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Maintenance Program Enhancements

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Maintenance Program Enhancements

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BOEING WORKS WITH THE INDUSTRY TO ENSURE THAT SCHED-ULED MAINTENANCE PROGRAMS MEET THE HIGHEST STANDARDS.

Boeing regularly works with an Industry Steering Committee to improve the efficiency of the maintenance tasks that operators use to create their scheduled maintenance programs for their commercial airplane models. These improvements optimize the content and interval of maintenance tasks to maintain safety and reliability and achieve cost efficiencies. Improvements are based on Boeing analysis of in-service data collected from the worldwide fleet. All improvements are reviewed and approved through an industry process involving Boeing, operators, and regulatory agencies.

Over the decades, Boeing has worked closely with the aviation industry to develop robust processes that ensure scheduled maintenance programs adhere to the highest safety and operational reliability levels. In creating and updating its scheduled maintenance programs, Boeing uses a process as outlined in Federal Aviation Administration Advisory Circular 121-22A (Maintenance Review Board Procedures) that involves the establishment of an Industry Steering Committee (ISC), in-service data collection and analysis, and a recommendation from Boeing for each individual task under review.

INDUSTRY STEERING COMMITTEE

An ISC comprises operators, manufacturers, and regulators who follow the guidance outlined in Advisory Circular AC 121-22A to develop the scheduled maintenance program for an airplane model and the resulting Maintenance Review Board Report (MRBR). It is the function of the ISC, under the direction of a chairperson (an operator selected by its peer operators), to develop and establish policy for the development of the MRBR proposal and participate in the review and approval process of the ISC.

ISC meetings for all models, which are held on an as-needed basis, take place in Seattle, Wash., or Long Beach, Calif., and generally last one week. Meetings are open to all operators and typically cover a specific Boeing airplane model or defined set of models.

The airframe manufacturer serves as an ISC co-chairperson and has the duties of receiving in-service data to be analyzed for proposed MRBR changes, providing the ISC with sufficient technical data to base decisions on proposed changes, providing relevant training to the ISC as needed, and coordinating and participating in ISC and working group activities.

The Federal Aviation Agency (FAA) and European Aviation Safety Agency (EASA) have Maintenance Review Board (MRB) chairperson duties, which consist of inviting other regulatory authorities, in coordination with the manufacturer, to participate in the MRB process; reviewing and accepting or rejecting the policy and procedures used throughout the process; and providing final acceptance of the MRBR.

The ISC makes ongoing improvements to the scheduled maintenance program using the most current maintenance philosophy (see “History of Maintenance” on p. 28). These improvements not only maintain the inherent safety and reliability of the airplane but can also produce substantial savings for the operators. Any operator may become a representative voting member of an ISC.

