ROBERT W. CAMPBELL AWARD

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- International Institute of Risk and Safety Management (Worldwide)
- International Safety Council
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- Occupational Safety and Health Council, Hong Kong SAR
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- European Network Education and Training in Occupational Safety and Health, ENETOSH
- BG RCI
- National Safety Council of India
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- Center of Environmental Safety and Health Technology
- Taiwanese Institute of Occupational Health and Safety

EHS Excellence in Boeing's Second Century

Submitted by:

The Boeing Company

Attention

EHS Excellence in Boeing's Second Century

Application for the National Safety Council's Robert W. Campbell Award 2018

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Tyler Kulp (right)
737 program

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737 program

Mary Kennedy
777 program

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777 program

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Aviation brings together people, countries, and cultures. Every day, around the world, more than nine million passengers board commercial aircraft. About half of those airplanes are built by Boeing. As the world's largest aerospace company, The Boeing Company is in the business of designing and building the safest form of long-distance transportation in history. For a sense of the scale of this accomplishment, consider that just one particular Boeing model, a 737, takes off or lands every 1.5 seconds. At any moment, there's an average of more than 2,800 737s in the air. The 737 has flown more than 122 billion miles, the equivalent of five million times around Earth. Guinness World Records confirms that the 737 is the most-produced commercial jet airplane of all time. In 2017, aviation celebrated its safest year ever. There was not a single passenger jet crash anywhere in the world.

Boeing is committed to making our aircraft as safe to build as they are to fly. In the 1960s, the popularity of air travel increased one hundred times over; with that increase came the concern that more flights would mean more accidents.[1] It seemed like a logical correlation, but instead, fatal accidents have fallen every decade since the 1950s. How had this happened? Studying aviation's safety journey from canvas to composites, we saw several turning points in aviation safety. These were often marked by tragedy, followed by a major safety innovation. Aviation and aircraft manufacturers rallied to challenge the logical correlation between increased flights and increased risk, and aspired to a seemingly unreasonable goal, a goal of zero. So it was human ingenuity and innovation that had made the difference in aviation safety.

Five years ago, after three tragic incidents in quick succession at our factories, Boeing set out to reinvent production safety just as we had reinvented product safety. We reviewed our past workplace safety data, overlaying our product delivery rates with the recordable injury rate dating back to the year 2000. We saw a correlation between our production levels and our injury profile. As production increased, accidents increased. It seemed like a logical correlation. But in 2013, Boeing leadership took a stand on workplace safety, challenged that reasonable correlation, and dared to aspire to a goal of zero. Once again, we looked to human ingenuity and innovation to transform safety.

We studied the safety programs of industry leaders including USG, Chevron, Dow, DuPont, Raytheon, Duke Energy, and UTC. Next, we engaged in an elevated level of self-scrutiny, challenging ourselves to reevaluate everything, even our cherished ideas about what we were doing *right*. We found that over the course of our hundred-year history of growth and diversification, our workplace safety policies and processes had become increasingly specialized, and our organization localized. This approach was successful, to an extent. But we discovered that good is the enemy of the best. Our steady focus on improvement prevented us from reaching for a goal beyond improvement, to zero. It became clear that to reinvent workplace safety, we would have to reinvent ourselves.

We partnered with a consulting firm to transform our safety culture, and train us in a new paradigm of safety: *all injuries are preventable*. Over 93,000 Boeing employees have participated in Incident and Injury Free (IIF)[2] engagements, which consist of a culture assessment, commitment workshops, safety culture orientation sessions, formation of zero-injury mindset leadership teams, and personal coaching. The experience created an almost seismic shift in our corporate view of safety. Both leaders and employees report that after the training, they can no longer allow a safety issue to go unresolved.

[1] Between 1959, the first year of commercial jet business in the US and Canada resulted in 49,000 flights, by 1970 that number increased nearly 100 times to almost 4,800,000 flights.

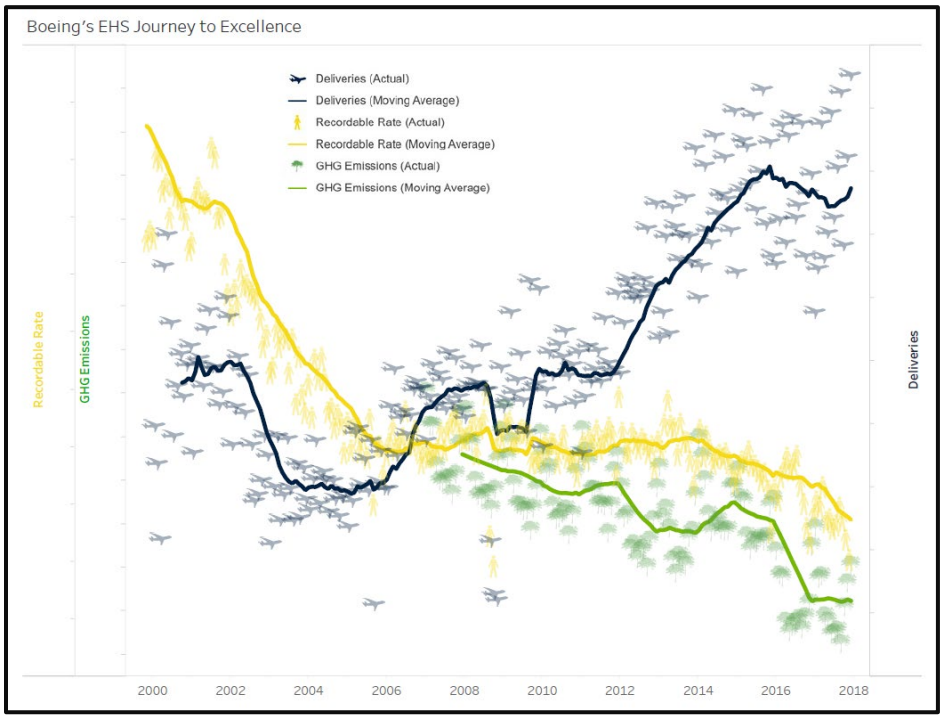
[2] Used by permission from JMJ Associates, Inc.

In 2013, Boeing's Executive Council gathered at a factory in St. Louis to sign the Boeing Safety Promise on a live webcast to 17,000 managers. In company parlance, this event is called "a safety stand down." It was a defining moment in our history, and marked the launch of *Go for Zero — One Day at a Time*. This ambitious, multi-dimensional, all-encompassing campaign was centered around people, and focused on transforming safety culture across the Boeing enterprise.

In 2016, we centralized our Environment, Health & Safety (EHS) organization to better leverage the ingenuity of our most valuable asset — our employees. This was a departure from our historical approach of embedding EHS personnel in the operations reporting structure. Despite some initial reservations, we soon saw that the centralized EHS organization was more nimble and adept at responding to our operations customers' needs. We found that we could embed safety *culture* in operations without embedding the safety *reporting structure* there. In fact, more and more we saw operations and the business units step up to own safety. The role of EHS changed from player to coach. It was working.

Since the launch of *Go for Zero*, Boeing has increased its production by 25% while reducing our recordable injuries by 40% in that same time frame across the enterprise. Moreover, in 2017 Boeing's injury rate dropped below 3.0 for the first time in our history. By year end, that translated into an additional 5,427 injuries avoided since the launch of *Go for Zero*. Importantly, serious injuries have decreased nearly 60%. We've seen historic progress toward our environmental goals too. While increasing production by 25% from 2013 to 2017, we reduced Greenhouse Gas emissions by17%. In 2016 alone, Boeing's emissions reduction was equivalent to removing over 13,000 vehicles from the roads for a year.

Our *EHS Journey Chart*, fondly known as our "people, planes, and trees" chart (*below*) illustrates this remarkable story, about the human capacity for reinvention. It reminds us that progress occurs in the space between the predictable and the possible (which often appears impossible at first). And just as aviation leaders asserted almost 60 years ago, our Chairman, President, and CEO Dennis Muilenburg often reminds us that "We are the founders of our future."



Boeing's EHS journey continues this year with internalizing our IIF mindset training, consolidating our EHS IT platforms, and for the first time in history, integrating our product and production engineering teams to work together to build the airplane and the production process at the same time. Having achieved our environment targets for the last five years, Boeing has set forth aggressive environmental targets through 2025. This is the result of shifting our safety focus upstream from response to prevention; "designing in" safety and environmental considerations; and embedding EHS best practices into standard work in all phases of our business. We know that we must be vigilant, and never take our EHS progress for granted. Going for zero isn't the same as getting to zero. EHS excellence doesn't necessarily mean the end of setbacks. What makes a champion isn't the absence of challenges, it's the response to them.

As a leader in an industry that has had such a profound influence on shaping the last century, Boeing recognizes its role and responsibility as a global industrial champion during its second century. Having benefited from our experience as a finalist for the Campbell Award last year, Boeing is poised to win the 2018 Campbell Award. Our application theme — *As Safe to Build as to Fly* — speaks to the parallel flight paths of aviation safety and workplace safety, both of which celebrated record-breaking successes in 2017. The time is right: With this application, we articulate our journey to EHS excellence, and assert our readiness to commit our vision, reach, and resources to piloting the EHS message around the clock and around the world, on land, at sea, and in space, for a safer and more sustainable future.

SECTION I: BUSINESS PROFILE

Business Description

The Boeing Company is the world's largest aerospace company. We design and manufacture some of the world's most iconic and technologically advanced aircraft and spacecraft. We build airplanes, war fighters, and missiles, helicopters, lunar rovers and the first solar panel placed on the moon. Game-changing innovation defines our past, present and future, and is at the very heart of our corporate culture. In 2016, we celebrated 100 years of leadership in the aerospace and aviation industry.

Making all this possible are our more than 140,000 employees, located in all 50 states and 65 countries, including more than 50,000 factory employees and more than 45,000 engineers. Boeing is the largest exporter in the United States, a position the company has held for the last decade. Our global reach includes customers in approximately 150 countries. The company has manufacturing, service and technology partnerships with companies and governments worldwide and contracts with more than 20,000 diverse suppliers and partners in all 50 states and 48 countries. The enterprise is organized into three primary business units.

> **Boeing Commercial Airplanes** (BCA) represents about 76,000 employees, including commercial fabrication, located in three countries, and six airplane programs, including the 737, 747, 767, 777, 787 Dreamliner and Boeing Business jets. BCA culture values ingenuity, perseverance, and teamwork. Its major manufacturing operations are in Washington state and South Carolina.
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> **Boeing Defense, Space & Security** (BDS) is made up of 48,000 teammates in 460 locations, including defense fabrication, military aircraft and network and space systems. As the second largest defense contractor in the world, Boeing is proud to protect the people who protect us. BDS produces rotorcraft, missiles, satellites, space probes, tankers, fighter aircraft, and unmanned aerial and experimental vehicles. BDS operates in 30 countries and every U.S. state.
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> **Boeing Global Services** (BGS) was established in 2017 and is headquartered in Dallas, Texas. This dedicated business services unit comprises 20,000 employees in more than 300 locations in 40 U.S. states and 70 countries. BGS offers our customers the broadest portfolio of services in the industry, delivered across the entire lifecycle, to help our aircraft operate as efficiently as possible. Services include digital aviation and analytics, engineering modifications and maintenance, training and professional services.

Boeing's Environment, Health & Safety (EHS) organization represents a dedicated cadre of 700 professionals, located all over the world. Boeing's EHS programs, which focus on workplace safety and environmental leadership, are designed to support, connect, protect and inspire every person who sets foot on a Boeing site, at every level of our corporate structure, all around the world. The shared language of Boeing's Safety Promise, and the universal allegiance it articulates, is evident in all that we do, from design specification to in-flight safety cards, engineer to pilot, mechanic to passenger. Boeing EHS expectations extend to contractors, service providers, visitors, and the supply chain.

As part of *Go for Zero — One Day at a Time*, Boeing centralized the EHS function under the Supply Chain & Operations organization, led by Senior Vice President Jenette Ramos, who began her career as an environmental engineer at Boeing nearly thirty years ago. Jenette Ramos sits on the Executive Council ("ExCo"), which governs The Boeing Company. Like all members of the ExCo, she reports directly to the Boeing Chairman, President, and CEO Dennis Muilenburg. The ExCo is composed of our top-level business and functional leaders, including the Chief Executive Officers of BCA, BDS, and BGS, the Chief Financial Officer, Chief Technology Officer, Chief Legal Officer, Chief Internal Governance Officer, Chief International Officer, and the Chief Information Officer.

Boeing is a publicly held corporation, with stock (BA) listed on the New York Stock Exchange. Since 1987 Boeing has had the distinction of being one of the 30 companies that comprise the Dow Jones Industrial Average. In 2017, BA was the top performing Dow component stock, with shares up over 90% as of the last full trading day of the year. Revenue for 2017 was $93.4 billion, representing a profit of $8.2 billion, up from $4.9 billion the previous year.

Over 96% of our business activity is aircraft manufacturing (NAICS 336411), with 3% is developing and producing prototypes for guided missile and space vehicle engines (NAICS 336415). The remainder of our activity falls under NAICS codes 336419 and 334220.

EHS, Business & Sustainability Challenges

The size, scale, diversity, complexity, and technology of Boeing's business sets us apart. We build huge, complex structures, often using new processes and technologies. Not only do we *build* huge, complex structures, we *are* a huge, complex structure. As a key player in an industry that has had such a profound influence on shaping the last century, Boeing recognizes our role and responsibility as a global industrial champion during our second century.

