



THE NATIONAL AVIATION OPERATIONS MONITORING SERVICE

An overview of program
background, development history,
and current status

PURPOSE



- A number of databases attempt to capture safety-related information concerning the National Airspace System (NAS)
 - NTSB Accident/Incident Database
 - FAA Data System (NAIMS)
 - Aviation Safety Reporting System (ASRS)

- A number of databases attempt to capture safety-related information concerning specific parts of the NAS
 - FOQA
 - PDARS
 - ASAP

- No existing database addresses the health and safety of the NAS as a whole in a quantitatively defensible fashion

Expressed Need for Event Data



Multiple and consistent recommendations for improvement in aviation data systems . . .

- **White House Commission on Aviation Safety and Security (“Gore Report”) --**
 - “Most effective way to identify incidents and problems in aviation is for the people who operate the system (pilots, mechanics, controllers, dispatchers, etc) to self-disclose the information.” (Page 13)

- **GAO Evaluation (Safer Skies Review, June 2000) --**
 - Additional performance measures required (by law)
 - Use precursors associated with past accidents to track safety baseline and improvements from interventions

- **NTSB (Safety Report on Transportation Safety Databases, 2002) --**
 - Over 19 recommendations for improvements in safety event reporting (1968-2001)
 - Need to address problem of under-reporting in current aviation safety data systems

- **FAA (internal studies, 2004 Strategic Plan draft)**
 - Identify risks before they lead to accidents

Survey Rationale



- **Reliable and valid results --**
 - Must be designed and implemented according to established scientific protocols
 - High response rate required

- **Survey methodology is widely used by industry and government policy makers**

- **Many federal programs use data for safety and management decisions --**
 - DOT Omnibus Transportation Survey
 - Telephone, monthly, ongoing, all households, 1,000 interviews per month
 - National Household Travel Survey (NHTS)
 - Telephone, 40,000 households, every five years
 - Commodity Flow Survey
 - Telephone, shippers of domestic products, every five years, over 100 k sampled each time survey applied

Survey validation information (LinChiat research findings summarized at high level here)

Functionality Sought



No existing data systems has the complete set of features designed into NAOMS . . .

- **Quantitative** -- data gathering is either demonstrably complete or uses a scientific sampling methods to obtain robust numeric estimates
- **Comprehensive** -- can address a broad array of aviation safety issues including human performance issues
- **Accessible** -- data are not proprietary, closely-held, or otherwise protected in a way that would hamper system-wide safety monitoring
- **Flexible** -- provision for both long-term consistent safety tracking measures and an easily refocused topical issue data gathering capability

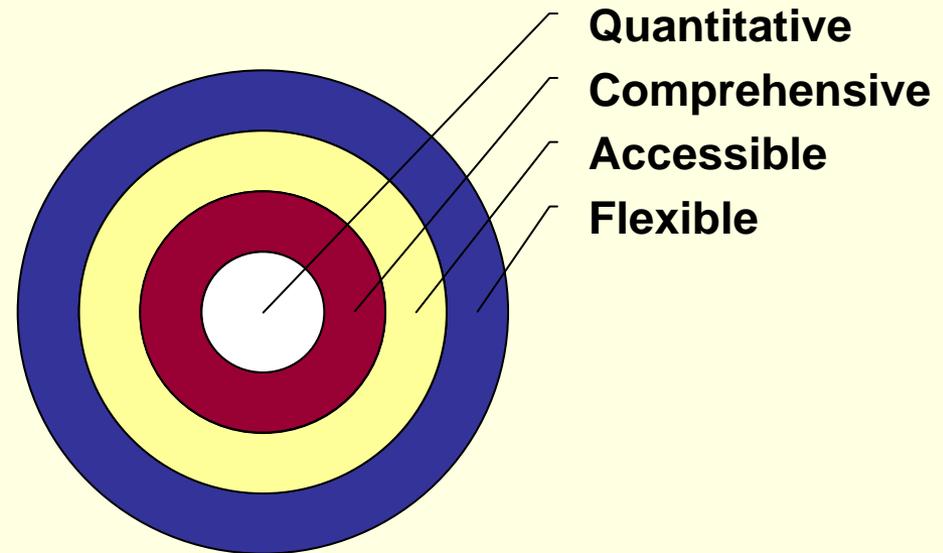
Conclusion: to achieve this functionality, a new system must be built

