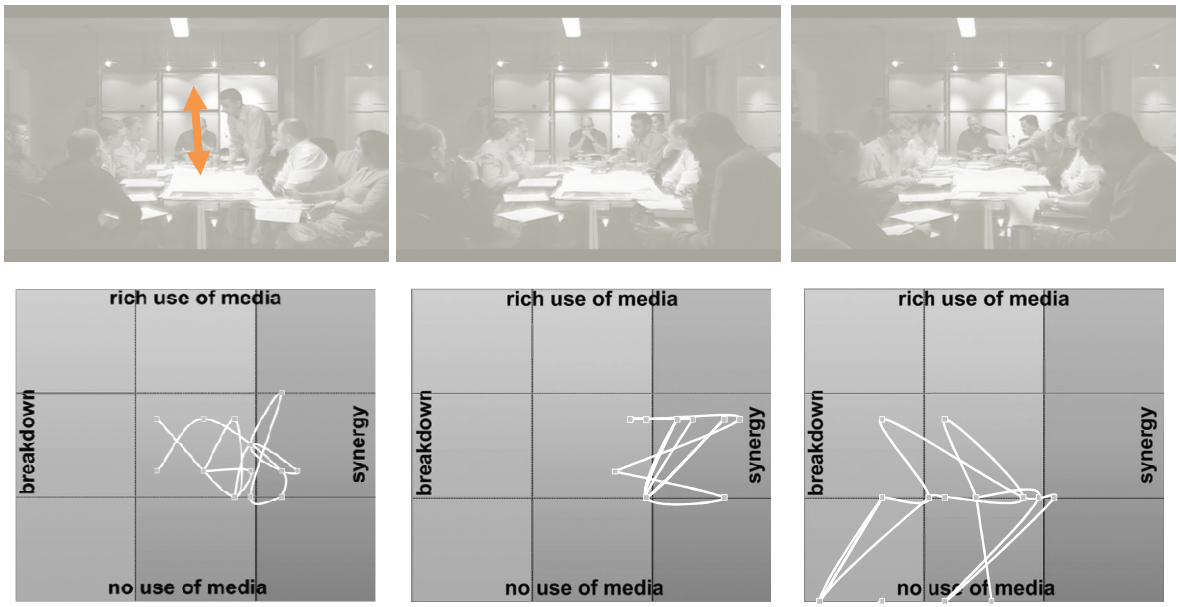



*Figure O-3: Media as Supporter and Part-Time Communicator*
*characterized by cyclical, inert, status quo and medium use patterns of mediated interaction.*
*(Meeting 20)*

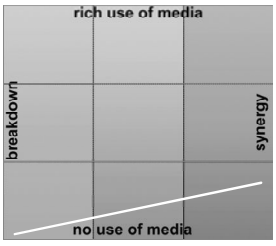



(A) Status quo/medium use Early in the meeting the team uses no media and then moves to a period of mixed use while trying to address an issue.

(B) Multiple team members use media to address an issue.

(C) Team moves between private media and semi-shared media, intermittent distractions, leading to inability to communicate and solve problems.

Media use is never rich since the team does not use shared media and does not use the media to actively engage. No one coordinates use of media or actively facilitates or structures the conversation.



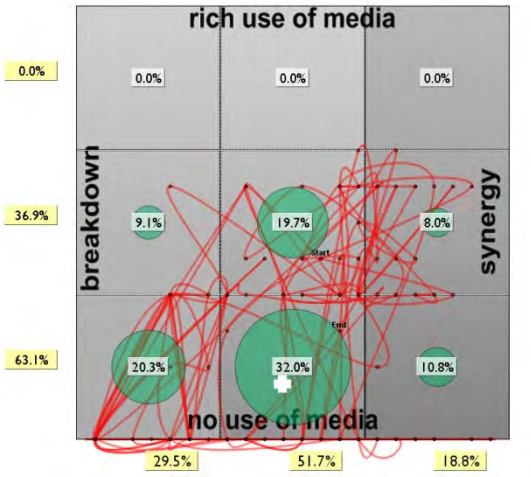
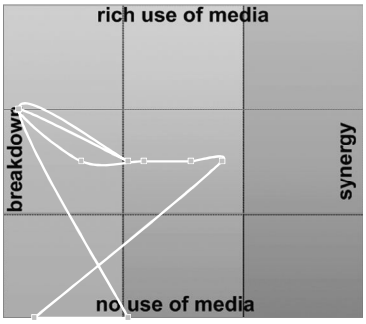
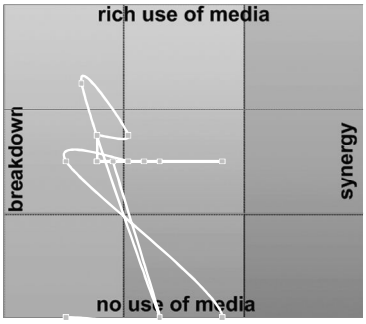



