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APRIL/MAY 2018

AMT AIRCRAFT MAINTENANCE TECHNOLOGY

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LEADERSHIP

The act of leading a group of people or an organization can be fun, rewarding, and at times very difficult

STRIKE UP A DISCUSSION SOMETIME WITH A GROUP OF CO-WORKERS about the characteristics that make a great leader. Or, discuss the leadership style and those at the top of your organization and I'm sure you will be met with a whole lot of differing opinions on the subject.

I went to the worldwide web and did a search for leadership and received the expected results; characteristics of a great leader such as honesty and integrity, ability to inspire others, commitment, accountability, and the list goes on. I did find this description which I liked (sorry I can't recall where it came from): *Great leaders find the balance between business foresight, performance, and character. They have vision, courage, integrity, humility, and focus along with the ability to plan strategically and catalyze cooperation among their team.*

I then searched specifically for aviation, airline, or aerospace leaders and leadership. The majority of the names that appeared were in the category of aviation heroes and famous pilots, most dating back decades and nothing really that I was looking for like names of aviation or aerospace businesses and individual names. Although a few airline names like Pan Am's Juan Trippe and Southwest Airlines' Herb Kelleher did surface and I'd agree with these. Then there were companies that are considered leaders in the aviation industry, not just a person, but a leading organization.

Over the years I've met many executives from a variety of organizations, government, MROs, and aircraft maintenance businesses, and I've gotten to know a few. Some I've watched as the organizations they have led maneuvered through the ups and downs of our cyclic industry. Some of the individuals I've met (and have worked for) I do consider industry leaders, and there are other individuals, organizations, and businesses that all could be considered a leader or providing great leadership in our industry.

I consider David Storch to be one of them. I've meet David a few times over the years and gained a respect for his leadership of one of the largest independant aerospace firms in the industry, AAR Corp. David recently announced his retirement as the second only CEO at AAR Corp. I had the pleasure of sitting down and speaking with David for this issue of *Aircraft Maintenance Technology*. Be sure and read the interview beginning on Page 14 about David's views on the MRO industry, his 39-year AAR career, and a bit about leadership.

Ron

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Lester Craft, *Publisher*
lester@AviationPros.com, (262) 473-9236
Ronald Donner, *Editor*
ron@AviationPros.com, (612) 670-6048
Barb Zuehlke, *Senior Editor*
barb@AviationPros.com, (920) 563-1641
Marino Boric, International Correspondent, mboric@aviationpros.com
Contributors: Jerome Greer Chandler, Tahlia Fisher, Bob Hobbi, Dr. Bill Johnson, Anja Koschinski, Brett Levanto, Maggie J. Ma, Christopher Whiteside

Julie Whitty, *Art Director*
Carmen Seeber, *Media Production Representative*
cseeber@southcomm.com
Debbie Dumke, *Audience Development Manager*

SALES
Michelle Kohn, *National Accounts Manager*
michelle@AviationPros.com, (224) 324-8529
Greg Szatko, *National Accounts Manager*
Greg@AviationPros.com, (920) 568-8314

SOUTHCOMM, INC.
Bob Mahoney, *CFO*
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Lester Craft, *Director of Digital Business Development*

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circ.amt@omeda.com
PO Box 3257, Northbrook, IL 60065-3257

ARTICLE REPRINTS
Brett Petillo
Wright's Media
877-652-5295, Ext. 118
bpetillo@wrightsmedia.com

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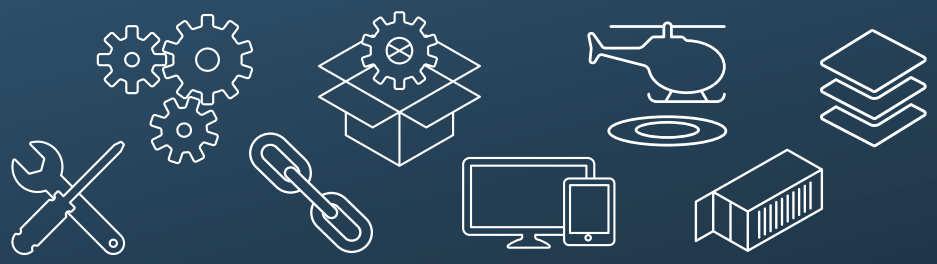

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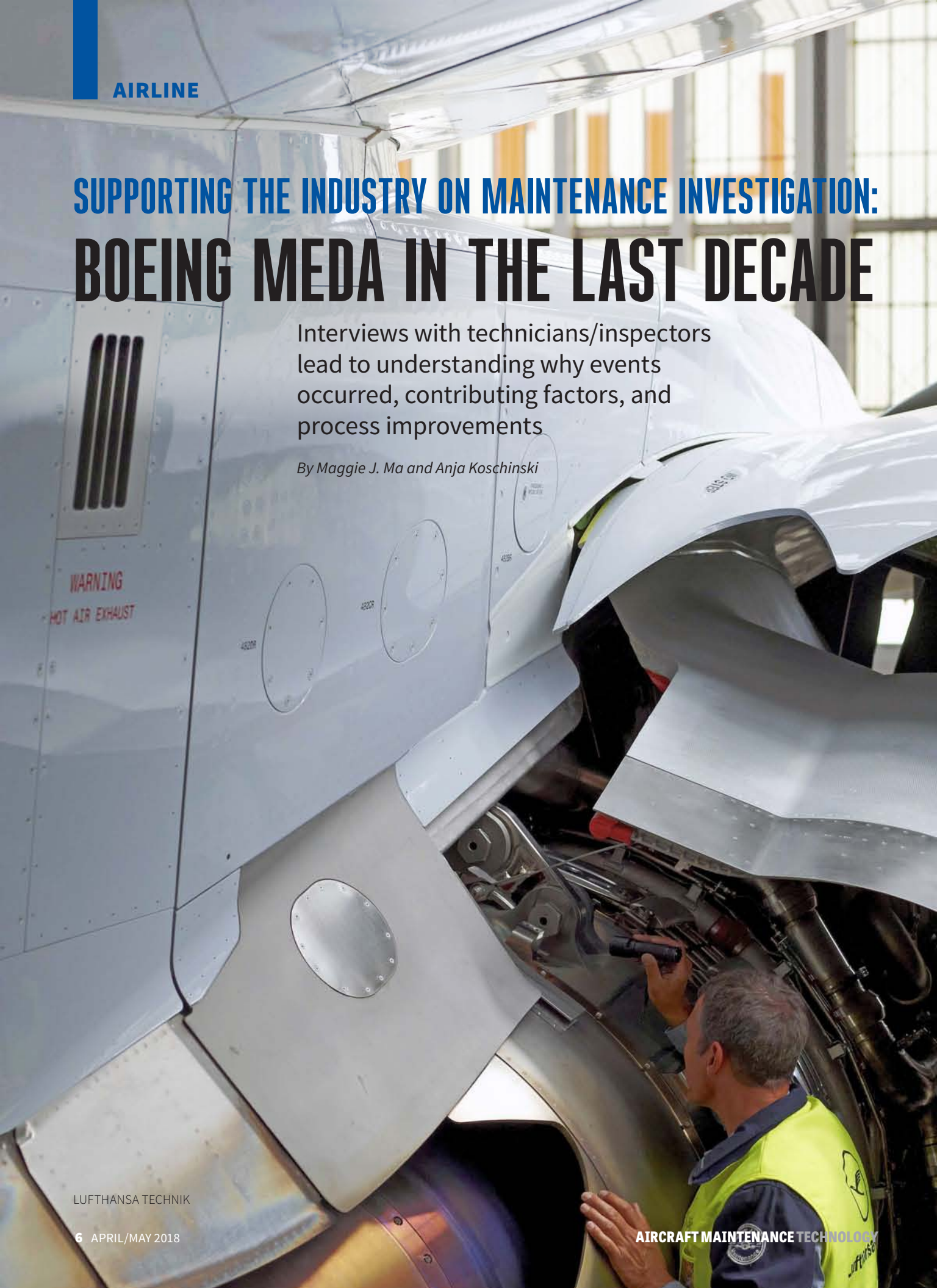
SUPPORTING THE INDUSTRY ON MAINTENANCE INVESTIGATION: BOEING MEDA IN THE LAST DECADE

Interviews with technicians/inspectors lead to understanding why events occurred, contributing factors, and process improvements

By Maggie J. Ma and Anja Koschinski



LUFTHANSA TECHNIK

MAINTENANCE ERROR DECISION AID (MEDA) is a structured process for investigating events caused by maintenance technicians and inspectors. As a jointed effort by Boeing maintenance human factors experts and industry in the early 1990s, MEDA was intended to help airlines shift from blaming maintenance personnel for making errors to systematically investigating and understanding why the errors had occurred. MEDA offers an organization means to learn from its mistakes. Since its inception in 1995, MEDA has been adopted by more than 800 organizations around the world. The MEDA process has set the standard worldwide for maintenance event investigation and has been recognized for its significant contribution to aviation safety (e.g., The Sir Frank Whittle Safety Award by the International Federation of Airworthiness).

HOW DOES MEDA WORK?

MEDA is based on the philosophy that errors and violations result from a series of contributing factors (anything that can affect how the mechanic does his/her job) in maintenance operations, such as misleading or incorrect information, design issues, inadequate communication, time pressure, and so on. Most of them (as high as 90 percent) are under management's direct control. Once they are identified, the organization can take actions to eliminate those contributing factors to prevent similar events from happening again.

Visually, this is how the MEDA process works. It's a reactive process. The event occurred, a maintenance organization has to decide the event was caused by mechanic/inspector performance, and then find the mechanic/inspector who did the work or who observed the work being done to interview them. The investigator typically knows what the system failures are before he/she conducts the interview. For example, mechanic did not connect the hose correctly and the system started leaking. There was a bolt missing on the side of the pump. Through the interview, the investigator talks to technicians to get the contributing factors and their ideas for process improvement. Some follow-up interviews may be needed. For example, mechanic said "I went to the store but a part was not available. There is another part that was compatible, so I used it. Later on I found that the part was not compatible." So in this situation, the investigator may want to go to the store to find out how they determine the part compatibility.

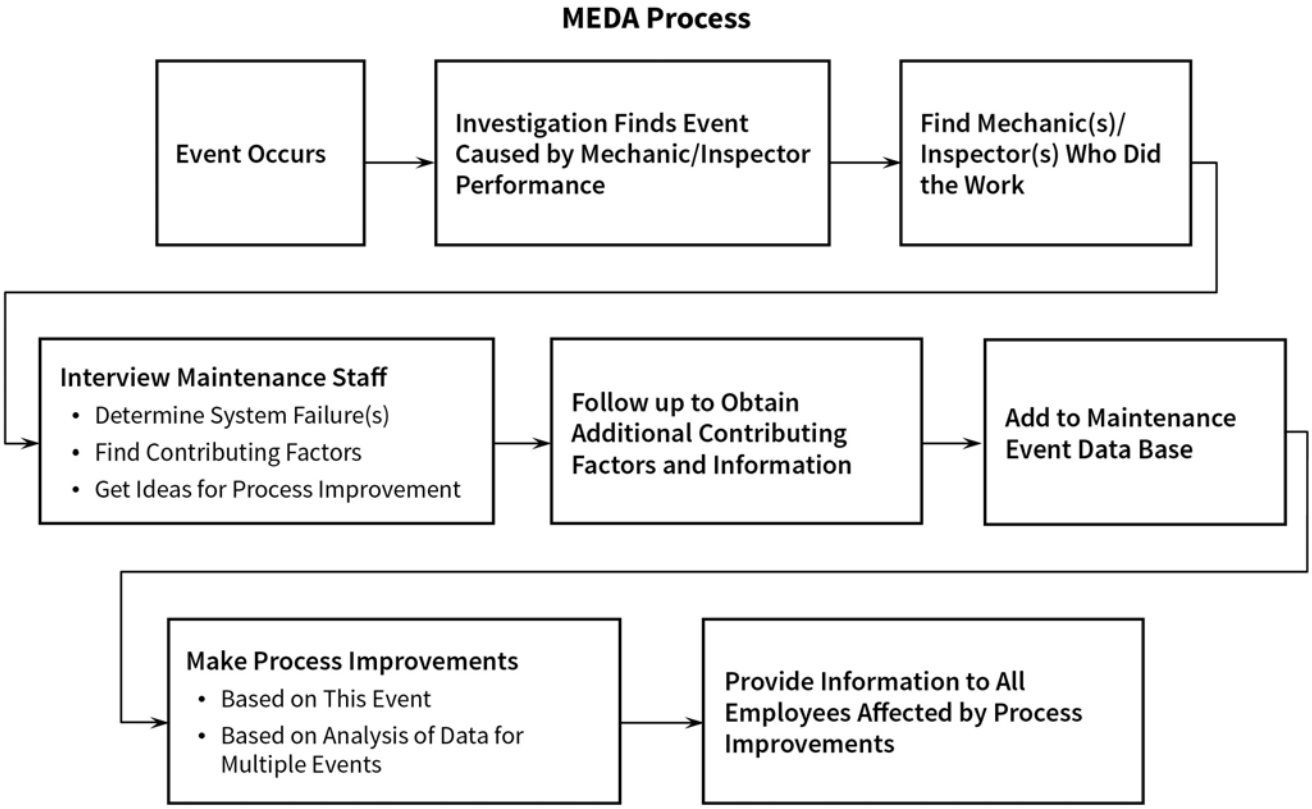


FIGURE 1. Process flow of MEDA investigations.

