



Safety Promotion at the Manufacturer Acknowledging the Past Helps Establish the Future

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Eric has been with Boeing since 2006 and has worked in areas such as production support engineering, flight test, and customer introduction field service before joining accident investigation in 2015. Eric received a Bachelor of Science degree in mechanical engineering from the University of Tennessee, Knoxville. Eric has presented air safety investigation topics at the Boeing Safety Promotion Center, the Boeing Flight Operations Symposium, the International Society of Air Safety Investigators (ISASI) Annual Seminar, and the US DOT Transportation Safety Institute. Eric is an active participant in aviation industry accident classification groups at ICAO and IATA.

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Introduction

Sharing safety information has been commonplace at Boeing Commercial Airplanes for half a century with the annual publication of Boeing's Statistical Summary of Commercial Jet Airplane Accidents.¹ Dissemination of safety-related actions and procedures as they relate to our products is an integral part of our in-service safety process. Boeing participates in multiple industry-wide proactive efforts across the global aviation community to share safety-related information and promote enhancements with organizations such as CAST², IATA³, ICAO⁴, state regulatory authorities, other manufacturers and suppliers, as well as our airline customers. Although most of these efforts to enhance worldwide aviation safety culture are well-known within the global aviation community, some aspects of safety promotion within Boeing may not be as apparent.

SMS - Safety Promotion

As a design and manufacturing organization in the United States, our voluntary SMS (Safety Management System) is based upon the safety management framework defined in ICAO Annex 19⁵, 14 CFR Part 5, and National Aerospace Standard NAS 9927⁶. Safety promotion is one of the fundamental components of SMS as defined within ICAO Annex 19. Training, education, and safety communication are important elements of safety promotion intended to encourage a positive safety culture and enhance safety objectives within an organization. These elements of safety promotion are part of many existing business processes at Boeing Commercial Airplanes within our SMS. Through continuous communication, safety promotion enhances our proactive safety culture, which includes a commitment to both workplace and product safety. This core value is conveyed to employees in many ways. The opening of the Safety Promotion Center at Boeing has allowed us a unique opportunity to both enhance our safety culture while sharing it with a broader audience outside of our company allowing others to learn more about aviation safety.

Safety Promotion Center at Boeing

The Safety Promotion Center at Boeing was opened in Everett, Washington in September 2017. Inspired by the Japan Airlines Safety Promotion Center⁷, it combines content from significant aviation accidents as well as the history of safety within our processes and products since Boeing was founded in 1916. Sharing of such safety information and lessons learned amongst different internal organizations that design, build, support, and operate our products is engrained in our safety culture. The center not only contains multiple exhibits that provide background on lessons learned from aviation tragedies and how they shaped the industry but also proactive activities including technological advancements and collaborative safety enhancement efforts across the industry. This helps to emphasize the importance of safety in all that we do as an industry by showing and discussing where we have been, where we are going, and why we must never be complacent in our pursuit of safety.

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Guided and self-guided tours of the Safety Promotion Center (SPC) are available to both internal employees and company visitors. Boeing safety professionals such as Air Safety Investigators, Airplane Safety Engineers, Regulatory Administrators, and Environment Health & Safety specialists regularly serve as tour docents. The guided tours allow employee tour participants to learn how safety is embedded throughout the lifecycle of our products and the implications for their role no matter what their role is within the company (engineering, supplier management, quality assurance, etc.). The key components of SMS beyond safety promotion such as our safety policy and objectives, safety assurance, and safety risk management are also regularly discussed. Visitors are encouraged to share their perspectives on what safety means to them – these perspectives add to the displays available at the SPC. All visitors are encouraged to provide feedback not only to foster continual improvement of the experience but also to allow their safety messages to be shared with other visitors.



