An Extended Case Study Methodology for Investigating Influence of Cultural, Organizational, and Automation Factors on Human-Automation Trust

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Project Summary

• Objectives
  – Reveal foundational lessons, best practices and real-world perspectives about how trust and reliance depend on cultural and organizational factors and automation capability
  – Synthesize and integrate results to develop a set of questions for further research leading to more trustable automation
• Automatic Ground Collision Avoidance System (Auto-GCAS) as the context for case study
  – Contemporary, unique, and of great public interests, especially for integration of UAS/UAV into the National Airspace System
  – Projected to save lives and money with 2014 F-16 deployment
  – Development spans 3 decades
  – Research team has access to key individuals and organizations
• Timeline for project completion: 18 months
Best Practice Solution

• Utilize an extended case methodology that combines grounded theory and traditional research
• Adapt methodology in response to challenges
• Be culturally competent in regards to participants
• Working with key personnel who facilitated access and served as informants
Key Stakeholders

- End Users: F-16 Pilot Community
- Team that conceived, designed, built, and tested Auto-GCAS
  - NASA Armstrong (formally Dryden) Flight Research Center
  - Air Force: Flight Test Center, AF Research Lab
  - Lockheed Martin
- Office Under the Secretary of Defense
- Air Force Office of Scientific Research: funded case study
Project Requirements

- Have sound understanding of the historical development of Auto-GCAS
- Confidentiality of participants and information
- Sensitivity to bureaucracies, politics, and professional environment
- Cultural and organizational competency
- Technical understanding of Auto-GCAS
- Timeline of completion (18 months)
Methodology

Extended Case Method(ology)

Grounded Theory, Ethnographic
- Interviews
- Surveys
- Field notes
- Stories from the field
- Collective story (key events, persons, meetings — generating hypotheses)

Traditional Research
- Literature Review
- Hypothesis-testing (e.g., Lee & See Model)

Theory Revising
Comparing Lee & See Model to ethnographic data model
Methods used and how

• Primary sources (grounded theory/ethnography)
  – Questionnaires and surveys
  – Interviews
  – Field notes
  – Observations

• Secondary sources (traditional research)
  – Literature review (including internal documents, videos, and reports)

• Data collected was coded using NVivo to extract emergent themes and theories

• Theories generated from both sources were compared to see if they converge or diverge

• Aggregated hypothesis are then used to revise existing theories
Challenges

• Project-related
  – Difficult to capture cultural and organizational factors
  – Limited prior literature in cultural and organizational factors on trust in automation
  – Time limitations of project
  – Limited access to personnel and confidential information
  – Busy schedules of participants
  – Participants are remotely located
  – Sensitive nature of politics, bureaucracy, and hierarchy of organizations

• Research team-related
  – Must have good understanding of a highly technical topic
  – Unfamiliar with the cultures of the participants
  – Must sustain team effectiveness when research team members have diverse education, time commitments, and training backgrounds
Strategies to Address Challenges (1/2)

- Project-related strategy
  - Multi-pronged approach using different methods to capture cultural and organizational factors
    - Requested and received training from key informants
    - Gained general background knowledge from literature
    - Immersed research team into the various cultures via observations and field notes
  - Used qualitative methods to fill in gaps from literature review
  - Utilized adaptable and agile methodology to account for time limitations of the project
  - Key personnel assisted in gaining entrée to participants, research sites, information and insights (cultural and organizational)
  - Modified 2-hour interview into 1-hour online convenient survey and 1-hour follow up interview to address participants’ schedules
  - Made extensive use of Skype, phone, and availability of participants travel schedule in addition to traveling to conduct face-to-face interviews
• Team-related strategy
  – Hone technical knowledge by reading technical papers and listening to video-recorded explanations of the technology
  – Continuously immerse research team into participant-rich environments to observe cultural and organizational factors in addition to reading literature
  – Created a project orientation guide and instruction manuals for new research assistants and the research team’s general knowledge
Lessons Learned (1/2)

• Extended case study methodology allowed for flexibility and was effective
  – Adapt interviews and questionnaire based on circumstances of availability of participants and opportunities presented
  – Extend field observations to include workplace, formal and informal gatherings to immerse into the culture of experimental test pilots
  – Add survey to capture current opinions of the larger test pilot community
Lessons Learned (2/2)

• Key personnel assisted in entrée and were key informants
  – Facilitate team visits to bases, participant recruitment & key connections
  – Establish credibility and trustworthiness of team
  – Despite key personnel assistance, research team is not able to get participation for all targeted groups

• Cultural competency
  – Having a good understanding of participant culture facilitates communication between the participants and the researcher
  – Positive communication creates respect, rapport, and trust of participants
Conclusions

• Team developed a unique and eclectic set of qualitative and quantitative methodologies, which are adaptable to the study’s challenges

• Extended case study approach was effective in collecting data in a military and sensitive environment, particularly for researching non-technology related factors in trust development of automation

• Methodological framework can be used to study other technological systems in similar environments
Thank You!

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Any Questions?