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

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Project Summary

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- 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

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- 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

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- 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

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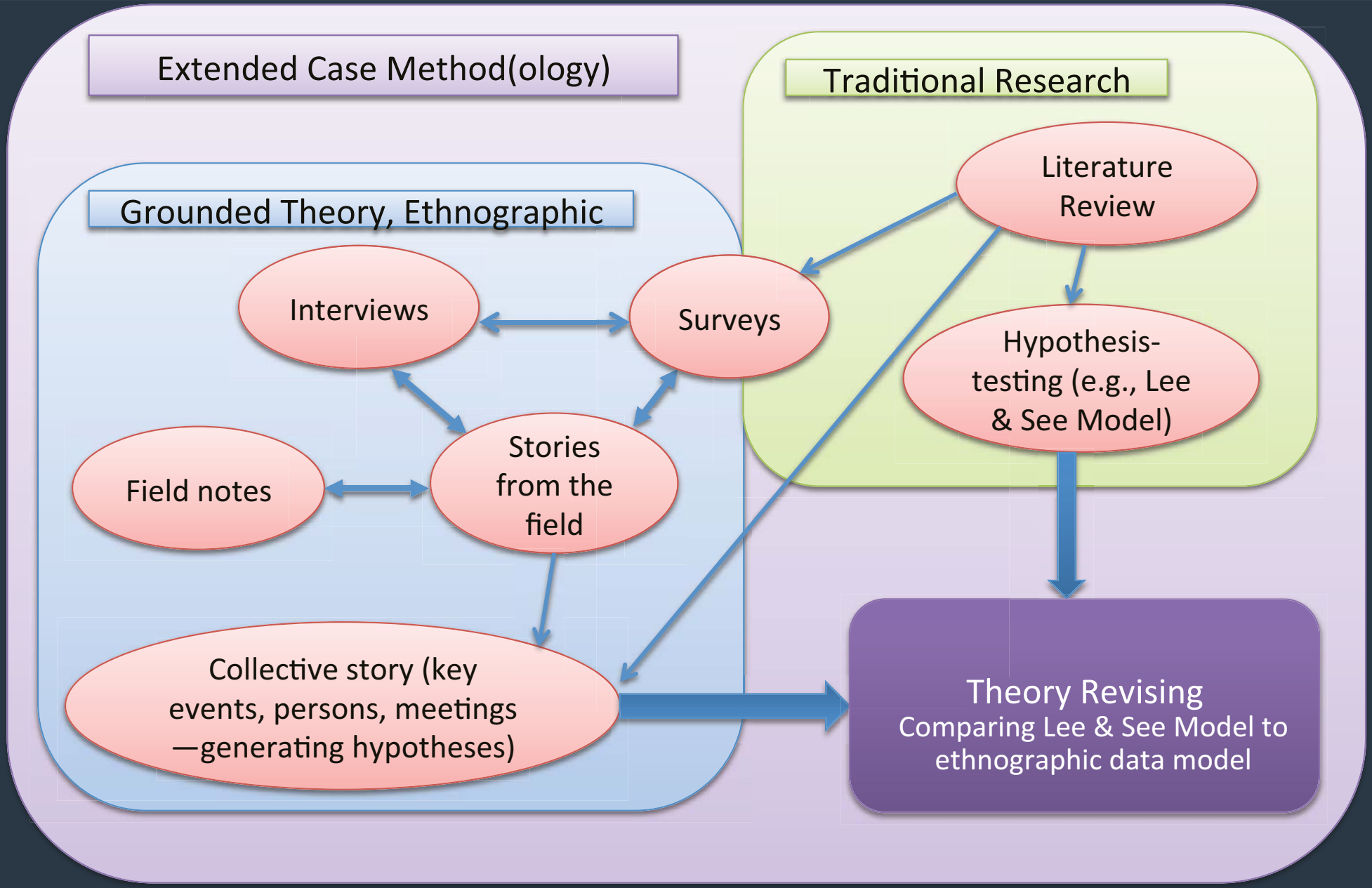
- Have sound understanding of the historical development of Auto-GCAS
- Confidentiality of participants and information
- Sensitivity to bureaucracies, politics, and professional environment
- Cultural and organizational competency
- Technical understanding of Auto-GCAS
- Timeline of completion (18 months)

Methodology



Methods used and how

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- 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

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- 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

Strategies to Address Challenges (2/2)

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- 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)

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- 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)

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- 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

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- 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

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Any Questions?