Maintenance event database is helpful for identifying and tracking patterns. Sometimes MEDA investigations reveal problems that need to be fixed right away. Sometimes it is reasonable to wait and see if a common theme will emerge out of multiple MEDA investigations, especially if the corrective action is a costly investment. It is also important to let the employees know what the company is doing with MEDA investigation findings. System improvements through MEDA will be the best promotion to foster trust and willingness to participate in any future MEDA investigations.

KEY MEDA REFERENCES

There are two main MEDA references:

(1) MEDA Results Form — used during the investigation, and also a template for writing an investigation report

(2) 70-page-long MEDA User's Guide — a "how-to" manual on carrying out a MEDA investigation.

The main references, complemented by practice scenarios and training, are updated on a regular basis.

The most important section in the MEDA Results Form is a checklist of 10 categories of contribution factors, which explain why errors and violations occur and result in system failures, which eventually resulted in an event.

Most of the causal relationships discovered in event investigations are probabilistic in nature (e.g., existence of contributing factors increases the likelihood of an error). Six rules of causation help to guide MEDA investigators to collect more, better data and be more effective in authoring investigator reports:

1. Each human error must have a preceding cause.
2. Each procedural deviation (violation) must have a preceding cause.
3. Causal statements must clearly show the "cause and effect" relationship.
4. Negative descriptors (such as poorly or inadequate) may not be used in causal statements.
5. Failure to act is only causal when there is a pre-existing duty to act.
6. Causal searches must look beyond that which is within the control of the investigator.

MEDA INVESTIGATORS APPLY COGNITIVE INTERVIEWING TECHNIQUES

The primary method to gather data in MEDA investigation is through conducting interviews with technicians or inspectors who were involved in the event.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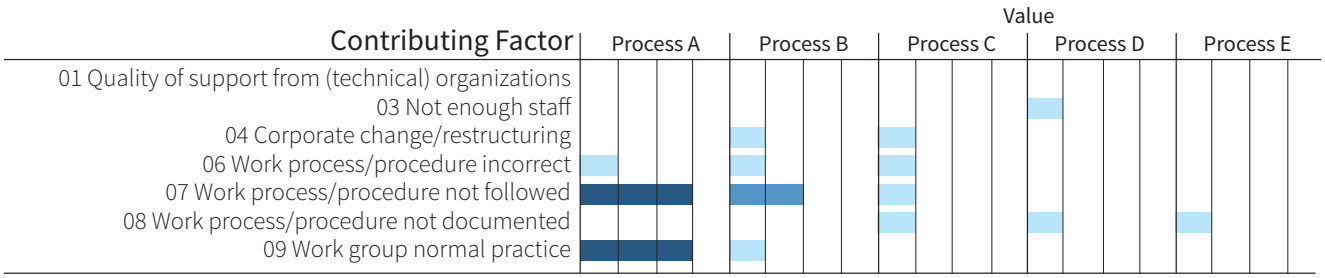

FIGURE 2. An example of data evaluation based on MEDA at LHT.

MEDA investigators are trained to apply some specific techniques to help the person being interviewed to remember and communicate while following a structured process during the interview.

AN IMPORTANT TOOL IN A SAFETY MANAGEMENT SYSTEM

Safety management systems (SMS) at airlines and maintenance organizations around the world have advanced rapidly in the past decade. Risk management, one major component of an SMS, requires that safety of flight hazards be identified, that the hazards be assessed for risk, and that unacceptable risk be mitigated to acceptable levels. Among the three approaches for identifying hazards (reactive, proactive, and predictive), event investigation is mainly responsible for identifying and communicating human performance issues within an organization. Boeing MEDA has been an important tool in the SMS reactive hazard identification process. It helps an organization systematically determine the hazards or contributing factors to events, and, based on these findings, allows the organization to develop and monitor a comprehensive fix.

A CONNECTION TO MANAGING HUMAN BEHAVIORS IN A JUST CULTURE

Both errors and violations can contribute to maintenance events. They often occur together to produce an unwanted outcome. MEDA investigators are trained to recognize errors, violations, and different types of violations (routine, situational, or exceptional), and investigate the preceding cause(s) to the errors and violations. In the next revision of MEDA Results Form, a new section will be added to help to document errors and different types of violations, which require different mitigation strategies. This new addition will offer a connection to how different human behaviors should be managed within a Just Culture:

1. Human errors — "To err is human …"

Human errors should be managed through consoling and other actions such as changes in processes, procedures, training, design, and environment. Upon close examination, repetitive human errors may warrant punitive actions.

2. At-risk behaviors (routine and situational violations) — "To drift is human …"

At-risk behaviors should be managed through coaching and the following:

- Removing incentives for at-risk behaviors
- Creating incentives for healthy behaviors
- Increasing situation awareness

Upon close examination, repetitive situational violations may warrant punitive actions.

3. (Occasional) Reckless behavior

Accountability rests wholly with the individual who chooses the reckless act.

HARNESS THE POWER OF VISUAL COMMUNICATION

A map or a diagram offers a level of information density that words and sentences alone cannot offer. For example, the amount of information that is captured and easily communicated on a single street map. Traditional written investigation reports do not illustrate causal relationships well. In the past few years, Boeing has been recommending a MEDA best practice — upon completion of an investigation, use a diagram to visualize and document causal relationships discovered in the investigation and produce "the big picture view." The diagram is also a great communication tool and helps to preserve the learning through the investigation.

In the next revision of MEDA Results Form, a new section will be added to offer a template for constructing the causal relationships discovered in the MEDA investigation.

MEDA BEST PRACTICES

Several factors contribute to MEDA's wide adoption and acceptance:

- The Boeing Company has been offering continuous and consistent support. For instance, between January 2012 and March 2018, 75 ses-

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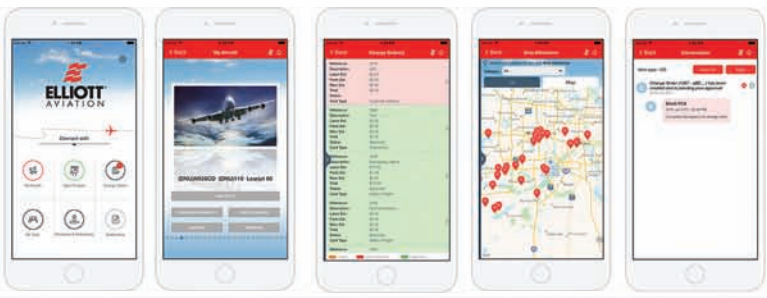

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LUFTHANSA TECHNIK

sions of MEDA investigator workshops were offered to Boeing customers and maintenance organizations around the world, which trained and retrained over 2,300 investigators.

- MEDA is a systematic and comprehensive yet highly customizable investigative process/tool; it can be easily integrated with other existing investigative programs.
- MEDA helps a maintenance organization to fulfill the "event investigation" requirement by national aviation authorities for maintenance human factors program.
- Airlines and other maintenance organizations are not required to share data.
- MEDA is supported/endorsed by labor unions/groups.

Boeing works closely with safety programs with Lufthansa Technik (LHT) and provided MEDA support to seven different LHT sites and Lufthansa Airlines around the world between April 2013 and March 2018.

HOW LUFTHANSA TECHNIK USES MEDA WITHIN ITS SMS

At the beginning of 2000, Lufthansa Technik (LHT) started to use the MEDA concept for error management within line maintenance, which enabled LHT to support transparent analysis and error solutions, and consequently created conditions for sustainable improvement. Soon after, LHT became interested in making this standard usable for the entire product range of the LHT Group. In addition to the standardized risk assessment, the collection of error and cause categories helps to identify systematic issues. So it was natural that the MEDA methodology was integrated as a part of the LHT's SMS.

Boeing works closely with safety programs with Lufthansa Technik (LHT) and provided MEDA support to seven different LHT sites and Lufthansa Airlines around the world between April 2013 and March 2018.

Due to the variety of products (e.g., line, base, shop maintenance), it was necessary to adapt the MEDA concept to the needs of LHT. In the MEDA concept the error categories are focused on maintenance system failure (Section III in the MEDA Results Form). This is perfectly designed for the needs of line maintenance and was easily transferred to base maintenance. For the component and engine service, however, it was necessary to expand the categorization. The same applied to the requirements of the design and production organization of LHT. There are similar considerations in the industry today that have led to the discussion about Component Error Decision Aid as a counterpart to MEDA. However, since LHT conducts the investigations worldwide using a standard IT system called q/star, the error categories were simply extended to meet LHT specific needs. For this reason LHT uses the term "error categories" instead of "maintenance system failure."

To make specific extensions of MEDA concept transparent, the LHT investigation process in q/star is called MEDA^{plus}, which is considered an important tool in its quality/safety toolbox.

LHT experience in collecting investigation data has shown that the categorization of contributing factors or cause categories (as LHT named it), is commonly applicable. When combined with the product or process data, the categories are informative, allow quick detection of systematic vulnerabilities, and thus help to ensure better product and process stability (see Figure 2). On this basis, appropriate significant improvements can then be demonstrated within a reasonable period of time. ***AMT***

DR. MAGGIE J. MA is a Certified Human Factors Professional (CHFP) who specializes in maintenance human factors. She is an associate technical fellow at Boeing where she enjoys supporting Boeing customers and other maintenance organizations on safety programs such as MEDA and Maintenance Line Operations Safety Assessment (M-LOSA) around the world.

MS. ANJA KOSCHINSKI is head of quality monitoring and reporting at Lufthansa Technik AG, Ms. Koschinski has a diploma in business education and is a Certified Systemic Consultant. She is responsible for the central processes of the LHT Group around SMS as well as the associated IT applications.

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DAVID STORCH and Ronald Donner during the 2017 Paris Airshow. MARINO BORIC

AMT Magazine chief editor Ronald Donner sits down with AAR Corp. outgoing CEO David Storch to talk about aviation, the MRO industry, and his career at AAR

By Ronald Donner

AMT EXCLUSIVE:

AN INTERVIEW WITH **DAVID STORCH**

David P. Storch is only the second CEO since AAR incorporated in 1955. Storch recently announced his plan to retire after 39 years with the company. AAR President and Chief Operating Officer John M. Holmes will become the next CEO. Storch will continue to lead the board as its non-executive chairman and work alongside Holmes on business strategy, talent development, and industry relations.

I recently had the pleasure of sitting down with David P. Storch in his office at the AAR Corp. World Headquarters in Wood Dale, IL. We discussed the aviation MRO industry, AAR, and his career.

Storch joined AAR in 1979 with responsibility for developing the company's aircraft engine business. In 1987 he was named president of the AAR Trading Group and became president and chief operating officer in 1989. In 1996 he assumed the additional role of CEO, and chairman of AAR in October 2005.

RWD: **David, first thanks for taking time from your very busy schedule to sit down and discuss the industry with me. While preparing for this interview I found a 2012 article in *Smart Business Chicago* with this quote, "David Storch has a knack for seeing opportunities in desperate situations. Unafraid to take strategic risks, he uses this ability to diversify his company's business and expand into new markets, which has bolstered it through economic lows, industry changes, and technological transitions." With that said, can you talk some about your leadership style and approach to business?**

DPS: Well, that's a heck of a lead-in Ron. I believe what's always driven this company is our ability to stay in touch with the industry and to understand what's happening in the industry; by networking and face-to-face contact with other leaders in this industry. To really try to understand and put ourselves in their shoes as to what challenges they are facing. Once we understand this we then figure out how to create solutions for their challenges.

The needs of the aircraft operator have changed and by staying very close and listening to the customer, we've been able to adjust our product offerings. Yes, I think that's been the skill of the company.

And, it's important to say doing all of this by maintaining our financial strength. Our financial strength has, at times, been challenged. However, we've always maintained the financial flexibility to allow us to pivot as our customers' needs have evolved and changed.

One example was taking on the former United Airlines maintenance space in Indianapolis. At the time, the airline industry was really in a bad way. The facility had been vacant for two years and I looked at it as an opportunity with risk; but an opportunity to fill a void that you could see coming.

The void you could see coming was the airline industry needed to focus on what they were good at: flying people and freight from point A to point B. There was a possibility that there could be growth in the third-party maintenance business as a result of that shift in focus at the airlines.