Figure 1 - Safety Promotion Center at Boeing Entrance Exhibit (Photo: Boeing)

Safety Is Our Responsibility

The first exhibit (Figure 1) includes five watches that represent the moment when time stopped for over 1400 lives that have been lost in these aviation accidents: 1977 Tenerife, Japan Airlines Flight 123, United Airlines Flight 232, American Airlines Flight 965, and Alaska Airlines Flight 261. Details of many of these events have been shared over the years through ICAO Annex 13 accident investigation reports as well as through excellent resources such as the FAA Lessons Learned website.⁸ These events and others like them served as catalysts for implementation of safety enhancements to commercial airplanes and the global aviation system. The circumstances of each accident is discussed during the tour and insight is provided about the significance of the accident and how each changed our industry. Many visitors (both internal and external to Boeing) have shared stories on how such events have affected their professional and personal lives and how important the commitment to safety is to them. Some

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share their experience and pride working to help design and build advancements on our products that arose from these events while others have shared their difficult experience of being on site as part of these very accident investigations. Others have also shared the tragedy of losing a loved one in an aviation accident. This exhibit also contains an area that acknowledges recent tragedies such as the accidents in Indonesia and Ethiopia. The exhibit and the experience it evokes helps convey the importance of safety in all that we do.



Figure 2 - Safety Evolution Timeline (Photo: Boeing)

Evolution of Safety

The tour continues with an exhibit that shows how workplace and aviation safety has evolved at Boeing over its more than 100 year existence. A timeline format (Figure 2) allows visitors to learn about safety innovations on our products such as instrument landing systems, flight data and cockpit voice recorders, ground proximity warning systems, traffic collision and avoidance systems, and electronic checklists. Some of these innovations are discussed in detail in other exhibits. Several historical artifacts are also on display in this area. One shows how employee innovations helped keep our employees safe during production in the 1940's while another shares how the 707 introduced commercial jet aviation in 1958. The advent of Extended-range Twin-engine Operational Performance Standards (ETOPS) into commercial aviation is also discussed including the design, maintenance, and operational aspects that work together to ensure reliability and safety.

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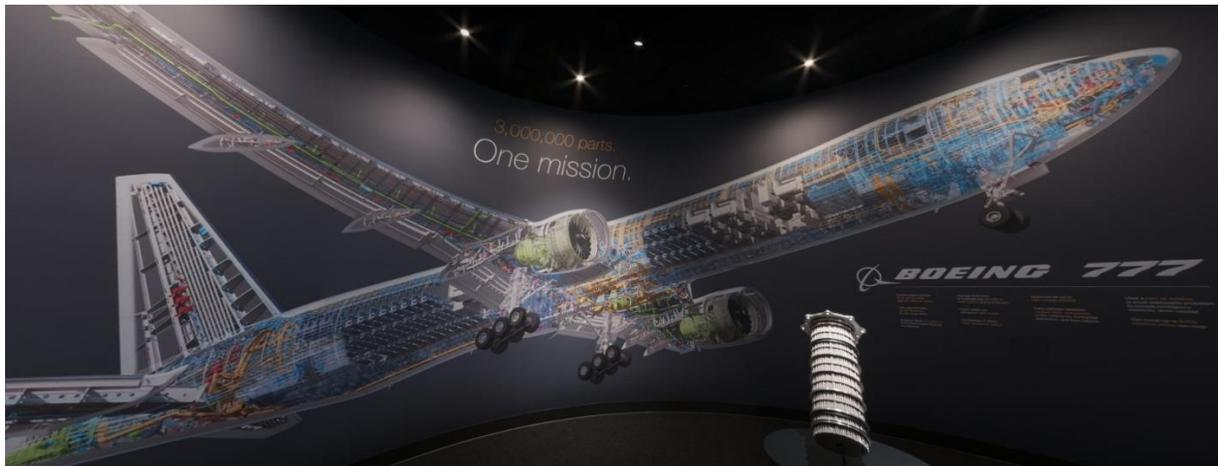


Figure 3 - Safety as a Mission Exhibit (Photo: Boeing)

One Mission

The central exhibit includes a view of a 777 airplane as well as a single fuel-oil heat exchanger (Figure 3) in the center of a large theater-like room. This exhibit shares information concerning British Airways Flight 38 which landed short of the runway at Heathrow in 2008. This event illustrates the collaboration that takes place during an accident investigation amongst the investigating authorities, the airline, regulators, and manufacturers. Discovering, understanding, and eliminating the circumstances of ice accumulation that occurred took a tremendous effort by all involved. This effort, along with the laboratory replication of the system and environmental conditions, is conveyed to visitors. The interim operational actions taken to keep the affected fleet safe is discussed along with the re-design incorporated on the hardware displayed in the exhibit. Visitors who may have little to no experience of Annex 13 investigations gain a greater appreciation for the collaborative process and the commitment it takes to understand what occurred in such an event and to prevent it from occurring again.