With air traffic expected to double in the next twenty years our commitment to breaking the CO_2 curve is imperative. The aviation industry has committed to being carbon neutral by 2020, and achieve 50% reduction in carbon emissions by 2050. And we're well on our way with product-over-product fuel efficiency gains. Boeing's fleet is the lowest emissions fleet on the market. And our emissions reductions extend to both product and production. For example, the new 737 MAX is as efficient as an electric car, in terms of CO_2 produced per 100 passenger kilometers, and it is built in a factory powered by 100% renewable energy.

We have outperformed our multi-year goals for our manufacturing footprint. In 2016 alone, Boeing reduced its CO_2 emissions by over 663,000 metric tons, which is equivalent to removing over 13,000 vehicles from roads for a year. Two of our biggest factories are powered by 100% renewable energy. 2018 marks the eighth consecutive year that Boeing received the EPA's ENERGY STAR Partner of the Year award for leadership in energy conservation and efficiency.

Even after delivery, we are working on green uses for our manufacturing scrap. This year marks a major milestone in Boeing's Green Stormwater Infrastructure (GSI) research, which has been a focus of our water conservation investment for a decade. Working with universities, research institutions, and non-profits in California and Washington State, Boeing has developed permeable pavement, which augments asphalt and concrete with excess composite material from our manufacturing operations. If successful, permeable pavement could significantly improve water quality by reducing runoff from roads and parking lots, which are major contributors to storm water contamination. Permeable Pavement has garnered worldwide attention, and in 2018 it graduates from laboratory "proof of concept" testing to a real-world application in a parking lot.

But we can't have a sustainable future without a healthy workforce. As our safety culture matures, the focus of our EHS efforts move earlier in the injury cycle, from lagging, to leading, to prevention. Examples of this pro-active focus include our Industrial Athlete job conditioning and symptom intervention program and Boeing's world-class well-being program. These initiatives provide Boeing employees with tools and resources that protect their safety and wellbeing both on and off the job. In 2015 we expanded our well-being programs to include financial health and emotional well-being, and have recently introduced modules on brain health, resilience, and mindfulness. These modules are now in a pilot stage, and safety awareness is being measured in participants before and after these engagements.

In 2017, Boeing invested $181 million in the communities where we conduct our business. This year, Congress cut Boeing's yearly tax bill, boosting our profit by more than $300 million. Our leadership has earmarked this windfall for investment in our future (employee skill-building and education), our heroes (transitioning veterans to civilian life), and our homes (community engagement).

Boeing's investors recognize that an investment in the safety, environment, wellbeing, financial health, and education of employees, is an investment in a sustainable future. Boeing EHS leaders have participated in industry forums seeking to define new leading indicators that reflect human capital investment, including Global Reporting Indicators (GRI) and the United Nations' Sustainable Development Goals (SDGs).

We leverage our reach and resources to lead our industry in a safe and sustainable future. We cofounded the International Aerospace Environmental Group (IAEG) to promote sustainable business practices at the industry level globally. We are also a founding member of the Aircraft Fleet Recycling Association (AFRA), a trade organization made up of more than 70 member companies. AFRA promotes best management practices for safe and environmentally responsible aircraft dismantling. Boeing has established 11 research and development centers, 16 consortia, and 22 joint global research centers to develop new ideas and innovative technologies. We are a member of the Campbell Institute, and have been a member of the National Safety Council since 1948.

With a $7 billion backlog of business, and locked-in jet orders for the next eight years, Boeing has the resources to develop sustainable technologies and advocate for EHS excellence in global industry.

SECTION II: LEADERSHIP

Organizational Leadership

Boeing's EHS function is a part of the Supply Chain & Operations organization, reporting to Senior Vice President Jenette Ramos, who sits on Boeing's Executive Council. The Vice President of EHS is a member of Jenette Ramos's leadership team, setting policy and strategy not just for EHS but for all key business areas of manufacturing, operations and supply chain. The EHS Directors are integral members of the Leadership Teams of all major programs.

Boeing's *Vision on a Page* is our one overarching, unifying, comprehensive framework developed by CEO Dennis Muilenburg and the ExCo to guide us in all that we do. Safety is at the center of this document, codified as an enduring value and reinforced by the Boeing Behaviors, which define the expectations of all employees across the enterprise, including leadership. Leadership encompasses how we act as individuals, team with others, advance Boeing, and serve the world we live in. Through sincerity, thoughtfulness, clarity, and integrity, we are passionate stewards for our people, planet, and possibilities.

Go for Zero demonstrated that EHS culture could be cultivated in our businesses and operations employees, and that embedding EHS culture in non-EHS personnel would be the key to disengaging the correlation between production rates and injury rates. Boeing invested $40 million in Incident and Injury Free (IIF) mindset training, resulting in a seismic shift in leadership and engagement around safety. Five years ago, it was incumbent upon EHS to "interrupt" the flow of work to deliver a safety message. Today safety is so seamlessly integrated into work processes that Operations or Business Unit Leaders talk about safety as a part of standard operating procedure.

Beyond Boeing, our EHS professionals provide support and guidance to many projects and campaigns, including non-government organizations, federal, state, and municipal agencies, institutions, and organizations concerned with health and the environment. Boeing executives serve on the Board of Directors of over 20 environmental and safety non-profit organizations in seven major operating locations internationally. Following are some examples of outstanding EHS leadership by our operations leaders.

Boeing's *We Care About Safety* program enrolls operations to commit one hour a day during the first week of every month to walk through production areas, engaging employees in conversations about safety. What began as a pathfinder practice in North Charleston was replicated and scaled to the Everett factory, where one in four Boeing employees works. We now plan for implementation across entire business units, potentially increasing participation to over 100,000 employees.

The IAM/Boeing Joint Programs Health and Safety Institute conferred EHS SVP Jenette Ramos with the first ever Ambassador award, for "always building bridges, and putting people first." They cited many examples of her advocacy over her 30-year career, including her support of the site safety committees, her initiating the apprenticeship program in Portland, and the fact that she had maintained her own Hazardous Materials certification long after she became an executive.

Boeing Chairman and CEO Dennis Muilenburg is Boeing's biggest safety champion. He receives a weekly safety status from the EHS Vice President and replies nearly every time with appreciation or encouragement to the teams for working safely. He is an active sponsor of *Go for Zero* in his monthly updates on enterprise-wide initiatives, and proudly leads the annual Chairman's Safety Award selection and awards ceremony. Each year, he is filmed leading the annual Safety Promise recommitment event. Last year's celebration included an unscripted discussion with employees about safety. This year, the leaders of each of the business units BCA, BDS, BGS and the leader of Engineering, will deliver a filmed message speaking specifically about their role in a safe and sustainable future.

Kevin McAllister, president and CEO of Boeing Commercial Airplanes spoke at the opening of the Boeing Safety Promotion Center in Everett in 2017. *"Safety is our most important job, our top priority. Millions of people each year count on Boeing airplanes to fly them safely to their destinations. Safety must be woven into everything we do. Our Safety Management System helps us achieve that. It is a 'must do.'"*

At Boeing Portland, General Manager Perry Moore asked his managers to talk about incidents during safety crew meetings, and to encourage workers to raise hazards and concerns. To this assignment Perry attached the request that managers share something personal about themselves at crew meetings. He asked those managers to email him directly with a summary of the crew meetings and the safety concerns raised. Perry replied to every one of the 100 or so e-mails, following up with personal notes. One manager recalls, "it made you want to support the effort." Four hundred hazards were identified through these crew meetings. Perry worked for nearly a year to resolve each and every one.

Commitment to EHS Goals

The members of Boeing's Executive Council (ExCo) model our commitment to EHS goals every year by being the first to sign the annual Safety Promise. This tradition began in 2013 when the ExCo gathered at a St. Louis factory, and on a live webcast witnessed by 17,000 managers, signed the Boeing Safety Promise. This defining moment in our history marked the launch of *Go for Zero — One Day at a Time.*

Every Boeing employee renews our safety pledge annually. Signed posters are displayed in Boeing sites around the world. Each and every employee participates in the renewal of the safety promise, endorsing our enduring value of safety, and the idea that safety leadership can be found at every level of our organization. We were heartened to learn that Boeing's annual demonstration of our EHS commitment has had impact even beyond Boeing. Through our Campbell Institute membership, we developed a relationship with former Campbell Award winner USG. They were so inspired with Boeing's annual EHS recommitment that they have instituted their own safety commitment signing events.

Across the Boeing enterprise, our annual re-commitment is refreshed on a quarterly cadence through the *Keep the Promise Alive* manager-led safety discussion. These pro-active safety discussions support open communication and often lead to new ideas and improvements.

Our safety culture and climate encourage creative collaboration and innovative thinking, and thousands of safety innovations have been introduced since the launch of *Go for Zero*, transforming our workplace. Every year the best of these safety advances are recognized by Boeing's Chairman and CEO himself through the annual Chairman's Safety Awards. All employees are eligible for the award. In 2017, the honorees collectively reduced risk by 65%, mitigated nearly 4,500 hazards, initiated nearly 1,500 near misses, reduced recordable injuries by 60%, and reduced LWDC by 78%. Applications for this honor have increased each year since its introduction, indicating a rising employee engagement with safety.

Along with this cultural transformation, clear EHS performance expectations are tracked and reported vertically throughout the company up to and including the Board of Directors. The ExCo reviews weekly safety status, monthly EHS performance, a bi-annual EHS report, and an annual comprehensive risk management report. The Board of Directors reviews monthly safety performance reports and an annual comprehensive risk management report.

Organizational Culture/Climate

Boeing's EHS programs, which focus on workplace safety and environmental leadership, are designed to support, connect, protect and inspire every person who sets foot on a Boeing site, at every level of our corporate structure, all around the world. Boeing EHS expectations extend to employees, subsidiaries, contractors, service providers, visitors, and the supply chain.

Over 100,000 employees responded to Boeing's annual employee survey. Survey data consistently show that Boeing employees are proud of the products and services we provide. ***84% of employees feel their safety is never compromised due to schedule pressures.***[3] While it's not yet 100%, it represents over 84,000 employees who understand what putting safety first really means. What *Go for Zero* has done culturally is to create enthusiasm beyond product delivery, to embrace the safety mission.

Contractors and Service Providers. Contractors are part of our business, and from an EHS perspective they are valued the same as our employees. Since contractors and service providers interface with Boeing operations and work closely with personnel from various Boeing organizations, they are expected to maintain Boeing's high standards for safety and the environment. This is in the terms and conditions of our service provider contracts, and it's a basic requirement to do business with Boeing. For more information see Section III, *Contractor & Supply Chain Management*.

Our commitment to Service Provider Safety begins with our contractors and service providers adhering to our enterprise safety standards, but it goes well beyond compliance. For an example of how our EHS culture engenders safe, sustainable practices across our supply chain, see Section IV, *Benchmarking & Transparency*.

[3] The three safety questions on the employee survey are: (1) When raising a safety concern, I'm confident the issue will be addressed promptly (80%); (2) I feel safe from accidents and health hazards in my work area (87%), and (3) My safety at work is never compromised due to schedule pressures (84%).

Subsidiaries. Optimal Enterprise Integration (OEI) extends the EHS centralization effort and the adoption of One Boeing IIF culture to our 23 non-fully integrated subsidiaries (NFIS). Beginning with BGS subsidiaries, OEI integrates: (1) environmental protection and compliance requirements, (2) processes and *Go for Zero* standards, (3) common IT tools and systems, and (4) EHS team engagement. We use our *Go for Zero* standards and best practices as a means to integrate our NFIS, and this allows us to include them in audits and assessments. In November 2016, EHS IT Systems integration began at four pathfinder sites, one of which is international. We will apply what we learn from this effort to the broader implementation. Subsidiary EHS personnel are now well integrated with EHS process management and our IT System process workstream development.

International Sites. As a multi-international business, Boeing supports employees all around the world. EHS partners with the Boeing international group's global functional leaders to ensure policies, procedures, standards as well as any local EHS regulatory requirements are being met at all Boeing locations. Our EHS management system ensures that our international partners remain aligned with our principles and our practices, especially as we enter new markets around the world. This year, we created an international edition of our Service Provider Manual (SPM).

In 2017, a Global Occupational and EHS (GOEHS) Community of Excellence group was created to address international EHS and occupational health. Deploying a *One Boeing* approach, and guided by our Safety Guiding Principles, GOEHS groups ensure the well-being of our employees, and industry best-in- class environmental protection and sustainability.

Boeing Canada Winnipeg is Safe Work Certified. The province's safety and health certification is based on international, national, and provincial best practices, standards, and legislation. By voluntarily seeking out and meeting this standard, Boeing Canada Winnipeg receives a prevention rebate on Workers Compensation Board premiums with further reductions over time. **Aerospace Composites Malaysia** won a Chairman's Safety Award in 2017 for leadership in embracing safety at work and at home. This site celebrated a four-year period (more than 8 million work hours) without a lost workday case. In May 2018, that will likely increase to five years and 10 million hours.

Partnership with Unions. Sixty-seven thousand Boeing employees are represented by 38 unions. Our engagement efforts with unions are designed to increase support of safety initiatives and drive a culture of caring. Sixty-five percent of union plans have an embedded safety incentive, for pro-active behaviors to prevent injury. As an example of this, Boeing works with our largest union, the International Association of Machinists and Aerospace Workers (IAM), to co-sponsor the Joint Programs partnership. This program offers leadership training for union stewards and union safety coordinators, and programs such as Body Mechanics training and Don't Fear the SHEAR (Safety, Health and Environment Action Request). At each IAM site, a joint safety committee conducts safety walks, incident investigations, and partners on improvement initiatives.

