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Hearing on Aviation Safety and the Future of Boeing's 737 MAX
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Introduction. Chairman Wicker, Ranking Member Cantwell, and Members of the Committee, thank you for the opportunity to be here today in my capacity as Chairman of the Joint Authorities Technical Review (JATR) to discuss the JATR's efforts to improve aviation safety.

Before I begin, I would like to extend my sincerest condolences to the families and friends of the passengers and crew on Lion Air Flight JT610 that crashed a year ago today, on October 29, 2019, and on Ethiopian Airlines Flight ET302 that crashed less than five months later, on March 10, 2019.

The following describes the JATR and why it was created, discusses some of the recommendations that it submitted to the Federal Aviation Administration (FAA), and then briefly describes a training challenge that has come to light as a result of the JATR's efforts.

The JATR. The Boeing 737 MAX (MAX) Flight Control System Joint Authorities Technical Review, created by the FAA, had its kickoff meeting in late April/early May 2019, and its charter was signed and became official on June 1, 2019. It consisted of technical representatives from the FAA, the National Aeronautics and Space Administration (NASA), and civil aviation authorities from Australia, Brazil, Canada, China, Europe, Indonesia, Japan, Singapore, and the United Arab Emirates. The FAA intentionally did not include on the JATR team any of its staff who were involved in the MAX certification process.

I was asked to lead the JATR, in part because of my experience in aviation safety and accident investigation. I was at the National Transportation Safety Board for a total of 12 years, including as Chairman. I also have a regulatory perspective from 14 years at the FAA. To ensure a fully objective review, I was not compensated by the FAA for this role. I would also note that I am not a certification process expert, so I don't have the perspective of "this is how we have always done certification and we should keep it that way." I was honored to be asked to lead this important international aviation safety improvement effort.

Why the JATR. The FAA's aircraft certification process has played a major role in producing airliners with an exemplary safety record. Nonetheless, as with any system that is designed and operated by humans, the certification process can never be perfect, and the two tragic MAX crashes noted above revealed a critical need to review the process to determine whether improvement and modernization are warranted. The JATR was created to conduct that review and make improvement recommendations as warranted. The JATR completed its review on October 11, 2019, when it gave its compilation of team members' recommendations (not necessarily with consensus, as noted below) to the FAA.

The JATR was not chartered to become involved in returning the MAX to service, nor was it chartered to become involved in the two accident investigations. Moreover, the JATR was not created to determine fault or blame in the certification process, but to consider whether the

appropriate regulations and policy were applied to the MAX; to assess whether compliance was shown with the applicable requirements related to the flight control system; and to recommend improvements to the certification process.

The JATR was unprecedented in that it was the first time an aviation safety regulator has voluntarily called for what is essentially an international peer review of its certification process, and then made that peer review public. The FAA's willingness to use such a process to improve safety, and doing so with such transparency, are indicative of the safety culture that permeates the commercial aviation industry that has produced such an exemplary airline safety record.

Unprecedented Groundings. The grounding of the MAX was also unprecedented and placed the worldwide aviation industry in uncharted territory. The other two airliner groundings by the FAA in in the last 40 years were the McDonnell Douglas DC-10 in 1979, after an engine separated from the wing shortly after takeoff; and the Boeing 787 in 2013, due to lithium-ion battery thermal runaways and fires. In those two groundings, the airplanes were rendered unairworthy by mechanical malfunctions.

Because the airplanes were unairworthy, the problem was solely an airplane problem and pilot competence was not an issue. Because those groundings resulted entirely from airplane problems, the primary country that decided when to ground the airplanes and when to return them to service was the country where the airplanes were manufactured – in those two instances, the U.S.

The MAX grounding, on the other hand, involved automation that usually worked but sometimes failed; and when it failed, some pilots knew how to handle the failure (including the pilots on the Lion Air MAX the day before it crashed) but some did not, even after the additional attention to the issue that resulted from the Lion Air crash; and among those who did not know how to handle the failure were those who crashed. Hence, the scenario was not just an airplane problem, but a problem of the interaction between the airplane systems and its pilots. Thus, not only the country where the airplane is manufactured, but also every country that licenses and trains pilots must be involved in the decisions to ground and to return to service.

My expectation is that the international aviation community will be challenged to figure out how to handle this new scenario because future airliner problems are more likely to be of the airplane-pilot interaction type and less likely to be of the airplane-only type. The JATR was a first step in figuring out how the certification process can best address what may be a new normal.

Hence, I commend the FAA's inclusion in the JATR of representatives from nine other civil aviation authorities because this is not just an FAA certification process issue but a worldwide certification process issue. Because most of the aviation authorities in the JATR also certify aviation products, this was an opportunity for the certifying countries to begin working together to determine how best to navigate this uncharted territory. Moreover, all of the aviation authorities in the JATR are involved in the licensing and training of pilots.

The JATR process. The JATR met three times in Seattle, starting with the kickoff meeting in the Spring in Seattle (noted above) for initial briefings from Boeing and the FAA. At that first meeting the JATR was divided into seven subgroups, with the following focus areas:

A: Applied Regulations and Policy
B: Compliance with applicable portions of 14 CFR part 25, subparts B (Flight) and G (Operating Limitations and Information)
C: Compliance with applicable portions of 14 CFR part 25, subparts D (Design and Construction) and F (Equipment)
D: Boeing Systems Engineering Practices
E: Organization Designation Authorization (ODA)
F: Operational Suitability, Maintenance, and Training
G: Preliminary Accident Information

In mid-Summer the JATR had an intensive follow-up meeting in Seattle with Boeing and FAA personnel, including an extensive review of various certification documents.