Also included in this central exhibit is a series of quotes representing different employee roles that express the importance of safety in each role. This area is particularly impactful to help individuals new to the company and those more experienced share some of what they do in their jobs. This in turn prompts discussions about, and drives awareness of, the elements of SMS they use in their day-to-day work.

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Figure 4 - Safety by the Numbers Exhibit (Photo: Boeing)

Exponential Success

While the level of safety in commercial air travel is well understood by aviation safety professionals the tireless work of maintaining and improving this safety record can be difficult to explain to those outside of our industry. The exhibit shown in Figure 4 illustrates the exponential growth of our industry and the dramatic reduction in the number of onboard fatalities in commercial aviation. This number continues to reduce by roughly half for every 200 million flights accrued by the commercial fleet. While this graphic shows data of 700 million commercial flights as of 2015, since that time the number of flights has grown by almost another 200 million flights. This continued growth reinforces the need for the industry to remain diligent in all that we do to work together proactively to prevent aviation tragedies no matter the current level of safety.

Collaborative Success

One success story of how industry collaboration can affect change within the world of aviation safety is the Commercial Aviation Safety Team (CAST). This team of industry and government stakeholders came together starting in 1997 with the goal of reducing the fatal accident risk in US commercial airline operations by 80% within 10 years. This goal was achieved by reaching an 83% reduction which was recognized by the National Aeronautic Association (NAA) who awarded CAST with the 2008 Collier Trophy that is on display. This achievement and Boeing's continued participation in this combined effort as well as the important efforts of some of the many other organizations that promote safety across the world are shared with visitors. Details about these organizations such as CAST, Flight Safety Foundation, ICAO, RTCA, SAE, as well as

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the FAA and NTSB are available on touchscreens in the exhibit. These examples help to show the history of success in working together and that the aviation industry does not compete on safety.

Safety in Technology and Design

Throughout the center many different areas of technology advancements are on display that have enhanced aviation safety across the industry. Some of the interactive displays include information on Ground and Terrain Awareness. Information on related aviation accidents such as the Marshall University tragedy in West Virginia (1970), Tenerife (1977), and Cali Colombia (1995) are provided. The adoption of ground proximity warning systems (GPWS) over history and more recent enhanced GPWS and TAWS (Terrain Awareness and Warning Systems) are discussed along with the huge impact these systems have had on reduction of CFIT (Controlled Flight into Terrain) accidents is shared along with how airplane systems detect and display this information on the 787 flight deck (Figure 5).

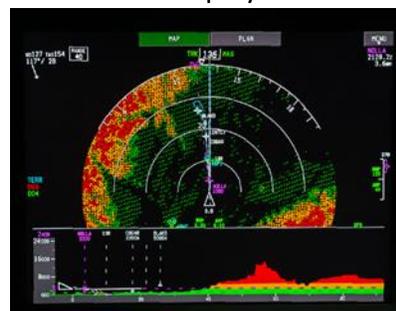


Figure 5 – 787 TAWS Display

Graphic: Boeing

The adjacent exhibit highlights improvements in crashworthiness and the evolution of cabin interior design. Different aspects that work together to improve survivability of an accident are displayed. The structural strength of the airframe along with structures and systems that incorporate cargo smoke detection and suppression, fireworthiness and reduced smoke/toxicity of interior materials, engine fire detection, emergency lighting, seat strength, and evacuation systems all work together to help protect passengers and crew. An example of the effectiveness of these features is discussed in regards to a 2008 Continental accident in Denver that experienced an external fire that consumed much of the airplane's aluminum skin while the cabin interior continued to be protected. Many individuals that do not have an engineering or airline operations background find this exhibit especially informative as much of this info is displayed in a fuselage cross-section view (Figure 6) which shows how the familiar and visible cabin interior fits within the overall airframe.



