Commercial Aviation Safety Team (CAST)

Loss of Control (LOC)
Joint Safety Implementation Team Report

2/15/03

I. EXECUTIVE SUMMARY

The Commercial Aviation Safety Team (CAST) is a collaboration of major organizations sharing a common aviation safety mission, to reduce the commercial aviation accident rate 80% over a ten-year period ending 2007. CAST includes the Federal Aviation Administration (FAA), the National Aeronautics and Space Administration (NASA), and the Department of Defense (DOD), representing government, and many organizations representing the aviation industry. Among those organizations are airplane, engine, and avionics manufacturers; Part 121 certificate holders (airlines); their trade organizations, such as Air Transport Association (ATA), Regional Airline Association (RAA), and National Air Carrier Association (NACA); and pilots' associations such as the Air Line Pilots Association (ALPA) and the Allied Pilots Association (APA).

The general aviation community, in association with government, collaborates through a similar organization, the General Aviation Joint Steering Committee (GA JSC).

In September 1999, CAST chartered the Loss of Control (LOC) Joint Safety Analysis Team (JSAT). CAST previously had determined that loss of control, due to aircraft design, aircraft malfunction, human performance, and other causes, was among the top three categories of fatal accidents in commercial aviation in the United States and elsewhere. Loss of Control in fact has surpassed controlled flight into terrain as the most common category of fatal accidents.

CAST chartered the JSAT to review and analyze data on loss of control accidents, then develop and recommend interventions that could reduce the rate of loss of control accidents and thereby support CAST's goal to reduce the fatal accident rate by 80 percent by 2007. In addition, CAST directed the JSAT to review the analysis and findings of an earlier industry-government study, "Propulsion System Malfunction and Inappropriate Crew Response" (PSM+ICR). The review was designed to ensure that the JSAT had considered all mutually effective interventions.

On December 15, 2000, CAST accepted the "Results and Analysis" report submitted by the LOC JSAT. That report identified 332 total interventions and rated the overall effectiveness of 291 of the interventions for potentially preventing each of the reviewed accidents. The other 41 interventions were either listed as potential research and development activities or simply not rated. CAST immediately chartered the LOC Joint Safety Implementation Team (JSIT) to identify the interventions recommended by the JSAT that were likely to be feasible and which offered high safety benefits. The JSIT then was to develop initial planning documents for the implementation of the selected interventions from the JSAT.

The JSIT accomplished its task by using the JSIT guidelines contained in the document entitled "Process Handbook – Joint Safety Implementation Team." Consistent with the handbook, the team evaluated each intervention proposed by the LOC JSAT and developed intervention strategies and a recommended priority for implementation. Priority is based on the overall effectiveness as determined by the JSAT and the feasibility of implementing each intervention in the United States as determined by the JSIT.

Those interventions that were determined to have high priority were then consolidated into three broad project areas. Next, the JSIT developed a detailed implementation plan for each of the separate safety enhancements contained within the project areas. Finally, the JSIT submitted the proposed

implementation plans to CAST. CAST reviewed the proposed implementation plans, amended them in some cases, and approved them for implementation, as amended.

The three project areas and the safety enhancements approved by CAST for implementation are as follows:

I. Aircraft Design
   1) Autoflight Design Features in New Airplane Designs (Safety Enhancement #32)
   2) Display and Alerting Features in New Airplane Designs (Safety Enhancement #34)
   3) Criteria for Flight in Icing Conditions for New Airplane Designs (Safety Enhancement #39)
   4) Flight Envelope Protection in New Airplane Designs (Safety Enhancement #40)
   5) Vertical Situation Display in New Airplane Designs (Safety Enhancement #85)

II. Policies and Procedures
   6) Risk Assessment and Management (Safety Enhancement #27)
   7) Standard Operating Procedures (SOPs) (Safety Enhancement #26)
   8) Dissemination of Essential Safety Information and Procedures (Safety Enhancement #28)
   9) Flight Crew Proficiency Program (Safety Enhancement #29)

III. Training
   10) Human Factors and Automation (Safety Enhancement #30)
   11) Advanced Maneuvers Training (Safety Enhancement #31)

In addition, research and studies (both recorded as safety enhancements for numbering purposes) that might have potentially high future safety leverage were included in the final JSIT recommendations to CAST. CAST reviewed the proposed research and study plans, amended them in some cases, and approved them for implementation, as amended. These include:

<u>R&D</u>
Aircraft Design – Minimizing Mode Confusion in New Airplane Designs (Safety Enhancement #36)
Aircraft Design - Icing Detection, Annunciation, and Mitigation (Safety Enhancement #119)
Training – Advanced Maneuvers, Flight Simulation Devices (Safety Enhancement #86)
<u>Study</u>
Aircraft Design – Flight Envelope Protection in Existing and Future Derivative Airplane Designs (Safety Enhancement #41)
Aircraft Design - Display and Alerting Features in Existing and Future Derivative Airplane Designs (Safety Enhancement #35)

This report includes results, conclusions and implementation plans that are products of months of concentrated efforts by carefully chosen experts. Those experts comprise core LOC JSIT members and extended members, and countless associates of those members. The LOC JSIT believes that this report brings together data and ideas in a form that offers considerable value to its readers in our universal mission to reduce accidents caused by loss of control.

II. INTRODUCTION

In the fall of 2000, the Commercial Aviation Safety Team (CAST) chartered the Loss of Control (LOC) Joint Safety Implementation Team (JSIT) to develop a practical implementation agenda. (See Appendix A for complete charter.) The LOC JSIT's mission would be to prioritize, select, and implement the interventions recommended by the LOC JSAT that would have the highest possible safety benefits. The LOC JSIT would take into account all major practical constraints, such as technical feasibility, time, and cost.

Using the generic JSIT Process document entitled "Process Handbook - Joint Safety Implementation Team," February 28, 2000, and several CAST approved amendments, the LOC JSIT has produced this report, which is a comprehensive agenda to reduce commercial aviation accidents caused by loss of control.

This report includes results, conclusions and detailed implementation plans that are products of months of concentrated efforts by carefully chosen experts. Those experts comprise core LOC JSIT members (See Appendix B for the list of members) and extended members, and countless associates of those members. Together the LOC JSIT comprises a rare cross-section of specialists from the commercial aviation community.

The LOC JSIT believes that this report brings together data and ideas in a form that offers considerable value to its readers in our universal mission to reduce approach and landing accidents.

III. DESCRIPTION OF THE ANALYSIS PROCESS

The Loss of Control JSIT followed the generic JSIT Process document entitled "Process Handbook - Joint Safety Implementation Team," February 28, 2000. Additional refinements were developed to improve the process with respect to gaining final approval from CAST for project implementation, prioritizing implementation plans among the different JSITs, and subsequent tracking of the projects that were selected for implementation. These refinements were briefed to and approved by CAST before they were implemented. These process improvements were based on experience gained from previous JSITS and the desire by CAST to be able to compare potential accident reduction benefits across plans submitted by several JSITs. These changes will be incorporated into the "Process Handbook - Joint Safety Implementation Team, Revision A."

Review of LOC JSAT Final Report and Identified Interventions

The JSIT reviewed the document furnished by the JSAT, "Final Report, Loss of Control JSAT, Results and Analysis, " December 15, 2000. During the initial review, members of the JSIT who had also served on the JSAT presented the rationale for the events-based sequence and history and previous experience were shared. Specific examples of cause and event sequence analyses were presented to the team.

The LOC JSAT final report contains a total of 332 interventions presented by the JSAT. The CFIT and ALAR JSATs previously presented a number of these same interventions. The JSAT developed a rating of the overall effectiveness of 291 interventions for preventing future loss of control accidents based upon the analysis of the LOC accidents selected for the JSAT study. Of the remaining 41 interventions, 29 were not rated by the JSAT but were presented to the JSIT for evaluation as potential research projects and 12 were not rated and were presented for possible incorporation into

implementation plans with highly ranked interventions. Five (5) of the 291 interventions were rated as zero on the overall effectiveness scale.

After the LOC JSAT began its work, CAST had asked the team to analyze the effects of icing in selected loss of control accidents. As a result, 19 of the 332 interventions were specifically related to accidents associated with icing and were identified separately by the JSAT in the final report.

The LOC JSAT final report also contains a compilation of 5 broadly based strategies to reduce loss of control accidents. The charter for the LOC JSIT assigns the JSIT the responsibility for identifying prospective intervention strategies for implementation. Thus, the JSIT was not bound by the JSAT's suggested groupings, but nonetheless did refer to these as a sanity check. As a matter of record, 3 of the 5 strategies were ultimately selected by the JSIT for implementation.

Grouping of Interventions into Projects

One of the more difficult activities for the JSIT is grouping the large number of interventions proposed by the JSAT into projects for feasibility analysis and preparation of implementation plans. The initial cut resulted in seven broad project areas that had a common theme or concentration area:

- Aircraft Design
- Air Traffic Control
- Data Collection and Analysis
- Policies and Procedures
- Training
- Icing
- Weather JSAT

After this initial grouping, the JSIT reviewed the proposed icing interventions and assigned each of them to one of the other project areas rather than have them evaluated as an individual project. Working groups consisting of 5-10 JSIT members with expertise in the subject area were identified for each of the project areas and a group leader was selected. The Weather JSAT project area was simply a "parking lot" to hold all of the interventions that will be passed on to the Weather JSAT. Table 1 is a list of those interventions.

TABLE 1. INTERVENTIONS FORWARDED TO THE WEATHER JSAT

No.	Intervention
397	397 To provide accurate wind information to flight crews, regulators should ensure that weather information providers and air traffic services employ systems and procedures, which will ensure accurate measurement of wind data and dissemination of wind information.
545	545 To provide the national airspace system with accurate, real-time inflight weather conditions (automatic or manual), a system should be developed and implemented to effectively transmit airborne weather related information to air traffic facilities.
507	507 To ensure that flight crews have all necessary weather information prior to flight, the airlines/operators should immediately review their system of weather information dissemination to ensure all significant weather information is provided for their route of flight.

466	466 To further improve the quality of weather information provided to the flight crews, the regulators should implement recommendations from the weather product working group of the 1999 FAA In-flight Icing Operations Conference.
460	460 To ensure a better understanding, by air crews, of appropriate procedures for use of ice protection systems, operators, manufacturers and regulators should expedite the modification of training programs and distribution of media, to include ice bridging and deicing boot operation.
497	497 To minimize exposure to flight operations in icing conditions, air traffic service providers should initially and periodically train controllers on the hazards / impacts of icing on aircraft performance when holding or vectoring aircraft to the final approach course in areas of known or reported icing conditions.
509	To reduce the risk of encountering hazardous weather conditions (e.g. super-cooled large droplets (sld), thunderstorms, etc.) research must be conducted to develop methods for accurate prediction and identification of these conditions.

Determination of Intervention Feasibility

The working groups assigned a feasibility value to each intervention in each project using the six feasibility elements and values defined in the JSIT Process Handbook. In the Aircraft Design working group, some interventions were replicated and assigned an intervention number xxx.1 to signify that they would be considered separately for retrofit in existing airplanes. The groups' assessments were collated and an average feasibility value for each intervention was calculated. All of the working groups decided that the project areas should be further sub-divided into smaller projects. This resulted in a total of 45 projects. The entire JSIT then reviewed the numerical assessments for the feasibility elements, and changes were made in order to reach consensus.

Generation of Color-coded Spreadsheets

The LOC JSIT used the color-coding technique described in the JSIT Process Handbook to identify the high-priority projects that would be recommended for implementation. The initial step in generating color-coded spreadsheets was to numerically sort the interventions by their overall effectiveness and feasibility ratings. This sorting identified clusters in the data where colors could be assigned. Break points for overall effectiveness and feasibility were set wherever naturally occurring breaks appeared between clusters of ratings. The analysis and visual presentation was key to visually segregating data.

The LOC JSIT assigned color-coding as follows:

	Overall Effectiveness	**Feasibility**
Red	0 - 2	1 - 2
Yellow	2 - 3	2 – 2.66
Green	3 - 6	2.66 - 3

Prioritization of Interventions

The next step conducted by the JSIT was to determine the product of the overall effectiveness rating (OE) and the feasibility rating (F). The simple math of multiplying the overall effectiveness value, already determined by the JSAT, by the feasibility value, determined by the JSIT, yielded a rating that was used to determine priorities of interventions. This resultant product, OE times F (OExF), is

captured in the spreadsheet and shown in a separate column. The interventions were then sorted by this product value to aid in the prioritization of the interventions. The sorted interventions are shown in Appendix C. Based upon the resulting sort of OExF, a cutoff value for OExF was determined to identify the highest leveraged interventions to reduce accident rates. The cutoff value used in the current analysis was 5.61. All projects containing one or more interventions with an OExF value of 5.61 or greater were considered as high-priority.

This prioritization process resulted in the identification of 30 high-priority projects from the total list of 45 projects. Some of the high-priority projects had already been presented to and approved by CAST as CFIT or ALAR projects. Others were combined, or the interventions distributed to various other projects. The list of 45 projects and their disposition is given in Appendix D.

This left the following 9 projects to be dealt with by the LOC JSIT:

I. Aircraft Design
   1) Autoflight Design
   2) Display and Alerting System Requirements
   3) Basic Airplane Design
   4) Flight Envelope Protection

II. Policies and Procedures
   5) Risk Management
   6) Standard Operating Procedures (SOP)
   7) Policies

III. Training
   8) Human Factors and Automation
   9) Advanced Maneuvers Training

Identification of Longer-term Research and Studies

During the disposition of interventions recommended by the JSAT, consideration was given to interventions pertaining to research activities. Where technology solutions were needed, or in cases where better problem understanding might lead to future solutions, an intervention based on research or a study might be appropriate. As research solutions tend to be longer-term actions, care was taken not to discount these potential interventions due to potential low short-term overall effectiveness and feasibility ratings. Research interventions, which might have potentially high future safety leverage, were included in the final JSIT recommendations to CAST.

Development of Statements of Work

Once the high-priority project areas were identified, project leads from the JSIT team were identified. The project leads generated Statements of Work (SOW), with the assistance of the JSIT team, for their respective projects.

Development of Project Plans

The SOWs for the 9 high-priority projects were then presented to CAST as part of a "plan-for-a-plan" (see Appendix E for all SOWs and associated interventions) for CAST initial approval (CAST-E) and direction to proceed with a detailed implementation plan. CAST identified the appropriate organizations to support the projects and resource implications/availability. CAST gave the JSIT approval to pursue Initial Implementation Plans, but requested that the JSIT deviate from the existing process as described below.

Executive Summaries and Detailed Implementation Plans used for CAST-F and CAST-G approval contain "outputs" which are defined as the products and services produced and delivered and/or implemented in support of the stated outcome. During the initial development of the JSIT process, the inclusion of outputs was only intended to assist CAST in monitoring the project implementation after final approval of the entire project. As additional JSITs were chartered and the CAST process evolved, the outputs became increasing more important, with CAST eventually choosing to vote on each one individually, i.e. no longer in the context of a project. A "Commitment Letter" was required for each output and had to be signed by each CAST member organization in order for the output to achieve consensus. Once approved, outputs were individually tracked, leading to an unwieldy number of items. In addition, there was not a means to compare the effectiveness of all projects (and/or outputs) proposed by the various Joint Safety Implementation Teams (JSITs).

In order to improve the efficiency of the CAST voting and tracking processes, the concept of a "safety enhancement" was introduced. A safety enhancement can consist of one or more outputs and is usually a subset of outputs from a project. For example, the outputs from the LOC JSIT project listed above, "Autoflight Design," were divided into two safety enhancements, "Autoflight Features in New Airplane Designs"(with 5 outputs) and "Autoflight Features in Existing & Future Derivative Airplane Designs" (with 2 outputs). The CAST Joint Implementation Management and Data Analysis Team (JIMDAT) reviewed all of the outputs, approved and proposed, and grouped them into safety enhancements for either approval or tracking or both. The JIMDAT process allows the proposed safety enhancements to be removed from the "silos" represented by the various accident categories by estimating the effectiveness of the enhancements against a wide-ranging accident set. For example, for its initial assessment the JIMDAT scored all CAST JSIT proposed enhancements against all US Part 121 (or equivalent) fatal and hull loss accidents that occurred between 1987 and 2001.

Summary Sheets for the 9 projects presented earlier for CAST-E approval were now prepared as 19 safety enhancements, which are included in Appendix F. Table 2 lists the safety enhancements.

TABLE 2. LOSS OF CONTROL SAFETY ENHANCEMENTS

ORIGINAL PROJECT	SE#	SAFETY ENHANCEMENT(S)
Autoflight Design	32	Autoflight Design Features in New Airplane Designs
	33	Autoflight Design Features in Existing and Future Derivative Airplane Designs
Display and Alerting System Requirements	34	Display and Alerting Features in New Airplane Designs
	35	Display and Alerting Features in Existing and Future Derivative Airplane Designs
	85	Vertical Situation Display in New Airplane Designs
Basic Airplane Design	37	Standard Operating Procedures that Account for Crossover Speeds
	38	Crosswind Information for Flight Crew Members
	39	Criteria for Flight in Icing Conditions for New Airplane Designs
	36	Minimizing Mode Confusion in New Airplane Designs
	119	Icing – Detection, Annunciation, and Mitigation

Flight Envelope Protection	40	Flight Envelope Protection in New Airplane Designs
	41	Flight Envelope Protection in Existing & Future Derivative Airplane Designs
Risk Management	27	Risk Assessment and Management
Standard Operating Procedures (SOP's)	26	Standard Operating Procedures (SOP's)
Policies	28	Dissemination of Essential Safety Information and Procedures
	29	Flight Crew Proficiency Program
Human Factors and Automation	30	Human Factors and Automation
Advanced Maneuvers Training	31	Advanced Maneuvers Training
Advanced Maneuvers Training	86	Flight Simulation Devices

Two major additions to the Summary Sheets from previous JSIT submittals were the "score" and a much more detailed estimate of resource requirements. The JIMDAT developed a process to produce a score that considered four factors: the effectiveness of enhancements at reducing accidents, the severity of the accidents that may be prevented, the likelihood of a dramatic change in the various type of accidents, and the enhancements' expected level of implementation. The LOC JSIT developed a resource template that includes cost estimates for items such as:

- R&D to develop the technology
- Equipment cost for each airplane
- Airplane design non-recurring
- Installation non-recurring
- Downtime of airplane to install
- Operating cost delta for airplane/airline
- Government/industry cost for certification, new regulations, etc.
- Training of flight crews

The JIMDAT scoring process and the more accurate estimate gives CAST an important decision making tool. It allows CAST to determine which grouping of enhancements may provide the optimum short term or long term safety benefits in light of resource limitations and other practical constraints, and to then plan implementation accordingly. A complete description of the JIMDAT scoring process will be incorporated in a JIMDAT process document that will be completed at a later date.

CAST gave "F" approval for the JSIT to develop Detailed Implementation Plans (DIPs) for all 19 safety enhancements. The JSIT's minimum requirement for the detailed plans was that they contain strategies for implementing the interventions in the selected projects that were above the OExF cutoff value of 5.61. As much as possible, the lower ranked interventions were included in the detailed plans unless the inclusion would result in activities that required excessive resources or time to implement. After an initial presentation of the DIPs to the CAST and consultation with the JIMDAT and the Executive Committee, three of the original 19 safety enhancements were withdrawn by the JSIT (SE #'s 33, 37 and 38), three were presented to the CAST for consideration for additional studies prior to a final decision regarding implementation, and two safety enhancements were presented as R&D

recommendations. CAST shared the DIPs with their stakeholders and reconfirmed resource commitments by their agency/organization. Eleven safety enhancements were given final approval for implementation (CAST-G). Brief descriptions of each of these projects follow and the complete DIPs are given in Appendix G. Need to include what happens to the R&D and studies.

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IV. DETAILED PLAN SYNOPSES

AUTOFLIGHT DESIGN FEATURES IN NEW AIRPLANE DESIGNS

Purpose: To reduce fatal accidents due to loss of control, recommend and support the development of regulations and guidance material that ensure or encourage autoflight (autopilot and autothrust) systems in new airplane designs to accomplish the following:

- Minimize the probability of creating a thrust asymmetry that could lead to loss of control,
- Yield control to significant manual flight control forces (e.g., force disconnects),
- Annunciate to the flight crew if aircraft response differs significantly from what the autopilot has been commanded to do
- Ensure autopilot internal monitor logic does not inappropriately disconnect the autopilot when it is properly attempting to correct for deviations from the commands it receives.
- Include low speed protection.

LOOPC: FAA AIR-1

SAFETY ENHANCEMENT: (SE-32)

New airplane designs incorporate autoflight systems that assist the pilot in potential loss-of-control situations and minimize the potential of causing or contributing to loss-of-control.

Score: 2007-(0.0) 2020-(1.0) 100%-(4.8)

Completion Date: 4 Years, 6months

Actions	Completion	LOOC
ARAC Flight Guidance System Harmonization Working Group (FGSHWG) provides its recommendations to the FAA.	6 Months	AIR-1
FAA takes rulemaking action as appropriate.	Within 4 Years after ARAC	AIR-1
JAA takes rulemaking action as appropriate	Within 4 Years after ARAC	JAA
FAA produces accompanying guidance material.	Within 4 Years after ARAC	FAA
JAA produces accompanying guidance material.	Within 4 Years after ARAC	JAA

IMPLEMENTING ORGANIZATION(S):
Aircraft Manufacturers, FAA, and ANM-100

DISPLAY AND ALERTING FEATURES IN NEW AIRPLANE DESIGNS

Purpose: To reduce fatal accidents due to loss of control, display and alerting systems in new airplane designs should include:

- Graphic speed trend information
- A pitch limit indication
- Bank angle limits to buffet
- Barber poles and amber bands on primary airspeed indications
- Detection and annunciation of conflicting attitude, airspeed and altitude data information
- Detection and removal of invalid attitude, airspeed and altitude data information (i.e.., from an internal fault)
- Detection and removal of misleading attitude, airspeed and altitude data information (e.g., from an external sensor fault) to the extent feasible
- Information to perform effective manual recovery from unusual attitudes using chevrons, sky pointers, and/or permanent ground-sky horizon on all attitude indications
- Salient annunciation of autoflight mode changes and engagement status changes (e.g., blinking/colored/boxed mode information)
- Effective sideslip information and alerting of excessive sideslip (e.g., split trapezoid on attitude indicator)
- Clear annunciation of engine limit exceedances and significant thrust loss

LOOPC: Aerospace Industries Association (AIA)

SAFETY ENHANCEMENT: (SE-34)

New airplane designs include several display and alerting system features that improve flight crew situational awareness and assist in identifying situations that could lead to loss of control.

Score: 2007-(0.0) 2020-(1.4) 100%-(7.1)

Completion Date: 6 Years, 6 months

Actions	Completion	LOOC
ARAC Avionics Harmonization Working Group tasked by FAA to include JSIT features in the scope of their present task (AC 25-11).	6 months	ANM-100

ARAC provides recommendations to FAA and JAA.	2 Years	ARAC
FAA develops guidance material as appropriate	Within 4 Years after ARAC	ANM-100
JAA develops guidance material as appropriate material.	Within 4 Years after ARAC	JAA

IMPLEMENTING ORGANIZATION(S):
Aircraft Manufacturers, FAA, and ANM-100

VERTICAL SITUATIONAL DISPLAYS – ALL AIRPLANE DESIGNS

Purpose: To reduce fatal accidents due to loss of control, all airplane designs should be modified, if feasible, to include a real time graphical depiction of their vertical situation.

LOOPC: Aerospace Industries Association (AIA)

SAFETY ENHANCEMENT: (SE-85)

Where feasible, all airplane designs will include vertical situation displays. It is expected that new airplanes will incorporate this feature.

Score: 2007-(1.0) 2020-(8.9) 100%-(16.6)

Completion Date: 2 Years, 8 months

Actions	Completion	LOOC
Applicants for new airplane designs agree to incorporate Vertical Situational Displays.	8 Months	AIA

IMPLEMENTING ORGANIZATION(S):
Aircraft Manufacturers, Suppliers, Operators, AFS, AIR, and ANM-100

CRITERIA FOR FLIGHT IN ICING CONDITIONS FOR NEW AIRPLANE DESIGNS

Purpose: To reduce fatal accidents due to loss of control, recommend and support the development of amended icing certification criteria, for new airplane designs not equipped with evaporative (i.e. hot wing) systems, that include performance and handling qualities requirements for the following:

- Residual ice;
- Intercycle ice;
- Delayed anti-icing/de-icing system activation;
- De-icing/anti-icing system malfunction.

LOOPC: Aerospace Industries Association (AIA)

SAFETY ENHANCEMENT: (SE-39)

New designs for airplanes not equipped with evaporative systems accommodate flight in an expanded icing envelope and additional de-ice/anti-ice system malfunctions.

Score: 2007-(0.0) 2020-(0.3) 100%-(5.7)

Completion Date: 3 Years

Actions	Completion	LOOC
ARAC Ice Protection Harmonization Working Group (IPHWG) publishes expanded icing envelope. ARAC Flight Test Harmonization Working Group (FTHWG) publishes recommendations that address airplane performance and handling characteristics in icing conditions. FAA and JAA issue regulatory and guidance material as appropriate.	3 Years	ANM-100

IMPLEMENTING ORGANIZATION(S):
NASA, Aircraft Manufacturers, ARAC IPHWG and ARCA FTHWG

FLIGHT ENVELOPE PROTECTION IN NEW AIRPLANE DESIGNS

Purpose: To reduce fatal accidents due to loss of control, new airplane designs should include angle-of-attack / low speed protection, thrust asymmetry compensation, and bank angle protection, using hard or soft limits.

Fly-by-wire active flight envelope protection technology does not exist for turboprop airplanes, turbo-prop manufacturers should strive, to the fullest extent, to provide the protection benefits of these systems in their new airplane designs.

LOOPC: Aerospace Industries Association (AIA)

SAFETY ENHANCEMENT: (SE-40)

New airplane designs include angle-of-attack / low speed protection, thrust asymmetry compensation, and bank angle protection, using hard or soft limits.

Score: 2007-(0.0) 2020-(3.7) 100%-(18.3)

Completion Date: 8 Months

Actions	Completion	LOOC
Manufacturers of all new airplane designs agree to incorporate angle-of attack/low speed protection, thrust asymmetry compensation, and bank angle protection, using hard or soft limits.	8 Months	AIA

IMPLEMENTING ORGANIZATION(S):
Aircraft Manufacturers

POLICIES AND PROCEDURES – RISK ASSESSMENT AND MANAGEMENT

Purpose: The purpose of this project is to identify or develop and implement methods for operators, regulators, and manufacturers to prioritize safety related decisions. The project will improve methods of risk assessment for operational issues related to service bulletins, aircraft accident/incident analysis, flight critical safety information, and recurring intermittent failures related to dispatch.

LOOPC: Office of Aviation Safety (ASY)

SAFETY ENHANCEMENT: (SE-27)

Aviation safety will be improved through the use of risk assessment/management methods.

Score: 2007-(10.7) 2020-(10.7) 100%-(12.6)

Completion Date: 3 Years

Actions	Completion	LOOC
Compile and assess guidance materials related to risk assessment and risk management tools to prioritize safety related decisions for operational issues regarding service bulletins, aircraft accident/incident analysis, flight critical safety information, and recurring intermittent failures related to dispatch.	12 Months	ASY
Based on the assessment from Output 1, develop guidance materials for operators, regulators, and manufacturers on risk assessment and risk management tools to prioritize safety related decisions for operational issues.	12 months	ATA
Operator, regulator, and manufacturer Directors of Safety (DOS), or equivalents, should ensure all appropriate managers implement and use risk assessment tools to prioritize safety related decisions developed in Output 2.	12 Months	ATA

IMPLEMENTING ORGANIZATION(S):
FAA, CAMI, AIA, DOD, Pilot Associations, Member Organizations, Aircraft Manufacturers, Operators, and Air Transport Canada.

POLICIES AND PROCEDURES – STANDARD OPERATING PROCEDURES

Purpose: The purpose of this project is to ensure that all airline operators publish and enforce clear, concise, and accurate flight crew standard operating procedures (SOP). These procedures should include expected procedures during pre/post flight and all phases of flight i.e.: checklists, simulator training, PF/PNF duties, transfer of control, automation operation, rushed and/or unstabilized approaches, rejected landings and missed approaches, in-flight pilot icing reporting, and flight crew coordination. Operator instructors and check airman should ensure these SOP's are trained and enforced in their aircrew proficiency and standardization programs.

LOOPC: Airline Transport Association (ATA)

SAFETY ENHANCEMENT: (SE-26)

The establishment, maintenance, and use of flight crew SOP's in accordance with AC 120-71 (Standard Operating Procedures for Flight Deck Crewmembers) will improve aviation safety.