GOALS



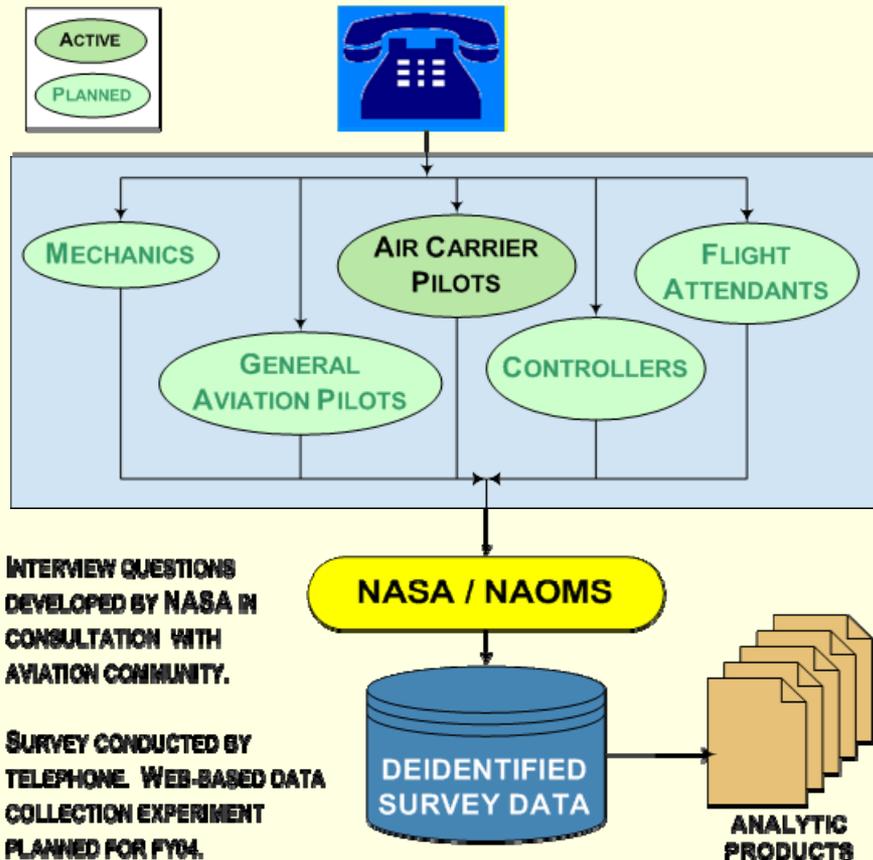
To create a new national capability that will :

1. Track long-term aviation safety trends and patterns.
2. Monitor the impacts of technological and procedural change on the system.
3. Make substantial contributions to data-driven aviation safety decision making.



**Features sought
in NAOMS**

NAOMS SURVEY APPROACH



- **Regularly survey those who operate the National Aviation System (NAS)**
 - View the NAS through their eyes
 - Include all types of operations (air carrier, regional, corporate, GA)
- **Collect data on respondents' events (as operationally experienced)**
- **Guarantee confidentiality of data**
- **Achieve scientific integrity by**
 - Using well crafted survey instruments
 - And, rigorous analytic methods.

Nature of the Data



- NAOMS counts event occurrences not opinions
- NAOMS data provide important information but they are not intended to stand alone
- Notable NAOMS trends or findings require additional corroboration and investigation

NAOMS Team



NASA Managers

- **Mary Connors** AvSP, Level 3
- **Linda Connell** AvSP, Level 3

Battelle Support Service Contract to NASA

- **Loren Rosenthal** Battelle Manager
- **Robert Dodd** Principal Investigator
- **Jon Krosnick** Survey Methodologist
- **LinChiat** Survey Methodologist
- **Mike Silver** Survey Methodologist
- **Joan Cwi** Survey Application
- **T. Ferryman** Statistician
- **Bruce Ellis** Statistician
- **Mike Jobanek** Aviation Safety Analyst
- **Rowena Morrison** Aviation Safety Research