We went into that facility when airlines were either in or on the verge of bankruptcy. The requirements had definitely been diminished as the fleet sizes had shrunk or diminished. Moving into the facility at the time was risky. But if you looked to where the future was heading and how airlines were reorganizing you could make the business case.

RWD: **So, talking about transformations, in a recent AAR press release announcing John Holmes as your successor you said, "We are well into the transformation of AAR with more actions coming to better serve the needs of the commercial and government customers worldwide." So, what are some of transformations yet to come?**

DPS: So Ron, when 9/11 happened, we had an extraordinarily large percent of our business supporting U.S. commercial airlines. In the midst of the 9/11 recovery I said, "This is one of those life experiences I never want to go through again." Why do I say this? In the financial period directly after this, our revenues had dropped 30 percent from the period ending Aug. 31, 2001. So in a 90-day period we had a 30 percent drop in our revenues.

I then said, "how should we be looking at this company going forward because we don't want to be in this situation again." So I set out on a path to diversify the company in three ways. One was, I wanted 50 percent of our business to be domestic, 50 percent international. At the time it was 85 percent domestic,

I believe what's always driven this company is our ability to stay in touch with the industry and to understand what's happening in the industry ... We've always maintained the financial flexibility to allow us to pivot as our customers' needs have evolved and changed.

15 percent international. I wanted 50 percent of our business to be military, defense, or government; 50 percent commercial. At the time, 85 percent of our business was commercial, 15 percent was military. And I wanted to go 50/50 on what I called front-end and back-end. At the time the company had little manufacturing businesses. I wanted more manufacturing because I wanted to have more control more or less over our destiny.

So over 10 years say 2002 to 2012 we diversified the company. We opened up more international business. We acquired defense-oriented suppliers and we acquired manufacturing capability to be more what I call front-end versus back-end only. In the 2015/2016 timeframe, we also sold off some of our front-end

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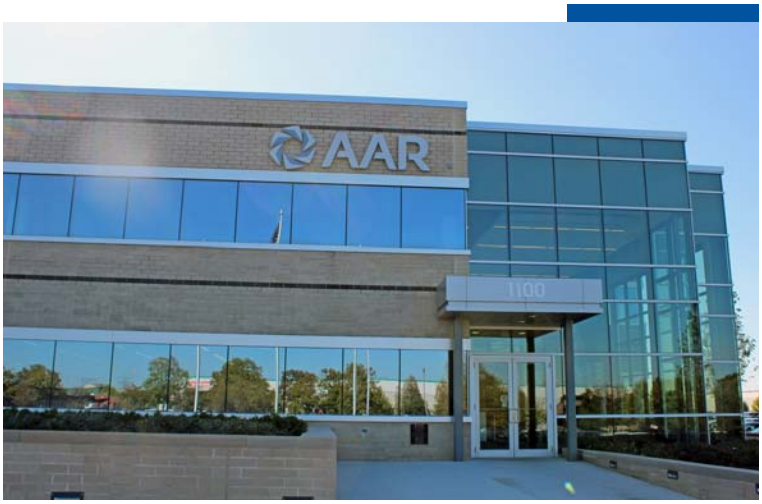

manufacturing business like Telair Cargo to focus more on our core competency of services and now there is less risk as airlines are financially more healthy.

So now for a company our size we're much closer to that 50/50 blend and it was out of a need to survive, quite frankly, and to be relevant. I'd say being nimble is one of the strengths of the company.

RWD: **How does AAR set itself apart from your competitors?**

DPS: As leader of this company, and I believe John will follow, I look at the company from a 25-year horizon. My view is to separate the company from the rest of the world; whether it be OEMs or independent companies like us. To offer superior service, we have to be a little bit faster with more precision than the competition. I want to be listening to my customer, paying attention to their needs, designing a solution for the customer (not for me), and then execute a best in class solution.

As an example, if an airline is faced with a challenge around reducing span time and repair downtimes on their maintenance cycle, I want to be out there trying to take out a day here and a day there, two days here and two days there to provide more value to the customer. I want to win on providing superior service execution. I want to be constantly innovating to come up with solutions that help my customers not just survive but help them compete, and help them win. So if you do business with AAR I'm on your team and I want to help you win.

RWD: **AAR has many segments and markets; MRO, the composite business, the airlift business, and so on. Can you talk about how they do or don't fit together?**

DPS: We think about the business more integrated than just the pieces like you said. For instance, our composite operation is really a composite capability inside of our MRO activities. Our MRO and supply chain work together in that our supply chains provide all the components parts, the piece parts, for our heavy maintenance. I think about these businesses as aviation services and we believe that's part of what's giving us a competitive advantage.

We want to grow at a rate faster than the industry is growing — which means A: we want to ride the growth rate of the industry, but B: we want to take market share by doing things I mentioned.

What I want to have is more capability in these buckets. I want you to be comfortable turning over your operation or your aircraft to us. That might either be a commercial or regional airline or a government. We have successes in each of these areas.

RWD: **Last year was the purchase of the two Canadian MRO facilities and the company recently announced a joint venture in India. You've used the word international expansion a lot in our short conversation. Can you talk more about this?**

DPS: Ron, when people like you and I came into the aviation business, the U.S. made up a very significant percentage of the business. Over time that's changed. And, you know, my goal is to follow the fleet. So as the fleet grows outside the United States, we have to physically go outside the United States.

Historically, we've been a U.S. domestic centric company but when I think of MRO, I look at foreign markets and I want to proceed with caution because I recognize that the key to success in MRO is matching your workforce and your mechanics. I don't want to be presumptuous and assume that we understand how different cultures operate around the world. So, by teaming as we did in India with a local businessman, we have a better chance, we believe, at being successful. And a much better chance for success with a local partner.

Our partner in India is a very ambitious business man. We see the same market he sees. He understands the local domestic markets in ways that we'll never understand. I think the partnership is very powerful because of that. We understand aircraft maintenance as well as anybody in the world. Our partner, in this case, understands the local market better than most.

Local Indian airlines are the target audience and assuming success, there's the possibility of bringing on aircraft from outside India.

To some extent, Canada, I think of differently than some of these other markets. We didn't necessarily feel we needed to partner in Canada the same way as we think of other markets.

RWD: **The other piece that's interesting is the African market. Last summer during the Paris Airshow I had the pleasure of meeting Cheryl Jackson, president of AAR Africa.**

DPS: I think we view Africa like a new frontier maybe. It's a large population base with a lot of different cultures inside the continent. One of our experiences is that we understand and appreciate that. I believe it's going to be very critical for the African continent leaders to develop air transportation systems that allow for commerce to flourish. Without an air transportation system, you really can't have a flourishing economy.

RONALD DONNER and David Storch at the AAR World Headquarters in Wood Dale, IL.

Currently we have a PBH (power by the hour) program with Kenya Airways for component support, do some similar technical support for SAATechnical, and we've had an engineering service contract with Ethiopia. We're looking at different things in Nigeria and western Africa. So, I think stay tuned but it may be a little slower.

RWD: **What are some of the biggest changes and maybe challenges yet to come in the MRO business?**

DPS: I think that if I were to find one key phrase for this industry over the past 40 years it would probably be the acceptance of outsourcing. One example is when I was trying to get business from an (unnamed) major airline years ago, I can recall talking with the CEO and he was telling me that, "Yeah. I get it. This makes sense. However, my vice president of maintenance doesn't want to see us give up control. And if we give you work we're going to be giving up control."

I tried to convince him that I would be under his control and you don't lose control. It's just that instead of having your own employees, you have my employees. But I can do it more flexibly. I can be more comprehensive. I can give you alternatives and, at the end of the day, make you more competitive. And, you know, they resisted it on the basis of giving up control.

AAR CORP.

The government was the same way. The people looking over the budgets might say, "Hey why don't we outsource this?" The people responsible for the platform would say, "No way, I'm not going to give up control."

I think the kind of acceptance over time of outsourcing your supply chain or outsourcing your maintenance to a third-party provider has really been a big change, a big adjustment.

RWD: **Is this more accepted today?**

DPS: Yes. And I think there's more to come. As companies like us build track records, show that we are capable, and show that we are as focused on safety of flights and quality, we can be the extension of the aircraft operator.

RWD: **What would you say has been the most rewarding part of your AAR career? Is there any one single accomplishment that is at the top of that?**

DPS: I see AAR as the people. We're a team of people working together to support our customers. In the case of commercial customers: help them compete with a focus on safety on flight. In the case of our government customers and the case of the military in particular, it's to be there for the war fighter and give the war fighter the tools he or she needs to perform their mission.

I'm most proud that we as a company have gotten our people excited about these two large missions. And I think we've performed pretty admirably in this way.

RWD: **That's certainly a testament to you and the leadership that you have provided.**

DPS: Thanks Ron, but my satisfaction is watching people do really well. I'm just one person and we have 5,000 plus people. It's the leadership's responsibility to make sure that the people inside the company are connected to the mission, the goals, and the objectives. For me it's been fun.

RWD: **David, this was such a great honor and a pleasure for me. Thank you very much and all the best to you and to AAR Corp.** ***AMT***

IT'S A MATTER OF COMMUNICATION

Accidents can occur because pilots and mechanics don't effectively communicate

By Tahlia Fisher

"IT IS THE TEAM, NOT THE AIRCRAFT OR THE INDIVIDUAL pilot, that is at the root of most accidents and incidents." *

Despite this quote now being some 25 years old, the question might still be asked how well we, as an industry, are providing the whole 'team' with the skills necessary to operate efficiently together in the dynamic, fast-paced world that is aviation. We might also ask who exactly we are including in the team. Pilots and flight attendants have traditionally reaped the benefits of learning how to effectively communicate together but how many others miss out? In many cases, aircraft mechanics are a prime example of such an oversight.

COMMUNICATION ACROSS PROFESSIONAL BOUNDARIES

While communication is a key component of their work, it is interesting to note that current maintenance human factors training tends to focus on communication between maintenance personnel. This is reasonable given the negative repercussions which can result from poor coordination at shift handover. The relative infancy of maintenance human factors programmes, compared to those developed for flight crews, also means that less consideration has been given to the unique work environments between, say, the hangar and line maintenance, leading to a lack of tailored training for the different maintenance specialties.

However, those mechanics required to interact with pilots as part of their work are essentially communicating across a professional boundary. As demonstrated by several well-known accidents where cabin crew have experienced difficulty communicating with pilots, the ability for people to interact effectively with those of different professions can present challenges. This is well known within the medical arena also where surgeons, anaesthetists, and nurses can struggle with communication in the operating theatre. Regarding the pilot-maintenance interface, this concept has been recognised, with the UK Civil Aviation Authority** stating: "Most line [aircraft maintenance technicians] appear to have a good understanding of how human factors affect them in their everyday work. Where they have less understanding is with regard to what the pilot is thinking. The reverse is also true; pilots currently appear to have a poor understanding of the [maintainer's] perspective."

DIFFERING PERCEPTIONS

While there are many jokes about communication between pilots and aircraft mechanics, the way in which the two parties inter-

act is not always so humorous. In 2015, for example, a physical altercation took place on an Air India flight deck between the aircraft's captain and a maintenance technician over whether a defect had been rectified correctly***. However, despite plenty of anecdotal evidence that communication between pilots and mechanics is not always particularly effective, research to identify why this might be the case has, to date, been limited.

Given that the logbook is the primary means by which they interface, most formal studies have focused on this medium and the frustrations pilots and mechanics experience using written communication. Data out of Australia and the United States, for example, has previously identified that both pilots and mechanics experience very different perceptions of each other's ability to communicate appropriately. A common finding with regard to the logbook is that each profession perceives that the other has poor write-ups/sign-offs in relation to the amount and detail of information which is provided about defects. Perhaps unsurprisingly, however, each group thinks their own logbook communication is satisfactory and fit for the purpose, illustrating a disparity between the actual information needs of pilots and mechanics.

BEYOND THE LOGBOOK

But are communication problems between pilots and mechanics driven by deeper issues? In more recent research****, findings from a series of focus groups held at an Australasian airline highlight some of the specific challenges faced by pilots and mechanics when they attempt to communicate. Along with pilots, mechanics who worked in the line maintenance environment were invited to discuss the factors they identified as causing difficulties across the flight-maintenance interface. Both professions raised similar concerns, indicating that despite having perceived differences, the issues they faced were actually common to both employee groups.

Communication difficulties were seen to stem from organisational factors such as the tempo of airline operations, lack of a face-to-face handover at the aircraft (i.e., solely relying on the logbook) and an absence of any opportunity to engage in joint-communication training or classroom activities. Interestingly, this lack of physical contact between the two groups appears to have broader implications than just the immediate difficulties associated with use of the logbook. Less face-to-face interaction between the two groups also leads to an increase in perceived differences with respect to each profession's underlying motives when dispatching an aircraft. This is despite the fact that both share an overarching goal of flight safety. Left unchecked, such misperceptions can affect fundamental aspects of the pilot-mechanic relationship, including trust in each other.