Score: 2007-(1.6) 2020-(1.6) 100%-(2.0)

Completion Date: 2 Years, 6 months

Actions	Completion	LOOC
ATA Training Committee and AFS-200 should conduct a review of AC 120-71 and incorporate relative information from the LOC JSAT interventions and operator SOP's.	6 Months	ATA
Based on results of Output 1, AFS-200 should consider a revision/appendix to AC 120-71.	6 Months	AFS-200
Based on results of Output 2, AFS-200 should review the Flight Standards Information Bulletin for Air Transportation (FSAT) 00-08 for possible revision. This revised FSAT should provide additional guidance to FAA principal operations inspectors (POI) for incorporation of the revised AC information into the operator's training programs and manuals.	6 Months	AFS-200
Air carriers should adopt the revised SOP information and revise their training programs and manuals to incorporate the proposed revisions.	12 Months	ATA

IMPLEMENTING ORGANIZATION(S):
APA, RAA, NATA, Aircraft Manufacturers, Operators, and Pilot Associations

POLICIES AND PROCEDURES - POLICIES

Purpose: The purpose of this project is to ensure that essential safety information and operational procedures generated by airplane manufacturers are included in companies' operating manuals, training programs for pilots and other appropriate employee groups, in daily operations. Operators should also develop a means to improve the performance of those flight crew members that meet the minimum criteria, but have shown a limited proficiency.

LOOPC: Airline Transport Association (ATA)

SAFETY ENHANCEMENT: (SE-28)

Aviation safety will be advanced by improving flight crew and other operator employees' performance through timely identification and dissemination of essential safety information and procedures.

Score: 2007-(6.4) 2020-(6.4) 100%-(6.4)

Completion Date: 12 Months

Actions	Completion	LOOC
Reliable processes should be developed to ensure flight operations and maintenance personnel are made aware of and incorporate essential operating information in a timely manner.	12 Months	AIA

SAFETY ENHANCEMENT: (SE-29)

Aviation safety will be improved by ensuring carriers have a process to enhance pilot proficiency.

Score: 2007-(3.3) 2020-(3.3) 100%-(3.3)

Completion Date: 12 months

Actions	Completion	LOOC
Pilots' associations and operators should review existing programs and collaborate to develop a mechanism to continuously improve pilot performance and proficiency.	12 Months	ALPA

IMPLEMENTING ORGANIZATION(S):
ATA, APA, RAA, NATA, and Aircraft Manufacturers.

TRAINING – HUMAN FACTORS AND AUTOMATION

Purpose: In order to reduce loss of control accidents, Part 121 air carrier training departments need to incorporate training that emphasizes flight crewmembers' situation awareness, crew coordination during multitasking, and the use of automation in conjunction with CRM. Flight crews should be trained to use the appropriate levels of automation. Emphasis should be placed on the knowledge of functional operation, capabilities and limitations of automation to ensure pilot control of the aircraft.

LOOPC: Airline Transport Association (ATA)

SAFETY ENHANCEMENT: (SE-30)

To improve the overall performance of flight crews to recognize and prevent loss of control accidents, through effective use of automation and CRM.

Score: 2007-(2.6) 2020-(2.6) 100%-(3.3)

Completion Date: 36 Months

Actions	Completion	LOOC
An evolutionary training aid that consolidates regulatory, academic, industry and pilot association literature that addresses the human factors issues surrounding the employment of automation within the context of CRM.	24 Months	ATA
All operators should incorporate applicable principles of the Training Aid into their training programs and standard operating procedures.	12 Months	ATA

IMPLEMENTING ORGANIZATION(S):
ATA T/C, ATA S/C, NASA, FAA, AFS-HFCC, DOS, Operators Flight Training Departments, and pilot associations.

TRAINING – ADVANCED MANEUVERS

Purpose: The purpose of this project is to collect and provide advanced maneuver training material and to encourage Part 121 operators to use these materials to implement advanced maneuver ground training and flight training using appropriate flight training equipment. Emphasis should be given to stall onset recognition and recovery, unusual attitudes, upset recoveries, effects of icing, energy awareness and management, and causal factors that can lead to loss of control.

LOOPC: FAA, Flight Standards (AFS)

SAFETY ENHANCEMENT: (SE-31)

Pilots will be better trained to avoid and recover from excursions from normal flight and loss of control.

Score: 2007-(11.4) 2020-(11.4) 100%-(11.4)

Completion Date: 36 Months

Actions	Completion	LOOC
A survey of existing training material from regulators, industry, operators, academia and other resources and a set of advanced maneuvers training material produced by a joint industry working group.	24 Months	ATA T/C
AMT ground training provided by all operators.	12 Months after training matl	ATA T/C
AMT flight training provided by all operators.	12 Months after training matl	ATA T/C
Research should be conducted to determine how existing flight simulation devices can be used effectively in AMT.	36 Month	AFS-400

IMPLEMENTING ORGANIZATION(S):
NASA, flight simulator manufactures, aircraft manufacturers, pilot associations, member associations, operators, and training center operators.

Executing Projects and Monitoring Progress

Once CAST-G approval has been obtained for the safety enhancement and the associated DIP, the responsible organizations in the plan are expected to begin implementation strategies. The JIMDAT has the responsibility to monitor the project implementation and effectiveness and provide information to CAST. In order to accomplish this task, the JIMDAT, working in concert with the JSIT, determines the project implementation milestones and the safety enhancement metrics. These metrics include indicators for measuring the success of the enhancement, how they are measured, and the responsible organization. Enhancement metrics for the 11 safety enhancements given G approval by CAST are given in Table 2.

V. CONCLUSIONS

In accordance with the charter creating the LOC JSIT, CAST provided input at every step of the JSIT process. At various points in the process, CAST also gave approval to the LOC JSIT on interim steps and products. It should be noted that the Detailed Implementation Plans (DIPs) found in Appendix G of this report have been accepted by CAST and given CAST's final approval for implementation. Final approval signifies that the various CAST representatives and their organizations have reviewed, commented and concurred to implement each project as presented in its respective DIP.

In developing the process to address the interventions recommended by the LOC JSAT, the JSIT considered numerous factors. Among those factors was the large number of interventions (332) recommended by the JSAT. The LOC JSIT and CAST itself recognized at an early point that such a large number of interventions would be constrained by limited resources and time, and could not all be implemented effectively under any implementation agenda.

The LOC JSIT applied a selection methodology consisting of two steps, grouping and prioritizing. Grouping would reduce the number of interventions to a manageable number while meeting the challenge of reducing the commercial aviation approach and landing accident rate by 80% over a ten-year period. Prioritization would identify some recommended initiatives in favor of others to afford the greatest possible safety benefit using the limited resources available.

As outlined in the JSIT Process document, the JSIT's selection methodology resulted in product-oriented projects containing all of the 332 interventions identified by the ALAR JSAT. Within each of those groups, the interventions were prioritized based upon their overall effectiveness (as determined by the LOC JSAT) and their feasibility (as determined by the LOC JSIT) in precluding a particular event, problem or accident. Based upon each intervention's priority and a mathematical cutoff (as outlined in the Process Document), the LOC JSIT identified as high-priority 11 safety enhancements that contained XX% of the LOC JSAT's recommended interventions and selected them for implementation under the LOC JSIT agenda.

The LOC JSAT interventions regarding research and development (R & D) are a small but important subset of the interventions selected by the JSIT and recommended to CAST. The LOC JSIT strongly recommends that CAST encourage the continuation of the XX R & D safety enhancements identified in Section IV of this report that could lead to significant reductions in the commercial aviation accident rate.

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TABLE 2. LOSS OF CONTROL SAFETY ENHANCEMENT METRICS

SE#	SAFETY ENHANCEMENT	INDICATOR	HOW	WHO
32	Autoflight Design Features in New Airplane Designs	▪ Percentage of new type design airplanes that include specified Autoflight features	▪ Review of Type Certificate design data	▪ ACOs & manufacturers
34	Display and Alerting Features in New Airplane Designs	▪ Percentage of new type designs that incorporate specified flight instrumentation features	▪ Review of Type Certificate design data	▪ ACOs & manufacturers
85	Vertical Situation Display in New Airplane Designs	▪ Percentage of airplanes with VSD	▪ Review of Type Certificate and Supplemental Type Certificate design data	▪ ACOs & manufacturers
		▪ Reduction in MSAW alerts	▪ MSAW alerts from ATC	▪ ATC
		▪ Reduction in valid GPWS alerts	▪ Airline FOQA/ASAP data, Altitude change request to ATC (Report??)	▪ Airlines, ATC
		▪ Percentage of operators who have adopted constant angle approaches	▪ POI interview or audit or ATA/RAA/airlines report to CAST	▪ POI, ATA, RAA, airlines
		▪ Continuous reduction in the number of approaches where descent rates exceed 1000 feet per minute in final approach phase	▪ FOQA/APMS/radar tapes	▪ Airlines/NASA/ASY
		▪ Continuous reduction in the percentage of dive and drive approaches	▪ FOQA/APMS/radar tapes	▪ Airlines/NASA/ASY
		▪ Continuous reduction in the number of unstabilized approaches	▪ FOQA/APMS/radar tapes	▪ Airlines/NASA/ASY
		▪ Continuous reduction in the number of busted approach gates	▪ FOQA/APMS/radar tapes	▪ Airlines/NASA/ASY
39	Criteria for Flight in Icing Conditions for New Airplane Designs	▪ Percentage of new type designs tested to new icing criteria	▪ Review of Type Certificate design data	▪ ACOs & manufacturers

TABLE 2. LOSS OF CONTROL SAFETY ENHANCEMENT METRICS

40	Flight Envelope Protection in New Airplane Designs	▪ Percentage of new type designs that incorporate flight envelope protection features	▪ Review of Type Certificate design data	▪ ACOs & manufacturers
27	Risk Assessment and Management	▪ Percentage of operators/manufacturers with risk assessment/management processes in place ▪ Continuous reduction in the number of operations with recurring intermittent failures in flight critical systems ▪ Percentage of operators with a process to include safety information in manuals	▪ PMI/POI interview or audit or ATA/RAA/airlines report to CAST ▪ PMI/POI interview or audit or ATA/RAA/airlines/mfrs report to CAST ▪ POI interview or audit or ATA/RAA/airlines report to CAST	▪ PMI/POI, ATA, RAA, airlines ▪ PMI/POI, ATA, RAA, airlines, mfrs ▪ POI, ATA, RAA, airlines
26	Standard Operating Procedures (SOP's)	▪ Continuous reduction in excursions from normal flight	▪ FOQA/APMS/radar tapes or ATC pilot deviation reports	▪ Airlines/NASA/ASY/ATC
28	Dissemination of Essential Safety Information and Procedures	▪ Percentage of operators with a process to include safety information in manuals	▪ POI interview or audit or ATA/RAA/airlines report to CAST	▪ POI, ATA, RAA, airlines
29	Flight Crew Proficiency Program	▪	▪	▪
30	Human Factors and Automation	▪ Reduction of the occurrence rate for flight crews becoming confused as to the mode of the flight management system	▪ CVR, FOQA/ASAP/ASRS or simulator training	▪ Airlines/NASA/ASY
31	Advanced Maneuvers Training	▪ Continuous reduction in excursions from normal flight	▪ FOQA/APMS/radar tapes or ATC pilot deviation reports	▪ Airlines/NASA/ASY/ATC

VI. RECOMMENDATIONS

The unifying goal of the LOC JSIT was to produce a practical agenda yielding significant safety benefits, not for a selected group of organizations, but for the entire commercial aviation community. Because not all organizations comprising the commercial aviation community are represented on CAST, the LOC JSIT recommends that CAST ensures prompt distribution of this report to all major organizations comprising the U.S. commercial aviation community, the presidents of IATA and IFALPA, the Chairman of the JAA Board, and the President of the Council of ICAO.

Most importantly, the LOC JSIT recommends that CAST and its member organizations implement the 11 safety enhancements identified in Section IV as soon as possible.

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Loss Of Control

Charter for Joint Safety Implementation Team (JSIT)

I. Purpose. To develop prioritized implementation strategies and action plans and after approval by the CAST, coordinate the implementation of the strategies and plans.

II. Background. Industry and government, through CAST, have jointly agreed to pursue a data driven approach to identify high priority safety initiatives. Industry and government have further agreed that cooperatively and selectively pursuing implementation of the high leveraged safety intervention strategies will maximize safety benefit. Implementation of some intervention strategies may be international in scope.

III. Tasks.

A. Intervention strategies identified by the Loss of Control JSAT, including those broken out in the appendices of the Loss of Control JSAT report, will be analyzed by the Loss of Control JSIT for the purposes of determining implementation feasibility and identifying prospective intervention strategies for implementation. Intervention strategies 397, 545, 507, and 456 will be forwarded to the Weather JSAT for disposition. This may require the Loss of Control JSIT to determine rankings for appropriate non-rated Loss of Control JSAT intervention strategies.

B. The Loss of Control JSIT will present the prospective interventions identified for implementation to CAST for review and approval. Rationale for how all the Loss of Control JSAT intervention strategies were dispensed will be included in the plan report.

C. For those CAST-approved Loss of Control interventions identified for implementation, develop an implementation plan.

D. The Loss of Control implementation plan will contain:
- prioritized implementation strategies
- identification of responsible parties
- a list of major implementation milestones
- metrics to monitor progress in meeting these milestones.
- metrics for tracking success of the interventions..

E. The Loss of Control implementation plan will include a communications strategy aimed at gaining “stakeholder” buy-in.

F. For Loss of Control implementation strategies which are international in scope, the Loss of Control JSIT implementation plan will consider how best to utilize the assistance of ICAO, IATA, FSF, IFALPA, and other international organizations and appropriate international certificating authorities.

G. The Loss of Control JSIT will present this detailed implementation plan to CAST for review and approval.

H. As directed by CAST, the Loss of Control JSIT will make periodic progress reports on implementation status to CAST.

IV. Products. The Loss of Control JSIT deliverables include:

- Description of any required JSIT process changes
- an initial implementation plan,
- a detailed implementation plan, and
- reports to CAST documenting progress, including implementation and established metrics.

V. Membership. The Loss of Control JSIT team membership will include "senior" representatives from those stakeholders who will be affected by the intervention strategies and those who may be responsible for implementation of those strategies.

VI. Resources. CAST participating organizations agree to provide appropriate financial, logistical and personnel resources necessary to carry out this charter and approved implementation strategies.

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Overall Effectiveness	Average Feasibility	OExF	Intervention No.	INTERVENTIONS	Initial Project Area
4	2.8	11.32	99	99 Airlines/operators should ensure that clear, concise, accurate, appropriate standard operating procedures are published and enforced. (See 110)	P&P
4.6	2.3	10.72	457	457 To ensure full protection throughout the icing envelope, regulators / manufacturers should expand icing certification criteria to include ice accretions due to residual, intercycle, delayed activation and system malfunction to ensure that icing protection equipment and/or procedures provide full operational envelope coverage. (See 459, 516)	A/C-DEZ
4	2.7	10.68	357	357 To ensure crews have the adequate skills to recover from extreme attitude upsets, regulators should require, and operators should immediately implement, initial and recurrent upset recovery training.	TRAINING
4.2	2.5	10.5	525	525 To mandate stall recognition and recovery training, regulators must modify the appropriate regulations.	TRAINING
3.8	2.7	10.15	532	532 To minimize the probability of accidents, operators should prioritize service bulletin implementation using operational risk management techniques to assess potential operational hazards, including aircraft modification, etc.. (See 98, 348)	P&P
3.3	3	9.9	7	7 Airlines/operators should ensure that their training/standardization programs emphasize review of approach and missed approach procedures. (See 329)	TRAINING
3.7	2.7	9.88	56	56 Airlines/operators should implement Flight Operations Quality Assurance (FOQA) programs to identify systemic procedural deviations and unsafe trends. (See 54, 55)	DATA
3.7	2.7	9.88	530	530 To optimize pilot workload, airlines/operators policies should stress using the appropriate level of automation. (See 246)	P&P
3.7	2.7	9.88	110	110 Airlines/operators and regulators should ensure that their training/standardization and monitoring programs emphasize the importance of adherence to standard operating procedures and identify the rationale behind those procedures. (See 99)	TRAINING
3.8	2.5	9.5	566	566 Manufacturers should incorporate an automatic yaw compensation to ensure that adequate yaw control is provided.	A/C-DEZ

4	2.3	9.32	486	486 To reduce the risk of loss of control, airlines/operators and manufacturers should train crews to understand the capabilities and limitations of automated flight systems, the conditions which would cause the systems to not function as the crew anticipates, and how to detect and recover from inadvertent activation of autoflight modes (see 331)	TRAINING
3.1	3	9.3	225	225 Airlines/operators and regulators should ensure necessary manuals (operational & maintenance) are complete, accurate, available and appropriately used.	P&P
3.1	3	9.3	15	15 Airlines/operators should ensure that their training/standardization programs instruct when to disengage automated systems and fly manually. (See 246)	TRAINING
3.1	3	9.3	142	142 Airlines/operators should establish policies, parameters, and training to recognize unstabilized approaches and other factors and implement a go-around gate system. (See FSF - "defined gates" p. 193) (See 116, 123)	TRAINING
4.6	2	9.2	516	516 To ensure full protection throughout the operational envelope, regulators / manufacturers should expand icing certification criteria to include performance and handling qualities testing which considers ice accretions due to residual icing, intercycle icing, delayed system activation and/or system malfunction. (See 457, 459)	A/C-DEZ
3.8	2.3	8.85	533	533 To prevent loss of control, manufacturers should design automated systems to yield control to manual inputs when those manual inputs are in conflict with the automated configuration.	A/C-DEZ
3.8	2.3	8.85	483	483 To ensure that the display of conflicting attitude information does not confuse or mislead the flight crew, the attitude sensing and display systems should be designed so that invalid information is detected and clearly annunciated to the flight crew and/or removed from display.	A/C-DEZ
3.8	2.3	8.85	361	361 To enhance the ability to analyze, identify and take corrective actions for preventing accidents, regulators and operators should create a collection and analysis process which utilizes all existing and future aircraft data collection systems, such as DFDR, FOQA, ASAP and other non-volatile memory systems.	DATA
3.8	2.3	8.85	535	535 To ensure adequate instructor / check pilot qualifications, operators must establish and maintain minimum line and instructor / check airman qualifications.	TRAINING
3.3	2.7	8.81	384	384 Since it is possible to enter a stall, airlines/operators should develop and implement a ground school and simulator training program to train pilots to handle post stall recovery as part of advanced maneuver training	TRAINING
2.8	3	8.4	114	114 Airlines/operators should ensure that their training/standardization programs provide sufficient training to ensure aircrew proficiency.	TRAINING
2.8	3	8.4	147	147 Airlines/operators should require training/standardization programs, which teach situation awareness. (The knowledge and understanding of the relevant elements of the pilot surroundings, including aircraft systems, and the pilots intentions)	TRAINING
2.8	3	8.4	165	165 Airlines/operators should provide training scenarios that match realistic situations (i.e. stall recoveries during approach, in landing configuration at flight idle with the autopilot on (in simulator)).	TRAINING
3.1	2.7	8.28	472	472 Since certain engine control and autothrottle system failures can result in undesirable asymmetry, manufacturers should redesign ATSs so that they disconnect (with appropriate annunciation) when unable to achieve the commanded thrust settings (analogous to autopilot disconnect logic).	A/C-DEZ

3.1	2.7	8.28	395	483 To ensure that the display of conflicting attitude information does not confuse or mislead the flight crew, the attitude sensing and display systems should be designed so that invalid information is detected and clearly annunciated to the flight crew and/or removed from display.	A/C-DEZ
3.1	2.7	8.28	380	380 To reduce the risk of inadvertent entry into stall, manufacturers should develop and implement stall protection features in all transport category airplanes, (e.g. stick pusher, alpha protection)	A/C-DEZ
3.3	2.5	8.25	80	80 Airlines/operators should verify, and regulators should check, that operators who create their own AOM's include all operational procedures prescribed by original equipment manufacturers Airplane Flight Manual (AFM).	P&P
3.8	2.2	8.25	546	546 Ensure that flight crews are adequately trained in an appropriate level simulator for the training being conducted (i.e. engine out, upset recovery, etc.) before being assigned to the line. (See 153, 312)	TRAINING
3.5	2.3	8.16	364	364 To protect aircraft against loss of control, regulators should develop as soon as possible, certification criteria, throughout the entire flight envelope, for crossover speeds and maximum rudder side slips. (see 431)	A/C-DEZ
2.8	2.8	7.92	511	511 To reduce the number of hazardous icing encounters and to keep air traffic apprised of current weather conditions, regulators should recommend that flight crews report all icing conditions to air traffic control and be required to report the occurrence of moderate to severe icing conditions. (ref. FAR 91.183)	P&P
4.6	1.7	7.68	445	445 To help avoid loss of control, manufacturers should develop and implement flight envelope protection	A/C-DEZ
3.5	2.2	7.6	431.1	431 To assist flight crews in avoiding loss of control on existing aircraft, regulators and manufacturers should evaluate the effects of crossover speeds and maximum rudder side slip throughout the entire flight envelope and disseminate the information to operators and flight crews. (See 364)	A/C -DEZ RETRO
2.5	3	7.5	207	207 Airlines/operators should develop procedures to specify how transfer of control is formally accomplished.	P&P
2.8	2.7	7.48	520	520 To ensure flight crews have a comprehensive knowledge of the automation system(s) functional operation, airlines/operators should ensure that their training /standardization programs emphasize these skills.	TRAINING

3.1	2.3	7.22	400	400 In order to promote safe crosswind landings, manufacturers will provide and airline operators will implement aircraft crosswind landing limitations, including considerations for flight control effectiveness and gust conditions.	P&P
3.1	2.3	7.22	408	408 To minimize undesirable effects of transition to manual flight from ALIGN mode, regulators should require that minimum altitudes and conditions be established for disengagement of automated systems when a manual landing is anticipated.	P&P
3.1	2.3	7.22	157	157 Airlines/operators, regulators, air traffic service providers should establish policies or programs to address rushed approaches, including elimination of rushed approaches, recognition and rejection of rushed approaches and training for those encountered.	P&P
2.7	2.7	7.21	488	488 To facilitate recovery and attitude awareness, manufacturers should include adequate instrumentation to optimize performance during recovery from unusual attitude.	A/C-DEZ
2.4	3	7.2	93	93 Air Traffic service should provide real time (most current) radio communication of critical airport and weather information.	ATC
2.4	3	7.2	322	322 Airlines/operators should develop and implement a ground school and simulator training program to train pilots to handle unusual attitude situations, e.g. American Airlines Advanced Aircraft Maneuvering Program.	TRAINING
2.4	3	7.2	427	427 To prevent inappropriate preoccupation with trouble shooting following engine or other system failure, airline operators should enhance training and checking to prioritize safe control of the aircraft.	TRAINING
4.2	1.7	7.01	366	366 To protect aircraft against flight control malfunctions, manufacturers must design and regulators must certificate derivative aircraft and components to current applicable certification requirements, i.e. single point failures, redundancy, and probability of failure.	A/C-DEZ
2.8	2.5	7	253	253 To prevent loss of control, there should be redundancy and failure tolerance features for all flight critical components, such as dual path design, fail operational redundant systems, with fault annunciation.	A/C-DEZ
3.5	2	7	423	423 To ensure that recurrent, flight critical intermittent failures are not allowed to persist, regulators should revise MEL dispatch requirements so that certain intermittent failures are considered to be full failures, if warranted by safety implications of the failures and frequency of occurrence.	P&P
2.4	2.8	6.79	218	218 Airlines/operators should properly surveil contractor training programs for adequacy of training. (See 110, 202)	TRAINING
2.4	2.8	6.79	314	314 Airlines/operators should develop simulator training scenarios that require flight crews to learn multi-tasking abilities and appropriate prioritization abilities in concert with CRM skills (see Red Flag LOFT scenarios).	TRAINING
2.4	2.8	6.79	460	460 To ensure a better understanding, by air crews, of appropriate procedures for use of ice protection systems, operators, manufacturers and regulators should expedite the modification of training programs and distribution of media, to include ice bridging and deicing boot operation.	TRAINING
2.7	2.5	6.75	305.1	305 Regulators should require airlines/operators to outfit aircraft with electronic checklists. If unable to install electronic checklists, use mechanical checklists or, at a minimum, develop a process to reinforce challenge and response checklists.	A/C -DEZ RETRO

2.7	2.5	6.75	305	305 Regulators should require airlines/operators to outfit aircraft with electronic checklists. If unable to install electronic checklists, use mechanical checklists or, at a minimum, develop a process to reinforce challenge and response checklists.	A/C-DEZ
3.1	2.2	6.73	515	515 To warn of impending loss of control with the autoflight system fully engaged, manufacturers should develop and regulators should require annunciation of an airplane flight condition which significantly differs from that being commanded by the selected autoflight system mode. (See 243)	A/C-DEZ
3.1	2.2	6.73	412	412 To avoid problems due to unexpected mode changes, automated flight system logic should be designed to be error tolerant or, at a minimum provide an alert when the desired mode is in conflict with aircraft energy state.	A/C-DEZ
3.1	2.2	6.73	214	214 Regulators should enforce timely incorporation of appropriate manufacturers recommendations. (See 98, 201)	P&P
3.1	2.2	6.73	98	98 Airlines/operators and regulatory agencies should review procedures to ensure that design changes (service bulletins) to flight critical systems are incorporated in a timely manner.	P&P
3.3	2	6.6	16	16 To prevent mode confusion, manufacturers should ensure that automated systems provide the flight crew with sufficient information (automation feedback).	A/C-DEZ
3.3	2	6.6	152	152 Airlines/operators and regulators should raise standards (e.g. crew pairing, approach minimums, etc.) for flight crewmembers that meet minimum qualifications but have demonstrated limited proficiency and/or competency. (See 151, 335, 337)	P&P
3.3	2	6.6	561	561 Airlines should maximize the use of autoland systems consistent with maintaining manual landing proficiency.	P&P
2.8	2.3	6.52	128	128 Airlines/operators and regulators should implement a no blame safety reporting and data sharing system with appropriate protections from litigation and prosecution concerns	DATA
2.3	2.8	6.51	82	82 Airlines/operators should clearly define, train and check the specific PF/PNF/FE duties.	TRAINING
2.3	2.8	6.51	111	111 Airlines/operators should ensure that their training/standardization programs emphasize basic airmanship skills and knowledge during initial and recurrent training.	TRAINING
2.3	2.8	6.51	115	115 Airlines/operators should ensure that their training/standardization programs emphasize the dangers of rushed approaches. (See 13, 157)	TRAINING
2.3	2.8	6.51	116	116 Airlines/operators should ensure that their training/standardization programs emphasize the dangers of high rate of descent and unstable approaches. (See 142)	TRAINING
2.3	2.8	6.51	328	328 Airlines/operators should ensure that flight crews are trained to think in terms of "I will go-around unless" rather than "I will land unless". Regulatory policy should support this approach. (See 142, 311)	TRAINING
2.3	2.8	6.51	329	329 Airlines/operators should incorporate in initial and recurrent training ways to recognize multiple cues that will require go-around. Including CFIT training aid 2.1.9, FSF definition of stabilized approach, risk assessment tool, and windshear training aid	TRAINING
3.5	1.8	6.41	364.1	364 To protect aircraft against loss of control, regulators should develop as soon as possible, certification criteria, throughout the entire flight envelope, for crossover speeds and maximum rudder side slips. (see 431)	A/C -DEZ RETRO

