**The Team**
* Dr Judith Orasanu (NASA Ames Research Center)
* Dr Susannah Paletz (University of Pittsburgh)
* Dr Kathy Mosier (San Francisco State University)
* Dr Ute Fisher (Georgia Institute of Technology)
* Ronald Miller (Dell Systems/NASA Ames Research Center)
* Don Gyles (University of South Australia)

**Funding**
* This research was funded by the Federal Aviation Authority through Inter Agency Agreement #DTFAWA-10-X-80005 with NASA Ames Research Center.
* Emphasise the complexity of coordination in ATC
* Outline NextGen Technologies
* Identify some of the common ways in which coordination breaks down
* Place these breakdowns in a theoretical framework of team functioning
* Examine the extent to which NextGen will change these breakdowns
* ATC is a complex coordination system with multiple interacting components (people)
* Has both distributed teamwork and co-located teamwork
* Has formal (rule-book) and informal (opportunistic) work practices
* Is safety-critical
The FAA has forecasted that air traffic in the USA will double over the next two decades.

In order to meet this increased level of demand new technologies will need to be introduced.

These new technologies promise to provide considerable benefits in terms of:

- enhancing operations
- improving safety

However, there needs to be a thorough human factors evaluation of these systems.
* Automatic Dependent Surveillance-Broadcast (ADS-B)
* System-Wide Information Management (SWIM)
* NextGen Data Communications
* NextGen Network Enabled Weather (NNEW)
* National Airspace System Voice Switch (NVS)
“A breakdown occurs when there is a failure of coordinated decision making that leads to a temporary loss of ability to function effectively.”

[Bearman, Paletz, Orasanu & Thomas, 2010, p177]
15 former air traffic controllers participated in an hour long interview.

Interviews were conducted in two parts.

- In part one participants were asked to describe situations involving breakdowns in coordination between the controller and flight crew.
- In part two participants were asked a number of general questions about breakdowns and NextGen technologies.

Participants had an average of 28 years of experience and an average age of 55. One participant was female.

The data was analyzed using a bottom-up thematic analysis technique.
* Adjacent sector controllers
* Radar controller (r-side) and assistant (d-side)
* Relieving and handing-over controller
* Instructors and trainees,
* Supervisors and controllers
* Oceanic controllers and the service that relayed information to the pilots.
* Using non-standard terminology and incorrect format
* Saying one thing and meaning something else
* Misunderstanding the intent of other controllers
* Not being clear about what authority has been transferred when another controller requests control of an aircraft in their airspace
* Forgetting to transfer control of aircraft to the next controller
  * Changes to the structure of sectors
* Neglecting to pass on information during handover
* Information about flow rates weren’t always passed on to the controller
* Neglecting to pass on information that would have been extremely useful to another controller
Neglecting to watch what the other controller was doing when there was an assistant

D-side controllers acting in unexpected ways

Perceiving information without really comprehending it

Instructors being out of the loop
Different comfort levels with non-standard solutions

Personality
- Ongoing conflict between controllers
- Non-communicative people
- Prickly individuals

Unprofessional behaviour

Expectation
- People taking short-cuts (e.g. dropping call signs)
- Assuming that the other controller will do something
* Dividing a sector into two
* Aircraft falling between sector boundaries
* Handing off an aircraft that does not fulfil the requirements for the next controller
* Noise in the control rooms
* Incorrect data entry
Adaptive Team Performance

Adaptive Cycle

Situation Assessment: Phase 1
- Cue Recognition
- Meaning Ascription

Plan Formulation: Phase 2
- Psychological Safety

Plan Execution: Phase 3
- Mutual Monitoring
- Communication
- Back-Up Behavior
- Leadership
- Coordination

Team Learning: Phase 4

Emergent States

Shared Mental Models
- Team Situation Awareness
- Team Situation Awareness
- Team Situation Awareness
- Psychological Safety

Team Adaptation
- Team Innovation
- Team Modification

Individual Characteristics
- Knowledge
- Task Expertise
- Team Expertise
- Mental Models

Attitudes
- Team Orientation

Traits & Abilities
- Openness to Experience
- Cognitive Ability

Job Design Characteristics
- Self-Management

Burke, Stagl, Salas, Pierce, and Kendall (2006)
It seems likely that NextGen technologies will reduce at least some of these causes of breakdowns because of:

- Automation reducing the interaction between controllers
- Datalink communications
- The ability to drag and drop routes
- Common information sources

However, NextGen technologies are still at an early stage of implementation.

There are likely to be other issues that are created by NextGen technologies that need to be considered.
ATC represents a complex coordination network

- A number of causes of breakdowns could be identified
- Breakdowns tend to disrupt controllers' shared situation awareness
- NextGen Technologies will reduce some of these issues