Recommendation 16-10: Flight Path Management Philosophy, Policy, and Procedures

I. Submission

The recommendations below were submitted by the Flight Path Management Workgroup (FPM WG) for consideration by the Air Carrier Training Aviation Rulemaking Committee (ACT ARC) Steering Committee at F2F-11. The ACT ARC Steering Committee adopted the recommendations with unanimous consent, and they are submitted to the Associate Administrator for Aviation Safety (AVS-1) as ACT ARC Recommendation 16-10.

II. Statement of the Issue

In their 2013 report on "Operational Use of Flight Path Management Systems," the PARC/CAST Flight Deck Automation Working Group noted in their findings that:

> "Increasingly, operators use a documented automation policy. Lessons learned in the application of these policies reveal that improvements could be made to better focus attention on the flight path management related tasks and more effectively use automated systems."

The WG found that policies and procedures that were in force at that time focused on the use of the automated systems or specified levels of automation as opposed to the application of automated systems as a tool to manage the flight path. Additionally, those policies and procedures varied widely in terms of how and when to use the automated systems, even across operators who based their procedures on a common aircraft manufacturer's philosophy and procedures. In some cases, the policy was vague, offered little guidance and left the determination on methodology to the flight crew.

The WG also noted that operators who operated multiple fleets and models within fleets tended to standardize procedures across the entire spectrum of their aircraft. Since the equipage across the aircraft fleets varied, those operators did not address some systems in their procedures because other models may not have been equipped with similar systems. As a result, the policy and procedures may be very general in nature and may not address unique equipage or situations.

The FltDAWG report has been corroborated by other researchers who noted that although some operators had published an "automation policy," those policies and procedures were not widespread nor did they focus on management of the aircraft flight path.

A noteworthy statement in the FltDAWG report that is a foundation of this FPM WG recommendation is:

> "It should be noted that there are important differences between policy for *design* of flight path management systems (by manufacturers) and policy for *operational use* of flight path management systems. Design philosophy/policy is established by the manufacturer (either explicitly or implicitly), and provides designers with a basis to develop new flight decks and modifications. Operational policy is established by the airline/operator, and describes how and when the pilot should use the systems."

The ACT ARC Steering Committee assigned the FPM WG the task of recommending guidance for development, continual assessment, and improvement of a flight path management philosophy, policy and procedures. This direction from the ACT ARC was incorporated in the FPM Working Group (WG) Terms of Reference (TOR) document and the WG subsequently developed a detailed task list from which the following recommendations were derived. Rationale for each recommendation follows.

III. & IV. Recommendations and Rationale

The ACT ARC proposes the following recommendations for FAA consideration:

> The ACT ARC recommends the publish guidance recommending development, continual assessment, and improvement of a clearly stated flight path management philosophy, policy and associated procedures. Items that should be included in an operator's flight path management philosophy, policy and procedures are listed below:
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> Note: The recommendations, as proposed by the FPM WG, are numbered in bold font with the rationale following each recommendation.

1. Each operator should have a clearly stated, comprehensive flight path management policy supported by the Operational Flight Path Management Philosophy and by standard operating procedures. (The philosophy should be founded upon elements outlined in Appendix A.)

   Rationale

   As the WG previous recommendations were formulated, the team identified that an operational philosophy of flight path management existed only in principle within the WG. The WG found that without a clearly defined FPM philosophy there was no overarching structure from which the policies and procedures could be developed. The philosophy states the general concepts and expectations of FPM. Subsequently, the policies state how the philosophy is to be achieved.

2. The policy should highlight and stress that the responsibility for flight path management remains with the pilots at all times; focusing on flight path management rather than simply focusing on the manipulation of automated systems. Procedures developed from this policy should include actions designed to mitigate or reduce hazards or risks that may influence flight path management.

   Rationale

   Policies that deal only with automation use can create a misplaced responsibility of flight path management onto the automation system where instead, it should remain with the pilots at all times. As the FltDAWG report notes "…focus on management of automated systems was not always well integrated with the focus on managing the flight path of the aircraft..." Conditions where pilot responsibility for flight path management may be neglected should be identified and procedures included mitigating or reducing their effects. Furthermore, industry documents and contributing factors in incident data underscore the need for procedures to deal with high task loads, fatigue, distractions, etc.

For example, complex ATC instructions can adversely influence pilot actions regarding the flight path and a pilot's natural tendency is to comply with those instructions. Stronger policy and procedures underscoring the responsibility of the pilot to reject the ATC clearance in this example could combat the routine/reflexive acceptance of clearances.

Note: See previously submitted recommendations for Intervention Strategies (ACT ARC Recommendation15-10) and Academic and Flight Training Elements (ACT ARC Recommendation 16-4) for complementary guidance on these procedures.