3.5	1.8	6.41	501	501 To assist flight crews in avoiding loss of control, manufacturers should develop and regulators should require autoflight system auto-disconnect logic which does not disconnect when the autoflight system is properly attempting to correct an abnormal flight situation/condition. (See 363)	A/C-DEZ
2.4	2.7	6.41	401	401 To ensure proper identification of engine malfunctions and avoidance of possible loss of control, airline/operators should provide enhanced and more realistic training for engine malfunctions, engine responses to control signal errors and the appropriate aircrew actions.	TRAINING
2.1	3	6.3	124	124 Air Traffic service providers should implement a Quality Assurance program to ensure adherence to established procedures.	ATC
2.1	3	6.3	25	25 Airlines/operators should establish a CRM training program and regulators should require and insure that the initial training is provided prior to line flying and require recurrent CRM training. (See 131, 132, 349)	TRAINING
2.1	3	6.3	107	107 Airlines/operators should ensure that their CRM training/standardization program emphasizes the importance of the team concept.	TRAINING
2.1	3	6.3	227	227 Airlines/operators should ensure that their training/standardization program emphasizes the benefits of inter-crew/company communications. (See 131)	TRAINING
2.1	3	6.3	553	553 Since performance calculations can have significant safety implications, regulatory authorities should ensure that pilot training and procedures adequately address their meaning and use.	TRAINING
2.7	2.3	6.29	433	433 To preclude inadvertent entry into stall conditions during autopilot operation, regulators should not permit and manufacturers should not design autoflight systems that will allow the autopilot to control the aircraft into a stalled condition.	A/C-DEZ
2.2	2.8	6.23	405	405 To enhance stability in the approach and landing phase, airline operators should train pilots to properly control the aircraft in the transition from autocoupled/autoland approaches to manual control.	TRAINING
3.1	2	6.2	424	424 To enhance crew awareness of automation modes, manufacturers should ensure that mode changes or disconnects, in the automated systems are annunciated in a way that is obvious to the flight crew.	A/C-DEZ
2.3	2.7	6.14	54	54 Airlines/operators should implement Flight Operations Quality Assurance (FOQA) programs.	DATA
4.6	1.3	6.12	445.1	445 To help avoid loss of control, manufacturers should develop and implement flight envelope protection	A/C -DEZ RETRO
2.8	2.2	6.08	416	416 To provide improved flight crew situation awareness, manufacturers should provide a clear indication that predicts the future aircraft energy state and/or autoflight configuration if the current course of action is continued (i.e., analogous to EGPWS mode that analyzes the airplane's descent rate vs. its terrain map, and tells the crew that a conflict will occur if they continue at that descent rate. The system would warn the crew that, if they continue at the current roll rate (for example), the plane will exceed the envelope, or the autopilot will reach the limits of its authority, etc.)	A/C-DEZ
2.8	2.2	6.08	490	490 In order to ensure that relevant information is shared during the pilot hiring process, airlines should implement and regulators require a storage and retrieval system that contains pertinent standardized information on the quality of airline pilot performance during training and service. (Reference 'Pilot Records Improvement Act' – FAA AC 120-68)	DATA
2.4	2.5	6	456	456 To help ensure appropriate decision making flight crews should be trained on the impact of automation on CRM.	TRAINING

2.1	2.8	5.94	13	13 Air Traffic service providers should enhance ATC training to emphasize the dangers of rushed approaches and performance characteristics of modern jet transports. (See 115, 157)	ATC
2.1	2.8	5.94	484	484 To ensure adequate FO proficiency, airlines/operators should incorporate the operating practice of alternating PF/PNF duties (alternating legs and landings).	P&P
2.1	2.8	5.94	23	23 Airlines/operators should ensure that regularly scheduled recurrent training (e.g. LOFT) emphasizes crew cooperation and working together to maximize safe operations. (See 308, 314)	TRAINING
2.1	2.8	5.94	112	112 Airlines/operators and regulators should ensure that the frequency and effectiveness of proficiency checks for simulated instrument failures (partial panel) are adequate.	TRAINING
2.1	2.8	5.94	308	308 Airlines/operators should ensure their formal CRM training is culturally appropriate and emphasizes the following management skills: decision making, workload management, crew coordination, planning, communication, situational awareness, and advocacy	TRAINING
2.1	2.8	5.94	325	325 Airline/operators should emphasize during initial and recurrent training the importance of maintaining systems status awareness during non-normal events and hazardous approaches (goal to avoid tunnel vision/narrowed attention)	TRAINING
2.2	2.7	5.87	382	382 To provide improved pilot awareness of airspeed, manufacturers should provide flight instruments with more effective airspeed trend indications and alerting.	A/C-DEZ
2.2	2.7	5.87	417	417 Because failures which result in yaw/roll upsets can be particularly difficult for crews to interpret and successfully handle, manufacturers and operators should give such failures increased scrutiny and higher priority for reporting.	P&P
2.7	2.2	5.86	522	522 Since it is possible to enter a stall, regulators should mandate the implementation of a ground school and simulator training program to train pilots to handle post stall recovery as part of advanced maneuver training. (See 384)	TRAINING
2.3	2.5	5.75	20	20 Airlines/operators should ensure that command oversight training for captains is provided during the upgrade process and in recurrent training and first officer responsibility for monitoring are reviewed during recurrent training.	TRAINING
3.8	1.5	5.7	533.1	533 To prevent loss of control, manufacturers should design automated systems to yield control to manual inputs when those manual inputs are in conflict with the automated configuration.	A/C -DEZ RETRO
3.8	1.5	5.7	483.1	483 To ensure that the display of conflicting attitude information does not confuse or mislead the flight crew, the attitude sensing and display systems should be designed so that invalid information is detected and clearly annunciated to the flight crew and/or removed from display.	A/C -DEZ RETRO
1.9	3	5.7	163	163 Airlines/operators should ensure that their training/standardization programs address common perceptions that could lead to unsafe practices	TRAINING
3.1	1.8	5.67	395.1	483 To ensure that the display of conflicting attitude information does not confuse or mislead the flight crew, the attitude sensing and display systems should be designed so that invalid information is detected and clearly annunciated to the flight crew and/or removed from display.	A/C -DEZ RETRO

2	2.8	5.66	131	131 Airlines/operators should ensure that their training/standardization program emphasizes the importance of the team concept, cross cultural issues, evaluation of options and the obligation of the FO to effectively communicate any concerns (CRM). (See 237)	TRAINING
2	2.8	5.66	415	415 To provide improved aircraft status awareness, airline/operators should enhance training to identify aircraft configuration and the repercussions of the aircraft's energy state.	TRAINING
2.1	2.7	5.61	474	474 Since indications of sideslip may not be prominent and can be masked by roll effects, manufacturers should develop improved sideslip indications and/or alerting (e.g. similar to pitch limit indications for pitch / angle of attack).	A/C-DEZ
2.1	2.7	5.61	442	442 To avoid delay in the recognition of engine malfunction/failure, manufacturers should develop and implement a direct aural and visual flight deck indication of engine malfunction/failure minor transients need not be annunciated.	A/C-DEZ
2.1	2.7	5.61	57	57 Airlines/operators, regulators, and manufacturers should implement a program designed for sharing of safety related information within the aviation community.	DATA
2.1	2.7	5.61	411	411 To reduce accidents during the landing phase, airline operators should establish criteria and procedures and train flight crews to recognize conditions which might require a rejected landing.	P&P
2.1	2.7	5.61	542	542 To preclude over reliance on automation, airlines/operators and regulators should create and/or clarify a definition of “appropriate levels of automation,” to include the need to validate against other information sources and insure that the resulting definition is published and included in all appropriate flight crew publications and manuals and training programs.	P&P
2.8	2	5.6	201	201 Regulators should develop adequate oversight as appropriate to ensure compliance with regulations. (See 145, 146, 202, 345)	P&P
2.8	2	5.6	463	463 To avoid treating an incident as an isolated occurrence and to ensure on-going assessment of aircraft specific loss of control problems, regulators, airlines/operators should conduct a focused safety or risk assessment of all accidents and incidents to determine the need for immediate resolution. (See 254)	P&P
2.8	2	5.6	331	331 Airline operators and manufacturers will train crews to understand capabilities and limitations of system, conditions which would cause the system to not function properly and how to detect failure to deploy and recommend contingency actions.	TRAINING
2.8	2	5.6	358	358 To provide optimal upset recovery training and to minimize negative training, regulators, aircraft and simulator manufacturers and operators should insure that training devices replicate aircraft performance and response necessary for effective training. (See 386, 475)	TRAINING
2.8	2	5.6	365	365 To ensure pilot capability to maintain or regain control, regulators should require and operators should implement training programs which address crossover speed effects.	TRAINING
2.8	2	5.6	502	502 To insure flight crews can identify possible upset conditions, airline/operators should implement flight crew training programs that demonstrate the operation of a normally functioning autoflight system under non-standard flight conditions (e.g. out of trim airplane/contaminated wing).	TRAINING
2.2	2.5	5.5	202	202 Airlines/operators should develop a quality assurance program to ensure compliance with regulations. (See 145, 146, 201)	P&P
2.5	2.2	5.43	257	257 To eliminate loopholes in crew rest requirements and to ensure adequate crew rest, regulators should clarify crew rest regulations. (See 31, 130, 203, 315, 316)	P&P

2.7	2	5.4	79	79 Airlines/operators should implement a reliable process to communicate information to the flight crew that may affect flight or aircraft operations.	P&P
1.8	3	5.4	64	64 Airlines/operators should ensure that their training/standardization programs direct the flight crews to regularly cross check all instrumentation.	TRAINING
2.1	2.5	5.25	467	467 To reduce unstabilized approaches, air traffic quality assurance programs should regularly evaluate Air Traffic Control system Command Center / Traffic Management Unit (ATCSCC / TMU's) to ensure traffic management programs and initiatives include all traffic (i.e. tower enroute clearance / enroute traffic), are implemented properly, effectively utilized and personnel are adequately trained.	ATC
2.1	2.5	5.25	497	497 To minimize exposure to flight operations in icing conditions, air traffic service providers should initially and periodically train controllers on the hazards / impacts of icing on aircraft performance when holding or vectoring aircraft to the final approach course in areas of known or reported icing conditions.	ATC
2.1	2.5	5.25	548	548 In order to provide flight crews with engine out training on takeoff without visual outside reference, regulators should require and operators should conduct takeoff engine out training and evaluation during the portion of the takeoff after rotation through initial climb.	TRAINING
2.4	2.2	5.21	381	381 To provide improved pilot awareness of the airplane's energy state, manufacturers should develop and incorporate more effective energy management monitoring and alerting systems.	A/C-DEZ
2.4	2.2	5.21	372	372 To ensure that in-service problems are reliably assessed for their safety implications and corrected, regulators, operators, and manufacturers should develop and implement a standard set of criteria for determining whether or not a problem is safety-related and for timely corrective action.	P&P
2.4	2.2	5.21	521	521 To ensure airline/operator training programs provide enhanced aircrew proficiency, regulators should revise FAR Part 121, Appendix F to raise the minimum standards. (See 114)	TRAINING
3.1	1.7	5.18	472.1	472 Since certain engine control and autothrottle system failures can result in undesirable asymmetry, manufacturers should redesign ATSs so that they disconnect (with appropriate annunciation) when unable to achieve the commanded thrust settings (analogous to autopilot disconnect logic).	A/C -DEZ RETRO
3.1	1.7	5.18	380.1	380 To reduce the risk of inadvertent entry into stall, manufacturers should develop and implement stall protection features in all transport category airplanes, (e.g. stick pusher, alpha protection)	A/C -DEZ RETRO
3.1	1.7	5.18	154	154 Airlines/operators should improve/increase training to increase awareness of icing effects on airplane type including dynamic simulator training.	TRAINING
2.2	2.3	5.13	528	528 To provide optimal training (including propulsion system malfunctions) and to minimize negative training, regulators, aircraft and simulator manufacturers and operators should ensure that training devices replicate realistic failure scenarios, aircraft performance and appropriate response. (See 358)	TRAINING
1.7	3	5.1	26	26 Airlines/operators should ensure that CRM training is provided prior to line flying.	TRAINING
1.7	3	5.1	113	113 Airlines/operators should ensure that their training/standardization programs emphasize the importance of adequate preflight planning.	TRAINING
1.7	3	5.1	393	393 To ensure system status awareness, airlines/operators should ensure that their training/standardization programs direct the flight crews to use all available tools to determine airplane system status.	TRAINING

				(See 47)	
1.7	3	5.1	529	529 To avoid negative training, airline operators should ensure that their training curriculum correlates with the AOM and other relevant manuals.	TRAINING
1.8	2.8	5.09	30	30 Airlines/operators should adopt the "delegated" approach to standard operating procedures. (e.g. monitored approach procedures)	P&P
3.8	1.3	5.05	566.1	566 Manufacturers should incorporate an automatic yaw compensation to ensure that adequate yaw control is provided.	A/C -DEZ RETRO
2	2.5	5	439	439 To ensure proper designation of pilots conducting non-standard flight operations (e.g., Functional Evaluation Flights), regulation and/or guidance should be revised to clearly indicate pilot experience, pairing, and training levels required	TRAINING
2.3	2.2	4.99	149	149 Manufacturers should install a HUD as standard equipment. (See 85)	A/C-DEZ
2.3	2.2	4.99	464	464 To ensure proper identification of flight critical issues, manufacturers, operators and regulators must develop consistent criteria to properly identify and disseminate (in a timely manner, including manual revisions) flight safety critical information.	P&P
3.3	1.5	4.95	16.1	16 To prevent mode confusion, manufacturers should ensure that automated systems provide the flight crew with sufficient information (automation feedback).	A/C -DEZ RETRO
2.7	1.8	4.94	488.1	488 To facilitate recovery and attitude awareness, manufacturers should include adequate instrumentation to optimize performance during recovery from unusual attitude	A/C -DEZ RETRO
2.1	2.3	4.89	409	409 To enhance stability during the approach and landing phase, airline operators should develop and implement policies and procedures that address mixed mode flight (e. g., autothrottles in manual flight) with specific emphasis on pitch/thrust coupling and aircraft control problems.	P&P
1.8	2.7	4.81	414	414 To reduce negative transfer effects during pilot transition to new aircraft, airline operators should determine the potential for negative transfer of inappropriate pilot actions and techniques on flight critical systems and overtrain to prevent their occurrence.	TRAINING

1.8	2.7	4.81	473	473 Due to increasing dependence on automation and the complexity of potential partial system failures, airlines/operators should modify training programs to emphasize the use of multiple data sources to confirm that the airplane and systems are performing as expected and in accordance with the operational mode.	TRAINING
1.8	2.7	4.81	519	519 To ensure pilot proficiency in basic airmanship skills and knowledge, regulators should require training/standardization programs that emphasize these subjects during initial and recurrent training. (See 111)	TRAINING
1.8	2.7	4.81	538	538 Airline/operators should train flight crews in team decision-making skills, including the ability to rapidly turn data into information and test conclusions. (See 314)	TRAINING
1.7	2.8	4.81	470	470 Since current airline training emphasizes recovery from approach to stall, airline/operators should emphasize to air crews the importance of proper analysis and response to incipient stall conditions (for example timely reduction in angle of attack) (Exist.Tech.)	TRAINING
2.4	2	4.8	531	531 To minimize the occurrence of loss of control during unstable approaches, manufacturers should design and implement a system to detect unstable approaches and provide an automatic callout to go around.	A/C-DEZ
2.4	2	4.8	345	345 Ensure regulators have adequate funding, training and processes to accomplish their oversight responsibilities. (See 201)	P&P
2.4	2	4.8	420	420 In order to assure that airline operations depts. understand the operational implications of dispatching with degraded systems, manufacturers and operators should develop a method for providing such information to crews, for MEL and other dispatchable failure conditions including intermittent failures.	P&P
2.8	1.7	4.68	527	527 To ensure that alerting and warning logic does not annunciate self-recovery functions or alerts that do not require pilot action, the manufacturer should design systems that annunciate only when pilot action is required.	A/C-DEZ
2.8	1.7	4.68	500	500 To ensure that flight crews initiate correct in-flight icing procedures, the regulators should require installation of ice detection system that provides annunciation that alerts the crew to respond appropriately to the icing hazard.	A/C-DEZ
3.5	1.3	4.66	501.1	501 To assist flight crews in avoiding loss of control, manufacturers should develop and regulators should require autoflight system auto-disconnect logic which does not disconnect when the autoflight system is properly attempting to correct an abnormal flight situation/condition. (See 363)	A/C -DEZ RETRO
3.1	1.5	4.65	424.1	424 To enhance crew awareness of automation modes, manufacturers should ensure that mode changes or disconnects, in the automated systems are annunciated in a way that is obvious to the flight crew.	A/C -DEZ RETRO
3.1	1.5	4.65	412.1	412 To avoid problems due to unexpected mode changes, automated flight system logic should be designed to be error tolerant or, at a minimum provide an alert when the desired mode is in conflict with aircraft energy state.	A/C -DEZ RETRO
2.3	2	4.6	383	383 To ensure adequate time margin between stall warning and actual stall, manufacturers and regulators should develop and implement stall warning systems that account for various entry rates/conditions to stall.	A/C-DEZ
2.3	2	4.6	438	438 To reduce the probability of accidents, operators should adopt operational risk management techniques for non-standard flight operations and/or flights requiring intensive training scenarios.	P&P

2.1	2.2	4.56	24	24 Airlines/operators should implement procedures to ensure appropriate crew pairing. (reference FSF corporate crew scheduling and fatigue evaluation.)	P&P
2.1	2.2	4.56	347	347 Parent airlines/operators should adopt a program to ensure the same level of safety in regional partners including, but not limited, to recruitment, training, operations and maintenance.	P&P
1.7	2.7	4.54	243	243 To prevent alerting overload, flight deck designs should consider smart alerting systems such as those with prioritization schemes or cancelable nuisance alerts.	A/C-DEZ
2.7	1.7	4.51	498	498 To ensure safe operating speeds in icing conditions, regulators shall require that minimum safe operating speeds in icing conditions be published in the aircraft flight manual (section 1) for all aircraft operating configurations.	A/C-DEZ
1.8	2.5	4.5	368	368 To enable pilots to develop situation awareness with respect to aircraft performance capability, regulators should require and manufacturers should provide angle of attack display.	A/C-DEZ
1.5	3	4.5	487	487 To minimize the occurrence of loss of control events, airline operators training programs should emphasize pattern recognition and skill-based procedures to cope with time critical situations, rather than relying on knowledge based analysis.	TRAINING
2	2.2	4.34	373	373 To ensure that manufacturers and regulators are aware of recurrent problems (type and frequency), manufacturers, regulators and operators should implement a reliable process for gathering and reporting safety-related problems.	DATA
2	2.2	4.34	48	48 Airlines/operators and regulators should strictly enforce flight/duty time limitations.	P&P
1.6	2.7	4.27	564	564 To reduce the need for pilots to work around the automation, manufacturers should ensure that systems designs and safety analyses consider the full range of operations.	A/C-DEZ
1.6	2.7	4.27	246	246 To reduce pilot overload, airlines/operators policies should stress using the appropriate level of automation.	P&P
1.7	2.5	4.25	370	370 To foster transfer of safety-related information, airplane and component manufacturers should participate in safety data sharing programs, (e.g. current Manufacturers' safety data sharing meetings).	DATA
1.7	2.5	4.25	447	447 In order to maintain adequate safety margins during flight training, operators should establish and regulatory agencies should require standards for conducting flight training which preclude overloading the trainee.	P&P
1.7	2.5	4.25	537	537 To ensure proper intra-cockpit communications, operators must ensure that the language used in the cockpit is compatible, understandable and consistent amongst all flight deck crewmembers.	P&P
1.5	2.8	4.25	508	508 To ensure that flight crews have and use all necessary weather information, airlines/operators shall train flight crews and airline dispatchers on the importance of reviewing weather information for potential in-flight icing.	TRAINING
2.1	2	4.2	129	129 Regulators should establish criteria to ensure operators overall quality assurance and compliance procedures are effective rather than reliance on spot checks of individual components.	P&P
1.4	3	4.2	17	17 Airlines/operators should ensure that their training/standardization programs emphasize the importance of all flight-related briefings. (See 342)	TRAINING

1.4	3	4.2	237	237 Airlines/operators should provide guidance to crew concerning evaluation of all options prior to decision making as part of CRM training. (See 25, 26, 131, 132, 133, 308)	TRAINING
3.1	1.3	4.12	515.1	515 To warn of impending loss of control with the autoflight system fully engaged, manufacturers should develop and regulators should require annunciation of an airplane flight condition which significantly differs from that being commanded by the selected autoflight system mode. (See 243)	A/C -DEZ RETRO
3.1	1.3	4.12	485	485 To preclude the accidental change of aircraft systems status, manufacturers should design flight decks to minimize the potential for inadvertent activation/deactivation of aircraft systems and/or unintended autoflight mode changes.	A/C-DEZ
2.7	1.5	4.05	433.1	433 To preclude inadvertent entry into stall conditions during autopilot operation, regulators should not permit and manufacturers should not design autoflight systems that will allow the autopilot to control the aircraft into a stalled condition.	A/C -DEZ RETRO
2.7	1.5	4.05	407	407 To minimize pilot reaction requirements during transition from autocoupled to manual flight during approach, regulators should require and manufacturers should design autoflight systems so that ALIGN mode need not be engaged when a manual landing is planned.	A/C-DEZ
2.2	1.8	4.03	153	153 Ensure that flight crews are adequately trained in a level D simulator for dynamic characteristics before assignment to the line. (See 312)	P&P
2.2	1.8	4.03	450	450 To ensure the aircraft can be safely flown by pilots with normal skill levels, regulatory authorities should require that handling quality tests and demonstrations intended to show compliance with applicable regulations include representative line pilots as test subjects.	P&P
1.5	2.7	4.01	504	504 To provide more tactile cues to flight crews on turboprop aircraft in icing conditions, airlines/operators should develop SOP's calling for flight crews to disengage autopilot during maneuvering, when workload permits.	P&P
2	2	4	437	437 To enhance the safety of functional evaluation flights (FEF), regulators should establish standards for critical aircraft handling maneuvers.	P&P
1.6	2.5	4	480	480 To improve operational oversight, regulators should institute processes for periodic review of POIs to ensure that appropriate oversight is being conducted for the POI's assigned operators.	P&P
1.8	2.2	3.91	491	491 To ensure adequate flight crew competency, airlines/operators should establish more effective pilot screening and Capt. upgrade criteria to identify candidates with demonstrable flying skill deficiencies. (See 335)	P&P
1.3	3	3.9	228	228 Regulators should require airlines/operators to modify their training to maximize benefits of inter-crew/company communications.	TRAINING
2.3	1.7	3.84	149.1	149 Manufacturers should install a HUD as standard equipment. (See 85)	A/C -DEZ RETRO
1.5	2.5	3.75	565	565 Manufacturers should incorporate an "input rudder" indicator to ensure that adequate yaw control is provided.	A/C-DEZ
1.5	2.5	3.75	350	350 Airlines/operators shall ensure that adequate approach briefings are conducted that includes descriptions of normal approach, non-normal conditions and the results of the risk assessment analysis. (See 300)	P&P

2.8	1.3	3.72	253.1	253 To prevent loss of control, there should be redundancy and failure tolerance features for all flight critical components, such as dual path design, fail operational redundant systems, with fault annunciation.	A/C -DEZ RETRO
1.7	2.2	3.69	454	454 Because latent and combination failures have been missed in failure analyses, manufacturers and regulators should conduct more intensive verification of all safety analyses associated with systems whose failures, singly or in combination with other system failures, can result in accidents.	A/C-DEZ
1.7	2.2	3.69	540	540 To ensure completeness, avoid erroneous procedures and prevent misinterpretation, manufacturers/operators should ensure and regulatory agencies should check that the guidance and procedures in AOM's are complete, clear and correct.	P&P
1.3	2.8	3.68	403	403 To ensure clear communication, airline operators should train flight crews to emphasize if action is required when giving status reports.	TRAINING
3.1	1.2	3.63	485.1	485 To preclude the accidental change of aircraft systems status, manufacturers should design flight decks to minimize the potential for inadvertent activation/deactivation of aircraft systems and/or unintended autoflight mode changes.	A/C -DEZ RETRO
3.1	1.2	3.63	413.1	413 To prevent negative transfer effects with flight critical systems, regulators should establish requirements for standardization of flight deck information/controls	A/C -DEZ RETRO
3.1	1.2	3.63	398.1	398 To provide real time accurate wind component information to flight crews, air traffic services and manufacturers should implement real time (automated) transmission/display of such information in the most directly useable format to the flight crew, during approach and landing phase. (See 94)	A/C -DEZ RETRO
3.1	1.2	3.63	413	413 To prevent negative transfer effects with flight critical systems, regulators should establish requirements for standardization of flight deck information/controls	A/C-DEZ
3.1	1.2	3.63	398	398 To provide real time accurate wind component information to flight crews, air traffic services and manufacturers should implement real time (automated) transmission/display of such information in the most directly useable format to the flight crew, during approach and landing phase. (See 94)	A/C-DEZ
2.4	1.5	3.6	391	391 Because of the interaction between systems, manufacturers should develop alerting systems that help pilots understand any common cause of multiple failure messages	A/C-DEZ
1.2	3	3.6	21	21 Establish/enhance quality assurance checks/training to ensure that timely and accurate communication between controllers and flight crews is occurring.	ATC
1.2	3	3.6	106	106 Air Traffic service providers should train and monitor ATC adherence to established communications procedures including hearback problems. (See 240)	ATC
1.8	2	3.6	223	223 Regulators should ensure POIs are properly qualified and trained to approve appropriate company operational procedures.	P&P
1.2	3	3.6	96	96 Airlines/operators should ensure that their training/standardization programs emphasize the importance of adequate approach preparation and contingency review prior to commencing an approach.	TRAINING
2.1	1.7	3.51	442.1	442 To avoid delay in the recognition of engine malfunction/failure, manufacturers should develop and implement a direct aural and visual flight deck indication of engine malfunction/failure minor transients need not be annunciated.	A/C -DEZ RETRO

1.5	2.3	3.5	371	371 To eliminate the potential safety consequences of system failures, manufacturers/operators should develop a reliable process for identifying, prioritizing, and resolving the safety consequences of system and component malfunctions throughout the operational envelope.	A/C-DEZ
1.5	2.3	3.5	387	387 To ensure that airplane systems function as designed, airlines/operators should develop processes to ensure adherence to manufacturer's recommended maintenance procedures.	P&P
1.6	2.2	3.47	481	481 Because POIs may be responsible for oversight of remote training activities, regulators should ensure that POIs have sufficient Certificate Holding District Office resources, including staff, to conduct appropriate oversight for the POI's assigned operators.	P&P
1.2	2.8	3.4	342	342 Airlines/operators should establish an SOP to ensure that flight crews should not begin the approach until adequate briefing is completed for the expected runway. (See 17)	P&P
2	1.7	3.34	94	94 Implement real time (digital) transmission of airport and weather information to the aircraft.	ATC
1.1	3	3.3	141	141 Airlines/operators and regulators should require training/standardization programs include training regarding physiological effects on aircrew performance, (e.g. low blood sugar, fatigue).	TRAINING
1.1	3	3.3	452	452 Since handling qualities and performance margins may be significantly different during high altitude cruise, airlines/operators should ensure that pilots receive adequate training and experience in manual flying in this flight regime.	TRAINING
1.8	1.8	3.29	151	151 Regulators should establish policies that require additional monitoring of flight crewmembers that have repeatedly failed check rides. (See 152, 335, 337)	P&P
1.8	1.8	3.29	543	543 In order to provide pilots with sufficient airplane performance margins to reduce exposure to potential to upsets, regulators should require airplane operation in a cruise flight envelope with at least 1.3g margin to buffet onset.	P&P
2.8	1.2	3.28	527.1	527 To ensure that alerting and warning logic does not annunciate self-recovery functions or alerts that do not require pilot action, the manufacturer should design systems that annunciate only when pilot action is required.	A/C -DEZ RETRO
2.8	1.2	3.28	416.1	416 To provide improved flight crew situation awareness, manufacturers should provide a clear indication that predicts the future aircraft energy state and/or autoflight configuration if the current course of action is continued (i.e., analogous to EGPWS mode that analyzes the airplane's descent rate vs. its terrain map, and tells the crew that a conflict will occur if they continue at that descent rate. The system would warn the crew that, if they continue at the current roll rate (for example), the plane will exceed the envelope, or the autopilot will reach the limits of its authority, etc.)	A/C -DEZ RETRO
1.5	2.2	3.26	371.1	371 To eliminate the potential safety consequences of system failures, manufacturers/operators should develop a reliable process for identifying, prioritizing, and resolving the safety consequences of system and component malfunctions throughout the operational envelope.	A/C -DEZ RETRO
1.5	2.2	3.26	469	469 To ensure clear understanding of flight crew tasking airlines/operators should develop criteria specifying when transfer of control is necessary or appropriate. (See 207)	P&P
1.4	2.3	3.26	489	489 In order to improve oversight of airlines, regulators should ensure their organizations (Flight Standards in the USA) are staffed to provide adequate inspector coverage for all airlines, (including small airlines).	P&P