IN-SERVICE DATA COLLECTION AND ANALYSIS

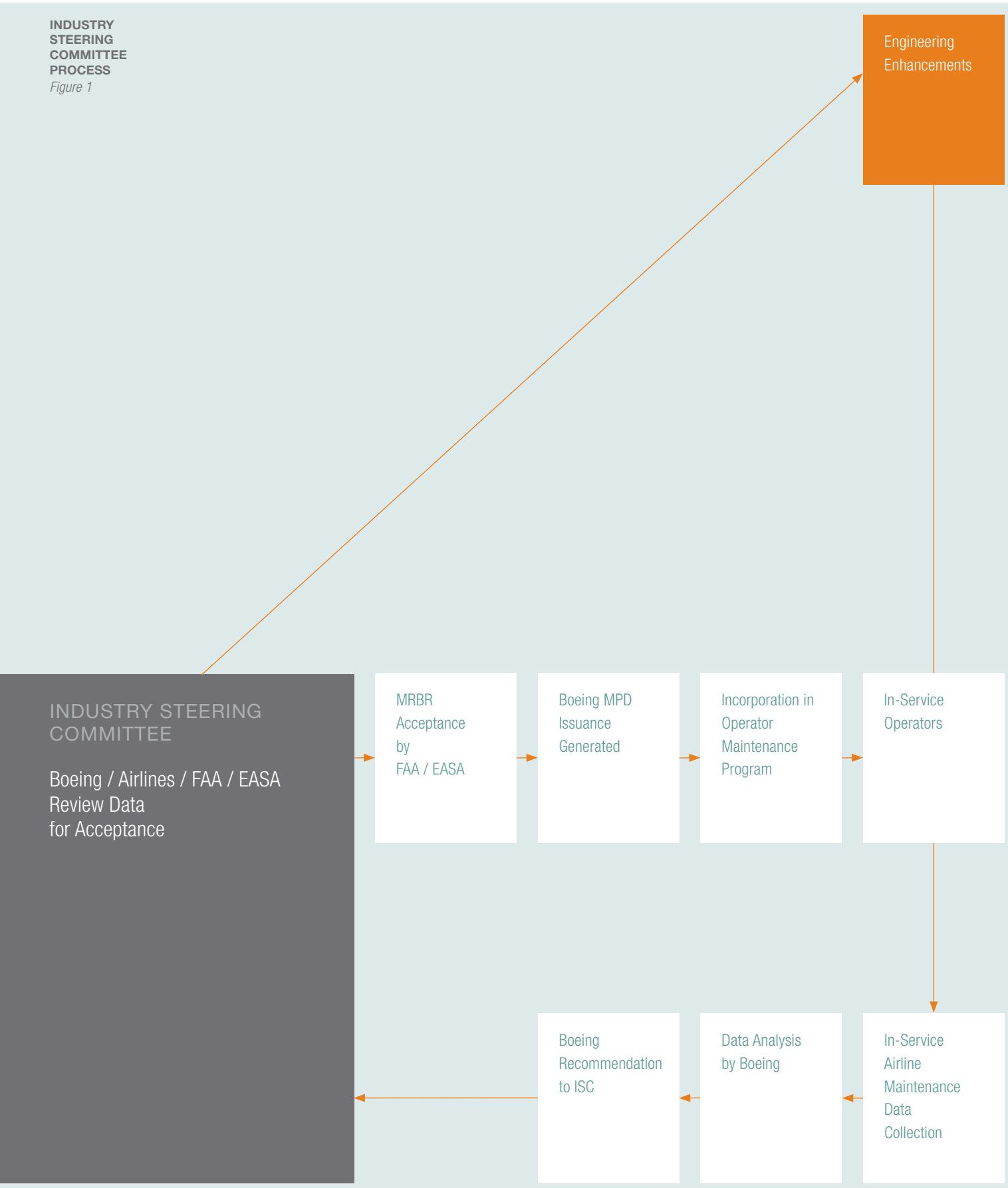
Operators strongly influence the success of a scheduled maintenance program revision by providing in-service data. Boeing analyzes the fleetwide data provided by the operators to identify important trends for incorporation into the scheduled maintenance programs through the ISC process.

The operators and Boeing work together to identify areas within the scheduled maintenance program to review for optimization. In-service data is collected by the operators and sent to Boeing for review and analysis. For each identified maintenance task, Boeing reviews the data and analyzes the positive and negative in-service results. Boeing also reviews service bulletins, reliability data, service letters, airworthiness directives and any other pertinent documents, and coordinates proposed changes with other Boeing or supplier engineering groups.

Once the analysis is complete, Boeing makes a recommendation for each individual task under review and presents it to the ISC-participating operators and the regulatory agencies. Each operator is entitled to one vote on the Boeing proposal. The entire process is observed by the regulatory agencies, which ultimately can approve or reject any proposed changes. Accepted changes are incorporated into the MRBR, requiring acceptance from the MRB chairperson (the FAA and EASA). The changes are also incorporated into the Boeing Maintenance Planning Data (MPD) document and Boeing-configured task cards, which are issued to the operators for inclusion in their own scheduled maintenance programs.

The ISC process (see fig. 1) ensures that operators have efficient scheduled maintenance programs with the highest possible levels of safety and reliability. The combination of operators’ experience and Boeing’s design-based analysis ensures that all safety items on the airplane are supported by scheduled maintenance tasks with appropriate intervals. The result is increased reliability with decreased labor hours and maintenance costs (see fig. 2). Boeing engineering design groups can develop resolutions to technical issues arising from the in-service data. The new design or process changes can improve reliability and result in maintenance cost avoidance for the entire fleet.

INDUSTRY STEERING COMMITTEE PROCESS
Figure 1



777 TECHNICAL DISPATCH RELIABILITY AND SCHEDULED MAINTENANCE LABOR HOURS
Figure 2

Reduction in scheduled maintenance cost has had no adverse effect on technical dispatch reliability.

777 SCHEDULED MAINTENANCE PROGRAM IMPROVEMENTS

A recent evaluation of the scheduled maintenance program for the 777 illustrates the ISC process. This evaluation included a review of approximately 400 777 maintenance tasks.