VERBAL COMMUNICATION DIFFICULTIES

In addition to the misperceptions which can influence their interactions, the times where pilots and mechanics do speak with each other in person can also become problematic. Mechanics, for example, raised concerns that despite feeling confident in their mechanical ability, they sometimes found it difficult to verbalise technical information in a way that would appear sound to a pilot, particularly in situations where they were outnumbered on the flight deck.

Conversely, some pilots were critical of the way mechanics would sometimes speak to them in an undermining fashion, discouraging them from asking what might be considered "silly" questions or reporting any minor "misdemeanours". One pilot raised the point that, after years spent together in the classroom practicing effective communication techniques, the relationship

with flight attendants was now such that there was always encouragement to report any concerns to the pilots and those working in the cabin always appeared confident to do so.

SO, WHAT OF IT?

The implications of poor communication between pilots and aircraft maintenance technicians can be far-reaching. Traditionally, a problematic interface between the two groups — say a poorly worded log write-up from a pilot — was assumed to simply result in difficulties for the mechanic in terms of successful defect rectification. However, a recent study**** of over 1,000 reports submitted to the NASA-administered ASRS database, illustrates the broader way in which poor communication can manifest. The reports (the majority which were submitted by U.S. airline pilots operating under rule part 121) outlined a range of issues including disagreements with mechanics over defect rectifications, appropriateness of deferrals, and confusion with the Minimum Equipment List (MEL). The results of such communication difficulties appear to be associated with two types of outcome — operational and safety-related.

Operational outcomes — which include flight cancellations, delays, returns to the gate, and pilots refusing to accept an aircraft — were associated with almost half of the reports in the data set. Needless to say, such disruptions to the schedule are obviously undesirable for an airline, both from an economic and customer satisfaction point of view. Problematic interactions between pilots and mechanics were also associated with adverse safety events. While some of these safety-related outcomes had a direct influence on the actual flight (e.g., operating on an incorrect MEL, incorrect maintenance being conducted, or having a maintenance-related event on the subsequent sector), others were seen to negatively impact on the pilot-maintainer relationship itself. For example, one-third of all the reports detailing a difficult communication encounter included feelings on the part of the submitter that the trust between the pilot and mechanic had been jeopardised as a result of the event. Almost one-fifth of reports describing disagreements between pilots and mechanics subsequently escalated into what could be described as "heated" arguments — not an ideal situation for either party to be faced with during their workday.

WHERE TO FROM HERE?

With regard to investment in the pilot-maintainer relationship, resource is certainly a genuine issue, at least from a practical point of view. Removing personnel from the workplace in order to undertake communication training is undoubtedly expensive and developing specialised training programmes also requires a considerable investment, as well as tremendous commitment from management. According to the UK human factors guidance (CAP 737), while airline CEOs and senior managers appear to understand the value of human factors and crew resource management education, there appears to be little inclination to conduct additional training beyond what is required by regulations. This is mainly due to the cost which is associated, an issue which is only compounded by the extensive use of contract employees. Thus, short of mandating joint crew resource management training for pilots and mechanics, the situation remains challenging.

The answer to this problem may well lie in how we, as an industry, "sell" communication training. Conceivably, this may require an approach which elects to steer away from marketing such programmes as purely safety-related. Traditionally, safety has primarily been the objective of aviation human factors research, yet, in mainstream occupational psychology, for example, improving business efficiency is a common focus for research teams. Human factors expert Don Harris argues that huge advancements could be made for airlines in terms of improving financial performance but only if our human factors focus shifts toward a wider, socio-technical perspective: "There needs to be greater integration between the various subdisciplines — selection, training, equipment design, and organisational pressures do not exist in isolation. They combine to contribute to accidents so they should be tackled in an integrated manner."

With aviation accidents now typically characterised by errors which have crossed many organisational boundaries, investment in a larger section of our workforce may well prove profitable in the long run. Consideration as to how we can be more inclusive with our communication training programmes could certainly be a good start. ***AMT***

ADDITIONAL RESOURCES

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TAHLIA FISHER currently works as an aviation safety specialist in New Zealand. Prior to this, Fisher was a commercial multi-engine instrument rated flight instructor. She left flying to pursue a career in flight safety and completed her air accident investigation qualifications at the University of Southern California and the National Transport Safety Board. Fisher has been an accredited air accident investigator with IFALPA and is a member of the International Society of Air Safety Investigators. She has recently completed her Ph.D. studying communication between airline pilots and line maintenance personnel.

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STEADY GROWTH, CONSOLIDATION

CHARACTERIZE BUSINESS AIRCRAFT MRO MARKET

By Ronald Donner and Jerome Greer Chandler

Steady, although not spectacular, growth characterizes the global business jet MRO market over the ensuing five years — all the while, the industry steadies itself to adapt to the seemingly irresistible gravitational pull exerted by continuing consolidation. Such is the consensus of nine geographically diverse business aircraft maintenance leaders.

"From our perspective, we see expanding opportunities and expect more growth in the new and pre-owned business jet segment as the global economy continues to grow stronger," says United Kingdom-based Mark Winzar, vice president of technical services for JSSI. "Maintenance activity will grow but owners and operators will need to engage in careful planning, management, and execution, as MRO resources continue to consolidate."

"The business aviation maintenance market is inextricably linked to the health of the industry at large," says Jean-Christophe Gallagher, Bombardier Business Aircraft's vice president and general manager of customer experience. "We expect the business aviation market to remain stable in 2018 in terms of deliveries, and in the longer term, the industry is poised for growth. This is a positive signal for the maintenance market: economic growth underpins increases in flight hours."

The same dynamic is driving Bombardier's archrival. "The continued growth of our fleet — now at more than 2,800 aircraft — and increased flight hours in 2017 — kept us busy throughout the year," says Derek Zimmerman, president of Gulfstream Product Support. "That level of activ-

BOMBARDIER MAINTENANCE facility at Biggin Hill airport near London, England.
BOMBARDIER

ity has continued into 2018." Gulfstream sports 11 company-owned service centers worldwide — eight in the United States and three international. Its maintenance base at Beijing Capital International Airport is a joint venture with HNA Technic. The company played the important China Card relatively early on, opening the joint venture operation in 2012 as China's first factory-owned service center for business jets.

Contributing to this growth, says Nuremberg, Germany-based FAI Aviation Group Chairman Siegfried Axtmann, is "an increase in demand for major projects from general aviation operators and business jet owners. These projects typically combine scheduled base maintenance with interior and exterior refurbishment along with

upgrades (to have aircraft 2020-ready) and the replacement of mature cabin management, entertainment, and communication systems."

"From our perspective, it's growing," says Kirya Shortt, senior vice president of Textron Aviation Service. "Throughout 2017, we saw a steady rise in flight activity both domestically and internationally, which is translating into increased activity and growth throughout our aftermarket business."

A number of factors are influencing this growth. Canadian-based Flying Colours Executive Vice President Sean Gillespie believes being a Bombardier Approved Service Center is a strong driver of business. This can stimulate owners "to use us for maintenance on their Bombardier jets," says Gillespie. "The Global model fleet is coming up to its first 120-month (8C) checks so we are busy with these inspections. We have enough of them going through the hangars that we have dedicated time and money to training our team and investing in our infrastructure with a custom-made tail-dock, to be ready to meet the demand."

OEM ALLIANCES A MUST?

Here's that gravitational pull we alluded to. It emanates largely from the OEMs. Partnering with the original equipment manufacturer is increasingly the prudent course for many an independent MRO.

Aviation MRO requires a constant update in the use and maintenance of new technologies. That, of course, isn't new. The change is that now, and more and more in the future, the MROs will be very restricted if they are not working in partnership agreement with the OEMs. So assert Nicolas Tejera and Ronnie McCrae, director of maintenance and third-party manager respectively for Falcon Engineering. The division of Falcon Aviation Services is based in Abu Dhabi.

Tejera and McCrae believe OEMs now realize that it's better for them to maintain the link with the aircraft even longer after it has been delivered to the owner. So cooperation between OEMs, MROs, and the authorities is key.

JSSI's Winzar reiterates, "The MRO market is consolidating; it's becoming more challenging than ever for independent facilities to be competitive. Key drivers include OEMs' control over authorizations and parts supply, selecting the right facility to complete maintenance." Partnerships are one way to stay independent while attracting new business."

"We've seen a lot of consolidation at the highest level of aviation with large conglomerates merging or acquiring each other," says Flying Colours' Gillespie. A classic case-in-point is Rockwell Collins and BE Aerospace. He foresees M&A trickling down to the smaller maintenance companies and alliances formed to strengthen their global presence.

ExecuJet Executive Vice President for MRO Services Graeme Duckworth puts the trend in global perspective: "In view of the increasing reliability of business aircraft, together with longer intervals between inspections, longer warranty

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periods, and manufacturers' power-by-the-hour programs, business aviation maintenance relies more than ever on the relationships between MRO facilities and manufacturers. Whilst the barriers to entry for newcomers are high, which in some cases reduces the competition; longer-range aircraft have many choices for maintenance. This is because many competing facilities are within nonstop range, thus motivating all facilities to provide service excellence at competitive pricing in order to be able to compete. For these aircraft, business aviation maintenance has become a truly global business."

FAI TECHNIK Nuremberg, Germany.
FAI

Amidst all this global growth and high-flying business jets there's still room for the savvy regional player. Oriens Maintenance Services is the newly established arm of Oriens Aviation, the authorized Pilatus Center for the British Isles. Maintaining the single-engine propjet PC-12 is the prime focus at Oriens' Biggin Hill base. "There is some very exciting growth within the sector at the moment," says Dave Plumpton, Oriens' director of maintenance. This mirrors an overall 4.3 percent uptick in business aviation growth in the UK during 2017, and 5.5 percent in Europe. Despite Brexit, "Business aviation growth in 2017 in the UK was well ahead of GDP growth and never has there been as much optimism as there is now," he contends.

That optimism is tempered by parts availability says JSSI's Winzar for independents. "MRO consolidation and access to parts will continue to present challenges. Selecting the right facility and taking a more proactive approach to planning scheduled maintenance will be a key factor in managing maintenance costs," says Winzar. Understanding parts requirements and having options for supply is important too.

CHALLENGES ON THE ROAD AHEAD

If parts supply is important, attracting, training, and hanging on to technicians is critical — be the MRO an indy or factory operation. Oriens' Plumpton says the industrywide challenge is prompting his company to look for alternative solutions to the traditional recruitment options. "We have concentrated hard on developing our internal skills base, while also looking to recruit at various levels within the skills requirements. The internal motivation associated with personal development has already shown significant motivation benefits" — benefits which he says prompt staff buy-in and ultimately generate more efficient ways of maintaining aircraft.

The internal nurturing of technical talent is also espoused by FAI Aviation Group. That doesn't mean, however, that the company won't recruit from outside. Chairman Axtmann says, "We undertake in-house training and also seek to hire

120-MONTH CHECK at the Flying Colours facility.

FLYING COLOURS CORP.

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GULFSTREAM AEROSPACE

staff from neighboring countries, where the increase of demand for such MRO services is not increasing in the same proportion as is the case in Germany."

Tilling the soil for the cultivation of future airframe and powerplant technicians can't start early enough. Textron is focusing its efforts far downstream, concentrating on promoting STEM (science, technology, engineering, and mathematics) efforts and partnerships with a range of local schools — not merely high schools and vocational schools but with elementary and middle schools as well.

The recruitment and retention problem is solvable, but not immediately so. The wild card is automation. The hangar floor just could be a future habitat for robots believes ExecuJet's Duckworth. "Although hard to imagine within the industry at present, the advances in robotics, in particular the use of drones and other remote-controlled devices, is very likely to impact our industry going forward. This will have the benefit of lowering ownership costs and downtimes — desired efficiencies for most businesses." There are, however, a couple of caveats. "[The] downside is that the capital expense for the MRO facilities will be high, with potentially lower returns, and it will inhibit employment levels because work would be carried out by machines. The latter is a global challenge

ORIENS AVIATION
ORIENS AVIATION

BOMBARDIER FACILITY in Biggin Hill near London, England.
BOMBARDIER

as we strive for efficiencies in a world with an ever-increasing population."

The feedstock for robotics is data — lots and lots of data. Gulfstream's Zimmerman says, "One change well underway is the increased use of augmented and virtual reality systems in maintenance organizations, including ours … Another is figuring out the best way to utilize and share the value from the huge amount of data generated by new aircraft technologies."

KEEPING THE CUSTOMER SATISFIED

The importance of alliances only works insofar as it serves the end user — the business aircraft owners and operators. The sine qua non of business aircraft MRO continues to be customer service. Those who confuse pure size as a substitute for intensive, customer-centric service do so at their peril.