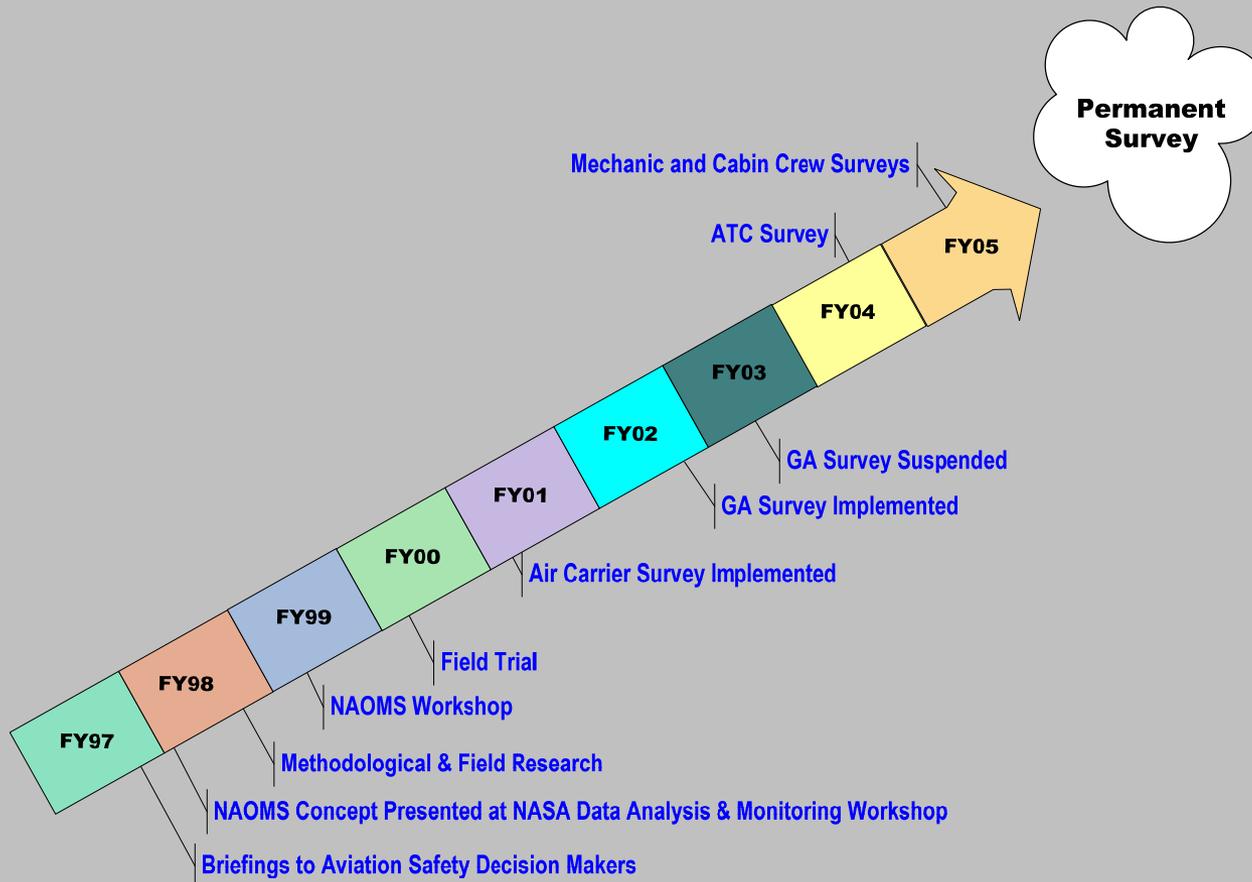
NAOMS Development

INITIAL STAGES



- **Initial program planning started in FY1997**
- **Part of NASA's AvSP program**
 - Method for evaluating impact of AvSP interventions
- **Workshops and briefings to FAA and industry through all phases**
- **Development process and OMB approvals were comprehensive, rigorous, and labor-intensive**
 - Required Federal Register Notices (FRN)
- **Routine data collection began with air carrier pilots in April 2001**

NAOMS Development Timeline



NAOMS Development: Survey Content



- **Reviewed literature, safety data systems and past surveys**
 - ASRS, NTSB, AIDS, NAIMS, FOQA programs, other
 - 43 of 62 core questions associated with past air carrier accidents
- **Conducted four ALPA-supported focus groups**
 - 36 active air carrier pilots
 - Gained insight into safety problems that concern active line pilots
 - Gained insight into their opinion of possible survey
- **Survey “talk-aloud” tests (individual pilots provide real time criticism of questionnaire content and structure)**
- **Developed a draft survey that was**
 - Extensively edited and corrected for non-technical wording by survey method experts
 - Edited and corrected for technical accuracy by aviation subject matter experts
- **Validation occurred in field trial among 630 active air carrier pilots**

NAOMS Development: Pilot Memory Organization and Recall



- **Conducted ALPA-supported experimental research with active line pilots**
- **How well pilots remember (period of recall)**
 - Recall period addressed how far back pilots are asked to remember events
 - Evaluated recall periods of one week to six months
- **How pilots organized memory of safety events (questionnaire organization)**
 - Question organization mirrors best understanding of pilot memory organization
 - Considered phase of flight, event seriousness and event cause

Extensive and detailed up-front effort was devoted to questionnaire development.