3. Policies and procedures should include guidance for the appropriate use of automated systems recognizing they provide a set of tools (but are not the only available tools) to effectively manage the flight path.

   Rationale

   Many operators have provided their flight crews with policies, guidelines or procedures on the use of the aircraft's automated systems. Those resources were typically in the form of an "automation policy" which provided flight crews with recommendations on the use of the autopilot-flight director system, autothrottle/autothrust and the flight management computer system (FMS). Some operators provided detailed guidance on the systems and the flight conditions in which to use the automated systems while others simply provided "levels of automation" and allowed the flight crew to decide which to use and when. However, flight path management encompasses much more than just the autopilot and associated systems. Planning, executing and assuring the aircraft trajectory requires continuous vigilance and use of the appropriate tools at the appropriate time to ensure safe and efficient flight. Flight crews should understand that the various automated systems are one of several tools to assist the flight crew to manage flight path. Similarly, the use of those systems should be well understood and used appropriately for the respective operation.

   Therefore, operators should provide guidance on the use of all tools (automated systems, manual flight, etc.). That guidance should provide detailed information on the operational application and utility of the respective tool(s) and consideration for combinations to best address the situation. The guidance should be specific to the aircraft type , operational environment and operator culture.

4. The Flight Path Management policies and procedures should be customized for the specific operator, and regularly reviewed and modified as necessary through a formal process.

   a. Procedures should be based on manufacturer procedures, and adapted/modified according to factors including, but not limited to, the following:

      - The operating environment
      - The equipment being operated
      - The demographic characteristics of the pilot group, including experience and other cultural factors
      - The operator's overall philosophies and policies.

b. Flight path management policies and procedures should be validated for operational effectiveness, and should take into account lessons learned from a regular review of feedback from training, line experience, and operational and safety data.

Rationale

Several factors will impact flight path management outcomes over time and deliberate efforts are needed to effectively oversee this critical component of safe flight operations. In order to maintain the risk associated with path deviations to a level as low as reasonably practicable, air carriers should review the safety assurance data and perform system analysis as part of the development, continual assessment, and improvement of flight path management policy and procedures. Applying the SMS methodology as required by 14 CFR Part 5 would adequately address the need to identify new and/or unknown hazards that could compromise safe flight path management. Air carriers should conduct the aforementioned review on an iterative basis as appropriate for that organization. (Reference: ACT ARC Recommendation 15-5.)

5. The Flight Path Management policies and procedures should include guidance for proper monitoring of the flight path and allocation of tasks between Pilot Flying (PF) and Pilot Monitoring (PM) to include:

   a. Monitoring the flight path during all combinations of manual and/or automated flight.

   b. Task allocation, workload and system management strategies, and methods to address malfunctions for which there is no specific procedure.

   Rationale

   Many operators have provided their flight crews with policies, guidelines or procedures that outline the “roles” of Pilot Flying and Pilot Monitoring; however, there is a general lack of SOP guidance related to the “tasks” that involve PM actions specifically related to monitoring the flight path. Flight crews should have a working understanding of automated systems in order to effectively monitor the guidance and control of FPM under manual or automated flight conditions. Planning, executing and assuring the aircraft trajectory requires continuous, coordinated monitoring by the flight crew to ensure safe and efficient flight.

   Operators should provide crew guidance on the use of all applicable tools and appropriate procedures and techniques that support effective monitoring of the flight path during normal and non-normal operations. That guidance should provide detailed information on the operational application and considerations for switching between the various tools or methods to best address the monitoring situation. The guidance should be specific to the aircraft type and take into account the operational environment and operator culture.

6. Policy should identify appropriate opportunities for manual flight operations to maintain proficiency.

   Rationale

   Degraded skills in manual flight operation is identified as a potential vulnerability to successful flight path management in the FltDAWG. Additionally, FAA SAFO 13002 noted a need for manual flight training and policy development to help mitigate this critical area of flight path management. A policy should be developed that creates the expectation for pilots to take advantage of opportunities (not necessarily a specific list) to exercise manual flight operations skills so this element does not degrade over time. Guidance would specify when automation is required vs. opportunities for manual flying.

   Note: See previously submitted recommendation 16-9 regarding manual flight operations.

7. Policies and procedures should use consistent terminology for flight path management systems and information automation systems. "Guidance," "control," and other terms that form the foundation of the operator's flight path management policy should be clearly defined.

   Rationale

   Flight path management terminology varies widely across the industry and to a large extent depends upon the culture of the respective operator and manufacturer nomenclature. That variation could be the consequence of terminology that is conceptually understood but not necessarily standardized. For example, terms such as manual flying skills, flight path, guidance and control are understood when used at a high level but disagreement enters into the conversation when attempting to define the fine details of each concept. To illustrate, where does "autoflight" fit into the above concepts? Is it a guidance or control system, or both?