Incident Review Board Review (IRB/EIRB). After every incident or potential serious incident that meets defined criteria, an IRB reviews and analyzes the event, employing a closed loop, systematic problem-solving methodology (root-cause-corrective-action). If warranted, the IRB elevates the analysis and recommendation to the Executive IRB (EIRB). Boeing policy ensures that there is a response to each incident (IRB), and that the universal applicability of the mitigation is considered by senior leadership (EIRB). The EIRB is comprised of senior leaders from operations and engineering, vice presidents from our major business units, and functional leadership from Human Resources, Legal, and Communications. The Board meets monthly, and has covered incidents or near misses related to automation, fall protection, and machine guarding, among other incident types.

SECTION III: INTEGRATED EHS MANAGEMENT SYSTEM

Policies, Goals, and Objectives

Boeing's mission is to connect, protect, explore, and inspire the world through advancing aerospace innovation. We aspire to be an enduring global industrial champion. Our work is rooted in values that include safety, corporate citizenship and environmental sustainability. Our EHS efforts are guided by Boeing's safety guiding principles, established by the Executive Council (ExCo) in 2013:

Guided by these principles, the ExCo sets policy, strategy and targets for EHS. The EHS function works across business units and the enterprise to establish objectives and plans to meet these company-wide EHS commitments. These goals and objectives are outlined in the annual EHS Strategic Guidance document which provides guidance to the Boeing business units for incorporation into their business plans. EHS uses a data dashboard called the *EHS One Plan* to track detailed performance to these commitments and report this progress, including leading and lagging indicators, to the ExCo on a monthly cadence. Advancing on an effort first launched in 2007, Boeing's 2025 environmental strategy outlines aggressive goals and performance targets for guiding many aspects of Boeing's business. The new approach focuses on environmental priorities and needs. This means the strategy is not about the next eight years, but about the next century and beyond. For more on how the *EHS One Plan* drives continuous performance improvement, see *Section V: Continuous Performance Improvement & Sustainability.*

Communications

Through our engagement with *Go for Zero,* we have not only become safer, we have become better communicators and collaborators. Our communication channels are many and varied, formal and informal, local and global. Seamlessly integrated into our standard work are pauses and pivots for productive communication about safety and the environment. Across the Boeing enterprise, the *Go for Zero* logo is the second most recognized Boeing symbol, after the company logo.

Built into our annual planning, EHS Communications' engaging, multi-media strategies keep the focus on safety fresh and relevant, while facilitating the exchange of ideas across a complex global network throughout the year.

In 2017, the Public Relations Society of America honored the *Go for Zero* Communications team with a Totem Award for excellence for the 2017 *Keep the Promise Alive* activity, which used sports-themed videos to make the safety conversations fun and informative.

Our safety communications extend beyond Boeing too. Boeing EHS professionals speak at conferences all over the world, contribute articles to safety publications and technical journals, teach at nearby schools, and host community safety events and training activities. Boeing experts participate in and often lead industry committees about some of the most critical issues of the day, including safety and automation, the efficacy of exoskeletons and exosuits, and the role of fatigue in workplace safety.

We use multiple avenues of communication to help socialize change and provide important requirements, share best practices, and resources. The following highlighted descriptions represent a blend of formal and informal communication practices, and show how our formal structure encourages a dynamic and spontaneous exchange of ideas and information.

By EHS Topic: Communities of Practice. The EHS conversation is just that, a conversation, and it is open to anyone. CoPs are a component of Boeing's broad knowledge Network. EHS Communities of Practice (CoP) are centered around a particular EHS subject such as ergonomics, recycling, or fall protection. Anyone, anywhere with an interest in a particular EHS area is welcome to participate in a CoP. These groups meet virtually to connect experts, provide mentor opportunities, share ideas, ask questions, and partner on problem solving.

Site Specific: Lean Manufacturing Tier Boards. Lean Manufacturing Tier Boards leverage both visual and verbal communication to identify areas of risk to production, including safety issues, and procure any help needed to mitigate the risk. The process has multiple levels of engagement, each of which is built into the Boeing production system. If a safety issue is identified during a tier meeting with crews and it cannot be resolved at that level, it is elevated to the next level tier board for resolution, and will be elevated to plant or site general managers if unresolved. This discipline ensures that critical issues are presented to site operations leaders in for timely and appropriate resolution.

EHS Team Communications: EHS team members are invited to participate in two quarterly WebEx calls designed to help coordinate initiatives and share best practices**.** The *Go for Zero Journey Call* is hosted by the Director of Workplace Safety, and focuses on workplace safety initiatives and engagements. The *All EHS Quarterly Meeting* is led by the Vice President of EHS, during which she shares guidance from her engagement with Boeing senior leaders, and industry insights, and answers employee questions. External speakers or EHS panels are often invited. The entire EHS management team gathers annually for a three-day leadership summit featuring internal and external speakers, such as John Dony of the Campbell Institute. EHS communicates emergent changes through EHS *Alerts, Bulletins and Communiques (ABCs).* EHS also communicates with team members through *Insite*, an Intranet platform.

Audits and Assessments

EHS audits and continuous improvement of the EHS Management System are fundamental components of Boeing operations. Beyond compliance with regulatory agencies, comprehensive auditing and assessment processes are thoroughly integrated into standard work.

Individual. Each day, across Boeing's vast enterprise, work begins with a discussion about safety. From the factory floor to the conference table, Boeing employees practice IIF pre-task check-ins. This best practice involves employees verbally stating any issue that could impede them from giving full attention to the work ahead. This promotes open communication, builds trust, and encourages employees to report unsafe or less safe situations before they become accidents. Boeing well-being programs offers mindfulness training to support situational awareness.

Team. EHS Audits and continuous improvement are woven into the very fabric of Boeing operations. Operations managers lead teams on localized safety walk inspections, which foster a culture of safety awareness — and not all observations are negative. The new universal IT platform now being deployed will document appreciations for safe behaviors as well as unsafe behaviors and hazards.

Site. Site self-assessments are performed at routine intervals, most often annually. Site EHS personnel evaluate programs, measuring effectiveness and looking for opportunities for improvement. These site assessments are sponsored by EHS and Operations leadership and are reviewed for closure during Enterprise audits. We use pro-active audits as a lever to innovation.

Enterprise. The Enterprise EHS Assessments group conducts its audits in cooperation with, and on behalf of, the Office of Internal Governance to ensure adherence to Boeing's policies and procedures. A Global Environment Health and Safety Risk Assessment (GERA) is performed annually at about 500 sites across the enterprise, including international locations. Audit frequency is determined by the GERA score, usually once in three to five years. Enterprise EHS audits evaluate both applicable compliance aspects and the maturity of the site's EHS management system. All audit findings are risk ranked, twelve elements of the EHS Management System are scored, and an overall audit score is derived.

Findings resulting from these audits require sites to develop and implement corrective action plans (CAPs) approved by the site leader, audit team, EHS legal, and business unit senior operations executive. CAPs are tracked with monthly status reports provided to EHS leadership, senior site operations executive, and, upon completion, are validated for effectiveness through site reviews performed by the Enterprise EHS audit team. Results of enterprise audits are communicated monthly to the Vice President of EHS, who provides a summary to the Executive Council. The Vice President of the Office of Internal Governance is copied on all audit reports.

External. As part of its commitment to EHS excellence, Boeing's occupational health and safety management system conforms to the requirements of OHSAS 18001. Our Environmental Management System conforms with ISO 14001. Fifty-five Boeing sites are in compliance with and governed by 26 ISO 14001 third-party certifications. Boeing is on track to meet the requirements of the updated ISO 14001:2015 standard by September 2018. Forty-nine sites are verified to conform to OHSAS 18001 safety management systems. The new standard, ISO 45001, was published in March 2018, and we are currently conducting a gap analysis between OHSAS 18001 and ISO 45001 requirements. EHS plans to adopt the requirements of ISO 45001 in select sites in 2018 and to additional sites in 2019, while maintaining conformance with current OHSAS 18001 safety management system requirements.

For root cause analysis, Boeing uses the Apollo method and the Integral Model which captures the systems, behaviors, values, and culture causes for a complete understanding of the generation of the issue.

Hazard Recognition & Risk Management

The first focus of *Go for Zero* was to mitigate the highest risk hazards, even if they were low probability. The High Hazard assessments were key tools in lifting workplace safety beyond compliance. Boeing invested $60 million dollars on this effort. Since 2013, our *Go for Zero* high hazard risk assessments have resulted in addressing nearly 23,000 issues related to high hazards.

The program uses a suite of tools to focus on eliminating conditions where a single point of failure could be tragic. The High Hazard assessments were key tools in lifting workplace safety beyond compliance.

We focus on nine process areas, below. Each area has an executive champion, not all of whom are from the EHS organization:

- Aircraft Hazardous Energy
- Aircraft Towing
- Working from Heights
- Vehicle-Pedestrian Interactions
- Confined Space Entry
- Crane Operations
- Machine Operations
- Chemical Process Management
- Ordnance

Today, Boeing's Serious Injury and Fatality Program (SIF) is a comprehensive set of requirements and practices that reduces the risk of serious and fatal injuries by engineering out high hazards, providing multiple layers of protection, and implementing human performance techniques.

Hazard Risk Assessment Process. In conformance to OHSAS 18001, Boeing uses comprehensive mechanisms, tools and techniques to identify and document hazards in the workplace. EHS professionals evaluate a broad list of activities involving hazards and document control measures for these activities in the Occupational Health & Safety Management System (OH&SMS). Additionally, detailed ergonomic evaluations are captured in the Boeing Enterprise Ergonomics System (BEES). Other hazard recognition and risk management mechanisms include: Process Hazard Analysis governed by Process Safety Management (PSM) requirements, Safety Health and Environmental Action Requests (SHEARs), Incident Reporting System (IRS), and Job Safety Analysis (JSAs).

Once hazards are identified through these systems, they are entered into a web-based Hazard ID and Risk Assessment (HIDRA) tool for risk assessment, prioritization and determination of mitigation actions. Risks are assessed by using a simple computation (*Risk = probability of adverse outcome X severity*). This computation results in a single value or risk score. Company policy requires the immediate correction of hazards, or cessation of work assessed as high-risk. The hierarchy of safety controls guides the mitigation of risks. The use of a quantifiable, standardized risk assessment score shows us where to focus our mitigation efforts, and provides a way to evaluate those efforts. A similar approach is applied to environmental hazards through Boeing's gated development process (See *Prevention through Design* for more detail).

Boeing's Leadership in Fatigue Management Research. Boeing and Jeppesen have jointly developed Fatigue Risk Management (FRM) functionality that enables airlines to control crew fatigue and fatigue risk in crew planning and operation. Scientific fatigue/alertness models (e.g., the Boeing Alertness Model or BAM) supply data used in constructing and maintaining crew schedules to ensure safety. Boeing is extending the reach of our research to partner with the National Safety Council in a study of fatigue management in the manufacturing workplace. In anticipation of an upcoming fatigue management study, Boeing and representatives of the Well-being committee of the NSC's Campbell Institute tested a questionnaire about scheduling with both employees and managers. A representative from the National Institute for Occupational Safety & Health (NIOSH) analyzed the data to recommend improvements.

Workstation break reminder software for keyboarders. Repetitive strain injuries (RSI) are a leading cause of lost work days for engineers. Also vulnerable are Boeing's 91,000 office employees, for whom computer-related RSI injuries are the second most frequent injury, right behind slips, trips and falls. In 2015, workstation break reminder software became an Enterprise Safety Standard, and was installed on computers at all U.S. sites. The software directs employees to take frequent short breaks and longer stretch breaks. We have recorded a 39% reduction in computer-related injuries since the implementation of this intervention.

BDS operations embeds wellness into work instructions. BDS Operations works with Industrial Athlete (IA) to identify awkward postures, and determines which IA mitigation (e.g., micro-breaks, specific stretches, etc.) applies to each. Then BDS inserts the mitigation into work instructions at prescribed intervals.

Exoskeletons and Exosuits. In 2017 Boeing achieved a significant milestone by establishing of the world's first exoskeleton and exosuit standard committee through the American Society for Testing & Material (ASTM). A Boeing EHS engineer chairs the F48.02 subcommittee on Human Factors and Ergonomics that established this standard and is featured by ASTM on their online launch video. Our exoskeleton research was also featured on the Boeing.com website, presented at three 2017 international conferences, and cited in an academic conference paper.

Boeing's leadership in exoskeleton technology has given rise to productive partnerships with other leaders in this space, including private industry, academia, NIOSH, National Institute of Standards and Technology, the US Navy, the US Air Force, the US Army, and a growing group of suppliers. More about these efforts can be found in *Section IV: Measurement Quality & Data Evaluation.*

Prevention through Design

The National Institute for Occupational Safety & Health (NIOSH) launched a Prevention through Design initiative focused on workplace safety in 2007. Boeing's first efforts to integrate ergonomic safety into the build design predates that by nearly two decades. In the early 1990s, Boeing engineers began to integrate safety considerations into design and build processes. This awareness grew as a result of the Lean Manufacturing process, which looks at each design iteration as an opportunity to build strength on strength. With each iteration, engineers asked what was learned and how that could be applied to the next effort. Tracing the Design-in safety and environment effort through three decades, we can see the *Plan- Do-Check-Act* cycle of continuous improvement maturing into a practice of *Plan-Do-Check-Act-Learn.*

Every Boeing airplane is developed through a standard process of phases and gates. The phases begin with customer and market analysis, concept definitions and continue through design maturity levels, to prototypes, testing, fabrication, production, flight tests and delivery. Each gate represents a checkpoint where the airplane must meet certain criteria including acceptable levels of risk or it cannot proceed to the next phase. A significant step toward integrating safety and environmental factors into an airplane before production occurred with the 787. Following this success in 2011, EHS requirements were formally embedded into our gated process for airplane development.