1.3	2.5	3.25	559	559 To reduce the likelihood of hard landings, airlines/operators should develop training syllabi with improved coverage of landings, including identification of and recovery from unstabilized flares, high sink rates, and bounced landings.	TRAINING
1.6	2	3.2	468	468 To ensure the highest quality of Air Traffic Services, regulators should establish policies that require additional oversight and training of AT controllers that repeatedly commit operational errors.	ATC
1.6	2	3.2	468	468 To ensure the highest quality of air traffic services, regulators should establish policies that require additional oversight and training of air traffic controllers that repeatedly commit operational errors. TX to ATC Team.	P&P
1.6	2	3.2	536	536 To prevent reoccurrence of accidents and incidents, regulators / manufacturers / operators should expedite development and application of an effective risk management continuing airworthiness assessment based upon prior incidents and disseminate the results (see 372, 373).	P&P
1.6	2	3.2	562	562 Airlines/operators should develop processes to identify and thoroughly review (seeking "no technical objection" from manufacturer, when appropriate) informal pilot techniques to ensure that they have no unacceptable unintended consequences.	P&P
2.4	1.3	3.19	531.1	531 To minimize the occurrence of loss of control during unstable approaches, manufacturers should design and implement a system to detect unstable approaches and provide an automatic callout to go around.	A/C -DEZ RETRO
2.7	1.2	3.16	407.1	407 To minimize pilot reaction requirements during transition from autocoupled to manual flight during approach, regulators should require and manufacturers should design autoflight systems so that ALIGN mode need not be engaged when a manual landing is planned.	A/C -DEZ RETRO
2.1	1.5	3.15	474.1	474 Since indications of sideslip may not be prominent and can be masked by roll effects, manufacturers should develop improved sideslip indications and/or alerting (e.g. similar to pitch limit indications for pitch / angle of attack).	A/C -DEZ RETRO
1.7	1.8	3.11	513	513 To preclude undesired flight control displacement due to aerodynamic forces, manufacturers should design flight controls so that the airplane does not experience uncommanded, adverse flight control deflections that are beyond the control of the flight crew. (throughout the flight envelope, including aerodynamic stall)	A/C-DEZ
1.1	2.8	3.11	375	375 To improve controller situation awareness, air traffic service providers should ensure that their training/standardization programs direct that controllers use all available tools to establish aircraft position. (See 75)	ATC
1.1	2.8	3.11	432	432 To facilitate recovery from flight upsets, airlines/operators should clearly define, train and check the specific PF/PNF upset recovery duties.	TRAINING
2.3	1.3	3.06	383.1	383 To ensure adequate time margin between stall warning and actual stall, manufacturers and regulators should develop and implement stall warning systems that account for various entry rates/conditions to stall.	A/C -DEZ RETRO
1.3	2.3	3.03	251.1	251 To preserve the original intended level of airworthiness, there should be a better definition and classification of subsequent in-service major and minor critical component changes. The definition of critical component should be more specific.	A/C -DEZ RETRO

1.8	1.7	3.01	368.1	368 To enable pilots to develop situation awareness with respect to aircraft performance capability, regulators should require and manufacturers should provide angle of attack display.	A/C -DEZ RETRO
1.5	2	3	573	573 To preclude late descent clearances, AT Service should ensure that standard terminal arrival procedures are in place to transition from enroute altitudes to the instrument approach procedure.	ATC
1.5	2	3	421	421 Since intermittent failures can persist for unspecified periods of time without correction, operators should develop specific policies, procedures and guidance defining when degraded systems or systems with intermittent problems should be disabled, invoking the appropriate MEL requirements.	P&P
1.5	2	3	573	573 To preclude late descent clearances, Air Traffic Service should ensure that standard terminal arrival procedures are in place to transition from enroute altitudes to the instrument approach procedure. TX to ATC Team.	P&P
1.1	2.7	2.94	436	436 To ensure adequate stall warning, regulators should mandate improved accuracy and integrity in the stall warning system (including aircraft currently in service)	A/C-DEZ
1.1	2.7	2.94	534	534 Airlines/operators should implement procedures that call for an immediate recovery maneuver following a warning that is indicating an imminent departure from normal flight envelope (e.g. stall warning, over-speed). (See 161)	P&P
1.1	2.7	2.94	493	493 To reduce the risk of pilots' non-readiness for flying, airlines/operators should train pilots to perform self-audit medical and psychological assessments prior to flight duty.	TRAINING
2.2	1.3	2.93	382.1	382 To provide improved pilot awareness of airspeed, manufacturers should provide flight instruments with more effective airspeed trend indications and alerting.	A/C -DEZ RETRO
2.2	1.3	2.93	245	245 To recover aircraft in unusual attitude, manufacturers should develop systems to return aircraft to normal attitude with one pilot button push (pilot initiated auto-recovery systems).	A/C-DEZ
1	2.8	2.83	224	224 Airlines/operators should ensure that all airline operations include compliance with all/seasonal guidance from the OEM.	P&P
1	2.8	2.83	378	378 To preclude continued flight into an unsafe energy state, Airlines/operators should establish procedures for flight crews to establish a safe, stabilized flight condition when situational uncertainty exists and THEN advise ATC of intentions.	P&P
1	2.8	2.83	506	506 To ensure that the airworthiness authorities know and understand the importance of complying with the international agreements, ICAO should distribute annual notices to the authorities emphasizing the importance of mutual distribution of continued airworthiness information.	P&P
1	2.8	2.83	482	482 To prevent inaction when the PF is confused or unresponsive to an in-flight hazard, airlines/operators should develop and train clear and explicit procedures to define when/how the PNF (especially the F/O) will take control of the airplane.	TRAINING
1.3	2.2	2.82	369	369 To provide adequate stall warning, regulators should require and manufacturers should develop stall warning systems for new/derivative aircraft that provide accurate information throughout the certificated flight regime.	A/C-DEZ

1.3	2.2	2.82	130	130 Regulators should account for realistic rest scenarios when developing and implementing crew rest requirements during travel segments. (See 31, 203, 257, 315, 316)	P&P
1.3	2.2	2.82	479	479 To improve operational oversight, regulators should establish selection criteria and appropriate training programs (e.g. training with carriers) to ensure that POIs responsible for air carrier oversight have appropriate knowledge and experience to perform those functions.	P&P
2.4	1.2	2.81	391.1	391 Because of the interaction between systems, manufacturers should develop alerting systems that help pilots understand any common cause of multiple failure messages	A/C -DEZ RETRO
2.4	1.2	2.81	381.1	381 To provide improved pilot awareness of the airplane's energy state, manufacturers should develop and incorporate more effective energy management monitoring and alerting systems.	A/C -DEZ RETRO
2.4	1.2	2.81	121	121 Air Traffic service providers should implement worldwide surveillance radar (example: ADS/B)	ATC
2.4	1.2	2.81	374	374 To provide terminal area position information in non-radar environments, ATS providers and airplane manufacturers should implement terminal area automatic dependent surveillance (ADS-B) (Traffic Information Services (TIS))	ATC
1.4	2	2.8	300	300 Airlines/operators should adopt, implement and train a risk assessment tool to enhance flight crew awareness of hazards associated with all approaches and airports (see risk analysis tactical checklist).	P&P
1.2	2.3	2.8	518	518 To ensure an adequate supply of qualified pilots, the aviation community should promote initiatives that screen youth for potential aviator qualifications, skills, and aptitude. The industry should identify and develop career paths for suitable candidates and mentor their career growth as successful aviators.	P&P
2.2	1.2	2.57	45	45 Manufacturers should ensure that all impending equipment failures or inappropriate settings that may affect the safe operation of the flight are properly annunciated to the flight crew by use of dual source sensing. (See 103, 138)	A/C-DEZ
1.1	2.3	2.56	418	418 Because not all operators understand the significance of failures which may result in yaw/roll upsets, manufacturers should provide airlines with more information regarding the airplane control implications of such failures.	P&P
1.4	1.8	2.56	316	316 Regulators should require airline/operators to train flight crews to recognize and counteract acute and chronic fatigue. (See 31, 130, 203, 257,315)	TRAINING
1.1	2.3	2.56	349	349 Airlines/operators should ensure training for instructors and check airmen include objective criteria to be used in evaluating crew CRM performance. (See 25,131)	TRAINING
1.7	1.5	2.55	402.1	402 To prevent a more serious event, manufacturers should revise product failure analyses if service history reveals unexpected consequences or failure modes.	A/C -DEZ RETRO
1.7	1.5	2.55	243.1	243 To prevent alerting overload, flight deck designs should consider smart alerting systems such as those with prioritization schemes or cancelable nuisance alerts.	A/C -DEZ RETRO
0.9	2.8	2.55	296	296 To mitigate confusion regarding ATC clearances, operators should develop procedures to ensure flight crews query ATC whenever uncertainty exists.	P&P

0.9	2.8	2.55	524	524 Regulators should establish flight crew phraseology guidelines and airlines/operators should train and monitor flight crew compliance with communication phraseology guidelines. (See 88, 240)	TRAINING
1	2.5	2.5	451	451 To allow adequate training in manual flight, manufacturers should develop models to allow flight simulators to accurately represent the aircraft's stability and control characteristics for all regions of the flight envelope likely to be encountered during normal operations, (i.e. Operation within the AFM-approved flight envelope with no failures affecting aerodynamic performance).	TRAINING
1.6	1.5	2.4	564.1	564 To reduce the need for pilots to work around the automation, manufacturers should ensure that systems designs and safety analyses consider the full range of operations.	A/C -DEZ RETRO
1.2	2	2.4	492	492 In order to ensure pilot medical fitness for duty, airlines/operators/regulators should establish a structured process for return to flight status after sick leave that includes medical clearance.	P&P
0.8	3	2.4	549	549 To prevent a blurring of flight crew responsibilities when two captains are paired to fly a trip sequence, one of the pilots should be designated as the pilot-in-command for the duration of the trip pairing.	P&P
0.8	3	2.4	133	133 Airlines/operators training of Captains and Chief Pilots should include Management practices that promote team building and effective human relations (leadership training beyond current CRM programs). (See 308)	TRAINING
1.1	2.2	2.39	523	523 To ensure that airline operation training departments accomplish their training responsibilities, they must be adequately funded.	P&P
1.1	2.2	2.39	348	348 Airlines/operators should utilize a self-audit process (such as FSF ICARUS recommendation), operational risk management programs and accident cost analysis to proactively identify and mitigate safety concerns. (See 318)	P&P
1	2.3	2.33	560	560 Since geographic organization of inspection responsibilities can affect the quality/timeliness of inspections conducted by supporting organizations at remote locations, regulators should ensure that these remote inspectors are more accountable to the requesting certificate office. (the CHDO/CMO).	P&P
1.7	1.3	2.26	513.1	513 To preclude undesired flight control displacement due to aerodynamic forces, manufacturers should design flight controls so that the airplane does not experience uncommanded, adverse flight control deflections that are beyond the control of the flight crew. (throughout the flight envelope, including aerodynamic stall)	A/C -DEZ RETRO
1.7	1.3	2.26	454.1	454 Because latent and combination failures have been missed in failure analyses, manufacturers and regulators should conduct more intensive verification of all safety analyses associated with systems whose failures, singly or in combination with other system failures, can result in accidents.	A/C -DEZ RETRO
0.8	2.8	2.26	123	123 Airlines/operators should implement a true no-fault go around policy (learning vs. blame).	P&P
1.5	1.5	2.25	565.1	565 Manufacturers should incorporate an "input rudder" indicator to ensure that adequate yaw control is provided.	A/C -DEZ RETRO
2.2	1	2.2	245.1	245 To recover aircraft in unusual attitude, manufacturers should develop systems to return aircraft to normal attitude with one pilot button push (pilot initiated auto-recovery systems).	A/C -DEZ RETRO
2.2	1	2.2	45.1	45 Manufacturers should ensure that all impending equipment failures or inappropriate settings that may affect the safe operation of the flight are properly annunciated to the flight crew by use of dual source sensing. (See 103, 138)	A/C -DEZ RETRO

1.2	1.8	2.2	495	495 To improve aircraft failure tolerance, manufacturers and regulators should conduct failure analyses for design and certification that reflect realistic levels of flight crew reliability	A/C-DEZ
1.1	2	2.2	143	143 Airlines/operators should and regulatory agencies must encourage a culture that enhances safety in their daily operations. (Safety Culture) (See 22, 63, 348)	P&P
0.9	2.3	2.1	541	541 To reduce the risk of loss of control during flight with a propulsion system malfunction in turboprop aircraft, if the engine failure procedure is not completed, airline operators should review the consequences of the malfunctioning propulsion system being placed in flight idle.	P&P
0.7	3	2.1	100	100 Airlines/operators should ensure that their training/standardization programs emphasize the importance of adhering to MDA/DH.	TRAINING
0.7	3	2.1	136	136 Airlines/operators should ensure that their training/standardization programs emphasize the importance of the sterile cockpit environment.	TRAINING
0.7	3	2.1	555	555 Because it is important that training reflect the realities of line operations, airline training departments should review and modify, in consultation with line pilots, training curricula to reflect realistic line operations scenarios and conditions.	TRAINING
1.1	1.8	2.01	203	203 Airlines/operators should provide crews with in-flight rest periods and adequate facilities. (See 31, 130, 315)	P&P
1.1	1.8	2.01	242	242 To prevent excessive fatigue, airlines/operators should consider circadian rhythm in crew scheduling to compensate for the effects of rhythm interruptions.	P&P
1	2	2	390	390 Because some partial system failures may not be reliably observed, manufacturers should develop warning systems that alert the pilot to those partial/total failures of flight critical systems and flight instruments.	A/C-DEZ
1	2	2	49	49 Regulators should establish criteria for, and manufacturers should evaluate and improve the reliability and failure tolerance of flight systems. (includes hardware, software and human performance). (See 332)	A/C-DEZ
1.2	1.7	2	42	42 Airlines/operators and air traffic service providers should implement a monitoring program to ensure the consistent use of the ICAO phraseology.	ATC
1	2	2	505	505 To ensure that safety related incident information is shared between validating and certificating authorities, regulators should develop a system to review the terms of and compliance to bilateral airworthiness agreements.	P&P
1.7	1.2	1.99	440.1	440 To ensure all aircraft meet currently-accepted minimum performance standards, regulators should require warning systems that meet airworthiness standards.	A/C -DEZ RETRO
1.3	1.5	1.95	446	446 To decrease the probability of ice buildup, manufacturers should design and install a system that automatically sheds ice from flight-critical surfaces	A/C-DEZ
1.3	1.5	1.95	526	526 To increase the number of available pilots, airlines should implement, and regulators should allow, a performance-based selection system that expands the eligible pilot pool beyond the current arbitrary limits (e.g., age 60 rule, minimum flight time)	P&P
0.9	2.2	1.95	310	310 Regulators should not allow noise abatement procedures that reduce the level of safety that existed prior to their implementation.	P&P
0.9	2.2	1.95	434	434 To enhance the safety of operations, regulatory agencies should develop adequate oversight to encourage the use of commonly accepted safe operating practices. (See 201)	P&P

0.7	2.7	1.87	557	557 Since current ATC procedures can result in non-standard use of autoflight systems (e.g. "slam dunk approaches"), air traffic service providers should harmonize ATC procedures so that they take into account the flight characteristics of modern airplane	ATC
0.8	2.3	1.86	376	376 To improve aircrew awareness of other traffic, manufacturers should install TCAS in all new aircraft, airlines/operators should retrofit TCAS into the existing fleet and international regulators should require the installation and use of TCAS. (See 35)	A/C-DEZ
0.8	2.3	1.86	563	563 Manufacturers should provide airlines/operators with training material designed to explain to pilots how and why systems work the way they do.	TRAINING
0.9	2	1.8	569	569 Since hard landings are identified primarily based on pilot subjective judgment and to ensure that individual airplanes are inspected when necessary, manufacturers should develop and regulatory authorities should require the implementation of objective means to identify the occurrence of a hard landing within an appropriate period of time.	A/C-DEZ
0.9	2	1.8	558	558 Since current ATC procedures can result in non-standard use of autoflight systems (e.g. "slam dunk approaches"), air traffic service providers and airplane manufacturers should develop and implement automated tools so that ATC clearances are integrated with and take into account the performance of airplanes using autoflight systems (e.g. CTAS/FMS program). (See 557)	A/C-DEZ
0.6	3	1.8	241	241 To eliminate hearback errors, ATC should reexamine and implement improvements to address hearback problems. (See 240)	ATC
0.9	2	1.8	476	476 Since repair processes can significantly affect the airworthiness of components, regulators should require manufacturer concurrence on all maintenance and repair procedures affecting critical aircraft structures, components, or performance.	P&P
0.6	3	1.8	105	105 Airlines/operators should train flight crews on how flight delays upon departure or enroute (weather, maintenance, ATC, etc.) can affect their subsequent decision-making relative to the safe conduct of the flight.	TRAINING
0.7	2.5	1.75	22	22 Airlines/operators should encourage a culture that emphasizes safe arrivals over timely arrivals. (See 63, 143)	P&P
0.8	2.2	1.74	396	396 To ensure a standard level of safety at all airports, airport operators should adopt airport operations procedures that are no less stringent than ICAO recommendations.	P&P
0.8	2.2	1.74	422	422 To ensure constant visibility of known intermittent failures, operators should develop procedures for continued reporting of and maintenance actions to address unresolved intermittent failures.	P&P
0.8	2.2	1.74	567	567 To minimize potential negative safety implications of procedural changes, airlines/operators should develop processes to review all proposed operating procedures in order to uncover and evaluate potential unintended consequences.	P&P
1.7	1	1.7	475	475 Since simulators cannot adequately replicate the motion cues associated with sideslip, the industry should develop improved methods for safely training pilots to recognize and respond to in-flight sideslip events. (See 358, 386)	TRAINING
0.6	2.8	1.7	162	162 Airline/operators should include in their training programs the awareness of potential safety risks due to the complacency when operating at a very familiar airport (e.g. home base).	TRAINING
1.1	1.5	1.65	436.1	436 To ensure adequate stall warning, regulators should mandate improved accuracy and integrity in the stall warning system (including aircraft currently in service)	A/C -DEZ RETRO

0.7	2.3	1.63	478	478 To improve maintenance quality, regulators should increase oversight of maintenance facilities that maintain safety-critical parts, components, or systems.	P&P
0.7	2.3	1.63	556	556 To reduce pilot overload, airlines/operators should develop standard operating procedures to help standardize the use of the appropriate level of automation for the operation and the airplane design (See 246, 530).	P&P
0.8	2	1.6	367	367 To provide necessary information to pilots, regulators should require and manufacturers should develop flight control position indicating and alerting systems which will provide warnings for critical aircraft flight control malfunctions, e.g., actual flight control position disagreement with commanded position.	A/C-DEZ
0.6	2.7	1.6	240	240 To reduce the possibility of error, confusion and workload increase related to ATC clearances, regulators should require and operators ensure that flight crews utilize proper phraseology and readbacks. (See 88)	P&P
0.7	2.2	1.52	477	477 To improve maintenance quality, regulators should require that airlines/operators institute processes for oversight of maintenance facilities that maintain safety-critical parts, components, or systems (e.g. CASE (Coordinating Agency for Supplier Evaluation) might be one type of program that could provide an acceptable method of compliance).	P&P
0.9	1.7	1.5	558.1	558 Since current ATC procedures can result in non-standard use of autoflight systems (e.g. "slam dunk approaches"), air traffic service providers and airplane manufacturers should develop and implement automated tools so that ATC clearances are integrated with and take into account the performance of airplanes using autoflight systems (e.g. CTAS/FMS program). (See 557)	A/C -DEZ RETRO
0.5	3	1.5	435	435 To ensure stall warning systems are properly functioning, manufacturers should establish appropriate inspection and calibration procedures.	A/C-DEZ
0.6	2.5	1.5	95	95 Airlines/operators should establish procedures for flight crews to review/cross check instructions, clearances, etc. to ensure consistency with expected procedures or practices.	P&P
0.5	3	1.5	88	88 Airlines/operators should train and monitor flight crew compliance with established communication phraseology guidelines.	TRAINING
0.5	2.8	1.42	19	19 Airlines/operators should implement a procedure to climb to a minimum safe altitude when position uncertainty exists by at least one crewmember. Flight crew must advise ATC of intentions.	P&P
0.5	2.8	1.42	297	297 To prevent CFIT, operators should develop procedures to ensure that flight crews do not descend when confusion exists concerning aircraft position.	P&P
0.7	2	1.4	363	363 To enhance aircraft controllability in severe or greater turbulence conditions, regulators and manufacturers should develop and implement certification criteria that consider effects of turbulence, including autoflight capability and disconnect parameters.	A/C-DEZ
0.7	2	1.4	389	389 To assist flight crews in responding to system malfunctions, manufacturers should develop and airlines/operators should incorporate readily accessible flight crew procedures for partial or total failure of flight critical systems.	P&P
0.7	2	1.4	570	570 To ensure appropriate crew experience levels, regulatory authorities should require procedures to ensure appropriate crew pairing. (ref FSF Corporate Crew Scheduling and Fatigue Evaluation)(see 24)	P&P
0.9	1.5	1.35	569.1	569 Since hard landings are identified primarily based on pilot subjective judgment and to ensure that individual airplanes are inspected when necessary, manufacturers should develop and regulatory authorities should require the implementation of objective means to identify the occurrence of a hard landing within an	A/C -DEZ RETRO

				appropriate period of time.	
1	1.3	1.33	49.1	49 Regulators should establish criteria for, and manufacturers should evaluate and improve the reliability and failure tolerance of flight systems. (includes hardware, software and human performance). (See 332)	A/C -DEZ RETRO
0.6	2.2	1.3	574	574 To ensure accurate and safe flight release, airlines / operators should ensure that dispatchers are aware of and take into account aircraft and flight crew qualifications.	P&P
0.7	1.8	1.28	547	547 In order to ensure that the certification process is based solely on safety and compliance with the regulations, certification should include an independent audit process to guard against the influence of non-technical considerations.	P&P
0.5	2.5	1.25	135	135 Airlines/operators and regulators should ensure checklist design and implementation of procedures to promote effective crew coordination and distribution of PF and PNF tasks. (See 82)	P&P
0.5	2.5	1.25	429	429 To reduce the risk of flight with a structurally damaged airplane, airline operators should institute procedures for a diversion to the closest suitable airport following an upset event that exceeds defined parameters.	P&P
0.5	2.5	1.25	394	394 Because of increasing interactions between systems, manufacturers and training organizations should develop new approaches for instructing pilots in the interrelationships between systems.	TRAINING
0.8	1.5	1.2	376.1	376 To improve aircrew awareness of other traffic, manufacturers should install TCAS in all new aircraft, airlines/operators should retrofit TCAS into the existing fleet and international regulators should require the installation and use of TCAS. (See 35)	A/C -DEZ RETRO
0.8	1.5	1.2	367.1	367 To provide necessary information to pilots, regulators should require and manufacturers should develop flight control position indicating and alerting systems which will provide warnings for critical aircraft flight control malfunctions, e.g., actual flight control position disagreement with commanded position.	A/C -DEZ RETRO
0.8	1.5	1.2	28	28 Implement a system to automatically transmit ATC instructions/information between the ground controller and the aircraft.	ATC
0.4	3	1.2	52	52 Airlines/operators should ensure that their training/standardization programs establish flight crew proficiency in the use of the FMS system.	TRAINING
1	1.2	1.17	390.1	390 Because some partial system failures may not be reliably observed, manufacturers should develop warning systems that alert the pilot to those partial/total failures of flight critical systems and flight instruments.	A/C -DEZ RETRO
0.7	1.7	1.17	363.1	363 To enhance aircraft controllability in severe or greater turbulence conditions, regulators and manufacturers should develop and implement certification criteria that consider effects of turbulence, including autoflight capability and disconnect parameters.	A/C -DEZ RETRO
0.4	2.8	1.13	46	46 Airlines/operators should implement procedures to increase flight crew awareness of recent aircraft maintenance actions.	P&P
0.4	2.8	1.13	441	441 To avoid confusion, regulators/operators should develop a consistent standard for stall speed calculation.	P&P
0.5	2.2	1.09	435.1	435 To ensure stall warning systems are properly functioning, manufacturers should establish appropriate inspection and calibration procedures.	A/C -DEZ RETRO

0.5	2	1	544	544 To ensure that flight controls are available during critical flight phases or conditions, manufacturers should design system overrides that are available to the flight crew to regain manual control.	A/C-DEZ
0.5	2	1	78	78 Airlines/operators and regulators should improve the availability, clarity, and prioritization of NOTAM information.	ATC
0.4	2.3	0.93	554	554 Because it is important that training reflect the realities of line operations, airline training departments should include instructors who regularly fly in line operations.	TRAINING
0.5	1.8	0.92	544.1	544 To ensure that flight controls are available during critical flight phases or conditions, manufacturers should design system overrides that are available to the flight crew to regain manual control.	A/C -DEZ RETRO
0.4	2	0.8	410	410 To enhance safety in the airport environment, regulators and airport operators should develop guidelines for minimizing the effects of environmental factors on windfields in the approach and landing areas of the runways and work with local authorities to ensure implementation.	P&P
0.4	2	0.8	571	571 To ensure the aircraft can be safely flown by pilots with normal skill levels, regulatory authorities should require that tests and demonstrations intended to show compliance with applicable regulations include representative line pilots performing representative line-type operations.	P&P
0.5	1.5	0.75	122	122 Air Traffic service providers should implement transmission of ATC instructions/information (between the ground and aircraft) via a computer link as opposed to voice communications.	ATC
0.3	2.5	0.75	388	388 Airlines/operators should encourage a culture that emphasizes safe operations over on-time performance (see 22)	P&P
0.3	2.3	0.7	503	503 To alert the flight crew of flight control trim changes, manufacturers should provide an appropriate level of aural annunciation.	A/C-DEZ
0.3	2.3	0.7	517	517 To ensure an acceptable skill level of pilots entering the aviation profession, the aviation community should encourage the development of and enrollment in aviation career training programs.	P&P
0.2	3	0.6	12	12 Air traffic service providers should emphasize in ATC training the controllers' potential in assisting the flight crew in improving their situation awareness. (See 377)	ATC
0.3	1.8	0.55	503.1	503 To alert the flight crew of flight control trim changes, manufacturers should provide an appropriate level of aural annunciation.	A/C -DEZ RETRO
0.2	2.3	0.47	575	575 To provide the flight crew with a more positive indication of autopilot engagement / disengagement , the manufacturer should develop and provide an active and positive annunciation of autopilot engage status which appears after flight crew initiation of a go-around	A/C-DEZ
0.2	2.2	0.43	137	137 Manufacturers should ensure cockpit design that does not interfere with or distract the flight crew from executing their duties (e.g. rain in the cockpit, location of switches in cockpits).	A/C-DEZ
0.2	1.8	0.37	575.1	575 To provide the flight crew with a more positive indication of autopilot engagement / disengagement , the manufacturer should develop and provide an active and positive annunciation of autopilot engage status which appears after flight crew initiation of a go-around	A/C -DEZ RETRO
0.2	1.5	0.3	137.1	137 Manufacturers should ensure cockpit design that does not interfere with or distract the flight crew from executing their duties (e.g. rain in the cockpit, location of switches in cockpits).	A/C -DEZ RETRO
0.1	2.8	0.28	404	404 To enhance crew performance in the approach and landing phase, airline operators should train pilots to understand the limitations of computed wind displays.	TRAINING

1.6	0	0	539.1	539 To ensure procedural compliance, manufacturers should design and incorporate 'smart' checklists that detect failures and provide the proper flight crew actions. (See 444)	A/C -DEZ RETRO
1.2	0	0	495.1	495 To improve aircraft failure tolerance, manufacturers and regulators should conduct failure analyses for design and certification that reflect realistic levels of flight crew reliability	A/C -DEZ RETRO
1.3	0	0	369.1	369 To provide adequate stall warning, regulators should require and manufacturers should develop stall warning systems for new/derivative aircraft that provide accurate information throughout the certificated flight regime.	A/C -DEZ RETRO
4.2	0	0	366.1	366 To protect aircraft against flight control malfunctions, manufacturers must design and regulators must certificate derivative aircraft and components to current applicable certification requirements, i.e. single point failures, redundancy, and probability of failure.	A/C -DEZ RETRO
1.6	0	0	211.1	211 Airlines/operators should retrofit equipment to provide automatic altitude callouts on final approach.	A/C -DEZ RETRO
2.1	0	0	159.1	159 Manufacturers should incorporate an "input rudder" indicator or automatic yaw compensation to ensure that adequate yaw control is provided.	A/C -DEZ RETRO
1.2	0	0	134.1	134 Airlines/operators and regulators should ensure check list designs prioritize critical items as recommended by NASA study, and that items are arranged in a manner to enhance checklist implementation.	A/C -DEZ RETRO
1.1	0	0	36.1	36 Airlines/operators should establish and implement the use of electronic checklists or other aids to ensure completion of all checklist items.	A/C -DEZ RETRO
1.6	0	0	14.1	14 Install aural warning devices on aircraft to alert flight crew of arrival at MDA/DH.	A/C -DEZ RETRO
1.6	0	0	539	539 To ensure procedural compliance, manufacturers should design and incorporate 'smart' checklists that detect failures and provide the proper flight crew actions. (See 444)	A/C-DEZ
1.7	0	0	440	440 To ensure all aircraft meet currently-accepted minimum performance standards, regulators should require warning systems that meet airworthiness standards.	A/C-DEZ
3.5	0	0	431	431 To assist flight crews in avoiding loss of control on existing aircraft, regulators and manufacturers should evaluate the effects of crossover speeds and maximum rudder side slip throughout the entire flight envelope and disseminate the information to operators and flight crews. (See 364)	A/C-DEZ
1.7	0	0	402	402 To prevent a more serious event, manufacturers should revise product failure analyses if service history reveals unexpected consequences or failure modes.	A/C-DEZ
1.3	0	0	251	251 To preserve the original intended level of airworthiness, there should be a better definition and classification of subsequent in-service major and minor critical component changes. The definition of critical component should be more specific.	A/C-DEZ
1.6	0	0	211	211 Airlines/operators should retrofit equipment to provide automatic altitude callouts on final approach.	A/C-DEZ
2.1	0	0	159	159 Manufacturers should incorporate an "input rudder" indicator or automatic yaw compensation to ensure that adequate yaw control is provided.	A/C-DEZ