"Over the past few years, we have expanded across our entire network to move closer to our customers around the world," says Bombardier's Gallagher. "We have added a dozen mobile response team vehicles worldwide, six more line maintenance stations in Europe, and new service centers and capabilities in North America, Europe, and Asia. We expanded our Biggin Hill Service Center with an additional hangar less than a year since its inauguration; we opened our Tianjin Service Center and received numerous certifications; and we expanded our Tucson Service Center's interior capabilities with a brand new paint shop and new tooling."

Investment in the MRO product is critical. Consider what Gulfstream is doing. "In October 2017, we announced that we would construct a nearly 70,000-square-foot/6,503-square-meter service center in Van Nuys, CA," says the airframer's Zimmerman. "In February 2018, we announced that we would build a nearly 180,000-square-foot/16,723-square-meter service center at our maintenance and completions site in Appleton, WI." Operations at both new facilities are expected to begin in 2019.

Although global reach is requisite, customer service is especially important for players such as Oriens Maintenance Services, whose core business is the care and feeding of the Pilatus PC-12. "We've found that our … customers have varying requirements," says the MRO's Plumpton. "We're learning this and developing processes that allow us to cater to each customer in a unique way."

Perhaps the biggest challenge maintenance, repair, and overhaul faces today is precisely that: catering to customers in a unique way, while ever extending its global reach at the same time.

Early evidence is the two are not mutually exclusive. ***AMT***

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WHY A 'LOCAL FIRST' APPROACH TO COMPONENT MRO MAY COST MORE

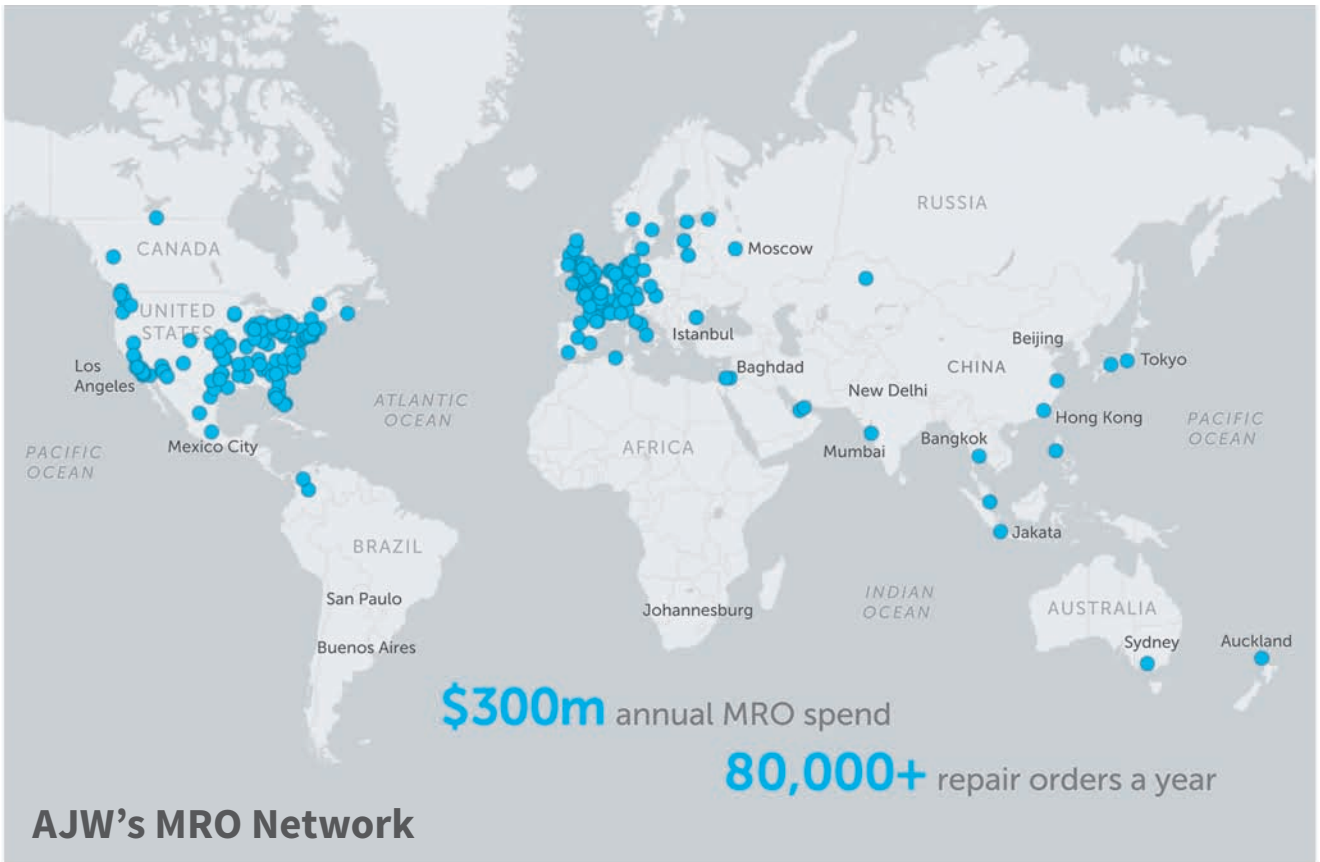
Airlines and manufacturers are realising that there are a range of 'hidden costs' that can be avoided by taking a more strategic and international approach to their parts maintenance

By Christopher Whiteside

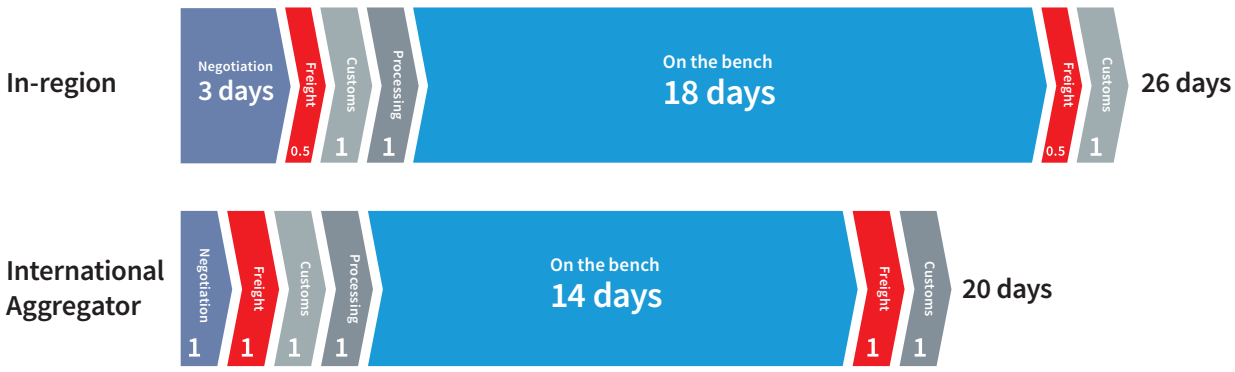
'GO LOCAL' IS ONE OF THE MOST COMMON — and potentially costly myths — influencing the way operators manage their component MRO. It may seem logical that an airline requiring a component repair in Kuala Lumpur should seek help in Singapore, rather than Montreal, but in fact the numbers seldom stack up.

IT'S A SMALL WORLD

Firstly, there is the misconception that component MRO is all about the time it takes to process and service a part. In reality, parts are rarely repaired while the aircraft waits, so the 'wing-to-shelf' time between the part being removed and replaced is the metric that really matters. For example, an



One Scenario for a Component Repair



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AJW

Integrated Drive Generator (IDG) can take over four weeks to repair, whereas it can be replaced in a matter of three hours.

When you consider that you are never more than a day away by air courier from all of the major MRO hubs across the globe, it's clear that shipping parts to the geographically closest market may not make sense. The freight costs may be slightly more, but as a percentage of the total overhaul bill, they are negligible.

Similarly, it's a false economy to ship a part to a nearby market that doesn't have the expertise needed to complete the job efficiently. A shop with highly relevant capabilities and experience anywhere in the world is likely to offer better value than a supplier in close range that lacks specialist knowledge and tools. Likewise, a shop in a location with a reliable supply chain may be a better option than a nearby supplier without good part supply.

Of course, there will always be certain parts that are too bulky or hazardous that will need to be transported overland and therefore serviced locally, for example, escape slides. However, this is only a very small sample of the thousands of components that operators replace and repair every day.

Aside from generating direct cost savings and benefits by going 'long haul' rather than local for parts MRO, airlines and manufacturers are realising that there are a range of 'hidden costs' that can be avoided by taking a more strategic and international approach to their parts maintenance.

TAKING AN AGGREGATED APPROACH

Sourcing local providers on a case-by-case basis leaves operators with the headache of managing a whole host of individual relationships with suppliers within the region, potentially including negotiating language barriers and different customs regimes. This is very time inefficient, and it is also tough for operators to ensure competitive pricing due to a small number of regional suppliers.

A shop with highly relevant capabilities and experience anywhere in the world is likely to offer better value than a supplier in close range that lacks specialist knowledge and tools.

Time and cost are heavily influenced by the enquiry, logistics, and approval process of sourcing a part, which can add to a minimum of at least six days if contracts and agreements are not in place. In response, airlines and manufacturers are increasingly outsourcing their component MRO to

aggregators, replacing a web of different suppliers with a single point of contact. A good network, with a pre-agreed contractual framework, can do much of the hard work before a part even leaves the aircraft.

Adopting this approach allows operators to benefit from a standardised quality of service and more streamlined processes. Aggregators are better placed to select the right supplier and can also more easily offer exchange options, avoiding the need to wait for repairs to be completed.

We are increasingly seeing demand from operators for this type of arrangement as it ensures better customer service — in their preferred language — plus savings derived from the aggregator's ongoing relationships with suppliers, where they benefit from economies of scale and can drive continual improvement and efficiencies.

Taking a global approach to MRO and working with an aggregator allows operators to spend wherever they are likely to see the best return — taking advantage of fluctuations in exchange rates. They can also spread risk by avoiding price spikes driven by regional natural events such as ash clouds and earthquakes.

THE DATA DIVIDEND

Thinking internationally and more strategically can unlock further benefits for operators as big data and technological advances open up new opportunities.

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AJW is highly regarded for its 24/7/365 AOG and critical response service excellence and has dedicated sales and service teams located worldwide, along with global stock locations. In addition, AJW has operational hubs in London (HQ), Dubai, Dublin, Miami, Montreal, Moscow, Shanghai, and Singapore. For more information visit www.ajw-group.com.

Large aggregators have access to a huge pool of component data across the aircraft they support and can benchmark operator's performance anonymously against their competitors. Some airlines with close links to each other are even considering shared agreements with aggregators to derive even greater value from sharing intelligence and pooling resources.

Over the course of a long-term partnership, an aggregator can monitor the true cost of a part failure — incorporating all the hidden costs mentioned above — and can drive efficiencies by drawing on best practices learned through work for multiple operators. They can also apply their expertise, backed by data, to advise on the best course of action; for example, they can assess whether a failure is due to poor use by the operator or whether warranty recovery is worthwhile.

AJW recently partnered with a major OEM to develop an online portal to log and maintain visibility on all its component MRO. Increasingly, we are referring to this type of data-driven, remote partnership as 'virtual MRO', since it can mean servicing a customer without touching a single part directly.

We often compare this approach to component MRO to an air traffic control tower, in that it ensures that parts for multiple customers are processed and shipped to their destination in a centralised and efficient way.

This type of partnership also lays the groundwork for effective predictive maintenance. Components often reach MRO suppliers without adequate records, which could see a part removed predictively pass the standard tests and go back into service on the brink of failing. A structured approach to data management and handling can help avoid the risk of this happening.

CONCLUSION

The aviation industry is notorious for its relentless focus on efficiency and streamlining — from the single olive that allegedly saved American Airlines $40,000 in the 1980s to the no-frills war between low-cost carriers that has recently diversified to include long-haul flights.

An aggregator can monitor the true cost of a part failure — incorporating all the hidden costs — and can drive efficiencies by drawing on best practice learned through work for multiple operators.

You might assume that against this backdrop, operators have iron-clad systems in place to ensure parts are maintained and repaired as efficiently as possible. However, the reality is that MRO — particularly component MRO — is one of the most complicated processes that operators have to negotiate — involving potentially millions of part numbers.