The 737 MAX airplane program was the first to fully adopt EHS airplane and production system design requirements from program start-up. This change systematically leverages our engineering talent to "design in" workplace safety and environmental sustainability into the Boeing aircraft design and build process. The integrated EHS team worked with design and production engineers to assess and verify EHS requirements throughout design of the airplane and factory. These efforts resulted in over 100 airplane design changes that mitigated workplace risk and prevented injuries. EHS has been integrated during the design of every airplane program since, and with continuing improvements, the resulting impacts are compounded.

Under *Go for Zero*, the responsibility for ensuring workplace safety in the design was assigned to the Chief Engineer, not the Operation leader or the EHS professional. The Chief Engineer was given a technical performance measure (TPM) as a requirement for the production design, to mitigate the known safety risks inherent in the design. To support engineering teams in meeting these EHS requirements, two enterprise-wide programs were established: Design for Ergonomics and Workplace Safety (DfEWS), and Design for Environment (DfE).

The design-in programs employ tools from simple checklists to computer-aided design (CAD) to state-of-the-art, virtual-reality visualization in order to identify hazards, and develop mitigations in products, tooling, facilities, production systems, and testing, including maintenance, repair, and overhaul.

The new Boeing Commercial 777X will be the largest and most efficient twin-engine jet in the world, unmatched in every aspect of performance. This is the result of the systematic and comprehensive integration of EHS considerations throughout the development process. This philosophy has influenced the 777X's development at every stage, from design studies to producibility evaluations to build instructions. Evidence of our having moved EHS considerations upstream is evident in our facilities, tooling, and work scheduling.

In Everett, a team of engineers, manufacturing operations employees, and EHS specialists using a systems-engineering approach integrated requirements and methods to improve safety, ergonomic, and environmental concerns into the 777X airplane development program. Using the HIDRA tool, more than 1,750 EHS hazards and risks have been identified: 15% were mitigated through engineering design, 50% were mitigated through tooling and equipment, and the balance were mitigated administratively or through personal protective equipment. So far, about 1,450 hazards have been mitigated, and 300 more are on plan for mitigation in 2018 and 2019.

The 777X prevention through design effort won a Boeing Commercial Airplane Development Excellence Award (2016), a Chairman's Safety Award (2016), and was a finalist for the National Safety Council Green Cross Award for Safety Innovation (2017).

But nothing tells the story of prevention through design and continuous improvement better than the fact that this 777X production system is already being surpassed by the next generation of product development. Boeing envisions an evolutionary step forward in aircraft manufacturing, as significant as the introduction of the moving assembly line. In the future, the production system will drive the product design instead of the product design driving the production system. With the aid of virtual reality, immersive technology simulations, the product and production design organizations can work in concert, designing the product and the production system *at the same time.* For more on how Boeing is redesigning the design process, see *Section VI: Lessons Learned.*

Operational EHS Programs

Boeing's EHS management system ensures policies and procedures are in place to meet and exceed all EHS regulatory requirements, domestically and abroad, including the OHSAS 18001 international standard for safety and the ISO 14001 international standard for environmental management. Further, Boeing works with agencies such as the Federal Aviation Administration (FAA), and the International Civil Aviation Organization (ICAO) to identify opportunities to exceed the compliance standards.

Compliance alone will not get us to zero. So, after studying the safety programs of world-class companies, Boeing recognized the strategic benefit of enhancing our policies and procedures to include universal standards that go beyond compliance. Boeing adopted this approach, and *Go for Zero* deployed three enterprise-wide safety standards in 2014: required eye protection in all manufacturing areas, high visibility vests on the flight line, and the safe use of electronic devices. We found benefit in universal standards that exceeded the physical protection itself. Boeing has introduced nine more enterprise-wide safety standards that apply to, and protect, all people on company property, including employees, contractors, suppliers, customers and visitors.

In addition to safety standards, more than 50 formally identified best practices are shared among team members and programs that perform similar operations and are specific to the type of work performed. Furthermore, hundreds of specific safety solutions are found in our Boeing Ergonomics Catalog, Fall Protection catalog, and the Assessments team's Best Practice website.

A "best practice" of Safety Check-ins was piloted in 20 groups in six Fabrication locations in 2016, and is now integrated into our standard crew start-up process. Every day, across Boeing's vast enterprise, in conference rooms and factory floors, work begins with a discussion about safety. At our 2018 EHS All Managers Meeting, Campbell Institute Director John Dony reported that this practice has been adopted by the National Safety Council.

Contractor & Supply Chain Management

Supply Chain. The supply chain is a value stream of companies providing goods and services to Boeing. In 2016, Boeing spent nearly $60 billion with more than 13,000 suppliers, supporting an additional 1.3 million supplier-related jobs in the United States. These businesses include suppliers for our commercial and defense production, non-production vendors, and subsidiaries. Supplier-provided components and assemblies make up about 65% of the cost of Boeing products.

Supplier Contract, Monitoring and Performance. Boeing requires suppliers to comply with all global, national and local laws that protect worker safety, human rights, guard against human exploitation and protect the environment. Period. These requirements are in the terms and conditions of our service provider contracts, and it's a basic requirement to do business with Boeing. We are diligent in ensuring the supply chain remains aligned with our principles and practices, especially as we enter new markets around the world.

EHS works with Boeing's five supply chain organizations to ensure that EHS requirements are built into Supplier contracts. Boeing's supplier contract process requires EHS regulatory compliance, requires suppliers to have EHS management systems, and includes special EHS provisions for work performed on Boeing property. Further considerations include whether a supplier uses rotable containers to reduce waste, and considers Greenhouse Gas emissions as criteria in business decision making.

Boeing is a founding member of the International Aerospace Environmental Group (IAEG) that works collaboratively to address environmental topics in aerospace, such as chemical regulations, supply chain engagement (e.g. ISO14001:2015 awareness, GHG reporting guidance, and supplier EHS surveys), and the development of chemical alternatives. Boeing's participation in IAEG allows us to extend EHS beyond Boeing's supply chain to the OEMs, major Tier 1 suppliers and other supply chain actors in the aerospace supply base.

Supplier of the Year Award. Boeing created a Supplier of the Year award to recognize partners who demonstrate leadership and performance in safety and environmental protection. In 2018 Boeing recognized 13 companies as 2017 Supplier of the Year Award winners in categories including: Safety, Environment, Collaboration, Innovation, Diversity, and Community Engagement.

Contractors and Service Providers. Contractors are part of our business, and from an EHS perspective they are valued the same as our employees. For the benefit of Boeing, other service providers, and the surrounding communities, all contractors and service providers are expected to maintain Boeing's high standards for safety, health, fire prevention, security, and the environment. As our safety culture transforms the way we do business, the way we do business transforms the way our partners do business.

First published in 2010, our Service Provider Manual covers safety and environmental requirements such as badging, conduct, workplace hazards, recycling, fire prevention and emergency procedures, and hazardous materials and radiation safety. Additional site-specific and work-specific requirements are added. Last year we introduced an international edition of our Service Provider Manual (SPM).

On-site Contractor/Service Provider Vetting and Monitoring. Boeing policy requires that all Service Providers are vetted prior to performing work on-site. For all Service Providers, a checklist identifying EHS-related requirements and subsequent expectations, must be completed, and a Boeing-designated On-site Activity Representative (OAR) is assigned to ensure that a project-specific EHS plan is in use, and that hazards have been communicated. As applicable to the specific project or work being performed, the Service Provider is provided with essential Boeing information. Examples include orientation meetings or shared risk discussions. This is typically the opportunity to ensure that all service providers, be they prime or subcontractors, have copies of the Boeing Service Provider Manual that sets general and site-specific expectations for safety and environmental protection and compliance. This process ensures two-way safety communication about the work to be performed. For construction management, where risk is greater, daily

tag ups are typical. Boeing's Incident Reporting System (IRS) allows reporting of incidents involving contractors and others without a Boeing employee ID. Reports entered into IRS involving non-Boeing personnel are tracked through to mitigation just as any Boeing incident reported in the IRS is. In most cases, the incidents are jointly investigated and findings are shared to assure all parties that risks are mitigated. Boeing plans to pilot the use of third-party companies to review and prequalify contractors for their EHS performance and capabilities, at several large manufacturing facilities.

Supplier and Service Provider Safety Summits. Boeing conducts an annual supplier summit where over 700 of our top performing and strategic suppliers participate in discussions with Boeing leaders on topics including workplace safety and environment. In December 2017, BDS Philadelphia hosted a pro- active Service Provider Safety Summit. About 50 representatives from the site's service providers joined Site Services and EHS for a discussion on workplace safety. Service provider representatives learned about Boeing's *Go for Zero* safety program and shared some of their own best practices, making for clearer communication, a safer workplace, and a platform for future exchanges of safety ideas. The event was so well received, there are plans for replicating it at other locations.

Management of Change

Enabling One Boeing requires that all employees perform in compliance with company standards. Policies, Procedures, and Process Management supports this objective with common policies and procedures, consistent process management, and clarity in our instructions to our employees. Boeing EHS's Change Management Process drives continuous improvement across the EHS management system and ensures on-going regulatory compliance.

EHS process changes are managed within a governance framework known as the EHS Process Management Structure. The Structure consists of a change board (Process Steering Team), Process Management Teams (PMTs), Project Work Teams (PWTs), and Communities of Practice (CoPs).

The Process Steering Team (PST) is the formal leader of the process management structure. This team maintains a minimum of five senior-level managers as voting members, who meet weekly to provide oversight and strategic guidance to the rest of the structure. Any employee can propose to create or update an EHS process or associated training. However, the primary sources of discovery are through the CoPs and PMTs. When considering change, we consider a variety of perspectives that reflect the communities who might be impacted by the change.

Process Management Teams (PMTs) are comprised of technical EHS Subject Matter Experts in areas determined by risk priority, such as ergonomics, ordnance, hazardous energy, fall protection, and hazardous waste. Their meeting cadence depends on the work. PMTs are responsible for comprehensive change management of training, tools, IT systems, policies, and websites. They set requirements, measure baseline results, identify and prioritize improvement opportunities, implement, and measure gains. This includes maintaining controlled Qualified Product Lists (QPLs), which help prevent use of non-compliant materials and aid in mitigating hazards in the workplace. PMTs are the first line of contact for problem- solving issues and other day-to-day tasks related to their identified subject matter.

Project Work Teams (PWTs) are temporary teams created out of necessity to work on emergent or discrete process-related projects. PWTs help the PMTs with larger scale process management changes. Once the project is completed, the deliverables are transitioned back to the PMT.

Communities of Practice (CoPs). Any employee, regardless of function in the company, who is interested in a particular EHS topic may participate in a CoP. These groups meet virtually on a quarterly basis to share

ideas, ask questions, and partner on problem solving. CoPs are an important component of Boeing's process management structure, as they represent a diversity of perspectives on a specific EHS topic. CoPs do not complete work. If a need for work is identified, it is elevated up the process management chain.

Changes to EHS processes (associated tools and training) may be triggered by regulations, company policies, issues, maintenance cycles, or process improvements. Initial requests for changes are sent to PMTs for consideration. Documents are then routed to a group of EHS subject matter experts assigned to the topic area. The change request goes through a rigorous review process across a broad range of designated experts before being approved. Once approved the document is published as an *ABC Communique.*

The success of the change management process is validated annually through the audit and assessment process (both at the site level and through the enterprise audit process).

Workforce Empowerment

Boeing values employee engagement as a key enabler of workplace safety, environmental sustainability, and business performance. From our company's beginning, Boeing has invested in employee-generated innovation. We've come a long way from the wooden suggestion box on the factory floor, but the spirit is the same. Ingenuity and initiative are foundational to Boeing's corporate culture. *Go for Zero* leveraged our culture of innovation to focus on EHS through award programs and gamification activities designed to build EHS skills, awareness, and collaborative partnership.

One recent example of cross-functional collaboration is a safety solution designed and built by a team with members from Flight Test Maintenance, EHS, Ergonomics, and Boeing Research & Technology. They worked together to invent a flight test instrumentation rack handling fixture that protects employees from safety and ergonomic risk and prevents product damage while instrumentation racks, weighing up to 400 lbs., are loaded in and out of customer aircraft with installed interiors. This solution was awarded a U.S. patent. Since 2012, Boeing received 280 safety-related invention disclosures, 150 of which Boeing either filed for patent protection or made a specific determination to hold as a trade secret.

Employee Involvement Teams. In 2017, Employee Involvement teams produced 4,190 projects company-wide. Thirty-four percent (1,436) of these projects involved the solution to a safety or ergonomic concern. Since the launch of *Go for Zero*, two employee communities have established problem-solving centers to facilitate innovation: the Engineering community created Innovation Cells, and the EHS community created the Safety Dojo.