The new program extends the maintenance inspection interval for zonal and structural tasks, involving such areas as doors, fuselage compartments, struts, and flight controls, from 25 to 37 months. Under the previous MRBR, an airplane was pulled out of service for approximately 5 days to perform required maintenance checks every 25 months. The addition of 12 months to this maintenance interval provides significant financial and scheduling opportunities to 777 operators. Other tasks that have been escalated in the new maintenance program include many general inspections, which have increased from 100 to 125 days.

The result saves more than 400 labor-hours per airplane per year and increases airplane availability by providing airlines with one additional day of revenue operation annually for each 777 in their fleet. Using industry averages, the reduced maintenance costs and increased revenue opportunities added more than $100,000 USD in annual value to each 777 in operation.

In total, the evaluation resulted in an escalation (i.e., lengthening of the interval between maintenance task accomplishment) of approximately 100 line maintenance phase check tasks (similar in content to the block program A-check) and approximately 250 hangar-level-check tasks (similar in content to the block program C-check). The ISC, however, did not escalate approximately 12 percent of the tasks reviewed and de-escalated (i.e., shortened the interval between maintenance task accomplishment) one task based on the findings from the in-service data.

For example, one task that was escalated on the 777 was "operationally check flight deck indicator lights in dim and bright mode," which is considered an economic, not a safety, task. Operators provided 1,500 test results for this task with no adverse findings, and the ISC determined that the interval for this task could be extended from 1,200 to 1,500 flight hours. As with the other tasks that were escalated, this change enables operators to arrange their maintenance programs in a more efficient manner without compromising safety.

FUTURE DATA COLLECTION

Boeing continues to seek optimization of its maintenance requirements using improved data collection and the ISC processes. Boeing is currently developing a program that collects and stores real-time in-service data from scheduled maintenance visits in a line and hangar environment and associates this data with the scheduled maintenance task. The program enables data to be gathered and analyzed centrally for use by the industry in adjusting current scheduled maintenance tasks or check intervals based on in-service findings.

This will allow ISCs to be more proactive in managing scheduled maintenance programs. It also will allow operators to benchmark against other participating operators, expedite ground times for line and hangar maintenance visits, and plan spares and consumables using worldwide averages for scheduled maintenance.

SUMMARY

The ISC process maintains safety and reliability standards and reduces waste by ensuring maintenance tasks are performed at the proper level of intensity and interval, based on industry in-service flight data and each airplane model's inherent design characteristics.

Data collection and operator participation in the ISC process remain key factors in future scheduled maintenance program improvements. For more information, contact Brian McLoughlin at MaintenanceEngineering@boeing.com.

history of maintenance

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In the early days of aviation, maintenance programs were developed by mechanics. The programs were simple and without analytical basis. The formation of airlines created the need for new regulations and broader regulatory involvement in maintenance requirements.

With the entry of large jet airplanes into the commercial market in the 1950s, the airplane manufacturer became the source of maintenance program development. The underlying concept was to overhaul every component at a given time.

In 1960, the industry formed a task force to investigate the capabilities of preventive maintenance. The findings of the task force led to a new type of maintenance called "on-condition" maintenance.

The handbook "Maintenance Evaluation and Program Development," also referred to as "MSG-1," was developed in 1968 for the 747 by the Air Transport Association (ATA) Maintenance Steering Group (MSG), a group of airframe manufacturers, airlines, U.S. Federal Aviation Administration (FAA) representatives, and suppliers. MSG-1 used decision logic to develop scheduled maintenance.

For aircraft in the 1970s, the document "Airline/Manufacturer Maintenance Program Planning," or "MSG-2," was developed. It was process oriented and analyzed failure modes from the part level up. The MSG-2 philosophy was based on the theory that all airplanes and their components reach a period when they should be "zero timed" or "overhauled" and restored to new condition.

In 1978, United Airlines, commissioned by the Department of Defense, developed a methodology for designing maintenance programs based on tested and proven airline practices. This new methodology was the basis for MSG-3, the current industry standard.

This methodology has a task-oriented approach to maintenance that analyzes system failure modes from a system level, or top down. Maintenance tasks are performed for safety, operational, or economic reasons. They involve both preventive maintenance and failure finding tasks.

Revisions to the MSG-3 philosophy have provided added methodology for improving coverage of all modes of failure, such as inclusion of the Corrosion Prevention and Control Program, Enhanced Zonal Analysis, and Lightning/High Intensity Radiated Fields.

Boeing continues to work with airplane operators, regulators, and the ATA to update MSG-3 to enhance the methodology.