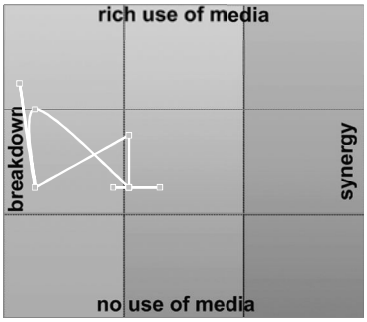
*Figure O-4: Media as Exploration*
*characterized by cyclical patterns of medium and rich media use in "towards breakdown/status quo" interaction zones*
*(Meeting 30)*




(A) The team explores features of the media environment.

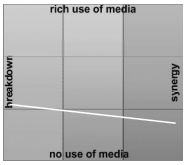



(B) The team directly interacts with the media and multiple participants engage with the media. The team briefly uses the media to explore a project issue.




(C) The entire team explores the features of the media.

The team moves from low to rich media use as they explore the new media environment. The team encourages use and direct interaction with the media, and experiments with using the media to address a project issue.



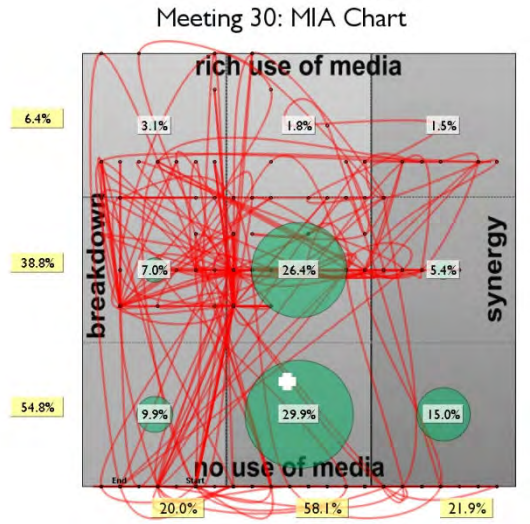
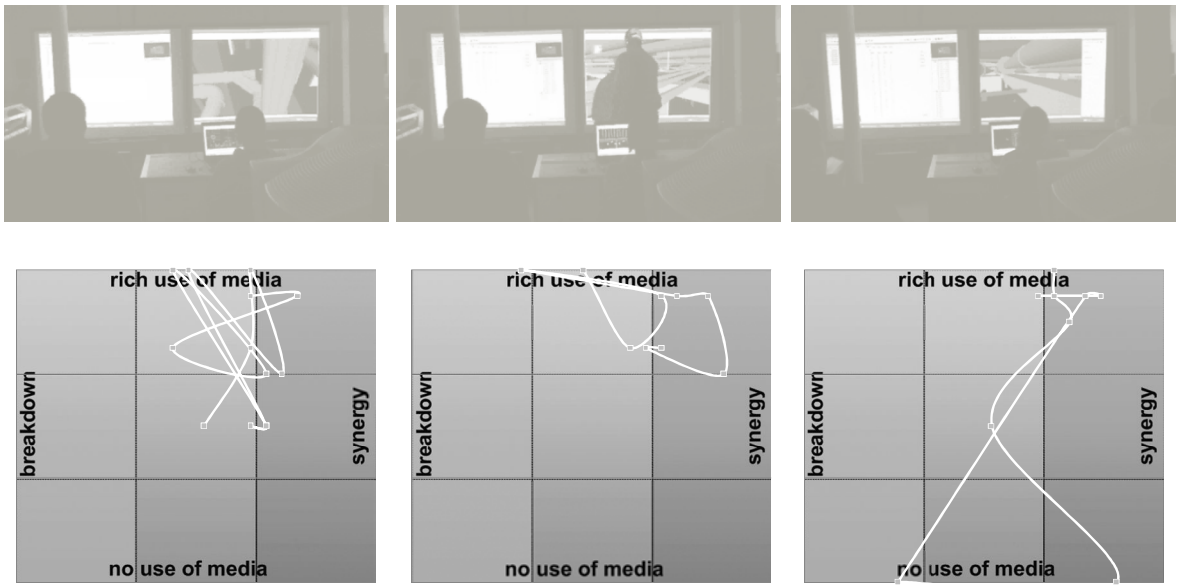