Union Involvement. Safety elements were added to the Aerospace Machinists Performance Program (AMPP) in 2012. We saw a nearly 300% increase in hazards identified and near-miss reports—well above the 25% improvement goal, and a 20% reduction in the recordable injury case rate.

Safety Always Wins: Gamification Campaign
As our safety culture matures, our focus shifts upstream from lagging indicators to leading indicators such as near-miss reporting. An analysis of gamification strategies showed a potential for incorporating these concepts with near-miss reporting for lasting benefits and behavior change. So we opened our incident reporting system (IRS) to input from all employees (previously restricted to managers), and employed gamification to encourage participation. Under the theme of *Safety Always Wins*, these competitions are designed to not only make Safety fun, but also to engage the broader Boeing community in building new safety skills.

Near Miss Madness. In March 2017, EHS hosted a basketball-themed campaign called *Near Miss Madness* that enrolled 66 teams (about 1,500 employees) from across Boeing. The teams were selected for participation based on their overall injury performance, and were personally and formally invited to compete by a Senior Vice President and ExCo member. The game involved four rounds of play over six weeks.

Near Miss Race Series. From May to July 2017, EHS hosted the *Near Miss Race Series*, which was modeled after car racing. The Race Series enrolled 179 teams (about 24,000 employees) from nine major organizations to compete in three "heats." Each team recorded near misses/hazards related to a specific focus area of their own choosing, (e.g., slips/trips, head strike hazards).

Ergo Space Race. In the first quarter of 2018, over 80 teams competed in a race around the solar system to find and fix ergonomics hazards. The teams were selected based on their injury risk profile, and were taught basic lessons on how to identify ergonomics hazards related to body postures, such as kneeling and working with arms overhead. The space race resulted in 20 times more ergonomics hazards being addressed during the competition than in the weeks prior.

And, the results are in! In the first three months of 2017, more near misses/hazards were reported than in all of the prior year (2016), even surpassing our ultimate near miss reporting goal for 2019. After the competition ended, some teams continued to report up to three times as many near misses as they had before the competition. For these teams, it appears that the gamification strategy created a positive, lasting change. Near miss reporting increased from 2,690 in 2014, to 13,770 in 2016 to 50,100 in 2017[4]. We are on track to beat this again in 2018.

Earth Day Activities. Boeing employees are increasingly invested in ideas and programs that benefit the environment. Boeing's environmental engagement program provides activities, tools, and resources to help employees save energy and water, reduce waste, and implement sustainable solutions. Since EHS began its focus on environmental activities in 2009, the number of annual events to celebrate Earth Day & World Environment Day increased by 477%. In 2017, thousands of Boeing employees participated in more than 300 Earth Day & World Environment Day events in 20 countries. These activities generate conversation, establish connections, and remind us that the work we do is both personal in its nature and global in its impact.

CSA Safety Champion. To recognize outstanding safety leadership at every level, Boeing's ExCo established The Chairman's Safety Award (CSA) in 2014. It is the first recognition award to be conferred by Boeing's Chairman. This program recognizes empowered EHS advocates who anchor our safety culture.
Our 2017 CSA Safety Champion exemplifies the power of a single individual to make a difference in workplace safety. As a product review engineer on the Defense, Space & Security P-8 (U.S. Navy aircraft) program, Katherine Belvin drove a collaborative approach to reducing risk related to hazardous energy control during production. She developed a tool that enhanced the P-8's lock-out tag-out program (LOTO), reducing incidents across the P-8 program. Plans are underway for enterprise-wide replication of this safety innovation. The next advancement, called *Shield*, will provide the ability to identify individuals working in the area, accessing control plans, and generating new LOTO log sheets in a centralized location.

Professional Development

Boeing is committed to ensuring the development of our workforce to ensure our future success. From providing meaningful job experiences to encouraging continuing education, it's our duty to make sure employees feel supported, motivated, and valued as they grow in their Boeing careers.

The EHS Development Experience Program. This program develops EHS skills while advancing EHS process, research, or problem solving. EHS teams meet and work together on six-month projects or project phases culminating in a recommendations report to leadership. Participants gain practical experience, senior management exposure, and a broader knowledge of EHS occupations while developing EHS networks across the enterprise. Since its inception in 2013, 143 employees have participated in 46 projects.

[4] NM totals include SHEARs (safety, health environmental action request), except for 2013, when these totals were not available

EHS Job Swap. The EHS Job Swap Program was created in 2016 to provide six-month job rotation opportunities within the function. In practice, these temporary assignments allow high performing EHS employees the opportunity to swap roles to gain new skills and site knowledge to share upon their return to their home location. Recently, a safety specialist from Fabrication North in Everett spent six months in Louisiana working on NASA programs. He says, "Job swap is like taking a new job. The rewards outweigh the struggles. I highly encourage anyone and everyone to take the opportunity to do all you can to learn and grow from any offered experiences." The program started in 2016 with four employees. In 2017 ten employees participated.

EHS and Engineering. All engineers are required to take six modules of EHS training – Design Awareness training, including Confined Space, Environmental Design, Ergonomics, Fall Protection Systems, Hazardous Materials, and Hazardous Energy. Further, Engineering offers a career rotation program where new hires can spend their first two years in different areas and job functions to find the best fit for their interests. These rotations often involve EHS.

Learning Labs. Fabrication introduced the Learning Lab, a simulated factory environment to coach individuals and teams through the discovery and resolution of realistic problems. The labs represent an intermediate step between classroom and workplace, allowing employees to practice and refine their new knowledge and problem-solving skills. Safety is integrated into the learning labs in several ways: a check- in to ensure focus on doing the work safely, use of pre-task safety checklists and personal protective equipment, application of safety standards, utilization of the IRS system for reporting and resolution of issues, and the evaluation of potential countermeasures, along with quality, cost, design, and operability. Learning Labs were first used at the Portland location, and have since been replicated in Salt Lake City and Auburn, and in the Interiors Responsibility Center and Composite Wings Center in Everett.

Recruitment and Succession Planning. Boeing EHS leadership identifies and prepares individuals for key leadership roles to fuel growth and ensure business continuity. In 2017, EHS leaders participated in an intensive executive presence and presentation skills clinic in order to better prepare them to promote EHS initiatives and establish partnerships both within and beyond Boeing. This was so successful that we are expanding and continuing the program to enroll 20% of the EHS professional workforce by the end of 2018.

Managers and executives throughout Boeing are trained at the Boeing Leadership Center, which accelerates growth through an international center of excellence approach to skill development, best practice sharing, and real-world business challenge resolution. EHS is embedded in the curriculum, which establishes the expectation that all leaders demonstrate a commitment to safety, and includes specific messaging around the Safety Guiding Principles, the IIF practice of checking-in, and the connection between safety as an enduring value and the Boeing Behaviors. Every Boeing leader has a talent profile that includes a safety engagement score. This score is based on the results of safety-related questions on the annual employee engagement survey for their group. In simplest terms, leaders are evaluated by how safe their work groups feel.

Impact Off the Job

Boeing is committed to employee health, safety and wellbeing, and environmental stewardship. The following programs exemplify that commitment.

Industrial Athlete (IA). More than 20 companies have benchmarked Boeing for our world-class job conditioning and symptom intervention program. We are benchmarked for *Industrial Athlete* more than we are for any other program. Boeing employees who do difficult, repetitive work often have to stand up to the same physical challenges as major league athletes. This multi-dimensional program was designed around the sports medicine model: increase physical ability to work, and provide early intervention for musculoskeletal symptoms in order to prevent work-related injuries, and assist in rehabilitation after an injury. Boeing manufacturing sites with 500 or more touch personnel are required to have this capability. From 2013 to 2017, nearly 15,000 participants have received more than 145,000 service engagements.

The program is composed of three elements: Job Conditioning, Symptom Intervention, and Onsite Rehabilitation. Participation is voluntary, services are available at no cost to our employees, onsite locations are convenient, and the benefits can be life changing. In 2016, IA went mobile: using retrofitted vehicles, IA professionals can now deliver symptom intervention services to mechanics at the side of the airplane, for immediate care.

IA Job Conditioning. A seven-week course meets twice a week to train production and maintenance employees in injury resistance, productivity, strength, flexibility, balance, posture, and agility. Effectiveness is assessed by participation or "dose" response. Participants who complete the course have a 30% reduced risk of a recordable injury, 50% reduced risk of a LWD.

IA Symptom Intervention. Boeing's Industrial Athlete program is an innovative workplace program that can help improve physical and mental resilience and eliminate the pain that often results from doing a physically demanding job. To help reduce pain, prevent injury and save time and suffering, the program combines proven therapies with innovative technologies -- many of which are used by trainers who work with Olympic and professional athletes. Results show that when a body part is treated, there is more than a 97% probability that that body part will not be injured again.

Onsite Rehabilitation. In Washington State, employees who have an open claim for a work-related injury and a recommendation from a physician are eligible to participate in rehabilitation services offered onsite, including physical therapy, work conditioning or work hardening during work hours. Physical therapy is aimed at restoring musculoskeletal function and eliminating pain. Work conditioning goes beyond Physical Therapy, and is aimed at restoring musculoskeletal strength, flexibility, and endurance. Work hardening is typically offered to Boeing employees who have experienced a significant occupational injury, causing a decrease in their ability to work and/or increased absences. It provides strength/conditioning with an emphasis on work simulation.

To read and download the complete Boeing Technical Journal paper titled "Industrial Athlete: Implementation and Effectiveness of a Multifaceted Program for the Prevention of Occupational Injury," click here.

Boeing Well Being. Research shows that employees with health risks are more likely to be injured or disabled, so we link workplace safety with employee health and well-being. Programs include emotional, physical, and financial health. Offerings are based on industry best practices and innovative program design. Our strategy and partnerships focus on holistic health and are cross-promoted throughout our portfolio and partnerships. We offer different modalities for choice and personalization through onsite, telephonic, online, and social support. Utilization and participation at Boeing consistently exceeds our suppliers' book of business.

Emotional Health. Boeing employs several approaches to improve our employee's emotional health across the continuum of care, from a resilience brain health program to help members reduce their stress levels to a full service offering of family care to a Healthy Minds Campaign, which is designed to help employees make the mind/body connection. Mindfulness meditation training is gaining momentum at Boeing, thanks in part to the partnership between EHS and Well Being.

Boeing on the Move. This is an incentivized step-counting program, in which both employees and their families may participate. More than 88,000 participated in 2017, and 25,000 provided comments through the group chat function. Boeing has a bicycle commuting policy with emergency ride home services, showers, and secure bicycle storage. Boeing's Chairman and CEO Dennis Muilenburg is an avid cyclist, and an advocate of Boeing's well-being programs. He often brings his bicycle on site visits to lead group rides. In 2016, EHS initiated a *Boeing on the Move* Safety Challenge, designed to extend safety culture to health and wellness off the job. Employees were incentivized to post home safety tips to an intranet website. We heard stories about eye protection, hydration, sunscreen, reflective vests, and distracted driving. Of the 90,000 employees eligible to participate, 78,000 did.

Family Health and Safety. In 2017, the first 3,800 employees who submitted a Near Miss Report received a year's subscription to the National Safety Council's *Family Safety & Health* magazine and were encouraged to share it with their families.

Ergonomic Support. Boeing offers sit-to-stand desks, and workstation break reminder software is installed on all office computers. This program increases office safety by identifying risk patterns in computer use, and generates break reminders, periodic stretch-break prompts, and helpful posture instruction. Ergonomic support services are offered regardless of whether the original injury occurred at work or at home.

Boeing Fitness. On-site fitness facilities are at 28 major locations in the U.S. Employees and spouses are eligible for membership at fees that are considerably lower than comparable community-based facilities. Participants who attend the facility 8X a month are reimbursed their monthly dues. We have seen over 10% utilization increase year over year, with more than 1.5 million visits. In 2017, 38% of our on-site fitness center members worked out at least eight times a month, and made 16,624 fitness coaching appointments.

Boeing Medical. Eighty-eight percent of employees completed health and fitness assessments; including employee spouses, a total of 170,453 health assessments were completed in 2017. Boeing Medical administered 328,000 flu shots to Boeing employees and dependents in 2017. Our tobacco cessation program is free and people have unlimited quit attempts. The smoking cessation program is offered free of charge to Boeing employees, spouses, domestic partners, and dependents aged 18 and over.

Holistic Wellness. Boeing's wellness programs have evolved into an integrated suite of holistic programs designed to enhance multiple facets of employee's lives. Our goal is to engage the right employees in the right programs at the right time. Our offerings are broad, including health lifestyle education, support to reduce health risks, support for life stage milestones, and chronic condition management.

Healthy Eating. Boeing Café Services practices a healthy eating initiative in most sites to promote healthy food choices at work and at home. Boeing Well-Being collaborated with Boeing on the Move to create signage in cafeterias that shows the number of steps it would take to burn off certain foods (e.g., One cookie = 250 calories = 5,000 steps).

Environmental Employee Engagement Activities. Since EHS began its focus on environmental activities in 2009, the number of annual events celebrating Earth Day & World Environment Day increased by 477%. In 2017, thousands of Boeing employees participated in more than 300 Earth Day and World Environment events in 20 countries.