1.2	0	0	134	134 Airlines/operators and regulators should ensure check list designs prioritize critical items as recommended by NASA study, and that items are arranged in a manner to enhance checklist implementation.	A/C-DEZ
1.1	0	0	36	36 Airlines/operators should establish and implement the use of electronic checklists or other aids to ensure completion of all checklist items.	A/C-DEZ
1.6	0	0	14	14 Install aural warning devices on aircraft to alert flight crew of arrival at MDA/DH.	A/C-DEZ
0	3	0	10	10 Air traffic service providers should train air traffic controllers to use all available tools to establish aircraft position (example: don't fixate on just DME).	ATC
0	2	0	465	465 To reduce flight crew workload in downloading voice ATIS information regulators, through consensus with the aviation community, should reexamine and limit the content of ATIS broadcasts.	ATC
0	3	0	108	108 Air Traffic Service providers should implement and/or review procedures to ensure ATC training does not create a hazard to flight operations.	ATC
0	3	0	108	108 Air traffic service providers should implement and/or review procedures to ensure ATC training does not create a hazard to flight operations. Tx to ATC Team.	P&P
				Overall Effectiveness 0-2(Red), 2-3(Yellow), 3-5(Green)	
				Feasibility 0-2(Red), 2.1-2.6(Yellow), 2.6-3.0(Green)	
				Cut-off at 5.61	

APPENDIX D – DISPOSITION OF INTERVENTIONS

	Project Area/Project Name	Interventions Above Cut-off of 5.61?	Disposition of Interventions	Final Selected Projects
	I. Aircraft Design			
1	Maintenance	No	Project NOT Selected by LOC JSIT	
2	Design	Yes	Interventions to "Basic Airplane Design"	Basic Airplane Design
3	Regulators	Yes	Intervention # 354 to "Basic Airplane Design" Intervention #413 to "Basic Airplane Design" Intervention #366 to "Basic Airplane Design" Intervention #436 to "Flight Envelope Protect" Intervention #369 to"Basic Airplane Design" Intervention #363 to"Basic Airplane Design" Intervention #440 to "Display & Alerting Systems Reqmts."	
4	Alerts	Yes	Interventions to "Display & Alerting System Reqmts."	Display & Alerting System Requirements
5	Autoflight	Yes	Interventions to "Autoflight Design"	Autoflight Design
6	Displays	Yes	Interventions to "Display & Alerting System Reqmts."	
7	Displays/Controls & Indicators	Yes	Interventions to "Display & Alerting System Reqmts."	
8	Displays/Controls & Indicators/Alerts	Yes	Interventions to "Display & Alerting System Reqmts."	
9	Envelope Protection	Yes	Interventions to "Flight Envelope Protection"	Flight Envelope Protection
10	Flight Controls	No	Project NOT Selected by LOC JSIT	
11	Safety	No	Project NOT Selected by LOC JSIT	
12	NAS	No	Project NOT Selected by LOC JSIT	
13	NAS Modernization	No	Project NOT Selected by LOC JSIT	
14	OEM Support	Yes	Interventions to "Basic Airplane Design"	
15	Policies	No	Project NOT Selected by LOC JSIT	
16	Icing	Yes	Intervention # 457 to "Basic Airplane Design" Intervention #516 to "Basic Airplane Design" Intervention #498 to "Basic Airplane Design" Intervention #446 to"Basic Airplane Design" Intervention #500 to "Display & Alerting Systems Reqmts."	
	II. Air Traffic Control			
17	NAS Modernization	Yes	Interventions Addressed by Previous JSIT(s)	
18	Data	Yes	Interventions Addressed by Previous JSIT(s)	
19	Policies & Procedures	No	Project NOT Selected by LOC JSIT	
20	Training	Yes	Interventions Addressed by Previous JSIT(s)	
	III. Data			
21	Data	Yes	Interventions Addressed by Previous JSIT(s)	
22	Data/FOQA	Yes	Interventions Addressed by Previous JSIT(s)	
	IV. Policies & Procedures			
23	Automation	Yes	Interventions to Training "HF & Automation"	
24	Certification	No	Project NOT Selected by LOC JSIT	
25	Communication	No	Project NOT Selected by LOC JSIT	
26	Crew Pairings	No	Project NOT Selected by LOC JSIT	
27	Data Analysis	No	Project NOT Selected by LOC JSIT	
28	FAA Oversight	Yes	Intervention # 214 to "Policies", Others Not Addressed by LOC JSIT	
29	Flight Crew Training	No	Project NOT Selected by LOC JSIT	
30	Fatigue/Rest	No	Project NOT Selected by LOC JSIT	
31	Icing	Yes	Interventions to P&P "SOP"	
32	Maintenance	No	Project NOT Selected by LOC JSIT	
33	MEL	Yes	Interventions to "Risk Management"	
34	Manufacturers	Yes	Intervention #400 to "Basic Airplane Design" Interventions #418 & #389 to "Policies'	
35	Policies & Procedures	Yes	Interventions to "Policies"	Policies
36	Risk Management	Yes	Interventions to "Risk Management"	Risk Management
37	Safety	Yes	Interventions to "Policies"	
38	Standard Operating Procedures	Yes	Interventions to P&P "SOP"	Standard Operating Procedures (SOP)
	V. Training			
39	Advanced Maneuvers	Yes	Interventions to "Advanced Maneuvers"	Advanced Maneuvers
40	Automation	Yes	Interventions to "HF & Automation"	Human Factors & Automation
41	HF & CRM	Yes	Interventions to "HF & Automation"	
42	Icing	Yes	Interventions to P&P "SOP"	
43	Operations Standards	Yes	Interventions to P&P "SOP"	
44	Training Standards	Yes	Interventions to P&P "SOP"	
45	Training Devices	No	Project NOT Selected by LOC JSIT	

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Statement of Work
Aircraft Design – Basic Airplane Design

SOW: To reduce fatal accidents due to loss of control, manufacturers should develop and implement certain aspects of basic airplane design including: (1) additional criteria for establishing crossover speeds and preventing operation below those speeds for new and existing aircraft, (2) icing certification criteria that are expanded to include performance and handling qualities requirements for new ice accretion conditions for new and amended type certificates, and (3) alleviation of automated

OE	F	OExF	No.	INTERVENTIONS
Aircraft Design				
Basic Airplane Design				
4.6	2.3	10.72	457	457 To ensure full protection throughout the icing envelope, regulators / manufacturers should expand icing certification criteria to include ice accretions due to residual, intercycle, delayed activation and system malfunction to ensure that icing protec
4.6	2	9.2	516	516 To ensure full protection throughout the operational envelope, regulators / manufacturers should expand icing certification criteria to include performance and handling qualities testing which considers ice accretions due to residual icing, intercycle
3.5	2.3	8.16	364	364 To protect aircraft against loss of control, regulators should develop as soon as possible, certification criteria, throughout the entire flight envelope, for crossover speeds and maximum rudder side slips. (see 431)
3.5	2.2	7.6	431.1	431 To assist flight crews in avoiding loss of control on **existing** aircraft, regulators and manufacturers should evaluate the effects of crossover speeds and maximum rudder side slip throughout the entire flight envelope and disseminate the information to
4.2	1.7	7.01	366	366 To protect aircraft against flight control malfunctions, manufacturers must design and regulators must certificate derivative aircraft and components to current applicable certification requirements, i.e. single point failures, redundancy, and probabi
2.8	2.5	7	253	253 To prevent loss of control, there should be redundancy and failure tolerance features for all flight critical components, such as dual path design, fail operational redundant systems, with fault annunciation.
3.3	2	6.6	16	16 To prevent mode confusion, manufacturers should ensure that automated systems provide the flight crew with sufficient information (automation feedback).
3.5	1.8	6.41	364.1	364 To protect aircraft against loss of control, regulators should develop as soon as possible, certification criteria, throughout the entire flight envelope, for crossover speeds and maximum rudder side slips. (see 431)

system mode confusion through a sufficient level of automation feedback for new type certificates.

Statement of Work
Aircraft Design –Autoflight Design

SOW: To reduce fatal accidents, changes to equipment design and regulatory environment are required to minimize the probability that the automatic flight control systems precipitate or contribute to loss of control situations. New type certificates should include autothrottle systems that disconnect when unable to achieve the commanded thrust settings. New type certificates should also include autopilot designs that:

- yield control to manual flight control inputs,
- contain monitor logic that prevents autopilot disconnect when the autopilot actions are appropriate to the flight situation,
- incorporate system control laws that prevent unintended deterioration in airplane energy state,
- will not stall the aircraft, and
- provide annunciation to the flight crew if aircraft response differs significantly from that commanded by the autopilot.

Where practical, the existing fleet should be retrofitted such that the autopilot designs yield control to manual flight control inputs.

OE	F	OExF	No.	INTERVENTIONS
Aircraft Design				
Autoflight Design				
3.8	2.3	8.85	533	533 To prevent loss of control, manufacturers should design automated systems to yield control to manual inputs when those manual inputs are in conflict with the automated configuration.
3.1	2.7	8.28	472	472 Since certain engine control and autothrottle system failures can result in undesirable asymmetry, manufacturers should redesign ATSs so that they disconnect (with appropriate annunciation) when unable to achieve the commanded thrust settings (analogo
3.1	2.2	6.73	515	515 To warn of impending loss of control with the autoflight system fully engaged, manufacturers should develop and regulators should require annunciation of an airplane flight condition which significantly differs from that being commanded by the selecte
3.1	2.2	6.73	412	412 To avoid problems due to unexpected mode changes, automated flight system logic should be designed to be error tolerant or, at a minimum provide an alert when the desired mode is in conflict with aircraft energy state.
3.5	1.8	6.41	501	501 To assist flight crews in avoiding loss of control, manufacturers should develop and regulators should require autoflight system auto-disconnect logic which does not disconnect when the autoflight system is properly attempting to correct an abnormal f
2.7	2.3	6.29	433	433 To preclude inadvertent entry into stall conditions during autopilot operation, regulators should not permit and manufacturers should not design autoflight systems that will allow the autopilot to control the aircraft into a stalled condition.
3.8	1.5	5.7	533.1	533 To prevent loss of control, manufacturers should design automated systems to yield control to manual inputs when those manual inputs are in conflict with the automated configuration.

Statement of Work
Aircraft Design – Display and Alerting System Requirements

SOW: The purpose of this project is to reduce fatal accidents due to loss of control by increasing pilot awareness of the airplane attitude and energy state; autoflight/flight management mode changes; autopilot/autothrottle engagement status; and known flight critical system and engine malfunctions/failures.

OE	F	OExF	No.	INTERVENTIONS
Aircraft Design				
Display & Alerting System Requirements				
3.8	2.3	8.85	483	483 To ensure that the display of conflicting attitude information does not confuse or mislead the flightcrew, the attitude sensing and display systems should be designed so that invalid information is detected and clearly annunciated to the flight crew a
3.1	2.7	8.28	395	395 To ensure that the display of conflicting air data information does not confuse or mislead the flightcrew, the air data sensing and display systems should be designed so that invalid information is detected and clearly annunciated to the flight crew a
2.7	2.7	7.21	488	488 To facilitate recovery and attitude awareness, manufacturers should include adequate instrumentation to optimize performance during recovery from unusual attitude
2.7	2.5	6.75	305.1	305 Regulators should require airlines/operators to outfit aircraft with electronic checklists. If unable to install electronic checklists, use mechanical checklists or, at a minimum, develop a process to reinforce challenge and response checklists.
2.7	2.5	6.75	305	305 Regulators should require airlines/operators to outfit aircraft with electronic checklists. If unable to install electronic checklists, use mechanical checklists or, at a minimum, develop a process to reinforce challenge and response checklists.
3.1	2	6.2	424	424 To enhance crew awareness of automation modes, manufacturers should ensure that mode changes or disconnects, in the automated systems are annunciated in a way that is obvious to the flight crew.
2.8	2.2	6.08	416	416 To provide improved flight crew situation awareness, manufacturers should provide a clear indication that predicts the future aircraft energy state and/or autoflight configuration if the current course of action is continued (i.e., analogous to EGPWS
2.2	2.7	5.87	382	382 To provide improved pilot awareness of airspeed, manufacturers should provide flight instruments with more effective airspeed trend indications and alerting.
3.8	1.5	5.7	483.1	483 To ensure that the display of conflicting attitude information does not confuse or mislead the flightcrew, the attitude sensing and display systems should be designed so that invalid information is detected and clearly annunciated to the flight crew a
3.1	1.8	5.67	395.1	395 To ensure that the display of conflicting air data information does not confuse or mislead the flightcrew, the air data sensing and display systems should be designed so that invalid information is detected and clearly annunciated to the flight crew a
2.1	2.7	5.61	442	442 To avoid delay in the recognition of engine malfunction/failure, manufacturers should develop and implement a direct aural and visual flight deck indication of engine malfunction/failure minor transients need not be annunciated.
2.1	2.7	5.61	474	474 Since indications of sideslip may not be prominent and can be masked by roll effects, manufacturers should develop improved sideslip indications and/or alerting (e.g. similar to pitch limit indications for pitch / angle of attack).

Statement of Work
Aircraft Design – Flight Envelope Protection

SOW: To reduce fatal accidents due to loss of control, manufacturers should develop and implement appropriate levels of flight envelope protection including: (1) angle of attack protection for all Part 121 aircraft, (2) yaw compensation for current type certificated aircraft produced after a specified date, new amended type certificates and new type certificates, and (3) structural load protection, bank angle protection, and high and low speed protection for all new type certificates (and existing type certificated aircraft where practical).

OE	F	OExF	No.	INTERVENTIONS
Aircraft Design				
Flight Envelope Protection				
3.8	2.5	9.5	566	566 Manufacturers should incorporate an automatic yaw compensation to ensure that adequate yaw control is provided.
3.1	2.7	8.28	380	380 To reduce the risk of inadvertent entry into stall, manufacturers should develop and implement stall protection features in all transport category airplanes, (e.g. stick pusher, alpha protection)
4.6	1.7	7.68	445	445 To help avoid loss of control, manufacturers should develop and implement flight envelope protection
4.6	1.3	6.12	445.1	445 To help avoid loss of control, manufacturers should develop and implement flight envelope protection

Policies and Procedures
Policies
Statement of Work

SOW:
Ensure that essential safety information generated by airplane manufacturers and the FAA is included in company: operating manuals, training programs for pilots and other appropriate employee groups, and daily operations. Manufacturers and operators should review/implement aircraft crosswind landing limitations and equipment failures that result in yaw/roll upsets and provide this information for inclusion in company manuals and training programs as appropriate.

OE	F	OExF	No.	INTERVENTIONS
Policies & Procedures				
Policies				
3.1	3	9.3	225	225 Airlines/operators and regulators should ensure necessary manuals (operational & maintenance) are complete, accurate, available and appropriately used.
3.3	2.5	8.25	80	80 Airlines/operators should verify, and regulators should check, that operators who create their own AOM's include all operational procedures prescribed by original equipment manufacturers Airplane Flight Manual (AFM).
3.1	2.3	7.22	400	400 In order to promote safe crosswind landings, manufacturers will provide and airline operators will implement aircraft crosswind landing limitations, including considerations for flight control effectiveness and gust conditions.
3.3	2	6.6	152	152 Airlines/operators and regulators should raise standards (e.g. crew pairing, approach minimums, etc.) for flight crewmembers that meet minimum qualifications but have demonstrated limited proficiency and/or competency. (See 151, 335, 337)
2.2	2.7	5.87	417	417 Because failures which result in yaw/roll upsets can be particularly difficult for crews to interpret and successfully handle, manufacturers and operators should give such failures increased scrutiny and higher priority for reporting.

Policies and Procedures
Risk Management
Statement of Work

SOW:
Develop/identify and implement methods for operators, regulators, and manufacturers to prioritize safety related decisions. This will be accomplished through improved methods of risk assessment for: aircraft design change service bulletins, aircraft accident/incident and failure analysis, operational issues, flight critical safety information and recurring intermittent failures related to dispatch.

OE	F	OExF	No.	INTERVENTIONS
Policies & Procedures				
Risk Management				
3.8	2.7	10.15	532	532 To minimize the probability of accidents, operators should prioritize service bulletin implementation using operational risk management techniques to assess potential operational hazards, including aircraft modification, etc.. (See 98, 348)
3.5	2	7	423	423 To ensure that recurrent, intermittent failures are not allowed to persist, regulators should revise MEL dispatch requirements so that certain intermittent failures are considered to be full failures, if warranted by safety implications of the failure
3.1	2.2	6.73	98	98 Airlines/operators and regulatory agencies should review procedures to ensure that design changes (service bulletins) to flight critical systems are incorporated in a timely manner.

Statement of Work
Policies and Procedures - SOPs

SOW:
Ensure that all airline operators publish and enforce clear, concise, and accurate flight crew standard operating procedures (SOPs). These procedures should include expected procedures during pre/post flight and all phases of flight i.e.: checklists, simulator training, PF/PNF duties, transfer of control, automation operation , rushed and/or unstabilized approaches, rejected landings and missed approaches, inflight pilot icing reporting, and flight crew coordination. Operator instructors and check airman should ensure these SOPs are trained and enforced in their aircrew proficiency and standardization programs.

OE	F	OExF	No.	INTERVENTIONS
Policies & Procedures				
Standard Operating Procedures				
4	2.8	11.32	99	99 Airlines/operators should ensure that clear, concise, accurate, appropriate standard operating procedures are published and enforced. (See 110)
3.3	3	9.9	7	7 Airlines/operators should ensure that their training/standardization programs emphasize review of approach and missed approach procedures. (See 329)
3.7	2.7	9.88	110	110 Airlines/operators and regulators should ensure that their training/standardization and monitoring programs emphasize the importance of adherence to standard operating procedures and identify the rationale behind those procedures. (See 99)
3.1	3	9.3	142	142 Airlines/operators should establish policies, parameters, and training to recognize unstabilized approaches and other factors and implement a go-around gate system. (See FSF - "defined gates" p. 193) (See 116, 123)
3.8	2.3	8.85	535	535 To ensure adequate instructor / check pilot qualifications, operators must establish and maintain minimum line and instructor / check airman qualifications.
2.8	3	8.4	114	114 Airlines/operators should ensure that their training/standardization programs provide sufficient training to ensure aircrew proficiency
3.8	2.2	8.25	546	546 Ensure that flight crews are adequately trained in an appropriate level simulator for the training being conducted (i.e. engine out, upset recovery, etc.) before being assigned to the line. (See 153, 312)
2.8	2.8	7.92	511	511 To reduce the number of hazardous icing encounters and to keep air traffic apprised of current weather conditions, regulators should recommend that flight crews report all icing conditions to air traffic control and be required to report the occurrenc
2.5	3	7.5	207	207 Airlines/operators should develop procedures to specify how transfer of control is formally accomplished.
3.1	2.3	7.22	408	408 To minimize undesirable effects of transition to manual flight from ALIGN mode, regulators should require that minimum altitudes and conditions be established for disengagement of automated systems when a manual landing is anticipated.

3.1	2.3	7.22	157	157 Airlines/operators, regulators, air traffic service providers should establish policies or programs to address rushed approaches, including elimination of rushed approaches, recognition and rejection of rushed approaches and training for those encountered.
2.4	2.8	6.79	460	460 To ensure a better understanding, by air crews, of appropriate procedures for use of ice protection systems, operators, manufacturers and regulators should expedite the modification of training programs and distribution of media, to include ice bridgi
2.4	2.8	6.79	218	218 Airlines/operators should properly surveill contractor training programs for adequacy of training. (See 110, 202)
2.3	2.8	6.51	82	82 Airlines/operators should clearly define, train and check the specific PF/PNF/FE duties.
2.3	2.8	6.51	111	111 Airlines/operators should ensure that their training/standardization programs emphasize basic airmanship skills and knowledge during initial and recurrent training.
2.3	2.8	6.51	115	115 Airlines/operators should ensure that their training/standardization programs emphasize the dangers of rushed approaches. (See 13, 157)
2.3	2.8	6.51	116	116 Airlines/operators should ensure that their training/standardization programs emphasize the dangers of high rate of descent and unstable approaches. (See 142)
2.3	2.8	6.51	328	328 Airlines/operators should ensure that flight crews are trained to think in terms of "I will go-around unless" rather than "I will land unless". Regulatory policy should support this approach. (See 142, 311)
2.3	2.8	6.51	329	329 Airlines/operators should incorporate in initial and recurrent training ways to recognize multiple cues that will require go-around. Including CFIT training aid 2.1.9, FSF definition of stabilized approach, risk assessment tool, and windshear trainin
2.4	2.7	6.41	401	401 To ensure proper identification of engine malfunctions and avoidance of possible loss of control, airline/operators should provide enhanced and more realistic training for engine malfunctions, engine responses to control signal errors and the appropri
2.1	3	6.3	227	227 Airlines/operators should ensure that their training/standardization program emphasizes the benefits of inter-crew/company communications. (See 131)
2.1	3	6.3	553	553 Since performance calculations can have significant safety implications, regulatory authorities should ensure that pilot training and procedures adequately address their meaning and use.
2.1	2.8	5.94	484	484 To ensure adequate FO proficiency, airlines/operators should incorporate the operating practice of alternating PF/PNF duties (alternating legs and landings).
2.1	2.8	5.94	112	112 Airlines/operators and regulators should ensure that the frequency and effectiveness of proficiency checks for simulated instrument failures (partial panel) are adequate.
2.1	2.7	5.61	411	411 To reduce accidents during the landing phase, airline operators should establish criteria and procedures and train flight crews to recognize conditions which might require a rejected landing.

Statement of Work
Training – Advanced Maneuvers

SOW:
Ensure that Part 121 flight training departments develop and implement effective advanced maneuvers ground training and flight training using appropriate flight training equipment. Emphasis should be given to stall recognition and recovery, unusual attitudes, upset recoveries, and energy awareness and management.

OE	F	OExF	No.	INTERVENTIONS
Training				
Advanced Maneuvers				
4	2.7	10.68	357	357 To ensure crews have the adequate skills to recover from extreme attitude upsets, regulators should require, and operators should immediately implement, initial and recurrent upset recovery training.
4.2	2.5	10.5	525	525 To mandate stall recognition and recovery training, regulators must modify the appropriate regulations.
3.3	2.7	8.81	384	384 Since it is possible to enter a stall, airlines/operators should develop and implement a ground school and simulator training program to train pilots to handle post stall recovery as part of advanced maneuver training
2.8	3	8.4	165	165 Airlines/operators should provide training scenarios that match realistic situations (i.e. stall recoveries during approach, in landing configuration at flight idle with the autopilot on (in simulator)).
2.4	3	7.2	322	322 Airlines/operators should develop and implement a ground school and simulator training program to train pilots to handle unusual attitude situations, e.g. American Airlines Advanced Aircraft Maneuvering Program
2.7	2.2	5.86	522	522 Since it is possible to enter a stall, regulators should mandate the implementation of a ground school and simulator training program to train pilots to handle post stall recovery as part of advanced maneuver training. (See 384)
2	2.8	5.66	415	415 To provide improved aircraft status awareness, airline/operators should enhance training to identify aircraft configuration and the repercussions of the aircraft's energy state.

Training
Human Factors & Automation
Statement of Work

SOW:
Ensure that Part 121 flight training departments develop training that emphasizes flight crewmembers' situation awareness, crew coordination during multitasking, and use of automation in CRM training. Training should include the use of appropriate levels of automation with emphasis on the functional operation, capabilities and limitations of the automation system(s). Proper control of the aircraft in the transition from autocoupled/autoland approaches to manual control should also be included.

OE	F	OExF	No.	INTERVENTIONS
Training				
Human Factors & Automation				
3.7	2.7	9.88	530	530 To optimize pilot workload, airlines/operators policies should stress using the appropriate level of automation. (See 246)
4	2.3	9.32	486	486 Airlines/operators and manufacturers should train crews to understand the capabilities and limitations of automated flight systems, the conditions which would cause the systems to not function as the crew anticipates, and how to detect and recover fro
3.1	3	9.3	15	15 Airlines/operators should ensure that their training/standardization programs instruct when to disengage automated systems and fly manually. (See 246)
2.8	3	8.4	147	147 Airlines/operators should require training/standardization programs, which teach situation awareness. (The knowledge and understanding of the relevant elements of the pilot surroundings, including aircraft systems, and the pilots intentions)
2.8	2.7	7.48	520	520 To ensure flight crews have a comprehensive knowledge of the automation system(s) functional operation, airlines/operators should ensure that their training /standardization programs emphasize these skills.
2.4	3	7.2	427	427 To prevent inappropriate preoccupation with trouble shooting following engine or other system failure, airline operators should enhance training and checking to prioritize safe control of the aircraft.
2.4	2.8	6.79	314	314 Airlines/operators should develop simulator training scenarios that require flight crews to learn multi-tasking abilities and appropriate prioritization abilities in concert with CRM skills (see Red Flag LOFT scenarios).
3.3	2	6.6	561	561 Airlines should maximize the use of autoland systems consistent with maintaining manual landing proficiency.
2.1	3	6.3	25	25 Airlines/operators should establish a CRM training program and regulators should require and insure that the initial training is provided prior to line flying and require recurrent CRM training. (See 131, 132, 349
2.1	3	6.3	107	107 Airlines/operators should ensure that their CRM training/standardization program emphasizes the importance of the team concept.
2.2	2.8	6.23	405	405 To enhance stability in the approach and landing phase, airline operators should train pilots to properly control the aircraft in the transition from autocoupled/autoland approaches to manual control

2.4	2.5	6	456	456 To help ensure appropriate decision making flight crews should be trained on the impact of automation on CRM.
2.1	2.8	5.94	23	23 Airlines/operators should ensure that regularly scheduled recurrent training (e.g. LOFT) emphasizes crew cooperation and working together to maximize safe operations. (See 308, 314)
2.1	2.8	5.94	308	308 Airlines/operators should ensure their formal CRM training is culturally appropriate and emphasizes the following management skills: decision making, workload management, crew coordination, planning, communication, situational awareness, and advocacy
2.1	2.8	5.94	325	325 Airline/operators should emphasize during initial and recurrent training the importance of maintaining systems status awareness during non-normal events and hazardous approaches (goal to avoid tunnel vision/narrowed attention)
2.3	2.5	5.75	20	20 Airlines/operators should ensure that command oversight training for captains is provided during the upgrade process and in recurrent training and first officer responsibility for monitoring are reviewed during recurrent training.
1.9	3	5.7	163	163 Airlines/operators should ensure that their training/standardization programs address common perceptions that could lead to unsafe practices
2	2.8	5.66	131	131 Airlines/operators should ensure that their training/standardization program emphasizes the importance of the team concept, cross cultural issues, evaluation of options and the obligation of the FO to effectively communicate any concerns (CRM). (See
2.1	2.7	5.61	542	542 To preclude over reliance on automation, airlines/operators and regulators should create and/or clarify a definition of “appropriate levels of automation,” to include the need to validate against other information sources and insure that the resulting definition is published and included in all appropriate flight crew publications and manuals and training programs

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LOC: Design – Auto Flight - New

Enhancement 32: Ensure autoflight systems (autopilot and autothrust) on new type designs include certain features: don't exacerbate thrust asymmetry, force disconnects, annunciate if can t close loop, bark before bite, and include low speed protections.