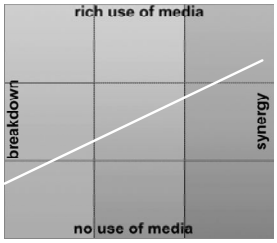
*Figure O-5: Media as Team Player: Coordinator, Workspace, Recorder, Communicator, Comic Relief characterized by rich, balanced, synergistic cyclical patterns of mediated interaction (Meeting 50)*




(A) The team uses the media to communicate and coordinate interaction. The left display acts a recording device and the right as communicator and workspace. The team repeats a pattern of walking through the digital model (left display), identifying a problem, working together to solve it, with a media facilitator managing the view, and another participant marking up the model.

(B) As the team cycles through problems, the team also balances this with social interaction and balances rich media use with no media use. At times, the team use of the media also reinforces social interaction.

The team acts as a coordinated unit integrating media use in every aspect of team interaction. The team facilities the process and media use and assigns functions to different media.



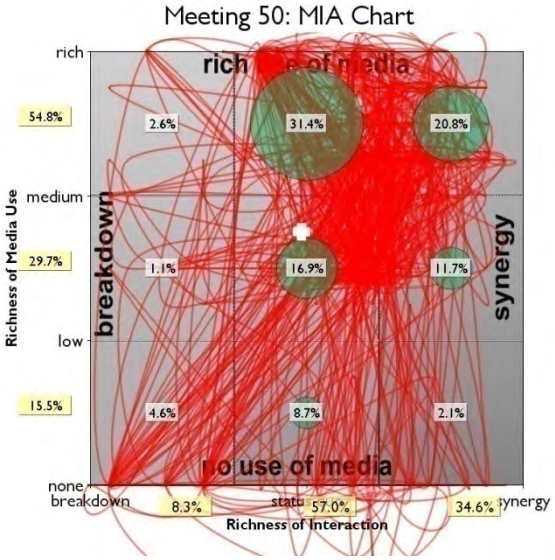
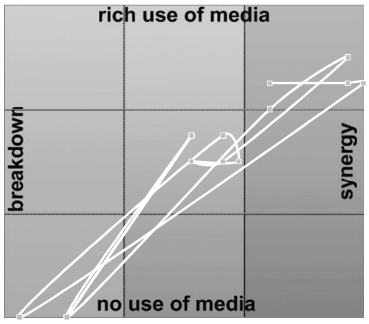
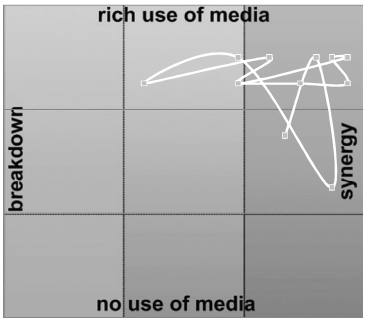



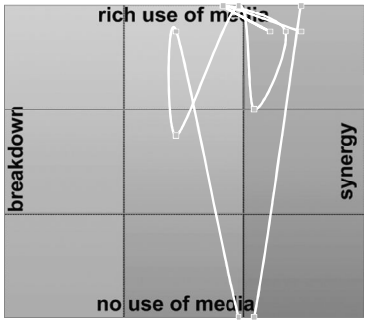
*Figure O-6: Media as Coordinator, Workspace, Communicator, Integrator, and Performer characterized by cyclical, synergistic, and regular patterns of balanced interaction. (Meeting 60)*




(A) The team uses the media to coordinate the process of design.

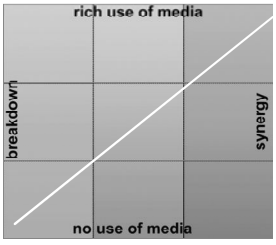



(B) Two participants act as media facilitators and take turns capturing ideas.




(C) the team balances periods of using media to produce ideas with periods to reflect and compare ideas.