EHS Team Building: Sharing Personal Stories to Generate Lift. In 2017, an EHS Development Experience Project team hosted a TEDx-style talk for EHS team members, designed to bolster team unity and connection through story-telling. With the theme, "Generating Lift," five EHS employees spoke about experiences that have shaped their view of life, safety, and community. Katja Jacob spoke about thoughtful preparation in solo adventure back-packing, and how that translates to her approach as a safety engineer. David Stern spoke about building relationships and risk perceptions, through motorcycle-riding. Abigail Sutphen shared a harrowing story of her family's experience during the Houston floods and encouraged the Boeing EHS team to be rescuers. Sherry Dixon shared how her mother's upbringing in Guam has influenced the way she coaches her team in Boeing South Carolina. Amy May's personal story about family loss showed how giving back to others actually improves ones own life and health.

Social Responsibility

Since its founding in 1916, Boeing has made giving back to the communities it calls home a core part of its mission. Our focus areas for charitable giving are our future, our heroes, and our home. In 2016, Boeing contributed $181 million to help build better communities, $8.5 million to support universities around the world, and $18 million to support non-profit organizations.

Boeing Distinguishes Itself with Industry-leading Habitat Protection Initiatives.
In South Carolina, Boeing spearheaded a novel, permitting-and-preservation initiative that conserved 4,000 acres around the Boeing South Carolina factory. This mitigation effort earned the highest level of conservation certification from the Wildlife Habitat Council. To achieve this extraordinary accomplishment, Boeing forged a three-way partnership with conservation organizations and engaged governmental and regulatory agencies to acquire and preserve land to make up for the displaced swamp, and replant and reintroduce native plants displaced by industry. Instead of purchasing mitigation credits as is the industry norm, Boeing devised a way to accelerate preservation of high conservation lands. This model is being used to lead similar efforts in the state. In 2017, Boeing secured a 2,300-acre conservation easement at Santa Susana in Southern California that will permanently protect the site's precious Native American artifacts and 16 plants and animals that are either endangered, rare, or a special species of concern. Each year more than 2,000 people visit this open space habitat to learn about the natural and cultural resources and study the environmental restoration effort. In Kansas, Boeing led the effort to transform the former Chemical Commodities site into the Pollinator Prairie, where native plants provide a habitat for pollinators like bees, birds, and butterflies, especially monarch butterflies. Boeing's restoration efforts have received prestigious awards from the US Environmental Protection Agency (EPA) and the National Oceanic and Atmospheric Administration (NOAA).
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Fire Prevention: Building Inspection, HazMat Training, Community Building
The Boeing Fire Department has a very progressive Fire Prevention program, rated at a Highly Protected Risk (HPR) status by our insurance providers. Only about 5% of all companies achieve this status. We provide Hazardous Materials Technician training classes and Hazardous Materials Incident Command Training to our neighboring Fire Departments.

In June 2017, the Boeing Auburn Fire Department expanded this training to include a broader area of Fire Departments. For a week, they hosted over 60 Hazardous Material Responders from five different fire agencies in the response area. Training included an overview of the Auburn site, a tour of our Chemical Distribution Center, and a class on tank line processes at one of Auburn’s seven tank lines.

Emergency Response Services. Boeing Fire responds to incidents occurring on or near Boeing property, regardless of whether those involved are Boeing employees, contractors, or visitors. Our Fire Department assists the city, county, or airport fire department about six to eight times per year on motor vehicle accidents and aircraft emergencies. Boeing Fire specializes in Aircraft Rescue Firefighting, supporting our aircraft operations across the county, and works with local Fire Departments to create integrated response plans to respond to any aircraft accident occurring near our facilities. Recent examples of mutual responses include: a private small aircraft inflight emergency, a brush fire near a highway, and personal non-Boeing car accident with injuries. Boeing Fire Department provides demonstrations, education, and emergency response during Boeing community day events. At Seattle's annual *Seafair* event, we provide aircraft protection to the U.S. Navy Blue Angels, and ambulance support for event spectators. The Boeing Fire Department participates in Seattle's annual Firefighter Stair climb to benefit Leukemia and Lymphoma Cancer research.

Boeing Steps Up to Combat Opioid Abuse. The Boeing Company has a comprehensive Drug Free Workplace Program to ensure the safety of our employees and our products and services. To combat the nationally recognized opioid crisis, Boeing has partnered with ESI to offer our employees the most advanced opioid management solution available today. ESI's AOM Suite of Services provides a dynamic way to fight opioid abuse, meeting patients at the doctor's office, at the pharmacy, and at home. Boeing implemented this clinically driven solution in January 2018.

Boeing EHS Invests in Clean Water through *Build Something Cleaner*. One of the tenets of Boeing's environment sustainability strategy is global collaboration. We fundamentally understand that to achieve our purpose, we must be a corporate social leader in the communities where are employees live and work, and where we conduct our business. In 2017, a portion of Boeing's overall community investment of $181M included grants for environmental restoration, conservation, stormwater quality improvements, and environmental education and conservation job skills training with a focus on underserved communities. In 2017 alone, these investments helped achieve meaningful outcomes including: treating millions of gallons of stormwater, conserving millions of gallons of potable water, training over 700 businesses on stormwater management, and educating over 81,000 students (including over 18,000 in underserved communities). A primary focus in recent years has been the protection of waterways in Puget Sound and Southern California through a watershed approach that advances green infrastructure solutions and technologies. Through partnerships with organizations like the Washington Stormwater Center, The Nature Conservancy, Stewardship Partners, and Los Angeles Conservation Corps, as well as collaboration with companies like Microsoft and Vulcan, we are helping to advance the science, technology, and community education to scale green infrastructure and improve water quality.

Boeing Charitable Giving. Boeing has invested more than $1 Billion in community investments over the last 10 years. Boeings Employee Community Fund is one of the largest employee-owned funds in the world. More than $35 million was donated by employees through giving programs in 2017. In December 2017, the U.S. Congress approved comprehensive corporate tax-reform legislation, making more of Boeings profits available. Boeing leadership allocated an additional $100 million for corporate giving, to support demand for employee gift-match programs and for investments in Boeing's focus areas for charitable giving: education, our communities, and veterans and military personnel. In 2017, $10 million was invested in grants to strengthen workforce preparation in high-demand sectors and more than $50 million in charitable grants was given to more than 500 nonprofit organizations across 50 countries.

Boeing Invests in a Safer Future through Education. Game-changing innovation has always been at the heart of Boeing culture. More than 40% of our charitable contributions are directed to educational programs, often with a Science Technology Engineering and Math (STEM) focus. But Boeing's investment goes beyond philanthropy and volunteerism. We work to establish lasting institutional resources in our communities. Notable examples include:

Boeing Advanced Research Center at the University of Washington (BARC) is housed in the College of Engineering. This research lab represents a new paradigm in industrial research at UW. Boeing-employed engineers serve as affiliate instructors and work with faculty and undergraduate and graduate students on research projects that directly address workplace safety at Boeing facilities. EHS funds research projects related to ergonomic risk, confined spaces, and manufacturing automation.
BARC research influences our EHS policies and procedures. In 2017 BARC tested commonly used riveting tools and developed recommendations for which tools to eliminate. EHS used that data to implement new guidance about the safest tools to use for specific applications.

The School to Work program in Philadelphia is now in its 22nd year. Students from three local high schools are invited to build and run virtual factories to produce a product of their choosing. To solve for safety, environmental, quality, and efficiency requirements, participants spend time with various functions, including EHS. Safety and environmental criteria are critical components of their factory designs and presentations.

Boeing Safety Promotion Center is a 5,856-square foot interactive installation located in our Everett factory. Opened in August 2017, the Safety Promotion Center features multimedia exhibits about product safety, workplace safety, and aviation system safety. It connects our pioneering legacy in product safety to our current mission in workplace safety, and underscores that each and every Boeing employee has a role in that effort. Over 3,000 Boeing employees and visitors have toured the Boeing Safety Promotion Center to date. A second Safety Promotion Center is planned at Boeing South Carolina.

SECTION IV: PERFORMANCE MEASUREMENTS AND INFORMATION MANAGEMENT

Boeing is deploying an enterprise-wide business performance portal called The Boeing Management System (BMS), through which senior leaders can manage the business. The portal will use comprehensive real-time data including production, performance, inventory, and pipeline. Safety data was the first element to be successfully connected to the portal, which went live in 2017. EHS is now working on incorporating environmental data into the BMS portal.

Leading & Lagging Indicators

Boeing documents and tracks industry-recognized leading and lagging indicators to monitor and assess the health of our EHS Management System.

- While Boeing increased production by 25% from 2013 to 2017, our Recordable Injury Rate (RIR) decreased by 34%, and our Lost Workday Case Rate (LWDCR) decreased by 49%. Serious injuries have been reduced nearly 60%.

- During that same time period, our Greenhouse Gas (GHG) emissions decreased by 17%, Solid Waste to Landfill decreased by 24%, our Diversion rate (Solid waste not sent to landfill) was 78%, Hazardous Waste (normalized to revenue) decreased 26%, and Water Consumption decreased by 21%

- Two years ago, Boeing required employees to include a safety goal in their annual performance management goals. In 2017, Boeing switched to conversation-based performance discussions in lieu of mandated goals, but 74% of employees opted to include a safety goal in their performance management document anyway.

- Near Miss/Hazard Reporting is an indicator of our shifting our safety focus upstream, from incident response to incident prevention to a seamless integration of safety culture in standard work. Since the start of *Go for Zero*, Near Miss/Hazard Reporting has increased 1,763% across the enterprise. In 2017, there were 50,067 Near Misses reported, for a ratio of Near-Miss-to-Injury of 17:1.

As our corporate safety culture matures from compliance-driven model to values-driven model, our safety focus shifts upstream from lagging indicators to leading indicators. Five years after the launch of *Go for Zero*, Boeing EHS is guided less by indicators associated with the path behind us, and increasingly on the indicators associated with the pathfinding before us.

Lagging indicators we track include:

- Recordable Incident Rate
- Lost Work Day Case Rate
- Lost Work Day Rate
- Million Work Hours without Lost Time
- High Severity Injury Rate
- Injuries Related to Safety Standards

Leading indicators we track include:

- Global EHS Risk Assessment (GERA)
- EHS Audit Compliance and Risk Scores
- Hazard ID and Risk Assessment (HIDRA)
- High Hazard Mitigation Tracking
- IRS Quality Review (preventative)
- IRS Mitigation Effectiveness Review (preventative)
- Near Miss Reports
- IA Participation: Job Conditioning (Team)
- IA Participation: Symptom Intervention (Individual)
- Employee-Identified Appreciations
- Employee-Identified Hazards
- Employee Involvement Team Projects

Measurement Quality & Data Evaluation

Boeing EHS uses data analytics to define safety standards and best practices.
We used data analytics to identify three areas of risk that contribute 47% of our incidents: (1) Slips/trips/falls, (2) injuries related to the Boeing safety standards, and (3) ergonomics for final assembly and structures mechanics. This analysis helped to shape our 2018 initiatives. In 2014 EHS used internal data analytics and determined that the use of bump caps in our 737 program in Renton led to a significant decrease in injuries. The pilot sites showed a 47% reduction in head strike and scalp laceration injuries for employees working around aircraft structures. We used the success of the bump cap standard in the 737 program to support the decision to add bumps caps to the 2015 enterprise safety standards. Data analytics led us to our most recent safety standard advancements, the soon to be implemented Forklift Standard and Hearing Protection standard.

Boeing EHS Uses data analytics to assess the safety and efficacy of new technologies.
Governed by Boeing's Human Subject Review Board, Boeing EHS team member Dr. Christopher Reid enlisted the help of Industrial Athlete (IA) and Industrial Engineering (IE) to engage in a six-month, longitudinal trial of exoskeleton use in a live production environment. This study, conducted in 2017, included shop floor observations and data collection, Industrial Athlete data collection, and Industrial Engineering productivity studies. Seven mechanics in three different production facilities were chosen to participate. The study was designed to determine if extended use of exoskeletons could reduce the risk of injury; understand, predict, and mitigate any adverse safety effects; develop usage and maintenance procedures for exoskeleton use; and perform a cost-to-benefit analysis of exoskeleton use in production.

My Safety Dashboard **is Boeing's powerful, dynamic IT portal for safety data, accessible by all.**
It allows any employee to log on and access real time data analytics, including injury and incident data for their work group or site. It also invites employees to ask safety questions, access EHS articles and links, find contact information for local EHS support, input a safety concern, report an incident, and track the status of follow-up activity.

Benchmarking & Transparency

Boeing's extensive industry partnerships provide many opportunities for benchmarking and peer review, both formal and informal. Boeing works extensively with government agencies, industry partners, and research institutions including the Environmental Protection Agency, the Defense Contract Management Agency, IAEG, ASTM, the Federal Aviation Association, and the EHS Officers Council and Operations Research Council (ORC).

Each year, we build a comparative injury rate chart using ORC data to illustrate to Boeing leaders and employees what we need to do to strive for to be a Global Industrial Champion. This is used in many discussions across the company to help create dialogue and envision what is possible.

We also engage voluntary, non-advocate, third-party assessments to drive our continuous improvement efforts. For example, Bureau Veritas conducted a contractor safety review at the end of 2017, and DEKRA is now assessing our Serious Injury and Fatality (SIF) program, with a report due in 2Q. Boeing is an active member of the Campbell Institute, believing in the mission to help organizations achieve EHS excellence. We participate in several Campbell subcommittees, including the Strategy team and leading the Well Being team. These activities provide insight and help us set direction and shape EHS policy.

As a result of input from the Campbell Award application process last year, we recognized an opportunity to better align and integrate our service providers' safety plans with Boeing's safety processes and procedures. After conducting best-in-class benchmarking, we made several improvements including: policy updates, deployment of training for Boeing liaisons with Service Providers; publication of awareness materials for supplier management, requisitioners, procurement agents and other relevant personnel; pilot a pre-qualification software; and an update of the EHS Service Provider Checklist.