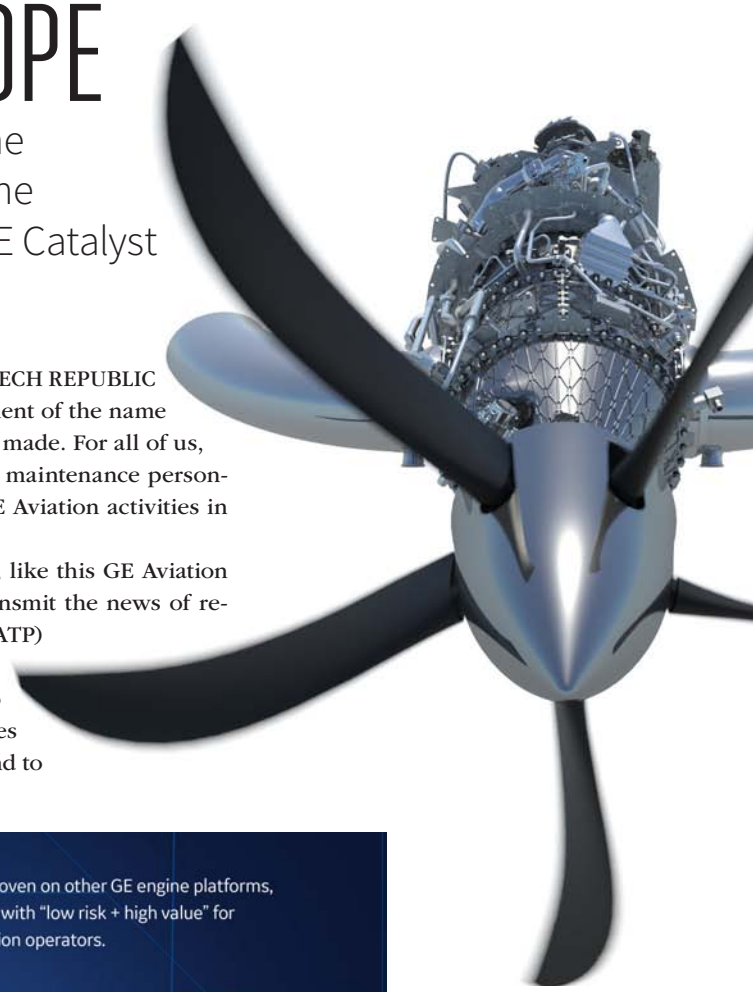
For decades, operators have had to make do by forming patchwork agreements with local MRO providers, but thanks to the emergence of MRO aggregators, combined with advances in technology and data management, operators are finding new and innovative ways of taking on the challenge. **AMT**

CHRISTOPHER WHITESIDE is president and CEO of AJW Group. For more information visit www.ajw-group.com.

GE HAS A STRONG (TURBOPROP) FOOTPRINT IN EUROPE

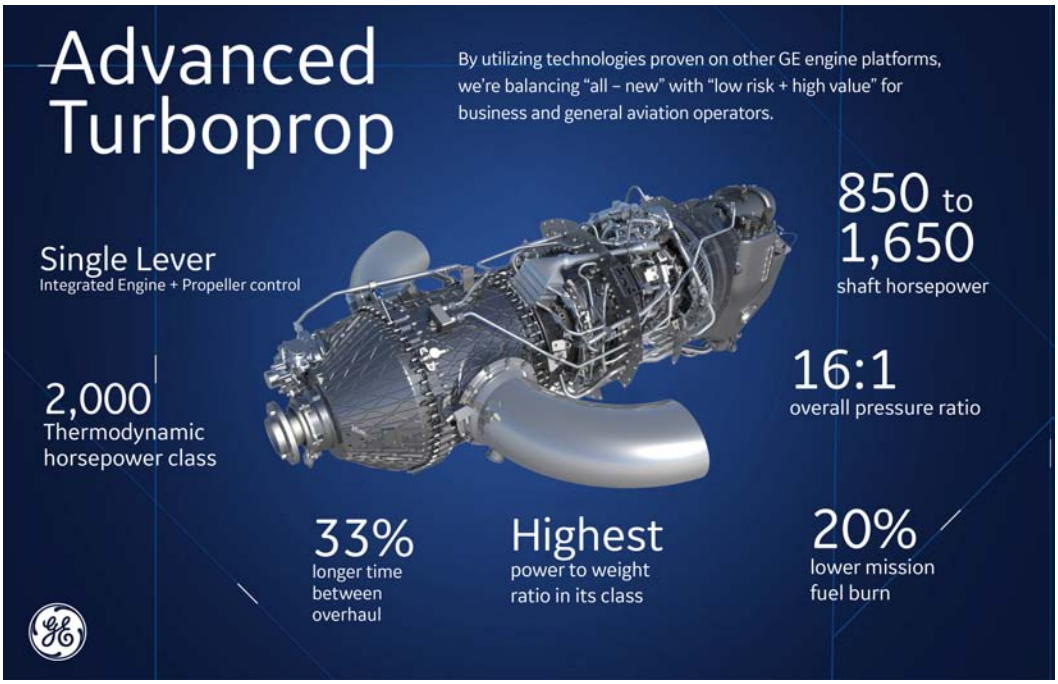
GE Aviation's journey in Europe has gone a long way. Out of this journey comes the Advanced Turboprop now named the GE Catalyst

By Marino Boric



AMT VISITED GE AVIATION IN PRAGUE, CZECH REPUBLIC this March. During the trip, the announcement of the name change of the ATP into the GE Catalyst was made. For all of us, *AMT* readers and specially for aviators and maintenance personnel, this visit was an excellent insight in GE Aviation activities in this entry engine (turboprop) field.

Life can be unpredictable and surprising, like this GE Aviation tour. The tour gave *AMT* the chance to transmit the news of renaming the high-tech Advanced TurboProp (ATP) which is now called GE Catalyst. Second, even more important, this tour gave me a chance to (finally) understand the GE Aviation activities in Europe, their work in this engine field, and to tell you this story.



GE CATALYST
GE AVIATION

10 YEARS OF GE'S TURBOPROP INNOVATION IN EUROPE

The activities of GE Aviation in Europe are much wider, deeper, and more important than I previously thought. I learned this from the best possible teacher, Bradley D. Mottier, vice president and general manager, Business & General Aviation & Integrated Systems Manager at GE Aviation. He narrated this fact in a passionate and proud way; he is a former entrepreneur, today's GE team leader, a pilot, and aircraft owner — what a blessing for a listener.

From today's perspective it's easy to say that GE Aviation has done all things along this path right, but the path wasn't looking so straight a decade ago. It was mastered by the capable individuals which formed a great team. Thanks to Mottier, himself a catalyst in this GE structure, there was always a leader with a strong commitment and a clear final target. According to him, the beginning of the GE activities in Czech Republic was not an easy one.

WALTER ENGINES AS A SMART PURCHASE

It began with the acquisition of the Czech turbine manufacturer Walter Engines in 2008. The gem of the former Eastern turbines world was located in Prague and had an EASA certified turboprop powerplant in its portfolio. The mission from the beginning was to build a team, to build a business from virtually nothing requiring self-belief and perseverance. "Better be frugal" was a motto in those days. Acquiring Walter Engines allowed GE to learn the marketplace, gain domain expertise, and learn how those engines are being operated.

The initial problems were not the turbine properties but the location of the plant. As the former production terrain was sold by Walter owners, GE had to move the production to today's site. This period was according to Mottier an "unbelievable six months" as they had to relocate each working bench and the overhaul of Walter Engines to a new location and re-building, actually mirroring it on a new location to retain the EASA certification.

STRONG HELP BY THE AUTHORITIES

In this process, as Mottier highlights it, (GE) "was tremendously helped" by a Czech government/Czech invest program which strongly believes in aviation, by EASA and the Czech Technical University in Prague (CVUT). The Prague University is partnering with GE in development of the new powerplant and shares its acquired data with GE which in turn further develops all their products testing them in its own (certified) test cell.

CVUT is today conveniently located, adjacent to the GE Aviation plant; with a new test bench where the first fired Catalyst is now installed. It will stay there for CVUT and GE research activities; a CVUT test bench has already created unexpected benefits: "a huge boost in student numbers which actually exceeds by 500 percent previous year's inscriptions" as per CVUT Professor Michael Valasek.

GE IMPROVES THE EFFICIENCY OF EXISTING TURBINES

In 2009 GE launched the H80 engine improving the efficiency of the existing powerplant by implementing technological achievements from big commercial engines. GE added new compressor, new blisks, and stators. Doing so and adding in year 2010, the GT blade, the H80 has become 20 percent more powerful and 10 percent more fuel efficient.

In Prague at GE Aviation site we could see the new "H" series turbine on the swiveling and tilting test stand which was fitted with a modified oil and lubrication system which will allow aerobatic and inverted flight. This "H aerobatic" engine will power the Austrian Dart 550 military-basic pilot trainer aircraft manufactured by Diamond.

BRAD MOTTIER speaks to a group of journalists at the GE Aviation Czech facility. MARINO BORIC

MARINO BORIC graduated with a university degree as an aeronautic engineer, and acquired degrees in business development/trade and commerce and in journalism. He is a civil and military pilot and has built experimental aircraft. As a journalist, he specializes in aviation and propulsion and travels worldwide, flight-testing UL, LSA, Experimental, and certified aircraft. He is writing for U.S., European, and Chinese media companies.

THE CATALYST OF A NEW ERA

In 2014 the Advanced Turboprop (the ATP) clean-sheet-design was conceived based on experience made by existing engines, grown customers feedback, and customer insights and from that moment a new era had begun for GE Aviation.

The new 1,300 SHP-rated Catalyst is the first entry in GE's new family of turboprop engines aimed at business and general aviation aircraft in the 1,000-1,600 SHP range; thermodynamically it is rated at 2,000 hp.

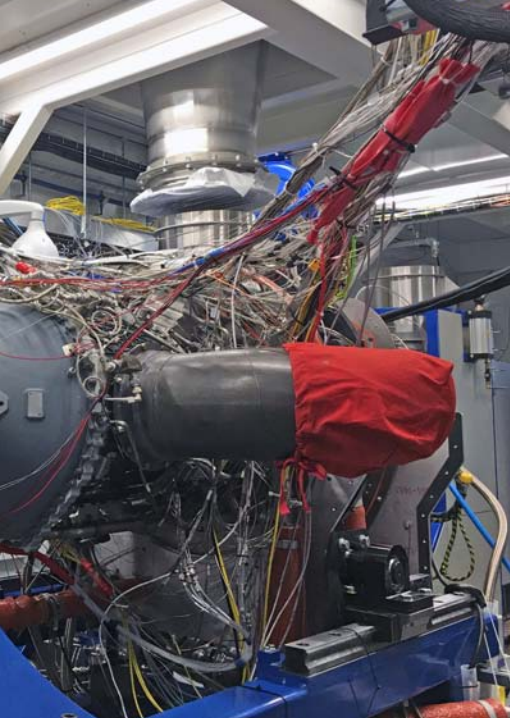
GE CATALYST CVUT test bench.
GE AVIATION

Catalyst work is predominantly being done in the Czech Republic, Poland, Italy, and Germany. The GE present position was reached through Europe-wide acquisitions (see Page 40).

Now, this first engine has been transferred to the brand new test chamber of the Czech Technical University in Prague located on the same site. Fitted with hundreds of sensors "which required technicians to use watchmaker skills for positioning them properly" it will be used by CVUT and GE to generate more data and engine insights in field use.

The ATP features an industry-best 16:1 overall pressure ratio (OPR), enabling the engine to achieve as much as 15 percent lower fuel burn and 10 percent higher cruise power compared to competitor offerings in the same size class with better time between overhaul (TBO) and class-leading performance retention. Some of the ATP's advantages are credited to the industry-first technology designed into the engine.

The use of additive manufacturing has simplified the engine's design, with fewer parts and solutions not feasible with conventional technologies, and also produced a lighter, more compact unit. The engine includes parts originally developed for supersonic jet engines. Its designers



used 3-D printing/ALD to combine 855 separate parts into just 12, and deployed digital controls that allow pilots to fly commercial turboprop planes like jets. The use of the ALD technology allows e.g. a hollow design of the air intake screen to

GE AVIATION engine assembly hall.

THE GE Catalyst uses many ALD or 3-D printed parts.

MARINO BORIC

18 YEARS OF EUROPEAN ACTIVITY

BORN IN EUROPE, GE AVIATION'S JOURNEY IN EUROPE HAS GONE a long way till it arrived at the current level. Many things happened on this path which can be condensed to this time line.

2000

▶ The GE Engineering Design Center (EDC) in Warsaw, Poland, was created under an agreement between GE Aviation and the Polish Institute of Aviation. EDC cooperates with GE businesses in aviation, but also in energy, oil and gas, and rail fields. The advanced hot section cooling technology was developed by EDC to meet the GE Catalyst's high power and performance requirements. EDC design responsibility includes all development phases from the conceptual phase through engine certification, and key disciplines including systems integration, mechanical design, thermal, secondary flows, lubrication, and pressurization systems.

2007

▶ GE Aviation acquired Smiths Aerospace in England enabling GE to grow its presence in Europe producing aircraft systems technologies. This includes Dowty Propeller in Gloucester, composite factory (aero-structures) in Hamble, and an electrical power R&D center in Cheltenham.