Figure 6 - Modern Fuselage Exhibit

Photo Boeing

Safety Begins with All of Us

The final exhibits of the center provide information concerning safety in the workplace before transitioning the sharing of safety messages. Several displays show the processes, procedures, physical controls, and areas of employee engagement that are utilized to help keep everyone

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safe in production environments such as the factory floor and flight line ramp. Innovations on display include an interactive fall protection interlock device for working at height during paint hangar operations. Advancements in virtual reality design tools are discussed along with how they are used in airplane development to help factory mechanics and airline maintenance personnel build and service airplanes. Video displays provide team member stories of recent aviation safety and workplace safety team success. There is an area dedicated to those recognized as our safety heroes such as the legendary Joe Sutter. As this center was inspired by their dedication to safety, Japan Airlines donated a message that is displayed as follows:

“Safety is our very foundation and social responsibility. We shall combine our utmost knowledge and capabilities to ensure safety in every single operation each day.”

- *Japan Airlines*

Not only do we encourage all visitors to share their thoughts on their experience through an electronic survey but we also encourage visitors to share their safety message as Japan Airlines did so others can learn from it. A series of touch screens is available that facilitates entry of a safety message. The messages that others have left is also continually displayed on these screens.



Figure 7 - Safety Message Displays (Photo: Boeing)

We end the tour by focusing on the importance of bringing everyone home safe. For Boeing employees that includes a personal commitment to safety. Whether it be a workplace safety hazard or airplane safety concern everyone is encouraged to communicate their concerns to their leaders or through internal reporting system websites which are provided in the safety promotion center.

Educating the Future

Some internal groups utilize the safety promotion center for safety meetings while others participate in guided tours as part of their training curriculum for their new employee on-boarding process. New team members get to share the experience of learning about historical safety enhancements in the areas of an airplane they may help design, build, or support as well as those areas they may be less familiar with. This usually take place in an environment where both experienced leaders and peers help add to these discussions in an organic, non-prepared, slideshow free manner. From an accident investigation perspective we utilize the safety

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promotion center as part of the training curriculum for new investigators as well as the engineering personnel and leaders that support us.

There have also been many opportunities to share the information presented in the Safety Promotion Center with other partners and colleagues in the global aviation community as well as members of the local community. Many different airline customers, aircraft and engine manufacturers, foreign and domestic aviation regulators, suppliers, accident investigation authorities, as well as members of the ISASI Pacific Northwest Regional Chapter have visited the Safety Promotion Center since it was opened. NTSB board members and legends in the aviation community such as Don Bateman have also visited and shared their feedback. Most of our external industry guests have commented that their organizations could benefit from such a safety focused center. In the summer of 2018 the Boeing Everett site held an open house during which access to the Safety Promotion Center was provided to the families of our employees. There was no need to provide any guided tours as employees themselves actively shared their experiences and the importance of their work as they led their families throughout the exhibits.

Summary

Our hope is that each visitor experiences something meaningful that they can learn from and take back to their internal workgroup or external colleagues to ensure the lessons learned that have shaped our industry are not forgotten. Many of our diverse visitors have exhibited this through our safety message interface. By sharing what safety means to them they help enhance our culture of safety as well as that of our future visitors.

¹ Boeing Statistical Summary of Commercial Jet Airplane Accidents website:
http://www.boeing.com/resources/boeingdotcom/company/about_bca/pdf/statsum.pdf

² CAST (Commercial Aviation Safety Team) Website: <https://www.cast-safety.org/>

³ International Air Transport Association

⁴ International Civil Aviation Organization

⁵ ICAO International Standards and Recommended Practices, Annex 19 to the Convention on International Civil Aviation – Safety Management, Second Edition, July 2016

⁶ FAA SMS Website – SMS for Design and Manufacturing Organizations:

https://www.faa.gov/about/initiatives/sms/specifics_by_aviation_industry_type/design_and_manufacturing_organizations/

⁷ Japan Airlines Safety Promotion Center website: <https://www.jal.com/en/flight/safety/center/>

⁸ FAA Lessons Learned website: <https://lessonslearned.faa.gov/>