Outputs:
1. **Amended FAR 25.1329 per ARAC FGSHWG report**
2. **Amended AC 25.1329 per ARAC FGSHWG report**
3. **Amended JAR 25.1329 per ARAC FGSHWG report**
4. **Amended ACJ 25.1329 per ARAC FGSHWG report**
5. **Manufacturers agree ARAC recommendations adopted**

CAST Stat: **"E" Level approval obtained; Ask for "F" in Nov**

JIMDAT #: **4.8 Full** **2020: 1.0** **2007: 0**

Resources: **$0.2M** **Man: Med** **'20 Imp: 20%**

Assumptions: **ARAC HWG is nearly finished -- no additional funding req'd.**

LOC: Design - Autoflight
(WITHDRAWN)

Enhancement 33: Study feasibility of ensuring current (in production, future derivative, and in-service) autoflight (autopilot and autothrust) designs yield control to pilot's manual inputs. Implement per results of study.

Outputs: 1 Each manufacturer completes study, by model
2 CAST tracks voluntary compliance with implementation

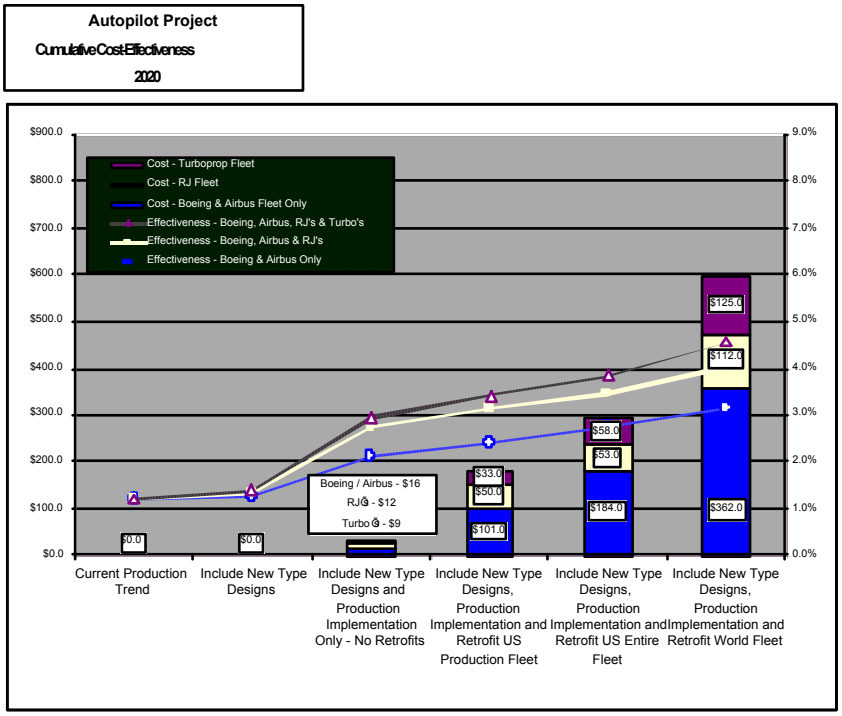
Withdrawn

CAST Stat: Withdrawn

JIMDAT #: -.- Full **2020:** -.- **2007:** 0.0

Resources: See attached **Man:** Med **'20 Imp:** 10%

Assumptions:
- Fewer features for "existing" airplanes than for "new" airplanes.
- Ultimately, we will aim for the knee of the curve (see attached).



LOC: Design - Displays/Alerting -

Enhancement 34: Implement certain display/alerting features (see attached list) on all new airplane cert and future derivative model planes.

Outputs: 1 Amend AC 25-11 to address features on the attached list
2 Amend ACJ 25-11 to address features on the attached list

CAST Stat: "E" Level approval obtained; Ask for "F" in Jan. '02
On proposed CAST plan

JIMDAT #: 7.1 Full 2020: 1.4 2007: 0

Resources: $6.8M '07 '07 Imp: 0%
$6.8M '07 '20 Imp: 20%

Assumptions: Avionics Harmonization Working Group will be chartered to update AC 25-11 and ACJ 25-11 to include these features.

See attached "List of Features"

List of Features

Displays/Alerting - New

Enhancement 34 cont.

- **Graphical depiction of vertical situation**
- **Speed trend information**
- **Pitch Limit Indication**
- **Bank angle limits to buffet**
- **Barber poles/amber bands (minimum and maximum speeds)**
- **Annunciation of conflicting attitude, airspeed and altitude info**
- **Removal of invalid attitude, airspeed and altitude info**
- **Removal of misleading attitude, airspeed and altitude info (i.e. from an external fault)**
- **Intuitive unusual attitude recovery information on ADI**
- **Salient annunciation of autoflight mode changes and engagement status**

LOC: Design - Displays/Alerting - Existing

Enhancement 35: Study feasibility of alerting features for production and in-service airplanes: conflicting attitude and airspeed info, known invalid attitude, airspeed and altitude info. Implement per results of study.

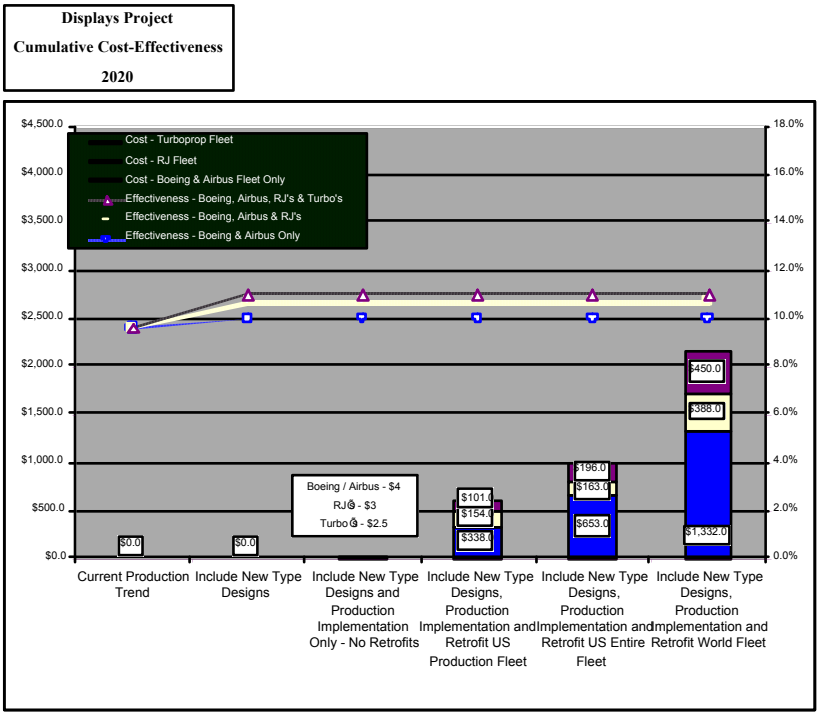
Outputs: 1 Each manufacturer completes study, by model
2 CAST tracks voluntary compliance with implementation

CAST Stat: "E" Level approval obtained; Ask for "F" in Jan. '02

JIMDAT #: 0 Full 2020: 0 2007: 0

Resources: $4M '07 '07 Imp: 10%
$12.8M '20 Man: Med '20 Imp: 40%

Assumptions:
- Fewer features for "existing" airplanes than for "new" airplanes.
- Ultimately, we will aim for the knee of the curve (see attached).



LOC: Design - Vertical Situation Display

Enhancement 85: VSD included in all new airplane designs. Determine feasibility of implementing a vertical situation display on existing airplanes. CAST will recommend implementation once study results are known.

Outputs: 1. Manufacturers agree to include VSD in new airplanes
2. Manufacturers complete retrofit feasibility study, by model
3. CAST tracks voluntary compliance with

CAST Stat:
"E" Level approval obtained ask "F" level in Jan '02
On proposed

JIMDAT	**16.6**	**2020:**	**8.9**	**2007:**	**1.0**
Resources:	**$8.0M '07**			**'20 Imp:**	
	$8.0M '20			**'07 Imp:**	

Assumptions:
- JIMDAT numbers reflect additional benefit of VSD over TAWS
- VSD uses TAWS
- This Enhancement requires a "gated" CAST approval process
- In advance of study, assume new designs and production only (NO retrofit)

LOC: Design - Crossover (WITHDRAWN)

Enhancement 37: Manufacturers provide 1-G rudder-lateral crossover speed data to operators per criteria established by FAA. Operators ensure maneuvering speeds account for these speeds.

Outputs:
1 FAA guidance on determining crossover speeds
2 JAA guidance on determining crossover speeds
3 Published operating speed data from type cert holders
4 Operators incorporate data appropriately into SOPs

Withdrawn

CAST Stat: "E" Level approval obtained; Ask for "F" in Jan. '02

JIMDAT #: -.- Full2020: 1.0 2007: 1.0

Resources: $1.0M '07 Man: Low '07 Imp: 100%

Assumptions: FAA and JAA guidance will be harmonized and will not necessitate significant data development.

LOC: Design - Cross-Wind Data (WITHDRAWN)

Enhancement 38: Flight Crews are more knowledgeable about hazards related to high cross-wind operations including geometric relationships (e.g. ground contact bank angles) and significant weather, airplane, and runway parameters

Outputs: 1 Manufacturers provide information to operators
2 Operators disseminate information to flight crews

Withdrawn

CAST Stat: Withdrawn

JIMDAT #: 0 Full 2020: 0 2007: 0

Resources: $1.0M Man: Low / Don't Do '07 imp: 100%

Assumptions: Manufacturers will not establish crosswind limits.

LOC: Design - Icing

Enhancement 39: Support current ARAC effort to update certification guidelines for flight in icing conditions. Implement guidelines on new type designs and future derivatives with "Booted" anti-icing systems.

Outputs: 1 Amended FAR 25, including Appendix C, and related AC's
2 Amended JAR 25 and related ACJ's
3 Manufacturers agree ARAC recommendations adopted

CAST Stat: Level approval obtained; Ask for"F"in Jan.'02
On proposed CAST plan

JIMDAT #: 5.7 Full 2020: 0.3 2007: 0.0

Resources: $1.4M '07 Man: Low '07 Imp: 0%
$1.4M '20 '20 Imp: 0.5%

Assumptions: Cost to comply with new guidance is not significant.

LOC: Mode Confusion

Enhancement 36: Develop specific guidelines for eliminating mode confusion. Implement on new type designs and study feasibility of implementing on existing type designs. Implement changes per feasibility study.

Outputs: See attached

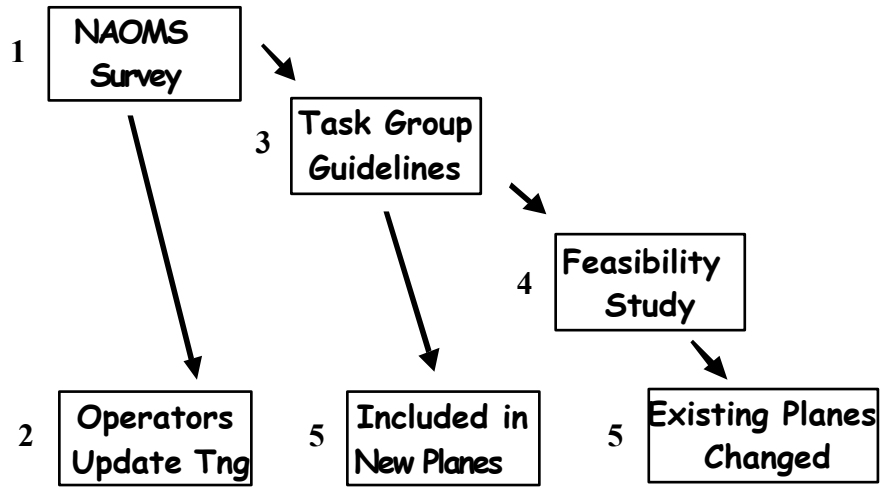
CAST Stat: "E" Level approval obtained; Ask for "F" in Jan. '02

JIMDAT #: 0 Full 2020: 0 2007: 0

Resources: $1.0M '07 '07 Imp: 0%
$1.0M '20 '20 Imp: 10%

Assumptions: This Safety Enhancement requires a "gated" CAST process.

Mode Confusion Outputs



LOC: Design - Envelope
New

Enhancement 40: Include certain envelope protection features in all new airplane designs: AOA/low speed, thrust asymmetry, bank angle. Hard limits (a la Airbus A340) or soft limits (a la Boeing 777) are acceptable.

Outputs: **1. Manufacturers of all new designs agree to incorporate**

CAST Stat: **"E" Level approval obtained; Ask for "F" in Jan. '02 On proposed CAST plan**

JIMDAT #:	**18.3 Full**	**2020: 3.7**	**2007: 0.0**
Resources:	**$0.07M '20**	**Man: High**	**'07 Imp: 0%**
	$0.07M '07		**'20 Imp: 20%**

Assumptions : All manufacturers will meet intent of this Safety Enhancement in their all new designs without any additional expense.

LOC: Design - Envelope Protection - Existing

Enhancement 41: Study feasibility of available and new envelope-protection-like features for production, future derivative, and in-service airplanes: AOA/low speed, thrust asymmetry, bank angle protection. Implement per results of study.

Outputs: 1 Each manufacturer completes study, by model
2 CAST tracks voluntary compliance with implementation

CAST Stat: Level approval obtained; Ask for "F" in Jan. '02

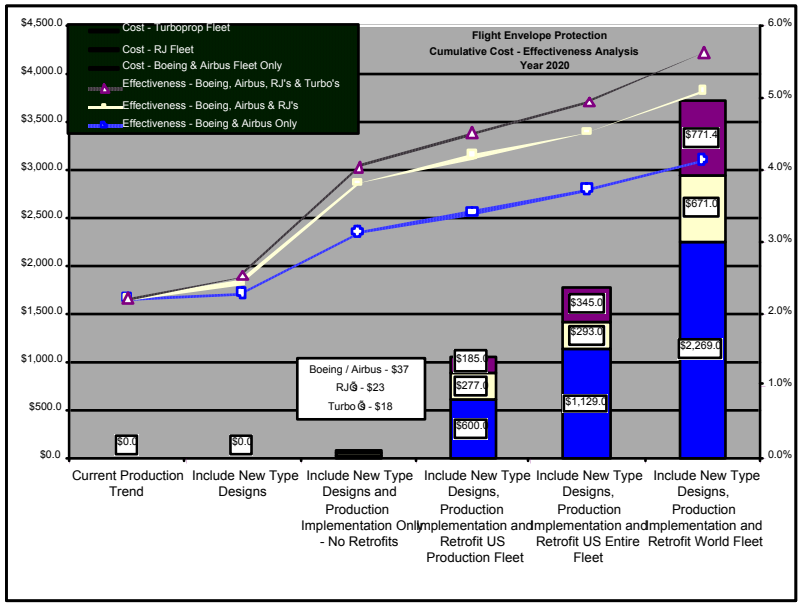
JIMDAT #: 15.5 Full 2020: 6.2 2007: 1.6

Resources: See attached Man: Med '07 Imp: 10%
'20 Imp: 40%

Assumptions:
- Ultimately, we will aim for the knee of the curve (see attached).
- This Safety Enhancement requires a "gated" CAST approval process.

Flight Envelope Protection
Cumulative Cost-Effectiveness
2020

Shows cumulative cost and effectiveness for the manufacturers. Effectiveness is based on mixed ratings (JIMDAT 11.5% for new designs and existing FEP airplanes, and my estimated 6.2% for proposed systems changes to existing non-FEP designs.



LOC: Policies & Procedures - Risk Management

Enhancement 27: Improve aviation safety through the use of risk assessment and risk management methods.

Outputs:
1. **Compile risk assessment and management tools**
2. **Develop risk management tools**
3. **Implement risk management tools**

CAST Stat: **"F" Level approved obtained; Ask for "G" in Jan. On proposed CAST plan**

JIMDAT #: **12.6 Full** **2020: 10.7** **2007: 10.7**

Resources: **$1.05M** **'07 Imp: 85%**

Comments:

LOC: Policies & Procedures - SOPs

Enhancement 26: Improve aviation safety by establishing, maintaining and using standard operating procedures (SOPs) in accordance with AC 120-71.

Outputs:
1 **Review AC 120-71 to incorporate LOC interventions.**
2 **Revisions to AC 120-71**
3 **Guidance for FAA Inspectors**
4 **Revisions to air carrier SOPs**

CAST Stat: **"F" Level approval obtained; Ask for "G" in Jan. On proposed CAST plan**

JIMDAT #: **2.0 Full** **2020: 1.6** **2007: 1.6**

Resources: **$1.2M** **'07 Imp: 80%**

Comments:

LOC: Policies & Procedures - Policies

Enhancement 28: Improve performance of flight crews and other employees through timely identification and dissemination of essential safety information.

Outputs: **1 Dissemination of essential safety information.**

CAST Stat: **"F" Level approval obtained; Ask for "G" in Jan.**

JIMDAT #: **6.4 Full** **2020: 6.4** **2007: 6.4**

Resources: **$0.45M** **'07 Imp: 100%**

Comments:

LOC: Policies & Procedures - Policies

Enhancement 29: Improve aviation safety by developing a process to enhance pilot proficiency and competency.

Outputs: **1 Develop a process to enhance flight crew proficiency**

CAST Stat: **"F" Level approval obtained; Ask for "G" in Jan.**

JIMDAT #: **4.1 Full** **2020: 3.3** **2007: 3.3**

Resources: **$5.4M** **'07 Imp: 80%**

Comments:

LOC: Training - Human Factors & Automation

Enhancement 30: To improve the overall performance of flight crews to recognize and prevent loss of control accidents through effective use of automation and CRM.

Outputs: 1 Evolutionary training aid consolidating HF issues
2 Incorporation of training aid into training programs & SOPs

CAST Stat: "F" Level approval obtained; Ask for "G" in Jan.

JIMDAT #: 3.3 Full 2020: 2.6 2007: 2.6

Resources: $0.85M '07 Imp: 80%

Comments:

LOC: Training - Advanced Maneuvers (AMT)

Enhancement 31: Pilots will be better trained to avoid and recover from excursions from normal flight and loss of control.

Outputs: 1 Survey and complete a set of AMT material
2 AMT ground training provided by all operators
3 AMT flight training provided by all operators
4 Research of existing flight simulation devices

CAST Stat: "F" Level approval obtained; Ask for "G" in Jan.

JIMDAT #: 11.4 Full 2020: 11.4 2007: 11.4

Resources: $1.1 M '07 Imp: 100%

Comments:

SE 32

Loss of Control
Joint Safety Implementation Team

Implementation Plan
for
Autoflight Features in New Airplane Designs

Statement of Work:

To reduce fatal accidents due to loss of control, recommend and support the development of regulations and guidance material that ensure or encourage autoflight (autopilot and autothrust) systems in new airplane designs to accomplish the following:

- Minimize the probability of creating a thrust asymmetry that could lead to loss of control;
- Yield control to significant manual flight control forces (e.g., force disconnects);
- Annunciate to the flight crew if aircraft response differs significantly from what the autopilot has been commanded to do
- Ensure autopilot internal monitor logic does not inappropriately disconnect the autopilot when it is properly attempting to correct for deviations from the commands it receives.
- Include low speed protection.

Lead Organization for Overall Project Coordination (LOOPC):

FAA AIR-1

Safety Enhancement:

New airplane designs incorporate autoflight systems that assist the pilot in potential loss-of-control situations and minimize the potential of causing or contributing to loss-of-control.

Score: 2007-(0.0) 2020-(1.1) 100%-(5.4)

Outputs:

Output 1:

Regulations and guidance materials are in place that adopt principles embodied in the final report of the ARAC Flight Guidance System Harmonization Working Group (FGSHWG) such that the following JSIT issues are addressed:

- Minimize the probability of creating a thrust asymmetry that could lead to loss of control;
- Yield control to significant manual flight control forces (e.g., force disconnects);
- Annunciate to the flight crew if aircraft response differs significantly from what the autopilot has been commanded to do
- Ensure autopilot internal monitor logic does not inappropriately disconnect the autopilot when it is properly attempting to correct for deviations from the commands it receives.
- Include low speed protection.

The ARAC FGSHWG final report submission to the FAA and JAA is expected to include specific recommendations for amending FAR 25.1329, JAR 25.1329, AC 25.1329, and ACJ 25.1329.

Resources: ANM-100 (LOOC), all ARAC Flight Guidance System Harmonization Working Group membership

Total government/industry resources: $0.2M (see separate worksheet for details)

Timeline: 180 days for ARAC to report recommendations (using current ARAC group), 4 years to amend the FAR, JAR, AC, and ACJ.

Actions:

1. ARAC FGSHWG provides its recommendations to the FAA.
2. FAA takes rulemaking action as appropriate.
3. JAA takes rulemaking action as appropriate.
4. FAA produces accompanying guidance material.
5. JAA produces accompanying guidance material.

Relationship to Current Aviation Community Initiatives:

ARAC Flight Guidance System Harmonization Working Group

Performance Goals & Indicators for Outcomes/outputs:

Goal: New airplane designs incorporate automatic flight control systems that assist the pilot in potential loss-of-control situations and minimize the potential of causing or contributing to loss-of-control.

- Indicator: ARAC releases recommendations
- Indicator: Manufacturers agree that new material meets intent of ARAC FGSHWG
- Indicator: FAA completes rulemaking activity
- Indicator: FAA publishes guidance material
- Indicator: JAA completes rulemaking activity
- Indicator: JAA publishes guidance material

Programmatic Approach:

Organizational Strategy

The LOC JSIT identified Bob Robeson, AIA, as the JSIT project lead for Autoflight Features in New Airplane Designs. The project lead will assist with the implementation of the activities outlined in this Implementation Plan and will, when requested, provide progress reports to the CAST. Implementation of this project is viewed as a shared responsibility and tasks will be divided between the FAA and organizations/persons in industry. The Lead Organization for Overall project Coordination (LOOPC) is AIA. The Lead Organizations for Output Coordination (LOOC) are identified in each Output of this Implementation Plan. The roles and responsibilities of the LOOPC and LOOC are described in the CAST approved JSIT Process Document.

Implementation Activities

The Loss of Control JSIT Airplane design team has coordinated with the ARAC Flight Guidance System Harmonization Working Group to ensure the intent of the proposal is included in their recommendations for rulemaking activity. All of the JSIT Autoflight Features In New Airplane Designs recommendations, have been adequately addressed by the ARAC. The FAA and JAA should review the ARAC recommendations and undertake the appropriate rulemaking and guidance material development activity. The manufacturers, including airframe and autoflight manufacturers, will monitor and comment on the regulations and guidance materials as they are presented for public comment. Any differences that arise will be resolved with consideration for the JSIT recommendations.

Key Products and Milestones:

- ARAC recommendations – 180 days
- Amended FAR/JAR 25.1329 – 4 years from receipt of ARAC recommendations
- Amended AC/ACJ 25.1329 – 4 years from receipt of ARAC recommendations

Plan and Execution Requirements:

Changes to certification rules and guidance materials only affect new airplane designs. Design changes, by nature, take a long time and require significant resources. Incorporating new safety features into new airplane designs is technically feasible and desirable. However, it takes many years for these changes to have a significant impact on overall fleet safety, given the time it takes to develop a new airplane and for these airplanes to become a significant part of the fleet.

Risk Description:

- Normal policy/rulemaking process and timeframe (e.g., ARAC, harmonization, etc.)
- Potential failures to properly implement regulatory and advisory material
- New airplanes will represent a miniscule part of fleet in 2007
- Potential economic burden on manufacturers and operators
- Potential inadequate resource availability for manufacturers and operators and FAA

Risk Mitigation Plan:

- JSIT will work with ARAC to address its recommendations prior to CAST formal request
- CAST will support timely and successful completion of ARAC activity
- CAST will support the incorporation of the ARAC recommendations into rulemaking and guidance material development

Impact on Non - Part 121 or International Applications:

All operators of new airplanes will be impacted by changes to the design.

SE 34

Loss of Control
Joint Safety Implementation Team

Implementation Plan
for
Display and Alerting Features in New Airplane Designs

Statement of Work:

To reduce fatal accidents due to loss of control, display and alerting systems in new airplane designs should include:

- Graphic speed trend information
- A pitch limit indication
- Bank angle limits to buffet
- Barber poles and amber bands on primary airspeed indications
- Detection and annunciation of conflicting attitude, airspeed and altitude data information
- Detection and removal of invalid attitude, airspeed and altitude data information (i.e.., from an internal fault)
- Detection and removal of misleading attitude, airspeed and altitude data information (e.g., from an external sensor fault) to the extent feasible
- Information to perform effective manual recovery from unusual attitudes using chevrons, sky pointers, and/or permanent ground-sky horizon on all attitude indications
- Salient annunciation of autoflight mode changes and engagement status changes (e.g., blinking/colored/boxed mode information)
- Effective sideslip information and alerting of excessive sideslip (e.g., split trapezoid on attitude indicator)
- Clear annunciation of engine limit exceedances and significant thrust loss

Lead Organization for Overall Project Coordination (LOOPC):

AIA

Safety Enhancement:

New airplane designs include several display and alerting system features that improve flight crew situational awareness and assist in identifying situations that could lead to loss of control.

Score: 2007-(0.0) 2020-(1.6) 100%-(8.2)

Outputs:

Output 1:

Guidance materials are in place that adopt principles embodied in the final report of the ARAC Avionics Systems Harmonization Working Group that address the following display features:

- Graphic speed trend information
- A pitch limit indication
- Bank angle limits to buffet
- Barber poles and amber bands on primary airspeed indications
- Detection and annunciation of conflicting attitude, airspeed and altitude data information
- Detection and removal of invalid attitude, airspeed and altitude data information (i.e.., from an internal fault)
- Detection and removal of misleading attitude, airspeed and altitude data information (e.g., from an external sensor fault) to the extent feasible
- Information to perform effective manual recovery from unusual attitudes using chevrons, sky pointers, and/or permanent ground-sky horizon on all attitude indications
- Salient annunciation of autoflight mode changes and engagement status changes (e.g., blinking/colored/boxed mode information)
- Effective side slip information and alerting of excessive sideslip (e.g., split trapezoid on attitude indicator)
- Clear annunciation of engine limit exceedances and significant thrust loss

Resources: ANM-100 (LOOC), ARAC Avionics Harmonization Working Group

Total government/industry resources: $6.7M (see separate worksheet for details)

Timeline: 180 days for FAA to task ARAC (completed), 2 years for ARAC to report recommendations from date of tasking, 4 years to amend the AC from date of tasking

Actions:

1. The FAA tasks the ARAC Avionics Systems Harmonization Working Group to elevate the priority of their AC25-11 revision, and to include the JSIT display and alerting features in the scope of this task.
2. ARAC provides its recommendations to the FAA and the JAA.
3. FAA develops guidance material as appropriate.
4. JAA develops guidance material as appropriate.

Relationship to Current Aviation Community Initiatives:

- ARAC Avionics Harmonization Working Group
- Industry activity on display standards

- NTSB Recommendation A-96-16, A-96-18 and A-97-19 relative to Birgen Air 757

Performance Goals & Indicators for Outcomes/outputs:

Goal: Revised AC 25-11 and ACJ 25-11 that provides guidance for future airplanes to include identified display system features to improve pilot situational awareness relative to recognition of, and recovery from, upsets and low energy conditions.

- Indicator: Published revision to AC 25-11
- Indicator: Published revision to ACJ 25-11

Programmatic Approach:

Organizational Strategy

The LOC JSIT identified Bob Robeson, AIA, as the JSIT project lead for Display and Alerting Features in New Airplane Designs. The project lead will assist with the implementation of the activities outlined in this Implementation Plan and will, when requested, provide progress reports to the CAST. Implementation of this project is viewed as a shared responsibility and tasks will be divided between the FAA and organizations/persons in industry. The Lead Organization for Overall project Coordination (LOOPC) is AIA. The Lead Organizations for Output Coordination (LOOC) are identified in each Output of this Implementation Plan. The roles and responsibilities of the LOOPC and LOOC are described in the CAST approved JSIT Process Document.

Implementation Activities

Several loss-of-control accidents involved cockpit displays of engine parameters, flight information and autoflight system mode status as contributory factors. The problems centered on not having sufficient, obvious and unambiguous information available to the pilot to adequately assess the aircraft status and then to accomplish the appropriate action to resolve problems. The objective of this project is to enhance the guidance in AC 25-11 by including additional recommendations for information to be displayed and modality of display logic.
Current state of the art glass cockpit airplanes address most of these issues. New aircraft and cockpit display designs will be evaluated with reference to the guidance provided in the amended AC25-11.