2008

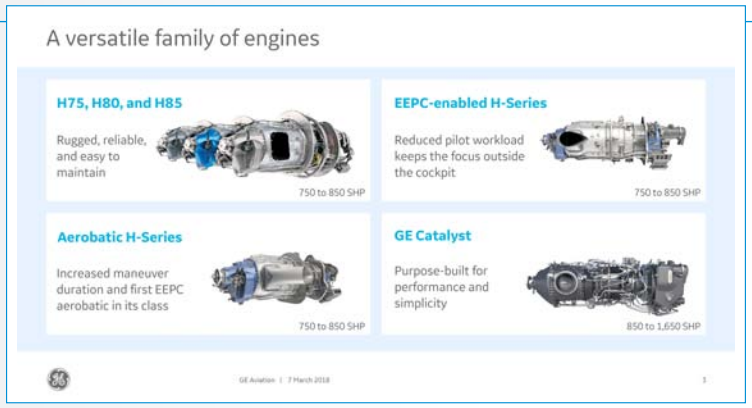
▶ GE BGA team was set up to take proven technology developed in GE's commercial engine business and apply it into small engines in the business/general aviation market space. The Czech Walter M601 was an engine which to GE confirmed that it could do while building domain expertise in the turboprop space. This led to the development of a clean-sheet design, now known as the GE Catalyst.

2013

▶ GE acquired the Avio Aero in Italy which extended GE's participation and expertise in the areas of mechanical transmission systems, additive processes, low-pressure turbines, combustion technology, and automation systems. Avio Aero sites are located in Turin, Pomigliano d'Arco (Naples), and Brindisi. In this plant, later this year the additive-manufactured components of the GE Catalyst engine will be produced. Avio is also testing the Catalyst FADEC system. www.avioaero.com

2016

▶ GE finalized the agreement with the Czech government to build its new turboprop headquarters for development, test, engine-production and overhaul in the Czech Republic.



▶ GE opened a global digital hub in Hungary as a strategic partner of the Hungarian government, and continues to invest and develop its industrial footprint in Hungary. With an investment of approximately $30 million US, GE opened one of its six global digital hubs in Budapest. It will be responsible for software development, business processes and application resiliency, building and running infrastructure, and offering access to big data solutions. This includes GE's Predix software, which the CVUT team (Czech University) was given access to build a turboprop engine health monitoring system. Delivering: Software and data solutions.

▶ GE purchased controlling shares of the Swedisch Arcam AB. The company is the inventor of electron beam melting machines for metal-based additive manufacturing, and the manufacturer and a producer of advanced metal powders with customers in the aerospace and orthopedic industries. It delivers additive machines as part of GE Additive.

▶ GE acquired 75 percent stake of the German Concept Laser, an additive machines manufacturer which is collaborating with the GE Additive Technology Center (ATC) in Cincinnati. There, GE engineers are identifying where additive manufacturing can be used to mass-produce sophisticated components for industrial products, including components for jet engines produced by GE Aviation. Today, GE owns around a 95 percent stake in the German company and plans to buy out the remaining shares. Delivering: Additive machines as part of GE Additive.

2017

▶ GE Additive opened a 2,700-square-foot Customer Experience Center in Munich, Germany which is co-located with GE's European Technology Center, and allows GE customers to experience every aspect of the additive manufacturing process from design, prototyping to operations. Here engineers have performed the test of the GE Catalyst Axial-Centrifugal Compressor Vehicle (ACCV). Delivering: Additive designs and prototypes.

ABOVE: H Series test bench control panel. Top right: H Series test stand is used to test aerobatic and unusual attitudes of engines. Bottom right: H Series test bench.
MARINO BORIC

the compressor, through the hollow mesh oil generated heat to prevent ice crystals to be ingested by the engine.

More GE Catalyst engines are being assembled (the parts of the fifth Catalyst were in the final assembly room fine balanced during our visit) with up to 10 this year, which will be tested in the GE Prague test facility in coming months.

The first aircraft equipped with the clean-sheet Catalyst engine will be another clean-sheet design for the Cessna Denali scheduled to enter service in 2020.

Thanks to Catalyst's dual FADEC system (digital turbine control) this turbine will be much more fuel efficient than existing designs and will give the turboprop pilots jet feel thanks to its single lever control. Thanks to its fully digital architecture — from the birth to resale — this engine will be run much more precise, burning less fuel, keeping the power to higher altitude because it has — first time in this turboprop class — variable stator vanes. The Catalyst will react faster to pilot input because the FADEC digitally controls not only the power but even the propeller pitch which according to Mottier means that full power means full power, or that any selected power will deliver exactly the selected value of available power. Simone Castellani, one of the lead development engineers of the GE Catalyst's digital controls, said that the full authority digital engine and propeller control (FADEPC) will make flying turboprops so easy "my mom could do it. In a way, it is just like flying a scooter."

This translates to a simplified cockpit, with a true single-lever operation, and ultimately less pilot workload. According to GE, the Catalyst family of powerplants will have on-condition maintenance — without any hot section inspection — and will have the ability to track exact flying conditions sending the engine flight data after landing to the manufacturer.

DIGITAL TWIN

Digital twin technology eliminates guesswork from determining the best course of action to service critical physical assets, from engines to power turbines. GE technology digs into any data, following the digital thread that defines its life-cycle. The thread starts with the development of a new jet engine/part, from the design through the build phase. This thread continues into the operation of the asset and its service history — all to predict what will come next, and suggest improvements and optimization throughout the cycle.

The digital twin is built on Predix, GE's platform for the Industrial Internet, which enables it to unravel that data and discern what may happen next with an asset, while continuously learning and improving the models. This technology is a natural fit for the aviation industry, where unexpected equipment failure is not an option. In aviation, Mottier told us, for example, GE collects operational parameters of turbines installed on GE's two Honda Jets to predict maintenance and to prevent failures. ***AMT***

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JUST CULTURE STORIES: THE GOOD, THE BAD, AND THE UGLY

By Dr. Bill Johnson

THE AUTHOR TELLS THREE STORIES ABOUT VOLUNTARY reporting and Just Culture. Fitting for this month's international theme, the stories reflect cultures from North America, Europe, and Asia.

A colleague from a U.S. university called and asked me for example stories related to the implementation of Just Culture. We spoke for a while as my memory and inclination for storytelling churned up a few examples. At the end of the conversation, the colleague said something like "Bill, those stories are great, you should write them down." Read on and decide for yourself if they have value to you. The stories are as true as my memory permits.

GENERALLY RECOGNIZED ATTRIBUTES FOR A JUST CULTURE

The term "Just Culture" is a household word in aviation safety. The concept advocates responsibility and accountability for each worker. It extends that accountability to the entire organization. Sometimes error is a function of human frailty, or even misfortune. Sometimes the root cause of an error goes beyond human performance and rests with the work environment, the expected activity, and the resources necessary to complete work safely, effectively, and efficiently.

Elements of Just Culture usually include clear communication and trust between labor and management, shared value

of safety, shared desire to know about errors and to prevent reoccurrences, a system to report and investigate events, and a cooperative national aviation authority. The Just Culture policy is usually documented and well understood. Everyone must be "on board" to achieve the just culture.

Just Culture programs can be complemented with investigative tools like Boeing's MEDA (Maintenance Error Decision Aide, see article on Page 6) and analytic tools like the Outcome Engenuity Just Culture Algorithm or the Baines Simmons FAiR System. Regulatory programs like the Aviation Safety Reporting System (ASRS), the Aviation Safety Action Program (ASAP), and other voluntary disclosure programs support just culture.

With that said, this article is about stories. It is not a Just Culture lecture.

THE GOOD STORY: JUST CULTURE BEFORE IT WAS COOL

A large German engineering company had expanded its MRO around Europe (West and East), into the Americas, and then to Asia, both via organic growth and via acquiring existing MRO facilities. Typically, the German company would rotate executives from the parent company into local management roles. The role would be held for a few years. This story is about the first rotation of a German executive into the Asian work environment.

On one of the German executive's first days on the job at a newly acquired MRO facility, there occurred a significant maintenance error. An engineering crew damaged a large engine cowling during removal by using the hangar lift. The damage to the cowling was extensive. All employees fully expected termination of the lift operator, who appeared to be the most responsible party. It was likely that other licensed engineers would also lose their long-time jobs.

The new German expatriate executive took the lead on the investigation. There had not been an explicit Just Culture policy since this event preceded popular adoption of such a concept. Immediately, the executive looked at the work environment, how the workers were trained for the engine cowl removal task, the clarity of the procedures, the adequacy of support equipment, and more. He and his team concluded that some aspects of the work environment — procedures, training, human factors approach,

etc. — had not positioned the workers for success and that the maintenance error had been an honest mistake. In a quest for justice, the executive did not fire anyone. They addressed all the contributing factors and installed a replacement cowl.

Later on, the German executive asked the same engineer to operate the lift for the new cowling installation. That was just! The entire workforce learned of the "damaged engine cowl event" and the fair treatment of the worker. That show of Just Culture influenced the new German-Asian cooperation in a manner that has had an extraordinary long-term impact on safety and efficiency.

The moral to this story is that you do not need a lot of process and procedures to achieve justice. While written policy is very important, a just attitude is most important.

THE BAD STORY:
A SMALL ERROR DURING TRAINING CAN BE COSTLY

This story goes back nearly eight years, when Airlines for America (A4A) cooperated with the FAA to design, develop, and implement a ground/maintenance version of the Flight Ops Line Operations Safety Audit (LOSA). The maintenance LOSA development process and all related products are available at www.humanfactorsinfo.com.

LOSA is a peer-to-peer assessment that takes place during normal operations. It does not have to be triggered by an event. LOSA permits observers to identify the strengths and weaknesses in the organization. Observations are absolutely nonpunitive because no names or identifying characteristics are recorded. Using a threat and error system, the observer may look at safety threats and whether the workers are managing the threats, or not.

Training is critical for LOSA programs to succeed. All employees must understand the LOSA concept. The general population of employees must know that LOSA observations are nonthreatening. LOSA observers require about eight hours of training to ensure that protocols are followed and that data is somewhat consistent among observers.

The negative story occurred during initial testing of the LOSA observation training. The LOSA team and trainers were preparing to launch LOSA at a package carrier for ground observations. In order to start the LOSA testing, there were extensive deliberations between labor and management. It was further complicated by FAA LOSA involvement. It took nearly nine months for all to agree to the LOSA test.

Because it was still in testing, necessary critical LOSA training was not delivered to all employees. The workforce merely saw people with clipboards walking around ground operations. That is seldom a welcome sight. The labor leaders told employees not to worry because it was a test and, in any case, no one would record names.

As fate would have it, one of the LOSA observation trainees noticed that a worker was not wearing protective shoes. Of course, that is a threat to worker safety. It was a valid LOSA observation and the observer noted it. Coincidently, the observer trainee was a friend and next-door neighbor of the manager of that area. During a coffee break the trainee saw the manager in the hallway and casually mentioned the improper footwear observation. The manager proceeded to send the worker home for the day without pay! That small incident negated nine months of planning and set the LOSA implementation back at least an additional year.

The lesson learned is that you cannot half-way implement a critical program. The observer was not ready, the manager was not ready, and what little the workforce knew was wrong on the very first day. That was bad!

THE UGLY STORY:
BE SURE THAT THE POLICY IS CLEAR TO EVERYONE

Just Culture implementation is not without growing pains. As early as the mid-1990s some airlines were listening to James Reason. Early adopters saw the safety, efficiency, and fairness merits of a voluntary reporting system based on just investigations. One such large carrier decided to test the voluntary reporting concepts. It was a large company with a powerful labor union. The top labor leaders and senior managers saw the potential benefits. When an event occurred everyone wanted to determine the root cause and find corrective actions.

The company went to great lengths to establish reporting procedures and Just Culture policies. The combination of the union and management delivered training to everyone. Since it was a radically new program, not all managers were convinced of its value and were concerned that it might lessen accountability. Many workers were fearful that a reported error would trigger disciplinary action.

Most Just Culture champions were at corporate headquarters where the largest repair facility was based. Leadership decided that the initial implementation would be at a satellite repair facility. The reasonable expectation was that it would be easier to ensure 100 percent training coverage for all of management and labor at the smaller facility.

Very early in the Just Culture implementation there was a maintenance event that would require expensive rework. The workers made a mistake. The supervisors and middle management understood the error and did not take action against the errant workers. When the top manager at the satellite facility saw the cost of the error, he took immediate disciplinary action against not only the workers but also the managers who followed the Just Culture policy.

The union at all company facilities justifiably pulled out of all Just Culture participation. It was years before confidence in Just Culture was restored. That was ugly!