The team repeats a cycle of using media to generate ideas, capture the ideas, and reflect. The team balances this with periods of social interaction.



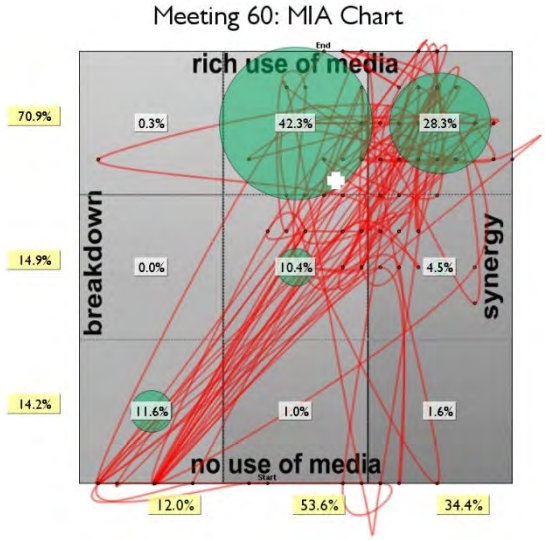
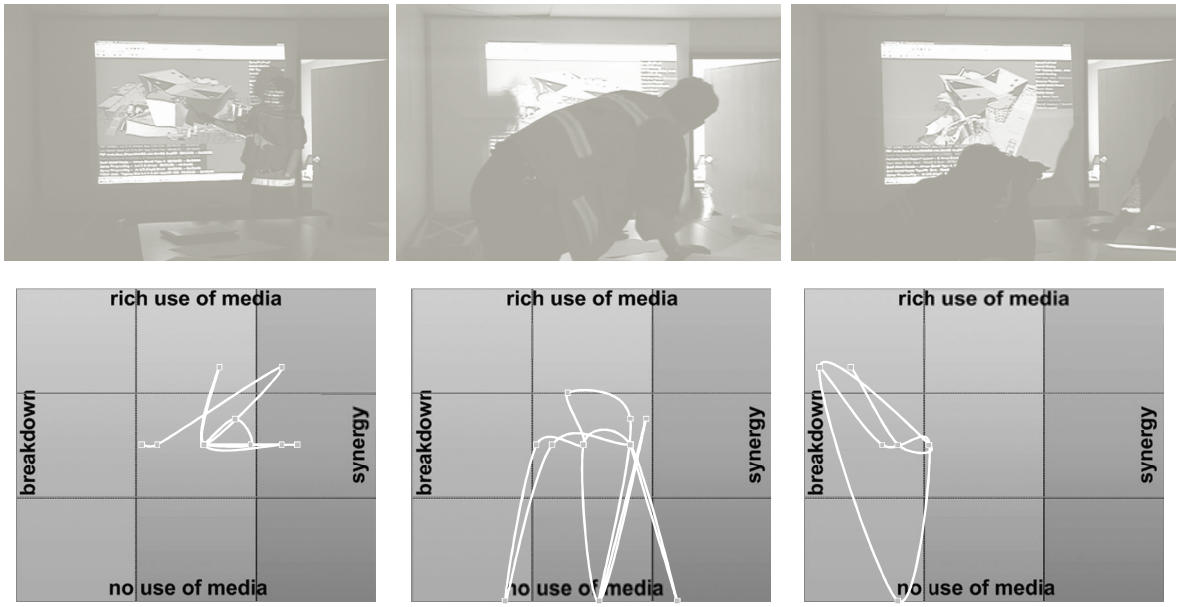



*Figure O-7: Media as Communicator and Backup characterized by status quo, cyclical media use (Meeting 70)*

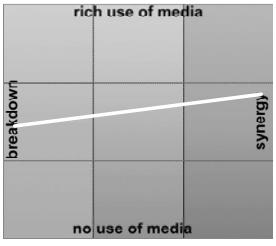



(A) The team lets the media do most of the communication. The team reviews the model, using a media facilitator and a media "annotator".

(B) This irregular pattern moving between medium and low use involves a series of questions for which the team must rely on information not communicated by the media.

(C) Several periods during the meeting involve transitions from the shared, digital media to semi-shared paper media on the table. This results in team interaction that falls below the status quo.

The team uses shared media to communicate, mixing semi-shared media. The team repeats this pattern using a media facilitator and using the media to structure the meeting process.