Key Products and Milestones:

- FAA tasks ARAC Avionics Systems Harmonization Working Group to include display system guidance in scope of their work – 90 days (completed)
- ARAC recommendations on display system guidance– 2 years from receipt of FAA tasking request
- Amended AC/ACJ 25-11 – 2 years from receipt of ARAC recommendations

Plan and Execution Requirements:

Changes to certification guidance materials only affect new airplane designs. Design changes, by nature, take a long time and require significant resources. Incorporating new safety features into new airplane designs is technically feasible and desirable. However, it take many years for these changes

to have a significant impact on overall fleet safety, given the time it takes to develop a new airplane and for these airplanes to become a significant part of the fleet.

Risk Description:

- Normal policy process and timeframe (e.g., ARAC, harmonization, etc.)
- Potential failures to implement advisory material
- New airplanes will represent a miniscule part of fleet in 2007
- Potential economic burden on manufacturers and operators
- Potential inadequate resource availability for manufacturers and operators and FAA
- Potential unwillingness to voluntarily implement project outputs
- Difficulty to incorporate a list of recommended display features into AC 25-11 without constraining manufacturer's ability to develop an integrated pilot interface design

Risk Mitigation Plan:

- CAST will support timely and successful completion of ARAC activity
- Ensure manufacturer and human factors input to AC 25-11 revision process

Impact on Non - Part 121 or International Applications:

All operators of the airplane will be impacted by changes to the design.

SE 85

Loss of Control
Joint Safety Implementation Team

Implementation Plan
for
Vertical Situation Displays – All Airplane Designs

Statement of Work:

To reduce fatal accidents due to loss of control, all airplane designs should be modified, if feasible, to include a real time graphical depiction of their vertical situation.

Lead Organization for Overall Project Coordination (LOOPC):

AIA

Safety Enhancement: (SE-85)

Where feasible, all airplane designs will include vertical situation displays. It is expected that new airplanes will incorporate this feature.

Score: 2007-(3.8) 2020-(9.5) 100%-(19.0)

Outputs:

Output 1:

Applicants for new airplane designs agree to incorporate vertical situation displays.

Resources: AIA (LOOC), manufacturers

Total government/industry resources: $0.07M (see separate worksheet for details)

Timeline: 60 days for AIA to issue communication, 180 days for manufacturers to respond to AIA letter

Actions:

1. CAST requests that the AIA communicate with manufacturers, encouraging them to incorporate vertical situation displays in their new airplane designs.
2. Manufacturers respond by indicating their intentions regarding incorporation vertical situation displays into new airplane designs.

Relationship to Current Aviation Community Initiatives:

- Industry activity on display standards

Performance Goals & Indicators for Outcomes/outputs:

Goal: Model-specific feasibility study of incorporating vertical situation displays.

- Indicator: Completed survey of all existing airplane models submitted to CAST via AIA
- Indicator: FAA conduct a biennial survey of the type certificate holders and operators to report back on implementation progress

Programmatic Approach:

Organizational Strategy

The LOC JSIT identified Bob Robeson, AIA, as the JSIT project lead Vertical Situation Displays. The project lead will assist with the implementation of the activities outlined in this Implementation Plan and will, when requested, provide progress reports to the CAST. Implementation of this project is viewed as a shared responsibility and tasks will be divided between the FAA and organizations/persons in industry. The Lead Organization for Overall project Coordination (LOOPC) is AIA. The Lead Organizations for Output Coordination (LOOC) are identified in each Output of this Implementation Plan. The roles and responsibilities of the LOOPC and LOOC are described in the CAST approved JSIT Process Document.

Implementation Activities

Several Controlled Flight Into Terrain, approach and landing, and loss-of-control accidents involved flight crew loss of vertical situation awareness. The problems are centered around not having sufficient, obvious and unambiguous information available to the pilot to adequately assess the aircraft vertical situation and then to accomplish the appropriate action to resolve problems. The objective of this project is to request the manufacturers to survey existing fleets to determine the feasibility of implementing vertical situation displays on all future production and existing in-service airplanes. The implementation of this project will require cooperation of the manufacturers and operators to incorporate changes in cockpit displays in the existing fleet, as appropriate.

Because current airplanes do not include this feature, a model-specific study should be performed to understand the feasibility of incorporating this feature. It is expected that each manufacturer, in coordination with their avionics suppliers, will develop an appropriate display for their individual airplane designs that will result in an integrated design consistent with the manufacturer's flight deck design philosophies.

Key Products and Milestones:

- AIA request for Vertical Situation Display Studies – 60 days
- Study results – 2 year from receipt of AIA request
- CAST endorsement of completed studies – 120 days from receipt
- FAA communication to type certificate holders and operators encouraging implementation of study results and requesting response regarding intentions – 60 days from CAST endorsement

- Type certificate holders' and operators' response to FAA letter – 180 days from receipt of letter

Plan and Execution Requirements:

Design changes, by nature, take a long time and require significant resources. Incorporating new safety features into existing aircraft or derivatives can have an impact on overall fleet safety, but these changes are usually expensive, technically complex, and can have significant operational impacts. Often the return on investment is low for retrofits to aging aircraft. Any near-term benefits to be realized through retrofit of the existing fleet require voluntary implementation by manufacturers and operators.

Model-specific feasibility studies for the existing fleet are required to establish the technical and operational feasibility of each applicable project aspect. This will determine the magnitude of the economic impacts and the likelihood that voluntary implementation will be undertaken. The resources to conduct the feasibility studies must be provided by the affected participants in order to proceed with any hope of implementation.

Risk Description:

- Potential economic burden on manufacturers and operators
- Potential inadequate resource availability for manufacturers and operators and FAA
- Potential inadequate findings from required surveys / studies
- Potential unwillingness to voluntarily implement project outputs
- Reluctance to retrofit aging fleets

Risk Mitigation Plan:

- CAST will advocate voluntary implementation among non-aligned air carriers
- Failure to implement advisory material for existing aircraft may require additional rulemaking.
- Seek consensus on the use of existing studies and surveys by citing use in industry
- Model-specific feasibility study for implementation in existing aircraft will be used to mitigate economic impacts and inadequate resource availability

Impact on Non - Part 121 or International Applications:

All operators of the airplane will be impacted by changes to the design.

SE 39

Loss of Control
Joint Safety Implementation Team

Implementation Plan
for
Criteria for Flight in Icing Conditions for New Airplane Designs

Statement of Work:

To reduce fatal accidents due to loss of control, recommend and support the development of amended icing certification criteria, for new airplane designs not equipped with evaporative (i.e. hot wing) systems, that include performance and handling qualities requirements for the following:

- Residual ice;
- Intercycle ice;
- Delayed anti-icing/de-icing system activation;
- De-icing/anti-icing system malfunction.

Lead Organization for Overall Project Coordination (LOOPC):

AIA

Safety Enhancement:

New designs for airplanes not equipped with evaporative systems accommodate flight in an expanded icing envelope and additional de-ice/anti-ice system malfunctions.

Score: 2007-(0.0) 2020-(0.3) 100%-(6.5)

Outputs:

Output 1:

Regulations and guidance materials are in place that adopt the principles embodied in the final reports of the ARAC Ice Protection Harmonization Working Group and the ARAC Flight Test Harmonization Working Group to establish new icing certification criteria, for airplanes not equipped with evaporative systems, that include performance and handling qualities requirements for the following:

- Residual ice;
- Intercycle ice;
- Delayed anti-icing/de-icing system activation;
- De-icing/anti-icing system malfunction.

Resources: ANM-100 (LOOC), NASA, ARAC Ice Protection HWG, ARAC Flight Test Harmonization Working Group

Total government/industry resources: $1.4M (see separate worksheet for details)

Timeline: 3 years to issue final rules and associated AC material

Actions:

1. The ARAC Ice Protection Harmonization Working Group publishes expanded icing envelope.
2. The ARAC Flight Test Harmonization Working Group publishes recommendations that address airplane performance and handling characteristics in icing conditions.
2. The FAA issues regulatory and guidance material as appropriate.
3. The JAA issues regulatory and guidance material as appropriate.

Relationship to Current Aviation Community Initiatives:

- ARAC Flight Test Harmonization Working Group
- ARAC Ice Protection Harmonization Working Group
- FAA Icing Plan
- NASA Aerospace Operation Systems Icing Project Plan

Performance Goals & Indicators for Outcomes/outputs:

Goal: Amended icing certification requirements for all new airplane designs

- Indicator: Manufacturers agree that new material meets intent of ARAC FGSHWG
- Indicator: FAA publishes new icing certification criteria
- Indicator: JAA publishes new icing certification criteria

Programmatic Approach:

Organizational Strategy

The LOC JSIT identified Bob Robeson, AIA, as the JSIT project lead for Criteria for Flight in Icing Conditions for New Airplane Designs. The project lead will assist with the implementation of the activities outlined in this Implementation Plan and will, when requested, provide progress reports to the CAST. Implementation of this project is viewed as a shared responsibility and tasks will be divided between the FAA and organizations/persons in industry. The Lead Organization for Overall project Coordination (LOOPC) is AIA. The Lead Organizations for Output Coordination (LOOC) are identified in each Output of this Implementation Plan. The roles and responsibilities of the LOOPC and LOOC are described in the CAST approved JSIT Process Document.

Implementation Activities

Numerous accidents have involved airframe icing as contributory or causal factors. The intent of this project element is to ensure that the proposed rulemaking product of the ARAC Flight Test Harmonization Working Group (FTHWG) includes those criteria that are significant to loss-of-control. Implementation of this project element will consist of:

- Providing the FTHWG with these criteria, and
- Supporting continued research regarding the effects of airframe icing on the performance and handling characteristics of aircraft.

Key Products and Milestones:

- Amended FAR/JAR Part 25 that includes new icing certification criteria – 3 years
- Amended AC/ACJ material that includes new icing guidance material – 3 years

Plan and Execution Requirements:

Changes to certification rules and guidance materials only affect new airplane designs. Design changes, by nature, take a long time and require significant resources. Incorporating new safety features into new airplane designs is technically feasible and desirable. However, it take many years for these changes to have a significant impact on overall fleet safety, given the time it takes to develop a new airplane and for these airplanes to become a significant part of the fleet.

Risk Description:

- Normal policy/rulemaking process and timeframe (e.g., ARAC, harmonization, etc.)
- Potential failures to implement recommendations of the ARAC into regulatory and advisory material
- New airplanes will represent a miniscule part of fleet in 2007
- Potential economic burden on manufacturers and operators
- Potential inadequate resource availability for manufacturers and operators and FAA

Risk Mitigation Plan:

- CAST will support timely and successful completion of ARAC activity
- Pending successful change to Part 25, industry will continue to comply with the more stringent JAA icing requirements

Impact on Non - Part 121 or International Applications:

All operators of the airplane will be impacted by changes to the design.

SE 40

Loss of Control
Joint Safety Implementation Team

Implementation Plan
for
Flight Envelope Protection in New Airplane Designs

Statement of Work:

To reduce fatal accidents due to loss of control, new airplane designs should include angle-of-attack / low speed protection, thrust asymmetry compensation, and bank angle protection, using hard or soft limits.

Fly-by-wire active flight envelope protection technology does not exist for turboprop airplanes, turbo-prop manufacturers should strive, to the fullest extent, to provide the protection benefits of these systems in their new airplane designs.

Lead Organization for Overall Project Coordination (LOOPC):

AIA

Safety Enhancement:

New airplane designs include angle-of-attack / low speed protection, thrust asymmetry compensation, and bank angle protection, using hard or soft limits.

Score: 2007-(0.0) 2020-(4.2) 100%-(21.0)

Outputs:

Output 1:

Applicants for new airplane designs agree to incorporate angle-of-attack / low speed protection, thrust asymmetry compensation, and bank angle protection.

Resources: AIA (LOOC), manufacturers

Total government/industry resources: $0.07M (see separate worksheet for details)

Timeline: 60 days for AIA to issue communication, 180 days for manufacturers to respond to AIA letter

Actions:

1. CAST requests that the AIA communicate with manufacturers, encouraging them to incorporate angle-of-attack / low speed protection, thrust asymmetry compensation, and bank angle protection into all new airplane designs as defined by published guidance material.
2. Manufacturers respond by indicating their intentions regarding incorporation of flight envelope protection into future airplane designs.

Relationship to Current Aviation Community Initiatives:

ARAC Flight Guidance System Harmonization Working Group
NASA LaRC Control Upset Prevention and Recovery technology development research

Performance Goals & Indicators for Outcomes/outputs:

Goal: Inclusion of angle-of-attack / low speed protection, thrust asymmetry compensation, and bank angle protection, using hard or soft limits in new airplane designs.

- Indicator: Letters received from manufacturers indicating their intentions

Programmatic Approach:

Organizational Strategy

The LOC JSIT identified Bob Robeson, AIA, as the JSIT project lead for Flight Envelope Protection – New Airplane Designs. The project lead will assist with the implementation of the activities outlined in this Implementation Plan and will, when requested, provide progress reports to the CAST. Implementation of this project is viewed as a shared responsibility and tasks will be divided between the FAA and organizations/persons in industry. The Lead Organization for Overall project Coordination (LOOPC) is AIA. The Lead Organizations for Output Coordination (LOOC) are identified in each Output of this Implementation Plan. The roles and responsibilities of the LOOPC and LOOC are described in the CAST approved JSIT Process Document.

Implementation Activities

The LOC JSAT/JSIT activity has identified flight envelope protection as the most effective intervention strategy for the prevention of future loss-of-control accidents. CAST will then request that the AIA communicate with manufacturers, encouraging them to incorporate angle-of-attack / low speed protection, thrust asymmetry compensation, and bank angle protection into all new airplane designs as defined by the guidance material. The Manufacturers should respond by indicating their intentions regarding the incorporation of flight envelope protection into their new airplane designs. FAA/JAA should work with the manufacturers and operators per business as usual to determine the acceptable characteristics of flight envelope protection systems for new airplane designs.

Key Products and Milestones:

- AIA communication to manufacturers encouraging implementation of flight envelop protection capabilities into new airplane designs and requesting response regarding intentions – 60 days from issuance of FEP guidance material
- Manufacturers' response to AIA letter – 180 days from receipt of letter

Plan and Execution Requirements:

Changes to certification guidance materials only affect new airplane designs. Design changes, by nature, take a long time and require significant resources. Incorporating new safety features into new airplane designs is technically feasible and desirable. However, it take many years for these changes to have a significant impact on overall fleet safety, given the time it takes to develop a new airplane and for these airplanes to become a significant part of the fleet.

Risk Description:

- New airplanes will represent a miniscule part of fleet in 2007
- Potential economic burden on manufacturers and operators
- Potential inadequate resource availability for manufacturers
- Potential unwillingness to voluntarily implement project outputs
- Technical feasibility of incorporating active flight envelope protection on turbo-prop airplanes

Risk Mitigation Plan:

The risks are relatively small and the technology is well understood, except for turbo-prop airplanes where additional technology development is required.

Impact on Non - Part 121 or International Applications:

All operators of affected airplanes will be impacted by changes to the design.

SE 27

Loss of Control
Joint Safety Implementation Team

Implementation Plan
For
Policies and Procedures - Risk Assessment and Management

Statement of Work: (SE-27)

The purpose of this project is to identify or develop and implement methods for operators, regulators, and manufacturers to prioritize safety related decisions. The project will improve methods of risk assessment for operational issues related to service bulletins, aircraft accident/incident analysis, flight critical safety information, and recurring intermittent failures related to dispatch.

Lead Organization for Overall Project Coordination (LOOPC):
ASY

Safety Enhancement:

Aviation safety will be improved through the use of risk assessment/management methods.

Score: 2007-(12.3) 2020-(12.3) 100%-(14.5)

Resource Requirements: The resources required for this project will be:

- 4 ½ man-years funded by each organization involved in the development and implementation of the risk assessment/management information.
- Approximately $150,000 for administrative costs.

Completion Date: 3 years

Output 1:

- Compile and assess guidance materials related to risk assessment and risk management tools to prioritize safety related decisions for operational issues regarding service bulletins, aircraft accident/incident analysis, flight critical safety information, and recurring intermittent failures related to dispatch.

Resources: (ASY) (LOOC), FAA, Flight Safety Foundation, CAMI, ATA, AIA, DOD, and ALPA. The resources required for this output will be mainly limited to the man hours funded by each organization involved in the identifying and distribution of the essential operating information. Using a team of 10 individuals for one week per month, a total of approximately 1 3/4 man-years will be needed to compile and assess the information. Also an administrative cost of approximately $60,000 will be needed for meeting rooms and incidental expenses of the meetings.

Timeline: 12 months

Actions:

1. ASY should survey various industry and DOD entities to determine risk assessment and risk management material available.
2. ASY should gather the available risk resource material (i.e. Advisory Circular (AC) 39xx, Part 25 risk information, and ALAR risk assessment).
3. ASY should lead an industry-government team to assess the material for applicability and utility.

Output 2:

- Based on the assessment from Output 1, develop guidance materials for operators, regulators, and manufacturers on risk assessment and risk management tools to prioritize safety related decisions for operational issues.

Resources: ATA (LOOC), RAA, FSF, NACA, labor unions, AIA, manufacturers, FAA, MOT of Canada, and Air Transport Association of Canada. The resources required for this output would be limited to the man-hours funded from each organization and administrative costs:

- Action 1 - Using a team of 10 individuals for one week per month, a total of approximately 1 3/4 man-years will be needed to develop the guidance. Also an administrative cost of approximately $60,000 will be needed for meeting rooms, equipment, and incidental expenses of these meetings.
- Action 2/3 - The FAA personnel costs to produce the AC and HBAT will be funded through normal methods and require approximately ½ man-year to produce. The cost to publish these documents will be absorbed by the normal document distribution process.

Timeline: 12 months after compilation of industry material in Output 1.

Actions:

1. ASY (with assistance from FSF, ATA and FAA) should combine material from Output 1 into risk assessment tools.
2. AFS-200 should publish the risk assessment tools in an AC for operators.
3. AFS-200 should develop and publish a Handbook Bulletin Air Transportation (HBAT) for FAA inspectors' guidance on risk assessment tool usage.

Output 3:

- Operator, regulator, and manufacturer Directors of Safety (DOS), or equivalents, should ensure all appropriate managers implement and use risk assessment tools to prioritize safety related decisions developed in output 2.

Resources: ATA (LOOC), RAA, NACA, labor unions, AIA, manufacturers, FAA, MOT of Canada, and Air Transport Association of Canada. After an initial meeting of all DOS's, or equivalents, to explain the program and risk assessment tools, an oversight team of 3 individuals should be formed. This oversight team will meet quarterly for the first year to clarify the principles and intent of a flexible risk assessment program. A total resource cost of approximately 1/2 man-year will be needed to assist in the implementation of the program. Also an administrative cost of approximately $30,000 will be needed for meeting rooms and incidental expenses of the meetings.

Timeline: 12 months.

Actions:

1. DOS's, or equivalents, working through senior management, should apply the principles contained in the AC to training programs and manuals used by operations and maintenance staff.
2. DOS's, or equivalents, should report to the respective industry association periodically, or to their CAST representative until all elements of the risk assessment and management program are implemented.

Relationship to Current Aviation Community Initiatives:

The following documents and organizations provide information to the aviation industry on the design and establishment of risk assessment management tools.

- MIL-STD-882D, Department of Defense Standard Practice for System Safety, dated 10 February 2000.
- AF PAMPHLET (AFPAM) 90-902 Operational Risk Management (ORM) Guidelines and Tools. This pamphlet is the process for the US Air Force Operational Risk Management Program as prescribed by AFPD 90-2, Operational Risk Management. AFPAM 90-902 provides the definitions, guidelines, procedures and tools for the integration and execution of ORM. It has application and use for all US Air Force organizations and personnel.
- Resources from Transportation Safety Institute.
- American Airlines Risk Management program.
- AC 139.xx, Part 25 Risk Assessment.
- ALAR Risk Assessment process.

Performance Goals & Indicators for Safety Enhancement/Outputs:

- Safety Enhancement Goal: Develop and implement risk assessment and management methods to prioritize safety related decisions.
  - Indicator: Reduction in accidents related to operational risk factors.

- Output 1 Goal: Compile and assess guidance materials related to risk assessment and risk management tools to prioritize safety related decisions for operational issues.

  - Indicator: Applicable risk assessment and management information is compiled.

- Output 2 Goal: Develop guidance materials for operators, regulators, and manufacturers on risk assessment and risk management tools to prioritize safety related decisions for operational issues.

  - Indicator: Guidance material is developed.

- Output 3 Goal: Operator Directors of Safety, or equivalents, should ensure all appropriate managers implement and use the risk assessment tools to prioritize safety related decisions developed in output 2.

  - Indicator: Operators, regulators, and manufacturers implement the risk management material.

Programmatic Approach:

Organizational Strategy

The LOC JSIT has identified ASY as the LOOPC organization. The LOOC's are identified in each output of this Implementation Plan. The roles and responsibilities of the LOOPC and LOOC are described in the CAST approved JSIT Process Document. ASY will provide the project lead for the Risk Assessment and Management Project. ASY will work with the various carriers and labor unions, FSF, manufacturers, principle operations inspectors (POI), and others to create a set of risk assessment guidelines. The project lead will coordinate the activities outlined in the implementation plan, and will provide progress reports, when requested, to the CAST. Implementation of this product is a shared responsibility between the FAA, air carriers, manufacturers and labor unions.

Implementation Activities

ASY should establish a working group of knowledgeable stakeholders to coordinate the collection and assessment of available risk assessment and management information. The FSF (with assistance from ATA and FAA) should then establish a working group to develop this information into guidance material for the industry. AFS-200 should then develop and publish an AC and an HBAT to use as guidance in the implementation and integration of the risk management tools to prioritize safety related decisions. This project should encourage air carriers to establish risk assessment and management programs under the company DOS. The LOOPC will also have oversight into the research outputs of this project if needed.

Key Products and Milestones:

The following milestones are based on the date of CAST "G" approval:

Products	LOOC	Milestone
• Collect, analyze, and assess existing risk management programs	ASY	G + 12 mo
• Develop risk management methods to prioritize safety related decisions	ATA	G + 24 mo
• Operators implement the use of risk management methods	ATA	G + 36 mo

Risk Description:

Low-Medium Risk. The collection of risk management information and its development into a user-friendly industry guide is relatively low risk. This information will provide a good basis to develop a risk program in a company that does not have one established. Additionally companies that already have a risk program and may not want to spend the resources to change it to conform to the new guidance. Also, some organizations do not embrace the concept of risk management as necessary and cost effective. Since the risk guidance is not immediately operationally apparent and is voluntary, some organizations may not see the long term cost savings.

Risk Mitigation Plan:

Since some manufacturers and air carriers presently use some form of risk management in their operations, the long-term value to these organizations should be stressed and promoted. A positive, close, cooperative effort between the FAA and industry organizations could help achieve widespread implementation of risk management programs. These programs would be an additional tool for air carrier operations and maintenance departments is use in making safety related decisions.

Impact on Non - Part 121 or International Applications:

This project could have a positive impact on non-Part 121 commercial, international, and corporate operations. The risk management tools developed in this project could be tailored to all operational situations and could be a method to assist in prioritizing safety rated decisions. The development of these processes could be a joint effort with foreign authorities and organizations and would be applicable to their operations.

SE 26

Loss of Control
Joint Safety Implementation Team

Implementation Plan
for
Policies and Procedures - Standard Operating Procedures (SOP's)

Statement of Work:

The purpose of this project is to ensure that all airline operators publish and enforce clear, concise, and accurate flight crew standard operating procedures (SOP). These procedures should include expected procedures during pre/post flight and all phases of flight i.e.: checklists, simulator training, PF/PNF duties, transfer of control, automation operation, rushed and/or unstabilized approaches, rejected landings and missed approaches, in-flight pilot icing reporting, and flight crew coordination. Operator instructors and check airman should ensure these SOP's are trained and enforced in their aircrew proficiency and standardization programs.

Lead Organization for Overall Project Coordination (LOOPC):
ATA

Safety Enhancement:

The establishment, maintenance, and use of flight crew SOP's in accordance with AC 120-71 (Standard Operating Procedures for Flight Deck Crewmembers) will improve aviation safety.

Score: 2007-(1.8) 2020-(1.8) 100%-(2.2)

Resource Requirements:

- Outputs 1-3 – estimated at 3 man-years
- Output 4 – estimated at ¼ man-year per operator
- Total Cost - $550,000

Completion Date: 24 months

Output 1/SE 26:

- ATA Training Committee and AFS-200 should conduct a review of AC 120-71 and incorporate relative information from the LOC JSAT interventions and operator SOP's.

Resources: ATA (LOOC), RAA, manufacturers, operators, and labor unions. The cost of this output would be mostly the individual's time from each organization involved. Initial cost estimates would be one man-year and $250,000, which would be shared by the operators, manufacturers, and labor organizations.

Timeline: 6 months.

Actions:

ATA convene training committee to review all applicable information.

Output 2/SE 26:

- Based on results of Output 1, AFS-200 should consider a revision/appendix to AC 120-71.

Resources: AFS-200 (LOOC), ATA, RAA, manufacturers, operators, and labor unions. The cost of this output would be mostly the individual's time from each organization involved. Initial cost estimates would be one man-year and $150,000, which would be shared by the operators, manufacturers, labor organizations, and government employees.

Timeline: 6 months from completion of review in output 1.

Actions:

AFS-200 should revise AC 120-71 as needed to provide recommendations about development, implementation, and updating of operator SOP information.

Output 3/26:

Based on results of Output 2, AFS-200 should review and possibly revise guidance to FAA principal operations inspectors (POI's) for incorporation of the revised AC information into the operator's training programs and manuals.

Resources: AFS-200 (LOOC), ATA, RAA, manufacturers, operators, and labor organizations. The cost of this output would be mostly the individual's time from each organization involved. Initial cost estimates would be one man-year and $150,000, which would be shared by the operators, manufacturers, labor organizations, and government employees.

Timeline: 6 months from completion of review in output 1.

Actions:

AFS-200 should update the FSAT as needed to provide guidance to all POI's for their oversight of air carrier training programs and manuals.

Output 4/SE 26:

- Air carriers should adopt the revised SOP information and revise their training programs and manuals to incorporate the proposed revisions.

Resources: ATA (LOOC), FAA, RAA, manufacturers, operators, and labor unions. The cost of this output would be mostly the individual's time from each organization involved. Operator cost to implement the revision is estimated to be approximately ¼ man-year per operator. Revisions will be made within the carriers' normal revision process.

Timeline: 12 months from completion of AC 120-71 revision.

Actions:

Operators should revise their company training programs and manuals to incorporate as many SOP item revisions as appropriate.

Relationship to Current Aviation Community Initiatives:

The following documents provided recommendations to the aviation industry for the establishment, usage, and revision of SOP's related to LOC:

- Loss Of Control JSAT Report.
- AC 120-71 dated 8/10/00, titled "Standard Operating Procedures for Flight Deck Crewmembers."
- Draft AC, 120-xx, titled " Part 121, 125, and 135, Flight Crew Procedures during Taxi Operations."
- Approach and Landing JSAT report.
- Flight Safety Foundation ALAR report.
- JSAT CFIT report.
- FSAT 00-08 dated 8/23/00
- Human Performance Considerations in the Use and Design of Aircraft Checklists (FAA) report dated January 1995

Performance Goals and Indicators for Safety Enhancements/Outputs:

- **Safety Enhancement Goal:** To improve aviation safety through SOP's, each operator should establish, maintain, and use flight crew SOP's in accordance with AC 120-71.
- **Indicator**: A reduction of LOC incidents and accidents related to SOP's.

Output 1

- Goal: Review Part 121 operators' SOP's relative to Loss of Control JSAT intervention information and make recommendations for improvement.
- Indicator: Recommendations provided to AFS-200

Output 2

- Goal: Revise AC 120-71 per recommendations from Output 1.
- Indicator: AC 120-71 revised and published.

Output 3

- Goal: Revise FSAT 00-08 to supplement revisions in Output 2.
- Indicator: FSAT 00-08 revised and published.

Output 4

- Goal: Operators adopt the revised LOC related SOP information.
- Indicator: Operator's training programs and manuals are revised to include this information.

Programmatic Approach:

Organizational Strategy

The LOC JSIT has identified ATA as the LOOPC organization. The LOOC's are identified in each output of this Implementation Plan. The roles and responsibilities of the LOOPC and LOOC are described in the CAST approved JSIT Process Document. The LOOPC will provide the project lead for the SOP project. The project lead will work with the manufacturers, labor unions, FAA Flight Standard's personnel, and others to complete the four outputs. The project lead will coordinate the activities outlined in the implementation plan, and will provide progress reports, when requested, to the CAST. Implementation of this product is a shared responsibility between the operators, the FAA, the manufacturers, and labor organizations.