SUMMARY

When it comes to voluntary reporting, there are many good, bad, and ugly stories. As you read this article, I am sure you thought of examples from your own experience. As I wrote this article and this summary, I thought of many more. Let me end on a positive note please. I went to an ASAP Event Review Committee meeting. It was like a courtroom hearing. A representative of the errant mechanic admitted that the mechanic did not follow a procedure. He reported the error. In this case, the company representative felt that there should be a stiff penalty. The labor representative felt that a mild letter of reprimand would be acceptable. The FAA member was the last to vote to achieve the necessary unanimous vote for action against the employee. He firmly stated: "I worked at an airline just like this one, with the same aircraft, for 20 years. Nearly everyone ignored that procedure. Let's stop blaming the worker and fix the procedure." THE END! ***AMT***

CORRECTIONS

Apologies to readers and Lufthansa Technik as the March issue had the wrong page number in the Contents page. It should have been Page 6 on the photo.

The caption on Page 30 should have read: B737 Winglet having the contour inspection performed prior to going to paint at Aviation Technical Services (ATS).

VISION JET WINS ROBERT J. COLLIER TROPHY

The National Aeronautic Association (NAA) announced that the Cirrus Aircraft Vision Jet has been awarded the 2017 Robert J. Collier Trophy for developing the world's first single engine Personal Jet and implementing the Cirrus Airframe Parachute System (CAPS) on the aircraft.

The Collier Trophy is selected by a committee that includes 25 industry leaders and is awarded annually to recognize "the

greatest achievement in aeronautics or astronautics in America, with respect to improving the performance, efficiency, and safety in air or space vehicles, the value of which has been thoroughly demonstrated by actual use during the preceding year." The nine nominees this year included the Edwards Air Force Base F-35 Integrated Test Force, Boeing 737 MAX, NASA/JPL Cassini Project Team and more.

"The arrival of the Vision Jet has forever changed general aviation and personal transportation" says Dale Klapmeier, Cirrus Aircraft co-founder and CEO, "and the 2017 Collier Trophy is dedicated to all of our employees and partners who have been a part of the development, production, and now delivery of this game-changing airplane. We will celebrate this great honor by continuing to focus on our core mission of creating safer aircraft, safer pilots, and safer skies."

LOCKHEED MARTIN WINS $248 MILLION CONTRACT TO BUILD NASA SUPERSONIC X-PLANE

Lockheed Martin Skunk Works has won a $247.5-million contract to build an X-plane for NASA that will be capable of flying at supersonic speeds without generating such a loud sonic boom.

The full-scale plane, known as the low-boom flight demonstrator, is to be built at the Skunk Works facility in Palmdale. The plane's first flight is set for 2021.

The X-plane is intended to create a "gentle thump" during flight, a sound that would be no louder than closing a car door, while cruising at about 940 mph at 55,000 feet, according to NASA.

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TELLING YOU WHAT **YOU ALREADY KNOW**

Illustrating a problem repeatedly is the only way to move toward action

AVIATION INTEREST GROUPS — particularly those like ARSA with a strong concern for the maintenance workforce — have spent a lot of time talking about the challenge of finding and retaining technical talent. After a while, the conversation becomes very familiar. When meeting with lawmakers, industry advocates, or government officials, you don't have to get too far into describing the issue before being hurriedly assured that your conversation partner gets it.

And they do, because they've heard the same story from every industry that depends on skilled workers: It's getting harder and harder to find new applicants to replace a quickly aging labor force and younger technicians and engineers already working are less likely to stay put than their predecessors.

Why do we spend so much time telling people what they already know? Why do we constantly reinforce that there's a looming crisis in the aviation workforce?

Because we have to. Illustrating a problem repeatedly is the only way to move toward action. The story also gets better with each telling, as more data, different perspectives, and more-pressing examples become available to support the central point that we need more people.

When this year's attendees arrived for ARSA's 2018 Symposium Week, dozens headed to Capitol Hill to update their members of Congress on the issues that matter to repair stations. As usual, they were prepped with good data provided to ARSA by Oliver Wyman's CAVOK division in the form of the 2018 Global Fleet & MRO Market Assessment. According to the U.S.-specific analysis provided to ARSA members through the report, there are 275,000 American workers in the aviation maintenance industry contributing $44 billion to the nation's economy and helping to ensure the safety of civil aircraft operating worldwide right now.

CAVOK projects that new technologies, a rising global middle class, and expanding fleets will drive the global aircraft maintenance market well beyond $100 billion in the next decade. However, demand for technicians will outstrip supply beginning in 2022; by 2028, the available workforce will fall 9 percent short of the number needed by employers. Realizing growth opportunity is difficult without people to do the work.

ARSA's own data suggests the impact is already being felt: More than 80 percent of respondents to the association's 2018 member survey report difficulty finding qualified technicians and half of respondents have unfilled positions. As a result, companies say it is taking longer to complete work for customers, that they are not adding new technical capabilities, and in some cases are turning down new business. Last year, we projected that the inability to fill open vacancies could already be costing repair stations $2 billion a year. Considering the fact that we're not even "short" of workers yet, it's pretty clear we're already in crisis.

The numbers provided to symposium attendees fit into the same narrative as those in reports by other industry and media organizations, including Boeing and Airbus, for years. In February, the club of organizations describing a workforce shortage was joined by our colleagues at Helicopter Association International. HAI projects the rotorcraft industry alone will fall more than 40,000 technicians short of the industry's need between now and 2038.

The good news for ARSA's participants on the Hill — and for all of our aviation allies — is that they had an answer to the inevitable question: **What do we do about it?**

Help us pilot an aviation maintenance workforce development grant program.

The program was laid out in legislation introduced on March 7 by a bipartisan group of U.S. senators. The bill authored by Senators James Inhofe (R-OK), Richard Blumenthal (D-CT), Jerry Moran (R-KS), and Maria Cantwell (D-WA) would establish a program to train maintenance professionals, help veterans transition to civilian careers, and recruit new technicians. Grants of up to $500,000 per year would be available to businesses or unions, schools, and governmental entities that partner to pursue creative solutions to one of the aviation community's most pressing strategic challenges.

Given the scale of the threat, 17 leading aviation organizations joined a letter coordinated by ARSA in support of the bill and delivered to the sponsoring senators on March 5. Armed with all this information, the aviation professionals on the Hill in March had one of the first concrete, albeit humble, steps toward turning the trend identified by CAVOK, HAI, and so many others around.

ARSA and its allies are working to gather additional sponsors to the Senate bill and get a companion to it introduced in the House. Stay tuned as the process, which will hopefully take advantage of the FAA bill's expected progress through Congress this summer, continues.

We've gotten good at telling each other what we already know … it's a nice change to know something can be done about it.

To see everything that happened at Legislative Day and throughout ARSA's 2018 Symposium Week, visit arsa.org/symposium. ***AMT***

BRETT LEVANTO is vice president of operations of Obadal, Filler, MacLeod & Klein, P.L.C. managing firm and client communications in conjunction with regulatory and legislative policy initiatives. He provides strategic and logistical support for the Aeronautical Repair Station Association.

SKYSCAPES GENERAL AVIATION BASECOAT SYSTEM OFFERS COMPLETE CHOICE OF CLEARCOATS

HIGH GLOSS FINISH DELIVERS MAXIMUM APPEARANCE AND PRODUCTIVITY

- Available in a solid, mica or metallic finish
- One double track coat application for most colors
- No baking required; dries quickly at ambient temperatures
- Apply additional colors without mechanically sanding
- Excellent opacity at low film thickness
- Excellent flow and leveling
- Easy to keep clean, maintain and repair

For information on the new clearcoat or the entire SKYscapes General Aviation Basecoat or other Sherwin-Williams Aerospace Coatings, call 888-888-5593 or visit swaerospace.com.

SHERWIN-WILLIAMS
Aerospace Coatings

Ideal for exterior painting on general aviation and helicopters, Sherwin-Williams Aerospace Coatings presents the SKYscapes® General Aviation (GA) Basecoat 855 Series – SG, SGE, SGM and SGP Colors.

It is designed to deliver the maximum in appearance and productivity by delivering a consistent and colorful solid, mica or metallic finish.

SKYscapes GA Basecoat features fast dry times (approximately 60 – 90 minute Dry-to-touch time), that lead to improved productivity, an easy 6 to 1 to 2 mixing ratio and excellent flow and leveling. After clearcoat, it provides a high gloss finish that can be easily cleaned, buffed and repaired.

AIRCRAFT OWNERS DEMAND ON-TIME DELIVERY

This SKYscapes GA basecoat-clearcoat system can reduce paint-process time to help meet customer demand for aircraft turnaround. That's because the SKYscapes system cures at ambient temperature in half the time of most single-stage systems.

Professional aircraft painters now have the option of which Clearcoat to use with one of three Sherwin-Williams SKYscapes systems: General Aviation Clearcoat - CM0850CC1 for increased speed; SKYscapes Clearcoat - CM0850180 - for improved chemical and fluid resistance; or our new SKYscapes GA clearcoat - CM0855CC3 - which combines the best of the two existing clears to allow it to be sped up or slowed down depending on the variety of aircraft applications and sizes.

SKYSCAPES GA BASECOAT ADVANTAGES:

- Quick drying; Allows for multiple color livery applications per day
- For small general aviation aircraft and helicopters requiring expedited production times

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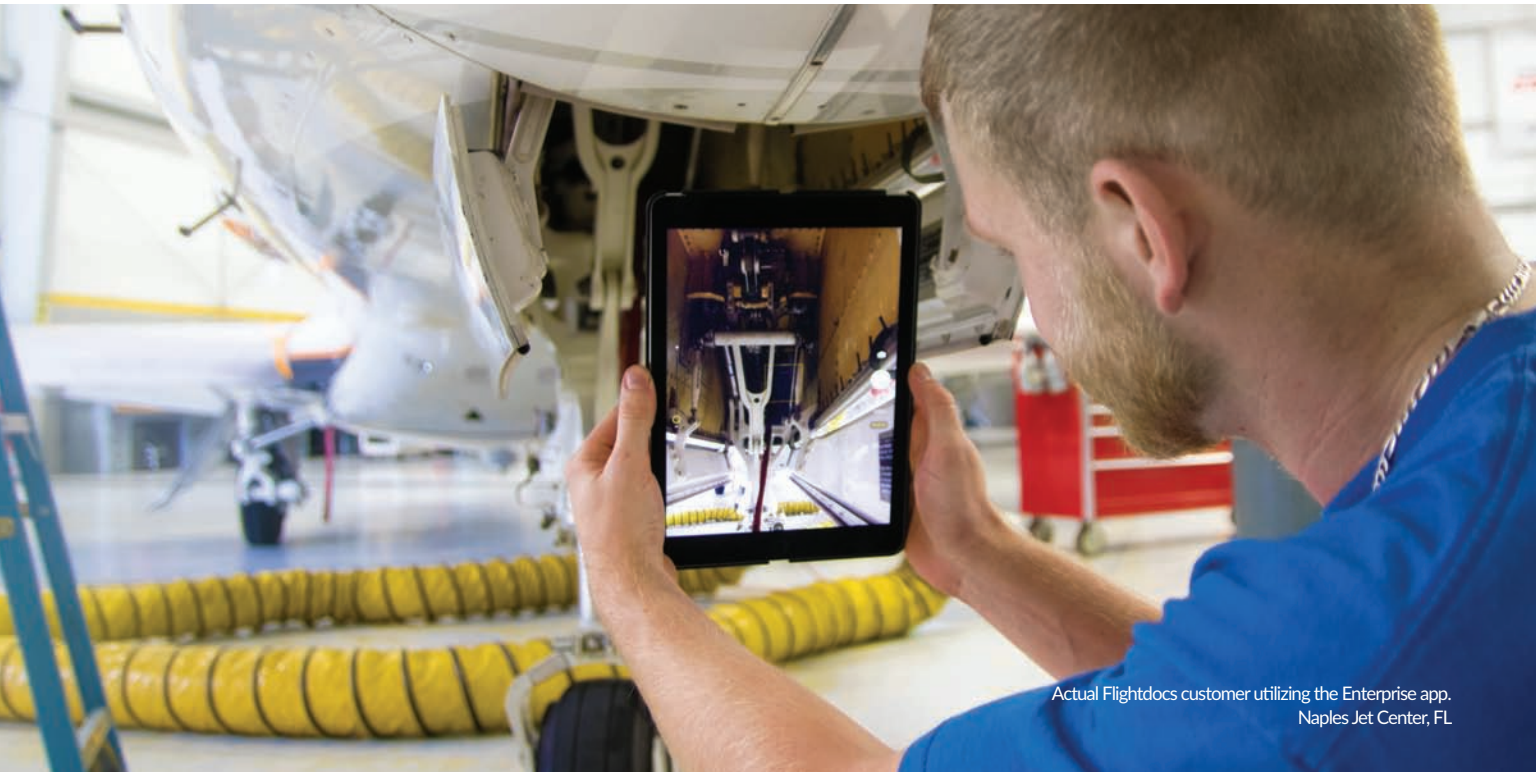
#1 Operator Recommended
Maintenance Management System



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Naples Jet Center, FL

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