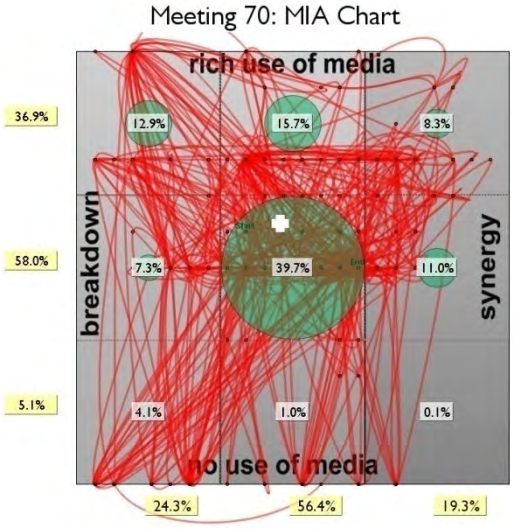
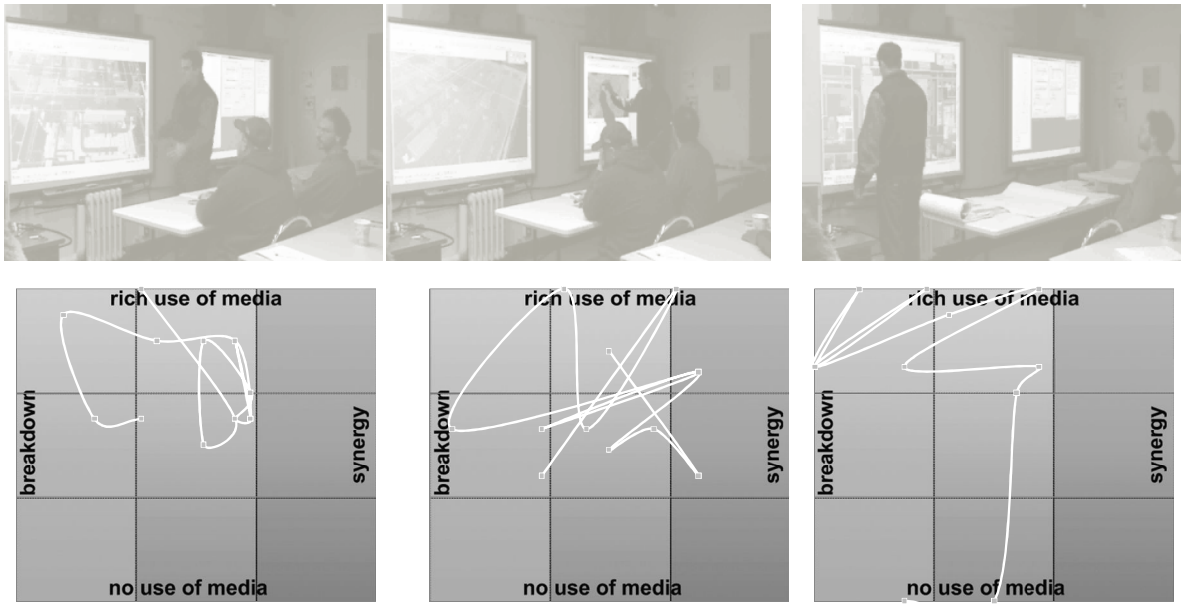



*Figure O-8: Media as Mediator, Divider, and Supporter*
*characterized by ad hoc patterns of rich media use and transitions from synergy to breakdown*
*(Meeting 80)*

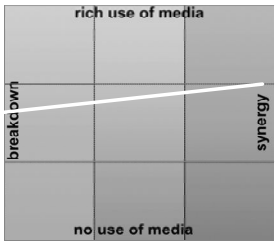



(A) The mediated interaction is not regular or consistent in this meeting. The interaction moves from breakdowns to status quo within the rich use zones and covers multiple zones of mediated interaction.

(B) When the team moves from one display to another the team loses focus and struggles with coordinating the media. Some participants focus on private media during these periods.

(C) This meeting has several irregular patterns of mediated interaction that move from rich use to no use and towards breakdown.

The same team member acts as facilitator and media facilitator. During periods of switching media or using the media the team does not focus. The team does not structure or balance the rich media use with reaction.The line of balance is flat.