In the past year or so, Boeing has benchmarked our safety strategy, reporting, targets, and policies with nearly twenty leading companies in industries including: construction, manufacturing, farm equipment, aviation, automotive, energy, entertainment, and the military. In recent years, many leading companies have turned to us for benchmarking on safety. Boeing's most frequently benchmarked safety program is our Industrial Athlete job conditioning and symptom intervention program. To learn more about it, please see page 19.

A Stop-Work Order Leads to an EHS Teaching Opportunity. In 2017 Boeing Commercial Airplanes contracted with a major supplier to build large-scale automated assembly and composite fabrication systems at the Charleston, South Carolina site. While highly qualified to integrate automation and tooling into production requirements, an EHS and Supplier Management assessment found the supplier's safety plan inadequate. A stop-work order was issued until corrective action could be taken by the supplier. We introduced the supplier to safety mechanisms such as interlocks, positive controls, and redundant systems, showing the supplier not only how to build safer systems, but how to build them more safely. We worked with them on their sites, even sending a Boeing EHS professional to their facility to ensure that their safety systems were in place prior to delivery to Boeing. The supplier made a presentation to Boeing leadership demonstrating true progress on their safety plan and a new safety awareness. The work resumed with an agreement that Boeing EHS would conduct periodic audits to ensure the supplier's safety plan is fully implemented. Not only did our safety leadership protect both Boeing employees and the supplier's employees, but now the supplier will bring this enhanced safety to its other customers too. This is just one example of how Boeing EHS proliferates workplace safety across the supply chain.

SECTION V: LINKAGE BETWEEN EHS AND BUSINESS PERFORMANCE

Integration of EHS & Business

Each year, EHS uses the strategic guidance provided by the ExCo to initiate a dialog with our business unit stakeholders (including operations, engineering, and business leaders). Through this dialog, EHS and business leaders achieve a balance between EHS goals and the specific business area's goals, in order to negotiate an aligned, unified, tactical plan for the next 12 months. This plan is called *The EHS One Plan*. Specifically, in 2018 EHS built plans around mitigating risk in three categories: slips/trips/falls, injuries related to safety standards, and ergonomic risk to final assembly and structures mechanics. EHS worked with business and operations leaders to establish projects to mitigate these risks, and through the year, these projects are tracked to the plan. Our Safety Management System ensures that the dialog happens.

EHS is considered one of the key pillars in running our business, as is evident in the broadest policy decisions to the finest details of our daily operations. For example, (1) ergonomics is a line item in our capital expenditures spreadsheet; (2) facilities requests feature a box to indicate if the request is related to a safety issue and if it is, the request is elevated; and (3) employees increasingly report that they would take action themselves if they saw an unsafe situation or incident.[5] It is impossible to talk about safety as separate from our work, or our work as separate from safety. Following are some examples of the integration of EHS and business, from across the Boeing enterprise.

Portland Fabrication Leads the Enterprise in Safety Excellence. Each year, thousands of landing gear assemblies were sanded and polished by hand by our fabrication team. To eliminate the risk of injury, Boeing employees from engineering, programming, operations, and finance worked together to move the work upstream to automated manufacturing machines. Hand Finish Elimination (HFE) was initially implemented at the Portland site. The automated process reduced hand-finishing time on a main landing gear beam from eight hours to zero hours over five years, and reduced related injuries by 38% between 2010 and 2013. Multiple cross-functional teams worked to develop and implement a standard process to eliminate hand finishing across many Boeing sites.

By integrating safety into the production system, focusing on people, and fostering safety leadership and problem solving, the Boeing Portland site achieved several safety milestones in 2014 — a 40% reduction of recordable injuries, a 30% reduction in first-aid injuries, and an over 100% increase in Near Miss Reporting. These efforts were celebrated with a second Chairman's Safety Award in 2015. The decision was made to standardize the approach so that all 15,000 plus Fabrication employees could benefit. Portland participated in a global Fabrication team that successfully implemented processes, tools, and organizational structures to sustain the safety culture gains of Incident & Injury-Free (IIF) engagements across all Fabrications sites. The Fabrication Production System, infused with safety culture, was launched in 2016. This achievement was celebrated with a third Chairman's Safety Award in 2016.
Among the many examples of success is the Fabrication-wide *Find It Fix It* program, which tracks near miss (hazard) reports from discovery through mitigation to closure. From January through October 2017, this program recorded 20,685 found, and 19,382 fixed.

These efforts produced positive results not just in safety performance, but in cost, delivery, and quality. The site has reduced quality defects 60% since 2012, while at the same time achieving an average annual 3% increase in productivity. Value added cost reduction and delivery performance at the site have been very significant each year. These improvements have made the site more competitive and provided opportunities for growth in work statement. These efforts produced positive results not just in safety performance, but in cost, delivery, and quality. In one case, a focus on root causes of hand injuries replaced manual sanding and polishing of main landing gears with automation. This reduced hand finishing time from eight hours to zero hours and is being adopted as a standard process at many other locations.

Boeing's ecoDemonstrator Drives New Technology and Industry Partnership. Boeing's ecoDemonstrator program is a collaborative flight test research program with customers, other OEMs and suppliers, including American Airlines, Rolls Royce, NASA, Honeywell, to develop and test aviation technologies designed to reduce the ecological footprint of commercial aircraft. The ecoDemonstrator enables research that accelerates the development of new technologies, methods and materials to improve the aviation industry's environmental performance and sustainability. This program has successfully introduced a wide variety of new technologies to save fuel and reduce community noise. Examples include parts made from sustainable recycled carbon fiber and an air traffic management system that shows pilots the most fuel-efficient route. In 2014, the ecoDemonstrator completed the world's first flight using biofuel. In 2018 Boeing partnered with FedEx to flight test the 777 ecoDemonstrator using 100% biofuel.

EHS Launches a *One Boeing* EHS IT Platform by 2020. In keeping with the centralization of EHS functions that began with *Go for Zero*, EHS is consolidating the 300+ systems that EHS employees and stakeholders use to track, complete and report their work, in a commercial off the shelf (COTS) EHS software suite, Enablon . All Boeing sites will adopt this universal EHS IT platform by 2020. EHS is working with a consulting agency to assist us in transitioning to the universal IT platform. The implementation of the first module, appreciations and hazards (both leading indicators), is in process at four pathfinder sites. This is an example of how EHS is shifting our safety focus earlier and earlier in the incident and injury cycle: from a recordable injury (lagging/post-injury or incident), to a near miss (leading/predictive hazard avoidance), to an appreciation (pre-leading/pro-active prevention). This consolidated systems approach allows for greater integration and greater data analytic insight with other Boeing business systems in business management, production, scheduling, medical, and other functions.

[5] EHS engages an external agency to conduct a bi-annual survey to measure employee attitudes about safety. Survey respondents represent a mix of employees across business units, job levels, and regions. Key results from the 2016 survey show increasingly positive attitudes toward safety.

Operational Performance through EHS

In 2012, Boeing leadership looked at the historical correlation of production and injuries and took a stand on safety. EHS set out to transform safety culture across the global Boeing enterprise. We benchmarked safety culture excellence with industry leaders, and invested $40 million in safety culture training. We centralized our EHS reporting structure.

One example of how EHS performance has contributed to operational improvement and financial returns is our rigorous approach to remediation liability reduction. Since 2011, we have reduced our financial remediation liability reserve by 31% and our risk by 28%. This results in improved financial earnings performance and reduced annual expenditures, which fuels growth and productivity investments in the business.

OpEx Our Operational Excellence organization is also driving the implementation of a single EHS IT platform by 2020. This IT platform will be implemented in domestic and global operations simultaneously. Oversight from the Operational Excellence group helps make sure that our technology investments and replication efforts are strategically sound, and that we derive the most benefit from our EHS innovations.

Five years after the launch of our world-class, comprehensive, paradigm-shifting safety initiative *Go for Zero*, our data show that the correlation between production rates and injury profile is no longer a reality. In fact, the data suggest that our safety excellence *enabled* our production and quality advances.

Ergo Challenge. This annual, enterprise-wide recognition program is designed to encourage team-generated solutions. In 2017, 350 employees across 22 locations submitted 68 entries, which collectively reduced ergonomics risk by 93%. Furthermore, quality improved in 37% of the project, total[6] cost savings was $2.6M, flow time decreased by 53%, and labor costs decreased by 62%.

Employee Development and Growth Enhancement (EDGE). This program at Boeing South Carolina purposefully embeds personnel from across many disciplines to work alongside Manufacturing Technicians in targeted factory areas for periods of four to six months with the intention of identifying and resolving factory safety and procedural obstacles. By performing the same manufacturing work instructions and operations as the MTs, the EDGE participants come to understand, appreciate and identify with the safety, ergonomic and productivity issues MTs experience on the production floor. Since the inception of EDGE, more than 1,238 productivity improvements valued at an annual savings/avoidance of $5.5M have been identified and implemented, of which 341 have been innovative safety solutions (people, tools, process, and product). These results have been achieved through the efforts of 24 EDGE factory rotation project teams, consisting of 206 participants from across 24 different organizations.

Boeing South Carolina Interiors Responsibility Center Closet Moving Line. Closets weigh between 40 and 250 pounds and are lifted and flipped about twelve times per day during installation, subjecting employees to the risk of ergonomic injury. This team leveraged a moving line concept to design a tool that significantly reduced the risk of ergonomic injury associated with closet installation. This safety innovation not only keeps employees safe, it reduces the installation flow time by six-and-a-half days.

BDS Satellite "Reframes" a Safety Issue. Work on a Boeing Defense, Space & Security global satellite program involved a process to test the satellite that was not ergonomically sound. It required employees to work at heights, and in awkward positions. A cross-functional team researched solutions to replicate, and constructed a large frame that can turn the satellite in any direction, thereby allowing the test to continue within ergonomic zones. The improvement removed all ergonomic risks, and cut build time by 3,300 hours.

[6] From injury cost avoidance, and process cost savings.

Boeing gives back to the communities it calls home in both formal and informal ways. Our investments—financial, time, and expertise—are evident in museums, schools, restored habitats, and community engagement activities. Beyond these formal means, many Boeing employees take their EHS culture and skills with them wherever they go.

IAM/Boeing Joint Programs Texting Maze. Representatives from the IAM/Boeing Joint Programs brought a texting maze to a worker and family safety expo hosted by U.S. Department of Energy at Hanford in the metropolitan area of Tri-Cities, Washington in April 2018. The Expo drew 30,000 people, including workers, families, and high school students. 3,000 attendees participated in the texting maze, trying to navigate a maze of obstacles while texting, and learned how distractions can cause injury.

Organizational Effectiveness

The centralization of the EHS organization helps codify the EHS function and manage it as a profession within Boeing. The EHS Executive Skill Team, comprised of eight EHS Directors and chaired by the Director of Operational Excellence, meets weekly to discuss strategic resourcing. They identify talent and opportunities to develop it, as well as areas where talent is needed. The Executive Skill Team charters a non-management Skill Team, where a group of senior managers consider the same strategic resourcing questions for the non-management population.

As Boeing moves into its second century of business, EHS plays a critical role in driving business success. Further, Boeing's EHS focus aligns our strategies, stimulates innovation, and invites collaboration to advance EHS excellence through our supply chain and into the aerospace supply base throughout the world. In recent years Boeing has partnered with companies and research institutes on six continents to drive EHS technology innovation forward. Advances in materials science include development of non-chromated primers, substitutes for ozone depleting substances and fire retardants.

As our safety culture matures, the focus of our EHS efforts move earlier in the injury cycle, from lagging, to leading, to prevention. Examples of this pro-active focus include our Industrial Athlete job conditioning and symptom intervention program and Boeing's world-class *Well Being* program. These initiatives provide Boeing employees with tools and resources that protect their safety and well-being both on and off the job. In 2015 we expanded our well-being programs to include financial health and emotional well-being, and have recently introduced modules on brain health, resilience, and mindfulness.

In 2017, 54 sites sustained zero injuries, representing 6,700 employees. Thirty-two sites, representing 65,000 employees, achieved a 25% or better reduction in injuries. So, nearly half of our employees are realizing safety performance excellence.

While Boeing increased production by 25% from 2013 to 2017, our Recordable Injury Rate (RIR) decreased by 34%, and our Lost Workday Case Rate (LWDCR) decreased by 49%. During that same time period, we exceeded our environmental targets for GHG, Solid Waste to landfill, Water Consumption, and Hazardous Waste.

Battle of the Buildings. In 2016 a Boeing office building in Renton beat out 800 competitors to win the EPA's nationwide *Battle of the Buildings* competition to reduce energy use, water consumption, and waste. The Boeing team recorded energy savings of 26%, or $200,000. For 2018, Boeing has internalized the competition, launching its own *Battle of the Buildings* competition across all Boeing sites nationwide.

Boeing Tianjin Composite Center. Located in Tianjin, China, this facility achieved the LEED Gold standard certification in 2013, following a 2012 site expansion, for which a number of environmentally progressive designs resulted in greater energy efficiency and lower operating costs. Those designs included a gray-water treatment facility, rain water collection, zero-energy gravity ventilation; extensive use of skylights and low-power LED lighting.