Writing the observations, findings, and recommendations commenced after the second meeting, and later in the summer the JATR met again in Seattle to consider the document as a whole as it was shaping up. Boeing and the FAA were very open and helpful to the JATR team in these meetings and in general throughout our review. We also received notable support from a number of FAA aircraft certification, evaluation, and oversight personnel throughout the process. As the document was being finalized, the JATR gave Boeing and the FAA an opportunity to review objective information assembled by the team for the purpose of ensuring the factual accuracy of the information on which the JATR team members based their observations, findings, and recommendations. After several iterations, the JATR submitted its final observations, findings, and compilation of team members' recommendations to the FAA on October 11, 2019.

The Recommendations. The JATR submitted recommendations in eleven areas involving the certification process, and one post-certification area. In order to encourage diversity of views from the team, the JATR's charter encouraged its members to provide recommendations irrespective of whether they reflected consensus. Consequently, the JATR did not check or measure consensus.

The initial scope of the JATR process was limited to the certification process itself, but the charter enabled the co-chairs, in their discretion, to expand the scope if warranted. Hence, one recommendation area pertains to post-certification activities because of its potential to help improve the safety of future certification processes.

In no particular order of priority, the eleven recommendation areas regarding the certification process are:

1. Changed Product Rule
2. Development and use of up-to-date requirements and practices
3. Consistent interpretation and application of requirements
4. Changes during the certification process

5. Delegation of certification authority
6. Holistic, integrated aircraft-level approach
7. Human factors
8. Development assurance
9. Impact of product design changes on certification
10. Impact of product design changes on flightcrew training
11. Impact of product design changes on maintenance training

The post-certification recommendation area is:

12. Post-certification corrective actions and data sharing

Some of the recommendations are very broad in their application and others are more specific.

Broad Recommendations. Some of the broader recommendations derive from the increasing complexity of aircraft systems, particularly automated systems and the interaction and interrelationship between systems. As aircraft systems become more complex, ensuring that the certification process adequately addresses potential operational and safety ramifications for the entire aircraft that may be caused by the failure or inappropriate operation of any system on the aircraft becomes not only more important, but also more difficult.

Other broader recommendations raise the foundational issue of whether a process that has historically served the industry well for decades based largely upon compliance needs to be revisited to address not only compliance but also safety. As systems become more complex and may interact in unforeseeable ways, the likelihood increases that regulations and standards will not address every conceivable scenario. To the extent they do not address every scenario, compliance with every applicable regulation and standard does not necessarily ensure safety.

Moreover, as systems become more complex, the certification process should ensure that aircraft incorporate fail-safe design principles that prioritize the elimination or mitigation of hazards through design, minimizing reliance on pilot action as primary means of risk mitigation.

Specific Recommendations. Some form of delegation will probably become increasingly necessary as the FAA and aviation regulators worldwide encounter increasing difficulty hiring and retaining leading technologists in rapidly advancing technologies. Thus, although the recommendations do not address the desirability of delegation in general or of the ODA concept in particular, they do recommend examining how to make the ODA process less cumbersome and bureaucratic to avoid stifling adequate communications in future certification processes about important characteristics of what is being certificated.

Query, for example, whether inadequate communications were partly responsible for the failure to address potential unintended consequences from the evolution of the Maneuvering Characteristics Augmentation System (MCAS) from a relatively benign system to a much more aggressive system; and query whether inadequate communications played a role in the failure to address potential unintended consequences that can result from designing software for one

scenario – in this case, high-speed windup turns – and then modifying the software for a different scenario – in this case reducing the pitch-up tendency at higher angles of attack at low speeds.

Other specific recommendations relate to revisiting the FAA's standards regarding the time needed by pilots to identify and respond to problems. Although existing standards have served the industry well for decades, the JATR members recommended an examination of whether those standards remain appropriate for the complex integrated systems in today's airplanes. For example, when the failure or inappropriate operation of a system results in cascading failures and multiple alarms, query how adequately the certification process considers the impact of multiple alarms, along with possible startle effect, on the ability of pilots to respond appropriately. Inherent in this issue is the adequacy of training to help pilots be able to respond effectively to failures that they may never have encountered before, not even in training.

The Future Training Challenge. The closer automation comes to completely removing the human, the more daunting are the challenges of becoming more automated. One of those challenges was highlighted by these two MAX crashes. These crashes were the latest of several crashes in the previous decade in which pilots encountered scenarios that they had never seen before, even in training, and responded inappropriately.

The increasing complexity and reliability of automation will exacerbate the international aviation community's challenge of training pilots to respond to problems that they have never seen before. Increasing complexity will exacerbate the training challenge because it will reduce the likelihood that pilots will fully understand the system's capabilities and what it does and does not do. Increasing reliability is obviously good, but an unintended consequence is that it will exacerbate the training challenge because it increases the difficulty of forecasting what types of failures might occur, which in turn decreases the likelihood of including the most important potential failure modes in training.

This issue is not within the scope of the JATR's charter because it is not a certification issue, but it has been brought to light by the JATR's activities. Hopefully the international aviation community will follow the collaboration example reflected by the JATR and work together to address this training challenge.

Conclusion. The JATR members hope that their recommendations will continue improving aviation safety by helping to improve the certification process.