NAOMS Statistics



- **Numerator: safety event counts**
- **Denominator: risk exposure**
 - Flight hours (events that can occur any time during flight)
 - Flight legs (events that occur mainly during terminal operations)
- **NAOMS collects data for the numerator (events) and denominator (exposure) at the same time**
- **Rates are developed for aircraft-size groups**
 - Small transport (<100k# GTOW)
 - Medium transport (\geq 100k# and <200k# GTOW)
 - Large transport (>200k# GTOW with single aisle)
 - Wide-body (>200k# GTOW with two aisles)
- **Confidence intervals are calculated for all rates**

Statistical Approach: Quality Assurance



- **NAOMS has QA checks during many steps during data collection and analysis process**
- **CATI (computer aided telephone interviewing) software used at data collection to minimize data entry errors**
 - Interviewers trained in aviation "termination"
 - Range checks on quantities
 - Valid value check on fixed fields
 - Standardized response menus for interviewers
 - Common responses for pilot questions provided to interviewers
- **Second-stage QA occurs during data processing**
 - Second validation check
 - Check for outliers (roughly 0.5% of data is unreasonable)
- **Additional review and calculation of results done by NAOMS team statisticians to verify analyses**

Statistical Approach: Future Directions



Future data products to be determined by guidance from the NAOMS working group

Government & Industry Groups Briefed



- FAA
- HAI
- GAMA
- AOPA
- ALPA
- CAST
- NATCA
- NATA
- Boeing
- NBAA
- SWAPA
- ASRS Advisory Subcommittee

Workshops

Preliminary NAOMS workshop, 5/11/99, Alexandria, VA, 60 attendees

NAOMS field study briefing 3/1/00, D.C., 75 attendees

Pre-Field Trial Industry and Government Workshop



- **May 1999 – Pre-Field Trial Workshop in Alexandria, VA**
- **Goals of workshop**
 - Described program and solicited input
 - Presented draft questionnaire and asked for comments
- **Participants**
 - Industry and Government invited, 52 participants
 - All major organizations represented, including FAA, NTSB, ALPA, ATA, etc.
- **Comments**
 - Conference discussion groups developed for comments
 - Comments were provided and summarized
 - FAA conducted internal survey and provided summary comments

NAOMS Development: Field Trial



- **Survey was tested in a field trial among 630 active air carrier pilots to determine its suitability and to discover weaknesses or flaws**
- **Pilots in field trial were asked to provide input into areas that were unclear, needed improvement, or topics that should be dropped or added**
- **Findings from field trial were used to further edit and revise questionnaire**

Post-Field Trial Industry and Government Workshop



■ **Goal of Workshop**

- Presented findings from field trial
- Described next steps of program
- Obtained additional input from industry and government organizations

■ **Participants**

- Industry and government invited, 39 participants
- All major organizations represented, including FAA, NTSB, ALPA, ATA, etc.

■ **Summary of results**

- Comments were provided and summarized

**March, 2000 - Post-Field Trial Workshop
in Washington, DC**

AIR CARRIER QUESTIONNAIRE STRUCTURE



- **Section A: Aviation Activity Data**
 - Hours and Legs by make-model and by crew position
 - Previous 60 days and Life-time (total hours only)
 - 8,000 interviews per year

- **Section B: Safety Related Events**
 - Consistent data set over time
 - Conflicts, spatial deviations, ground events, weather encounters, equipment problems, pilot-ATC interaction issues

- **Section C: Focus Questions**
 - Topics driven by government/industry priorities

- **Section D: Survey Feedback**
 - Confidence in recall ability
 - Relevance of questions
 - Any problems with specific questions



CURRENT STATUS



■ **Data Collection**

- Air Carrier > 18K telephone interviews completed
- General Aviation > 5K telephone interviews completed (interviews suspended but could be resumed at any time)
- ATC survey under development for FY04 test
- Web-Based Surveys being tested in FY04

■ **High-Level Analytic Paradigm being Developed and Tested in FY04**

■ **Working Group**

- First meeting scheduled for Dec, 18-19, 2003

PROPOSED NAOMS WORKING GROUP



■ Purpose

- Ensure that results are validly interpreted
- Gain agreement on content, level, and timing of information release
- Build community support for NAOMS

■ Industry and Government group

- Recruited from all major industry/labor segments
- Individuals selected for their personal knowledge & skills
- Participation is independent of employer

■ Non-Disclosure/Confidentiality agreement asked of industry participants

(Base on pre-decisional exemption from public information requirements)

■ Industry Participation thru Ames Associates Program

(No government compensation; no intellectual property rights; participants are covered by Workmen's Compensation by NASA Ames Research Ctr)



FAA Participation



- FAA representatives have participated in NAOMS briefings and at various stages in its development
- NASA has invited 2-3 FAA representatives serve on the NAOMS Working Group
- Encourage others within the FAA to provide feedback through the NAOMS Working Group
- Determine how the NAOMS results can best be used to support the FAA safety mission.

Summary



- NAOMS counts events not opinions
- It is intended to serve the aviation industry as a whole
- The NAOMS survey is designed to bring both adverse and positive safety trends to the attention of aviation safety decision makers
- Numerous briefings and workshops have been conducted with the aviation community
- Over 18,000 air carrier pilot surveys have been completed
- NAOMS is a quantitative, statistically defensible, safety assessment tool, complementing other databases and assessment tools