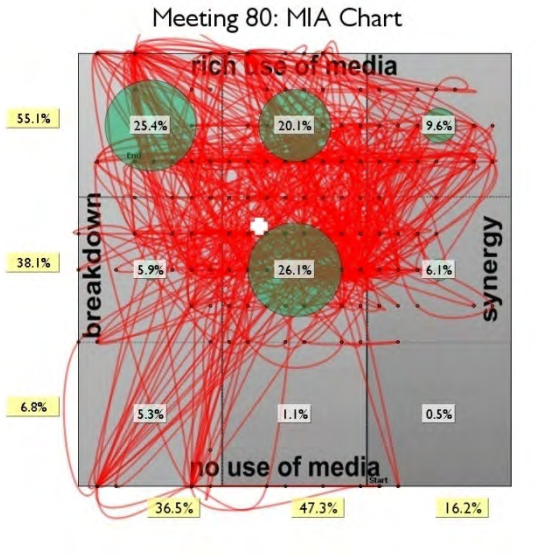
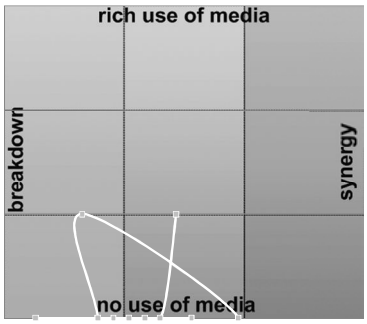
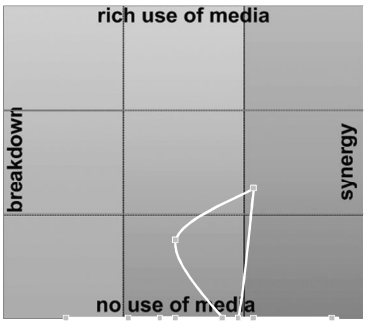
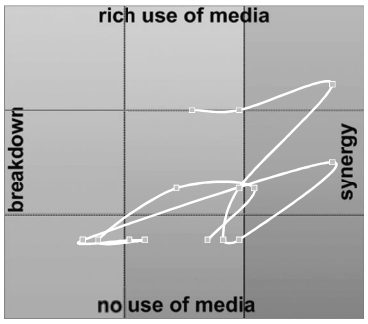



*Figure O-9: Media as Part-Time Supporter*
*characterized by low, status quo, cyclical patterns within one zone of interaction*
*(Meeting 90)*



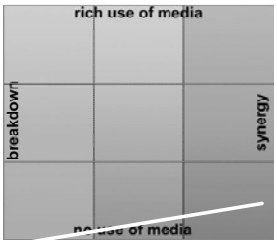



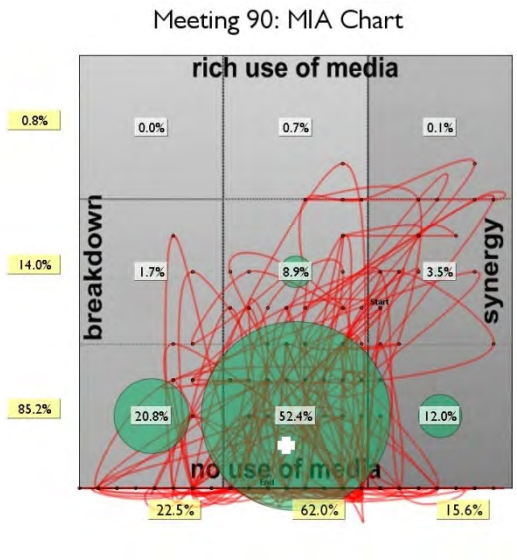

(A) The team rarely uses media (the dots along the bottom of the diagram). Intermittent periods of media use that involve use of private media by a single practitioner.

(B) The pattern of interaction rarely deviates from cycles of no to low media use and moves between towards breakdown and status quo. The regularity of the patterns is structured by an agenda and facilitated by a meeting participant.

(C) Late in the meeting, the team uses semi-shared media to describe an issue, but the media difficult for most of the participants to see. They come close to addressing the issue, but revert back to the patterns in (A) and (B)

Media use is predominantly low and infrequent. What keeps the team in status quo is the use of an agenda and facilitation by the project manager. The overall cyclical patterns within status quo are predominantly driven by the agenda. The team, though, is not actively engaged, and the meeting primarily focuses on what has happened ,and most of the issues that the team raises are not resolved during the meeting. The overall line of balance is flat and at the bottom of the mediated interaction zones.



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