Implementation Activities

The ATA Training committee should review the current operator SOP's related to LOC and LOC JSAT interventions. AFS-200 should use the results of this review to revise the AC as appropriate. Operators should then be encouraged to use this information to amend their own SOP's. In addition, HBAT 00-08 should be reviewed and revised as necessary to provide guidance to all POI's. The POI's should assist the operators in revising the operator's training program and manuals per the new guidance.

Key Products and Milestones:

The following milestones are based on the date of CAST "G" approval:

Products	LOOC	Milestones
• Review operator SOP's and JSAT interventions	ATA	G + 6 months
• Revise AC 120-71	AFS-200	G + 12 months
• Revise FSAT 00-18	AFS-200	G + 12 months
• Revise operator training programs and manuals	ATA	G + 24 months

Plan & Execution Requirements:

To implement the associated LOC SOP revision tasks identified within this implementation plan requires resources and support from the following organizations:

- Airline operators
- Airline labor organizations
- Airline member associations
- FAA Flight Standards

Risk Description:

Low-Medium Risk. The revision of the SOP information is a relatively low-risk activity because the operators participated in the initial ATA SOP review and AC 120-71 design. The operators should be willing to address the LOC intervention information and make appropriate revisions. The only medium-risk items that can be identified at this point are:

- The timeframe involved in the review and recommendations to the operator SOP's and AC.
- The timeframe to write and implement the revised AC and FSAT.
- The willingness of the operators to review and revise their manuals based upon a new set of guidelines and their staff time in competition with other projects.

Risk Mitigation Plan:

The project will include the operators as team-members of the SOP information review/revision process. This will provide them the opportunity to voice concerns at the early stages of information re-design to hopefully mitigate the risks later in the process. The success of this project may depend on operators' willingness to revise long-standing procedures. The use of SOP's has been encouraged through many other recent industry activities such as the CFIT Training Aid, CFIT Training Document, Flight Safety Foundation CFIT ALAR report, and the ICAO cover letter accompanying the CFIT Training Document.

Impact on Non-FAR Part 121 or International Applications:

Any SOP revision/recommendations that address LOC issues should improve the integrity of company manuals and training programs. Therefore, any International or Non FAR-121 operators should also benefit from the revised SOP information, AC and FSAT guidance material.

SE 28 and 29

Loss of Control (LOC)
Joint Safety Implementation Team

Implementation Plan
for
Policies and Procedures – Policies

Statement of Work:

The purpose of this project is to ensure that essential safety information and operational procedures generated by airplane manufacturers are included in companies' operating manuals, training programs for pilots and other appropriate employee groups, in daily operations. Operators should also develop a means to improve the performance of those flight crew members that meet the minimum criteria, but have shown a limited proficiency.

Lead Organization for Overall Project Coordination (LOOPC):
ATA

Safety Enhancement 1: (SE-28)

Aviation safety will be advanced by improving flight crew and other operator employees' performance through timely identification and dissemination of essential safety information and procedures.

Score: 2007-(7.3) 2020-(7.3) 100%-(7.3)

Resource Requirements:

- Approximately one man-year per organization.
- $250,000.

Completion Date: 1 year

Note: FAA, in agreement with ATA, CAST, and AFS-200, will complete the measurement portion of this plan (Output 1) utilizing their POI's/ PMI's during normal work program functions.

Output 1:

- Reliable processes should be developed to ensure flight operations and maintenance personnel are made aware of and incorporate essential operating information in a timely manner.

Resources: AIA (LOOC), ATA, RAA, ALPA, APA, manufacturers, etc. The resources required for this output will be limited to the man hours of each organization involved in the identifying and distribution of the essential operating information. Since most of this identification would be

integrated into the normal information review process once established, the initial cost estimates would be one additional man-year per organization and $250,000, which would be shared by the operators, manufacturers, and labor organizations. These costs should also cover the review of present documents.

Timeline: 1 year

Actions:

1. Manufacturers should review their processes for distributing essential operating information and to identify its significance.
2. Operators should distribute essential operating information identified by the manufacturers to flight crews and maintenance staff in an appropriate and timely manner.
3. Directors of Safety, or equivalent, should ensure the establishment of a process to identify, review, analyze and include essential operating information in training programs and in manuals used by flight crews and maintenance staff.
4. Operators should revise the company flight manual(s) in a timely manner as essential operating information is amended or added.
5. Principal Operations Inspector's should perform follow-up surveillance, within their normal work program, of completion of actions 1-4 IAW with HBAT 99-07 and HBAT 99-16a.

Safety Enhancement 2: (SE-29)

Aviation safety will be improved by ensuring carriers have a process to enhance pilot proficiency.

Score: 2007-(3.8) 2020-(3.8) 100%-(4.7)

Resource Requirements:

- Approximately two-man years to develop.
- Additional training costs of $5 million per year.

Completion Date: 1 year

Output 2:

- Operators, in collaboration with pilot associations, should ensure their training and qualification processes utilize information from programs such as FOQA, AQP, and ASAP to assist in assuring pilot proficiency.

Resources: ALPA (LOOC), ATA, APA, RAA, etc. The resources required for this output are:
1. Organizational time of approximately two-man years to develop this process.
2. Additional training/checking would be estimated to cost $10,000 per individual identified by the process. With an estimated ½ percent on the approximately 100,000 air carrier pilots affected, this would compute to a total training cost of $5 million per year.

Timeline: 1 Year for program development.

Actions:

- All pilot associations and operators should review existing programs and collaborate to develop a mechanism to continuously improve pilot performance and proficiency.
- Improved overall flight crew performance and proficiency should be paramount in program design.
- The program should be a joint effort among pilot associations and operators, with safe guards designed to protect confidentiality of individuals and information.
- The program shall be non-punitive, voluntary, and managed by the pilot associations on an individual airline basis. Entry into the program can either be by voluntary self-disclosure or through encouragement by the pilot associations Professional Standards or Standardization and Training Committees.

Relationship to Current Aviation Community Initiatives:

When the Air Transportation Oversight System (ATOS) was implemented in 1997, the FAA initiated the oversight of several major operators with a system-based safety approach. The program included safety attribute processes to assist in sustaining effective flight crew operating manuals. When HBAT 99-07 and HBAT 99-16a were released in December 2000, some Part 121 operators were already voluntarily correlating the flight crew operating manuals to the contents of the manufacturer's airplane flight manual (AFM). Output 4 of the Approach and Landing Accident Reduction (ALAR) report established an AFM database supported by the manufacturers and administered by the FAA in AFS-600. This process would consolidate AFM revisions, information, and Operator Bulletins into one WEB based/available information source.

FAA rulemaking is currently in progress to modify subparts N and O of 14 CFR Part 121. These changes may require each Part 121 operators to model their flight crew operating manual and related training and qualification program, on the approved AFM. This new rule would permit certain changes and additions to the AFM, but no omissions. The FAA is considering additional rulemaking that would establish a single source crew operating manual(s) as a required repository for all essential operating procedures generated by the manufacturer. This manual would be subject to FAA approval, and would be supported by an effective revision system. This manual(s) would be required as the core document for any operating manual developed by a Part 121 operator for use by its flight crews, and would be the primary document of the approved flight crew qualification program.

The current Part 121 training rules and AQP programs require pilots to be trained to proficiency and then evaluated with standardized checkride profiles. Many airlines and pilot associations have mechanisms in place that address pilot performance and proficiency issues, such as pilot training committees and review boards. Since 1995, 14 CFR Part 121.434 and 121.438 address the proficiency of newly qualified pilots and specify the consolidation of knowledge and skills, high landing minimums for new captains, and crew pairings considerations. The Pilot Records Improvement Act of 1996 requires background checks to minimize the likelihood of an air carrier hiring a pilot with a documented history of poor performance.

Performance Goals & Indicators for Safety Enhancements/Outputs:

Safety Enhancement 1:

- Goal**:** Improve flight crew and other operator employee's performance through timely dissemination of essential safety information and procedures.

    - Indicator**:** No Part 121 accidents related to lack of available essential safety information.

Output 1:

- Goal: Develop processes to ensure safety essential information is identified and distributed to operations and maintenance personnel in a timely manner.

    - Indicator: No LOC accidents related to lack of essential information.

Safety Enhancement 2:

- Goal: Develop a more effective pilot qualification and proficiency program.

    - Indicator: Decrease in Part 121 accidents related to pilot proficiency and competency.

Output 2

- Goal: Develop a process to enhance pilot proficiency and competency.

    - Indicator: Decrease in LOC accidents related to lack of pilot proficiency and competency.

Programmatic Approach:

Organizational Strategy

The LOC JSIT has identified ATA as the LOOPC organization. The LOOC's are identified in each output of this implementation plan. The roles and responsibilities of the LOOPC and LOOC are described in the CAST approved JSIT Process Document. The LOOPC will provide the project lead for the Policies and Procedures project and should work with AIA, ATA, RAA, labor unions, the FAA, manufacturers, and others to develop processes and systems identified in the outputs. The project lead should coordinate the activities outlined in the implementation plan, and should provide progress reports, when requested, to the CAST. Implementation of this product is a shared responsibility between the FAA, air carriers, manufacturers and labor unions, as appropriate.

The success of both outputs depends largely upon the safety posture of the industry. The essential safety flight crew information identified in Output 1 must be incorporated into existing operator manuals. This process would ensure this information is properly marked and disseminated to the flight crews and other personnel in a timely and efficient manner. Output 2 addresses the improvement of aviation safety by developing a process to enhance pilot proficiency and competency. This process will need to be designed and accepted by both the Part 121 operators and flight crew labor unions in order to be implemented. The privacy of the individuals involved in this program needs to be safeguarded.

Implementation Activities

Output 1: Until the current FAA rulemaking changes becomes fully implemented in 2007, manufacturers and Part 121 operators must voluntarily support and adhere to the safety intent of HBATs 99-07 and 99-16a. The FAA should also support certain culture changes, funding, and staffing issues in the ACOs and AEGs to build and maintain the AFM database in AFS-600. Manufacturers and the FAA should cooperate to fully populate this database with appropriate records relating to AFM revisions and operational bulletins. The FAA should fully fund and staff this database process to ensure its currency and usefulness to inspectors, in accordance with HBAT 99-16a.

Output 2: The support of the industry operators and pilot associations to recognize and design a program to address the flight crew member proficiency and competency is crucial to this project's success. There shall also be a means to protect the operator and individual privacy associated with this program.

Key Products and Milestones:

The following milestones are based on the date of CAST "G" approval:

• Develop processes to disseminate essential safety information	AIA	G + 12 months
• Develop pilot enhancement system	ALPA	G + 12 months

Risk Description:

Output 1 is considered Low Risk. All operators, manufacturers, and the FAA support enhancing the identification and dissemination of safety information and operational procedures to flight crew and other personnel. Operators are also already familiar with HBAT 99-07 and 99-16a that references correlating flight crew operating manuals with the manufacturers' AFM. This output will enhance these previous programs.

Output 2 is considered Moderate Risk. Many of the labor unions have expressed concern over the identification of different levels of pilot proficiency and competency. The issue of FOIA, litigation, and privacy protection of the information and data generated from this program is a very important concern. Also of concern is the philosophical objection to separating the pilots into "good or other" classifications. There is also concern over the increased cost of training for pilots identified in this classification and the administering of a separate listing for training and crew pairing.

Risk Mitigation Plan:

Output 1 has no apparent risk and should be supported by all organizations. The cost to design, implement, and sustain this program should be kept to a minimum to encourage its quick implementation.

Output 2 should be a joint program between among labor unions, and operators, with safeguards designed into the program. The positive intent to improve overall flight crew performance should be

paramount in the program design. The program should be designed as non-punitive, voluntary, and managed by the labor unions on an individual airline basis.

Impact on Non-FAR Part 121 or International Applications:

All operators can benefit from having the essential safety information and operational procedures identified by the manufacturers. This would encourage the non-FAR Part 121 operator to easily modify their operating manuals and training programs. Since these operators usually design their own programs patterned after the manufacturer's guidelines, they will therefore benefit from this information. The foreign operators can also benefit for this information in the same manner and should be a part of the design and implementation processes.

The process described in output 2 would be voluntary and would have minimal impact on the non-Part 121 or international air carriers.

SE 30

Loss of Control
Joint Safety Implementation Team

Implementation Plan
For
Training – Human Factors and Automation

Statement of Work

In order to reduce loss of control accidents, Part 121 air carrier training departments need to incorporate training that emphasizes flight crewmembers' situation awareness, crew coordination during multitasking, and the use of automation in conjunction with CRM. Flight crews should be trained to use the appropriate levels of automation. Emphasis should be placed on the knowledge of functional operation, capabilities and limitations of automation to ensure pilot control of the aircraft.

Safety Enhancement: To improve the overall performance of flight crews to recognize and prevent loss of control accidents, through effective use of automation and CRM.

Lead Organization for Overall Project Coordination (LOOPC): **Air Transport Association (ATA)**

Score: 2007-(3.0) 2020-(3.0) 100%-(3.7)

Resource Requirements:

ATA Training, Human Factors, and Safety Committees; NASA; FAA, including Flight Standards – Human Factors Coordinating Committee (AFS-HFCC); Directors of Safety, flight operations and training departments and pilot associations.

The total estimated cost would be 3 person-years and $250,000, most of which will be absorbed within current committee work. The remaining costs could be shared by operators, manufacturers, pilot associations and government.

Completion Date: G + 36

Output 1/SE 30:

- An evolutionary training aid that consolidates regulatory, academic, industry and pilot association literature that addresses the human factors issues surrounding the employment of automation within the context of CRM.

Resources: ATA (LOOC), ATA Training, Human Factors, and Safety Committees, NASA, FAA Flight Standards – Human Factors Coordinating Committee (AFS-HFCC), and pilot associations. Operators, manufacturers, pilot associations and government could share the cost since much of the work involved is already being accomplished. The estimated cost would be 3 person-years and $250,000, most of which will be absorbed within the current committee work.

Timeline: 24 months

Actions:

1. The ATA Training, Human Factors and Safety Committees should obtain other available academic, regulatory, industry and pilot association participation and information on human factors and automation.
2. The development of the training aid should be coordinated with appropriate recommendations in the FAA report on "Interfaces Between Flight Crews and Modern Flight Deck Systems."
3. The ATA, AQP/CRM Focus Group should complete its recommendations to revise the FAA AC 120-51 on CRM Training.
4. ATA Training Committee should coordinate the creation of a training aid. This training aid should include ATA Human Factors Committee, Automation Subcommittee Reports 1-4 and other human factors automation research and special study reports. The ATA committees should seek the active participation of the pilot associations in this work.

Output 2/SE 30:

- All operators should incorporate applicable principles of the Training Aid into their training programs and standard operating procedures.

Resources: ATA (LOOC), Operators Directors of Safety, flight operations and training departments, and FAA, AFS-200. Initial estimate of time required to implement the training aid would be sixty man-days.

Timeline: 12 months after the Training Aid is completed

Action(s):

1. FAA should post the training aid on the FAA public web site.
2. FAA should revise AC120-51 based on the training aid.
3. FAA should issue a bulletin to alert inspectors of the training aid and for them to encourage its use by operators.
4. Operators should review the training aid and include the applicable principles in their training programs and standard operating procedures.
5. A report from all DOS's on the implementation of the Training Aid principles within 36 months of CAST G approval.

Relationship of Project Outcome to Current Aviation Community Initiatives:

The following are some of the activities related to this project:

- The ATA AQP/CRM Focus Group is currently an on-going initiative involving government, industry, pilot unions and academia. The purpose of the initiative is to provide a realistic orientation to flight operations and to integrate CRM skills into air carrier training in a concise manner. The group assesses the means with which to accomplish these objectives and makes recommendations.

- There is on-going research in this area by FAA (AAR-100), NASA Ames and University of Texas, including work that has already been published.

- There is on-going work within the FAA to implement the recommendations contained in the "FAA Human Factors Team Report on: The Interfaces Between Flight Crews and Modern Flight Deck Systems."

- The ATA standing committees on Training, Human Factors and Safety are on-going activities for the purpose of sharing views, developing consensus and resolving operational and safety issues.

- The Human Factors and Pilot Training Group of the ALPA, Air Safety Structure has already produced its positions regarding CRM and Human Factors with respect to the use of automation.

- The Autoflight Industry Workshop is an ATA activity composed of four working groups, which meet quarterly. Its purpose is to find ways of helping to improve the way automation designed an implemented into aircraft flight decks.

- SAE G10, Aerospace Behavioral Engineering Technology (ABET) Committee, deals with the philosophies, principles and criteria by which designers, engineers, pilots and behavioral scientists structure systems to achieve maximum human workload compatibility for automation efficiency. The committee has several subcommittees with on-going work into human factors and automation.

Performance Goals & Indicators for Outcome/Outputs:

- Goal: Eliminate the misuse of automation and ineffective CRM as a contributing factor in loss of control accidents.
    - Indicator: A measurable reduction of loss of control incidents and accidents related to automation and CRM.
- Goal: Development and distribution of the Training Aid to the Director of Safety of every Part 121 certificate holder and to every FAA field office.
    - Indicator: Completion and distribution of the Training Aid within 24 months of CAST G approval.
- Goal: All air carriers should have incorporated the principles of the Training Aid into approved training programs and standard operating procedures.
    - Indicator: A report from all DOS's on the implementation of the Training Aid principles within 12 months after its issuance.

Programmatic Approach:

Organizational Strategy

The LOC JSIT recognizes that the ATA Training Committee actively addresses training issues. In addition, the Human Factors Committee, Subcommittee on Automation has already been addressing human factors and automation issues for many years. It has established a leadership position in these subjects. Therefore, the ATA would be in the best position to be the LOOPC and its Training Committee would be the LOOC. The roles and responsibilities of the LOOPC and LOOC are described in the CAST approved JSIT Process Document.

The LOOPC will be asking the Subcommittee to make a major commitment to recruit the required team members from industry, pilot associations and government organizations, and to develop a strategy for obtaining required funding. The LOOC will provide the project lead for the Training Aid project. The project team will coordinate the activities of the detailed implementation plan with the other appropriate ATA standing committees and outside organizations. The project lead will provide periodic reports, when requested, to the CAST. Implementation of this product is a shared responsibility between the FAA, air carriers, manufacturers and pilot associations.

Implementation Activities

The LOOPC should contact the chair of the ATA Subcommittee on Automation to provide a briefing on the LOC JSIT Human Factors and Automation Training project. The Subcommittee will identify a team leader. The team will establish the necessary working methods, project schedule, timelines and meeting dates. The actions in the detailed implementation plan will provide guidance to the team in establishing additional key products and milestones as needed to implement the Training Aid.

Key Products and Milestones:

The following milestones are based on the date of CAST "G" approval:

- LOOPC and LOOC established — G + 0 days
- ATA AQP/CRM Focus Group AC Recommendations — G + 30 days
- Training Aid team formed — G + 90 days
- Project schedule and deliverables established — G + 90 days
- Training Aid published and distributed — G + 24 months
- FAA AC120-51 amended to reflect Training Aid material — G + 24 months
- FAA bulletin to inspectors — G + 24 months
- Report from the DOS's on the Training Aid implementation — G + 36 months

Risk Description:

- Possible added training cost unacceptable to carriers
- The principle technical, cost and schedule risks are the inability to direct the resources and input needed to complete the ATA CRM Focus Group report and revise the FAA AC 120-51 on CRM training.
- Training Aid rejected by industry and/or regulators

Risk Mitigation Plan:

- Establish a consensus approach for the development of the Training Aid.
- Training Aid should be developed so it can be integrated within existing approved training programs.

Impact on Non - Part 121 or International Applications:

The training aid developed by this project will be made available to the JSC and to international organizations thereby enhancing safety of the overall aviation community.

SE 31

Loss of Control
Joint Safety Implementation Team

Implementation Plan
for
Training - Advanced Maneuvers

Statement of Work

Advanced Maneuvers Training (AMT) refers to training to prevent and recover from hazardous flight conditions outside of the normal flight envelope, such as, inflight upsets, stalls, ground proximity and wind shear escape maneuvers, and inappropriate energy state management conditions.

The purpose of this project is to collect and provide advanced maneuver training material and to encourage Part 121 operators to use these materials to implement advanced maneuver ground training and flight training using appropriate flight training equipment. Emphasis should be given to stall onset recognition and recovery, unusual attitudes, upset recoveries, effects of icing, energy awareness and management, and causal factors that can lead to loss of control.

Additionally, research should be conducted to determine how existing flight simulation devices can be used effectively in AMT.

Safety Enhancement: (SE-31)

Pilots will be better trained to avoid and recover from excursions from normal flight and loss of control.

Lead Organization for Overall Project Coordination (LOOPC):

FAA, Flight Standards (AFS)

Score: 2007-(13.0) 2020-(13.0) 100%-(13.0)

Resource Requirements:

FAA AFS-400, Air Transport Association Training Committee, National Air Carrier Association (NACA), Regional Airline Association, manufacturers, pilot associations, Principal Operations Inspectors (POI's), Directors of Safety, flight operations and training departments, NASA, aircraft manufacturers, flight simulation device manufacturers, training centers, existing training aids, and other materials.

The total cost estimate for the project is about 3 person-years and $500,000, which could be shared by the operators, manufacturers, pilot associations and government.

Completion Date: G + 36 Months.

Output 1:

- A survey of existing training material from regulators, industry, operators, academia and other resources and a set of advanced maneuvers training material produced by a joint industry working group.

Resources: Air Transport Association Training Committee (LOOC); National Air Carrier Association (NACA), Regional Airline Association, manufacturers, pilot associations, Principal Operations Inspectors (POI's), FAA/AFS-200 existing training aids, and other materials. Initial cost estimate would be one man-year and $250,000, which would be shared by the operators, manufacturers, pilot associations and government.

Timeline: 24 Months

Actions:

1. FAA should post the Airplane Upset Recovery Training Aid on its public web site.
2. FAA should distribute the Airplane Upset Recovery Training Aid to all appropriate FAA field offices and to all Part 121 certificate holders.
3. Non-swept wing operators and manufacturers should develop a similar upset recovery training aid.
4. The ATA Training Committee should gather currently used and available training aids and other materials and evaluate them for completeness.
5. ATA should charter and industry should sponsor a task force to develop remaining elements for a complete set of AMT materials.
6. FAA should make the set of training materials available to operators via its public web site.
7. FAA, ATA, and other interested parties should develop a strategy to maintain AMT training materials.

Output 2:

- AMT ground training provided by all operators.

Resources: ATA Training Committee (LOOC), Directors of Safety, flight operations and training departments, POI's, AFS-200, pilot associations and AMT materials. The cost would vary depending on the number of aircraft types, the number of aircraft and the number of flight crews.

Timeline: 12 months after completion of Output 1.

Actions:

1. FAA should issue a Handbook Bulletin for Air Transportation (HBAT) to announce and recommend the use of the AMT training materials.
2. ATA should report the level commitment by the operator's flight operations and training departments.
3. Operators should implement AMT ground training
4. FAA should revise policy and rules in 14 CFR Part 121to require AMT ground training and to promote AMT flight training in suitable flight simulation devices.

Output 3:

- AMT flight training provided by all operators. The expectation is that this training will be accomplished via ground and simulator instruction within the certified flight envelope, with emphasis on recognition, prevention and recovery techniques.

Resources: ATA Training Committee (LOOC), operator flight operations and training departments, Directors of Safety, and pilot associations. The cost would vary depending on the number of aircraft types, the number of aircraft and the number of flight crews.

Timeline: 12 months after completion of Output 1.

Actions:

1. ATA, to include RAA, NACA should promote a high level of commitment to AMT by operator flight operations and training departments. A check airman will administer AMT flight training.
2. The Loss of Control JSAT identified that a number of accidents involved the crew not recognizing or preventing entry into an unusual attitude and, when upsets occurred, were unable to effect recovery. Operators should implement AMT flight training emphasizing energy state management and early recognition and recovery from flight outside the certified aircraft operating envelope within the limitations of the training device being utilized. The expectation is that this training will be accomplished via ground and simulator instruction within the certified flight envelope, with emphasis on recognition, prevention and recovery techniques. Operation outside of the normal flight envelope must be discouraged to avoid

negative training. Advanced Maneuvers Training (AMT) refers to training to prevent and recover from hazardous flight conditions outside of the certified flight envelope, such as inflight upsets, stalls, ground proximity and wind shear escape maneuvers, and inappropriate energy state management conditions.

3. Output 4:

- Research should be conducted to determine how existing flight simulation devices can be used effectively in AMT.

Resources: FAA AFS-400 (LOOC), NASA, flight simulation device manufacturers, aircraft manufacturers, pilot associations, operators and training centers. Initial cost estimate would be 1.5 person-years and $240,000, which would be shared by the operators, manufacturers, training centers, pilot associations and government.

Timeline: 36 Months

Actions:

1. FAA should coordinate research into identifying the most effective methods for AMT to include the suitability and use of existing flight simulation devices.
2. Aircraft and flight simulation device manufacturers should cooperate in order to determine the feasibility of providing additional aircraft performance data to support modeling outside the normal aircraft operating envelope with the objective of increasing the effectiveness of AMT.

Relationship to Current Aviation Community Initiatives:

- Voluntary training currently being done – both ground and flight
- Wind shear training required since 1988
- FSAT 95-10 issued 1995, Selected Event Training
- Airplane Upset Recovery Training Aid, distributed 1998
- Continuing debate over simulator realism, adequacy of data, and "negative training" effects
- CFIT training endorsed by CAST, 2000
- Competent committee work underway, e.g., NASA, ATA Training Committee
- Manufacturers conducting research in energy management
- Commercial training products becoming available
- Rulemaking in Part 121, Subparts N and O, NPRM by December 31, 2001
- NPRM Part 60 – 2001, Simulator qualification rules

Performance Goals & Indicators for Outcomes/outputs:

- Goal: Reduce occurrence of LOC accidents.
    - Indicator: A measurable reduction of loss of control incidents and accidents related to excursion from normal flight.
- Goal: Develop and make available AMT material for use in Part 121 approved training programs

  - Indicator: Availability of the AMT material within 24 months of CAST " G" approval.

- Goal: All Part 121 operators incorporate AMT in their approved training programs
  - Indicator: Operators incorporate AMT material within 24 months of CAST G approval.
- Goal: Research will identify methods to improve use of flight simulation devices in AMT
  - Indicator: Industry acceptance and implementation of research results.

Programmatic Approach:

Organizational Strategy

The LOC JSIT has identified FAA AFS as the LOOPC organization. The LOOC are identified in each output of this Implementation Plan. The roles and responsibilities of the LOOPC and LOOC are described in the CAST approved JSIT Process Document.
The LOOPC will provide the project lead for the Advanced Maneuver Training Project. The project lead will work with the Air Transport Association Training Committee, manufacturers, Regional Airline Association, pilot associations, Principle Operations Inspectors (POI's), and others to create a comprehensive set of AMT materials. The project lead will coordinate the activities outlined in the implementation plan, and will provide progress reports, when requested, to the CAST. Implementation of this product is a shared responsibility between the FAA, air carriers, manufacturers and pilot associations.

Implementation Activities

The LOOPC will establish a working group to coordinate the collection, creation, and distribution of appropriate AMT materials. It will encourage air carriers to establish appropriate AMT components in ground and flight training. It will have oversight into the research outputs of this project.

AFS-200 will prepare a Handbook Bulletin, in collaboration with industry partners, recommending the scope of the training with respect to specific hazards associated with loss of control. The LOOPC should monitor the progress of implementing AMT through the Directors of Safety.

Key Products and Milestones:

The following milestones are based on the date of CAST "G" approval (months):

- Distribute currently available
- Airplane Upset Recovery Training Aid ASY-200 G + 6
- AMT material on WWW AFS-20 G + 24
- Publish HBAT AFS-200 G + 24
- Track adoption of AMT ATA G + 27, 30, 33, 36
- Publish research results AFS-400 G + 36

Risk Description:

- Some special interests might discredit AMT simulator training
- POI's might ignore AMT materials and/or Handbook Bulletin
- Operators might ignore AMT materials and/or Handbook Bulletin
- Operators of non-swept wing aircraft and the manufacturers might be reluctant to develop AMT material specific to these type of aircraft
- Operators might not accept the potential costs of this training

Risk Mitigation Plan:

Many of the air carriers presently provide AMT. Cooperation between FAA and industry organizations to obtain widespread implementation of the AMT would result in a substantial reduction or elimination of the causes of loss of control accidents.

Impact on Non - Part 121 or International Applications:

This project would have a positive impact on commercial and corporate operators using smaller aircraft because it would improve flight training standards for all operators. The project would also have international applications because the JAA and ICAO are both represented on the CAST and the information is routinely exchanged between those organizations and CAST.