Continuous Performance Improvement & Sustainability

The **EHS One Plan** focuses on three pillars of EHS success: **Zero Injuries, Environmental Leadership** and **Operational Excellence**. Each pillar includes enterprise-wide objectives that map to the strategy established by the Executive Council. Progress toward the three objectives is tracked and reported to the ExCo. Key Performance Indicators (KPI), which include both leading and lagging indicators, are established and used to indicate progress and performance across improvement objectives. Our robust audit cycle ensures continuous improvement in these areas.

Zero Injuries
Near-term goals for safety culture, conditions, and performance include: (1) advancing our safety culture program to be fully deployable by Boeing teammates, and no longer by consultants, (2) achieving a ratio of near-miss/hazard-to-recordable of 8-to-1. Our current ratio of 17-to-1 already exceeds that goal, and (3) using our technology roadmaps to accelerate innovation (e.g., exoskeleton, automation) that benefits our most-at-risk teammates.

Pathfinder, Best Practices, and Standards: EHS uses an architecture that matures ideas to standard solutions, through a focus on continuous improvement. Site teams conduct "Pathfinder" solution development activities, which once proven at a local level, are formally introduced Boeing-wide for consideration as a "Best Practice." If multiple sites validate successful results from the implementation of the "Best Practice," the solution is refined, as necessary, and then adopted as an enterprise-wide "Standard." An example of this is the Bump Cap standard.

EHS conducts workshops for continuous improvement, using the same Lean Manufacturing processes and tools as our Operations partners. Accelerated Improvement Workshops (AIW), Value Stream Mapping (VSM), Kaizen events, and structured problem solving have all been applied to EHS processes. Examples include an Injury Management VSM held in 2017 that brought together EHS, Medical, and Operations partners to identify ways to improve employee access to care following an incident, and structured problem solving applied to top injury areas, such as slips, trips, and falls and ergonomics risks, in Boeing Fabrication. In many cases, EHS teammates are able to facilitate these continuous improvement efforts themselves, by having completed Lean training and certification, making them eligible to teach and lead others. EHS teammates' interest in expanding their skills to teach and coach others helps to ensure excellence in EHS service delivery, and has served as a pathfinder business case as we work to deploy our own culture training without the use of consultants.

Environmental Leadership
Boeing's environmental strategy is focused on innovating for product performance, achieving excellence in sustainability, and inspiring global collaboration.

We are realizing product-over-product fuel efficiency in our aircraft. And we continue to work with industry partners on sustainable technologies such as biofuels. The industry reached major milestones for biofuel availability in 2016. The 787, 747-8, 737 MAX, and 777X all are 15 to 20% more fuel efficient than the aircraft they replaced, making Boeing the lowest emission fleet offering on the market. Since first introduced, the 787 has saved 17 billion gallons of jet fuel while connecting 160 new city pairs across the globe. Certified sustainable aviation biofuels for military and commercial operations which reduce emissions by 50 to 80% and flew the first demonstration flight on 100% biofuel on the 2018 ecoDemonstrator.

Our first set of company-wide environmental targets was established in 2007 and achieved at the end of 2012. This performance demonstrated the ability to uncouple business growth from environmental footprint growth in several key areas.

Our second set of enterprise-level targets, established for 2013 to 2017, committed to zero absolute growth from our 2012 baseline in (1) Greenhouse Gas (GHG) emissions, (2) Solid Waste to landfill, and (3) Water Consumption, and (4) zero growth (normalized to revenue) in hazardous waste generation. We exceeded these goals with GHG emissions reduced by 17%, Solid Waste to landfill reduced by 24%, Water Consumption decreased by 21%, and Hazardous Waste (normalized to revenue) decreased 26%.

Our next generation environment targets for 2018 to 2025 (to be announced externally in June 2018) are our most aggressive targets yet, committing to absolute reduction targets of (1) 25% in GHG emissions (2) 20% in solid waste to landfill, (3) 20% in water consumption, (4) 5% in hazardous waste generation, and (5) 10% in energy consumption.

One of the tenets of Boeing's environment sustainability strategy is global collaboration. We fundamentally understand that to achieve our purpose, we must be a corporate social leader in the communities where our employees live and work, and where we conduct our business. Boeing performs EHS due diligence to identify and mitigate risks with property transactions, corporate development, and company-wide use of hazard waste facilities. Key risk areas include sub-surface environmental liabilities in the context of property transactions, employee health, and safety concerns.

EHS provides value in every aspect the product lifecycle, from product design to operating footprint to recycling of manufacturing scrap and retired aircraft to site remediation. EHS risk assessment is a standard component of decisions in manufacturing, operations, IP, property transactions, and supplier partnerships. For example, in 2017 EHS completed 293 due diligence assessments; 181 of those assessments identified and mitigated EHS risks, with no risks materializing from mitigation plan failure. Our industry-leading conservation strategies aim to reduce our operating footprint and prevent the need for remediation. Boeing has successfully reduced its active remediation sites to 68 from a peak of 95 in 2008. All of these activities require engagement and partnership with agencies, communities, and industry partners.

Operational Excellence
When the EHS organization centralized, the Operational Excellence (OpEx) organization was created to help the newly unified EHS team work together to fulfill its mission to transform Boeing's EHS culture. OpEx's strategy is to (1) engage, align, and empower the team, (2) capture opportunities and mitigate risks and (3) embed EHS into standard processes.

In order to operate excellently, it's paramount that the entire Boeing Company is engaged on our EHS journey. To continually improve EHS performance across the enterprise, OpEx drives continued involvement of employee engagement teams for both safety and the environment, enterprise-wide engagement events such as Boeing Safety Day and Earth Day activities, and EHS skill development activities for both EHS and non-EHS employees.

In addition to having a robust Risk, Issue and Opportunity management system, sound Financial management, and active Audit and Assessment program; we apply program management discipline to ensure that we are investing in the right technologies. This discipline ensures that we are achieving process excellence through standard work and early engagement. Through this rigor, the EHS team streamlined over a 1,000 EHS process document writings down to 41 key documents, *so far*.

As we work to embed EHS into standard processes, OpEx is the opportunity engine. For example, as Boeing uses more carbon fiber to develop lighter aircraft and reduce product emissions, an OpEx discipline pro-actively identifies opportunities to calibrate production processes to minimize buying excess material and reuse or recycle scrap. Our comprehensive EHS audit cycles reinforce continuous improvement in both operational gains and EHS excellence.

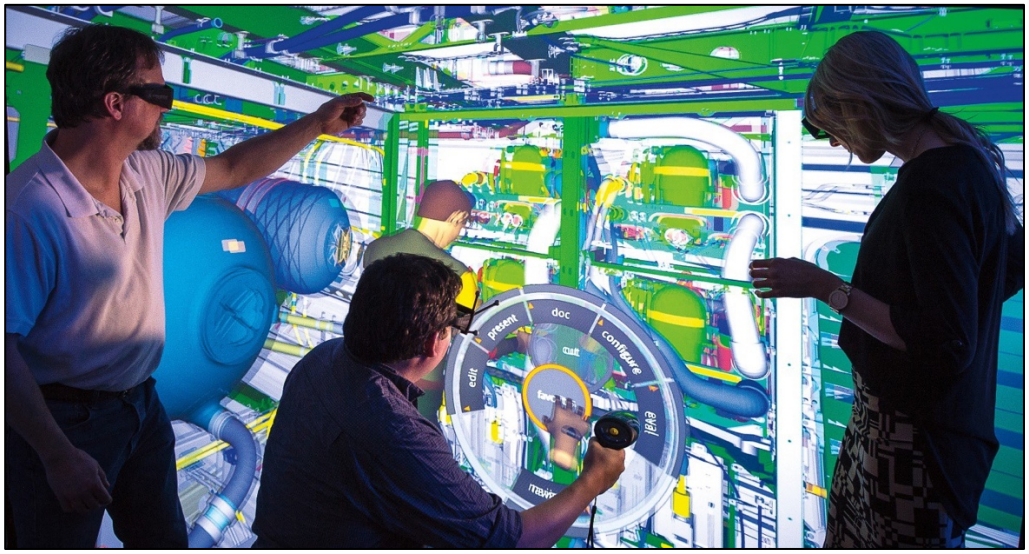
SECTION VI: LESSONS LEARNED: Redesigning the Design Process

Lessons Learned

When engineers design aircraft, they inherently help define the processes required to build and service them. Historically, design teams used physical mock-ups to envision these processes. The 777, launched in 1990, was the first jetliner to be 100% digitally designed using three-dimensional computer graphics. Throughout the design process, the airplane was “preassembled” on the computer, eliminating the need for a costly, full-scale mock-up. This virtual preassembly was a forerunner to the cooperative, immersive, virtual reality (VR) tools used to design the 777X. Aided by these VR technology tools and experiences, engineering teams are designing-in EHS considerations to the product, to the production, and to the maintenance of the aircraft.

While the computer-aided pre-assembly was a step forward from costly mock-ups, it could not produce the *experience* of downstream build and maintenance processes, and without this, engineers had a limited ability to grasp the safety ramifications of their decisions. The use of VR technology in product design began with the development of the 787 Dreamliner. Boeing Research and Technology (BR&T) partnered with EHS to develop VR tools and processes allowing engineers, operations teams and other stakeholders to participate in real-time interactive simulations of build processes and service tasks. These immersive design reviews allow our teams to experience those tasks from the perspective of a production mechanic or airline maintenance mechanic. Through such experiences design engineers can identify and mitigate risks inherent in their designs prior to the completion of the design phase. VR technology can help design teams see the big picture of our complex interdependent systems, without compromising the specialized technological focus required in today’s workplace.

Boeing has deployed 11 VR systems across the enterprise and have plans to install three additional systems this year. These systems have been utilized in hundreds of design reviews that have shaped the baseline configuration of multiple aircraft, the requirements of our supplied components and our production environment. The use of VR simulation during design reviews has led to the development of a range of tooling and equipment solutions that directly improve safety and mitigate ergonomic risks. Once identified, EHS risks are systematically managed within the engineering function. Engineering owns the EHS risk identification and tracks the risk mitigation to closure. Our safety culture transformation is so successful that EHS's work is to document these efforts, not to drive them. For this immersive collaboration to design-in safety and environment, we are now a finalist for the 2018 National Safety Council's Green Cross Award for Safety Innovation.



The development of the new Boeing Commercial 777X, scheduled for flight testing and certification in 2019, and delivery in 2020, launched the redesign of our design process, and signaled a sea change in aircraft manufacturing. Aided by immersive, VR technology reviews, this evolutionary step forward will migrate the 777X design-in approach even further upstream. In future development cycles, Boeing product design engineers and Boeing production design engineers will work together to design the product and production process at the same time, making real risk reduction mitigations in virtual factory processes. Vice President Mark Jenks, who led the development of the 787 Dreamliner explains that such an approach would "turn the tables" on the way airplanes have historically been developed. "How can we possibly, in this day and time, put mechanics at risk of injury by asking them to perform their jobs as instructed?" Jenks asks. "If we can't build and maintain an airplane safely, then we have to build a different airplane."

Forward Planning

About *three million parts* must come together to build a single commercial airplane. The complexity of the effort, the materials used, the manufacturing disciplines involved, the coordination of work teams around the world—each aspect introduces challenges. Now consider that we also build helicopters, warbirds and missiles, satellites and spacecraft: huge, high-tech, complex machines that do amazing things.

Building the company that builds those machines is a whole new order of amazing. The enterprise we know as The Boeing Company, is actually the amalgamation of several trail-blazing companies, each with its own distinct culture, products, history, policies, and production processes. To become Boeing, we enrolled disparate parties in a single mission, with a single set of enduring values, and a unifying code of conduct. *Go for Zero* reached across this vast and varied Boeing enterprise with a unifying EHS message: *All injuries are preventable*. Our safety protocols are translated into a dozen languages, but we all speak safety. From the Azerbaijan to Australia, from Tacoma to Tianjin, *Go for Zero* is the second most internally recognized Boeing symbol, after the company logo.

Boeing's strategies for workplace safety and environmental performance set the course to address future business challenges. Across our global operations we engage in nearly every manufacturing process there is, from welding to chemical processing, from composites fabrication (by hand and by fiber placement machines) to various methods of forming parts (super-plastic forming using high heat, rotomolding nylon, even underwater aluminum blast forming), and of course, drilling, riveting, and bucking. There is hardly an occupational situation for which we don't have applied EHS controls, and our own rigorous EHS disciplines lead to increased safety awareness and behavior in our suppliers and service providers. *(Please see example in Section IV: Benchmarking & Transparency).* In addition to striving for zero injuries, we are striving to lead the industry in product stewardship and the development of alternatives to hazardous materials (e.g., trichloroethylene, hexavalent chromium).

We are ready to rise to the role of EHS Excellence ambassador as the 2018 Campbell Award winner. As a leader in an industry that has had such a profound influence on shaping the last century, Boeing recognizes its role and responsibility as a global industrial champion in its second century. Having benefited from our experience as a finalist for the Campbell Award last year, and having addressed the recommendations generated from that review, we are well-suited to partner with the National Safety Council to advocate for EHS excellence. Our industrial partnerships and research collaborations demonstrate a record of EHS leadership, expertise, innovation, and advocacy. Our hundred-year history of manufacturing through boom and bust, war and peace, and galloping technology has schooled us in perseverance. And the time is right: both aviation safety and Boeing's workplace safety celebrated record- breaking years in 2017. With this application, we articulate our journey to EHS excellence, and assert our readiness to commit our vision, reach, and resources to a safer and more sustainable future, around the clock and around the world, on land, at sea, and in space.