   This committee understands that some FPM-related terminology has been used interchangeably in practice and some terms may even have established precedence as published in various documents. However, several of the terms central to FPM, although used in practice, have not been sufficiently defined. As the importance of FPM is now being emphasized as an important safety enhancement, consistent use of those concepts central to FPM is essential. For this recommendation on FPM policy, two concepts require clarification as suggested by the 2013 FltDAWG report: guidance and control. Although one can assume common meanings to these terms, the intent here is to define the two terms as they relate to the aircraft flight path.

   Guidance: A function that provides computed information portraying the flight path to the flight crew, and may be concurrently sent to the control systems (e.g. autoflight/ autothrottle) for the purpose of understanding/steering/ tracking the defined flight path. Examples of guidance avionics are the flight management computer system (FMS) and the flight director.

   Control: Response action(s) to commands (or deviation error signals in some systems) provided by the guidance systems, or tactical pilot inputs which result in a device activation or flight surface change to redirect the aircraft toward the defined flight path. Examples of control avionics are autoflight/autopilot, autothrust/autothrottle, and relevant alerting for such control systems.

8. Policies and procedures should specifically address information management as it relates to Flight Path Management.

   Rationale

   Managing information is a critical aspect of overall Flight Path Management; however, the industry lacks the instructional emphasis required of such an important dependency. One of the most important aspects of managing the flight deck is managing information presented via automated systems as well as non-automated systems. Information systems supporting Flight Path Management can vary widely and information systems have created vulnerabilities for air carriers. Information systems include electronic flight bags, Aircraft Communications Addressing and Reporting System, moving map displays, performance management calculations, multi-function displays and functions, data uplink, alerting systems including lights and audible and tactile alerts, and Flight Management Computer displays, etc. In addition to information access and management, the cross verification policy should be addressed.

   Information has introduced new vulnerabilities by changing the tasks, and by changing the way a task is performed or conceptualized. Furthermore, the amount of information available to flight crews has increased in modern aircraft. These advancements in technology have introduced new types of information and flexibility of information placement. This shift in historical pilot behaviors introduced the need to verify automatically calculated, sourced, or updated information as additional tasks that may distract, interrupt, and create conflicts in information and biases. More specifically, an aspect of the need for an information management policy addresses the issue of cross verification and utilization of information when a conflict between information systems exists. It is critically important that flight crews be proficient in understanding, interpreting, assessing reliability, and in using information across all flight situations so that it does not create error or generate confusion/distractions from effective Flight Path Management.

V. Background Information

FPM WG Scope of Work:

These recommendations complete the following component of the FPM WG Scope of Work:

1. Recommend guidance for development, continual assessment, and improvement of a flight path management philosophy, policy and procedures.

ACT ARC Initiatives:

These recommendations complete the following initiative assigned to the FPM WG:

- Initiative #34: Each operator should have clearly stated, comprehensive flight path management policy supported by standard operating procedures.

Source Reports:

- Operational Use of Flight Path Management Systems, Performance-Based Operations Aviation Rulemaking Committee (PARC)/Commercial Aviation Safety Team (CAST) Flight Deck Automation Working Group (FltDAWG) final report, September 2013
- Flight Path Management: An Analysis of Air Carrier Standard Operating Procedures, The MITRE Corporation, MTR140282, August 2014.

Appendix A

Operational Philosophy of Flight Path Management:

Ensuring that the aircraft is on a safe flight path[1] is the highest priority of each pilot[2] on the flight crew. Each pilot is responsible for…

- …being fully aware of the current and desired flight path of the aircraft, and
- …being fully capable[3] of manually flying the aircraft to match the desired flight path[4].

Automated systems installed on the aircraft are among the tools available for the flight crew to use to meet this responsibility. While each pilot is responsible for being proficient in the use of all combinations of the available tools, the responsibilities above are primary.

Regulations, guidance, policies, procedures, and training related to "Flight Path Management" should be designed and implemented in accordance with this philosophy.

[1] "Flight Path" means trajectory and energy state of the aircraft. "Flight Path" includes "Ground Path" if the aircraft is in motion on the ground.
[2] As described in SAFO 15011, only one pilot at a time is responsible for CONTROLLING the flight path, but ensuring the aircraft is on the correct flight path is the top priority of all pilots on the crew.
[3] "Capable" means having the knowledge, skills, and ability – it does NOT imply that multiple pilots are simultaneously acting as PF. While only one pilot at a time holds responsibility for controlling the flight path (the PF), other pilot(s) on the flight crew should be ready and able at all times to intervene if necessary to ensure the flight path.
[4] This capability should include normal and applicable non-normal situations. "Applicable non-normal situations" can be identified through an operator's SMS program, including safety data programs such as LOSA, ASAP, and FOQA, and industry programs (e.g. manufacturer-operator meetings, InfoShare, accident reports, and ASIAS).