Reflections on
Corporate Culture and Consequences

By Peter Morton
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1 Introduction

The Boeing 737 MAX accidents were a spur to think about near-term and long-term factors that played a role in these tragedies. Over a period of time in 2019 I wrote several letters and emails to fellow retirees and Boeing leaders expressing opinions bearing on the subject. In two cases I had direct "official" interactions with Boeing leaders, once at a Boeing-sponsored gathering for about 200 retirees hosted by the VP Engineering, and once at a workshop of retired and current flight deck designers exploring implications of the accidents on future flight deck design. During this workshop I presented material about demographics and skills emerging in the future pilot population; this event was attended under a non-disclosure agreement, so I am not free to discuss material learned. I own the rights to the presentation which is based on my involvement as an officer of the Aviation Accreditation Board International (www.aabi.aero).

This essay was inspired by a contact from Amelia Green-Dove on April 10, 2020, who said she is working on a Ron Howard Netflix production on the MAX. She indicated that Stan Sorscher had provided my name and contact information. The essay gathers material, including some contained in appendices, into a causal factor exploration of the circumstances that led, in my opinion, to the 737 MAX accidents. The history and conclusions are my own, colored by interactions and inputs verbal and written with/from fellow retirees*, and the experiences of a 42 year career at Boeing between July 1958 when I started in the Boeing Transport Division as a flight crew ground instructor on the 707 program and June 2000 retirement as vice president human resources (official title was "Vice President People") for Boeing Commercial Airplanes. The material is necessarily limited by imperfect knowledge and imperfect memory; and inspired by a passion for the Company that gave me a fulfilling and productive career.

The new purpose of this essay emerged in the writing, which is to document evolution in Boeing corporate culture. This is a broad topic. It underpins many formal and informal processes that provide character and inspiration to all stakeholders of the enterprise. Much of what we call "culture" is not documented, but everyone knows what it is, the behaviors expected, the joys of success, and the consequences of failure. I am attempting to describe what is usually not described, identify elements of leadership evolved over decades in which the leaders rarely were expository, and in which their actions set the tone for communication, inspiration, and commitment. I am not a social scientist and apologize for that shortcoming.

Hopefully this essay has value to persons who intend to do justice to thousands of Boeing employees for whom their work is a sacred calling. All of us and each of us identify with the nature of our product, and that above all it must be safe so that we are at ease when our families, friends, and strangers set off on a flight in a Boeing airplane. We say, tongue only partially in cheek, "If it is not Boeing, I'm not going".

Attribution: I provide this material hoping that attribution of content or mention of names in this document, including my own, will take place after specific approval by me. I prepared a letter of transmittal to provide as much assurance as I can that this will be so and in the spirit intended.

*Drafts of this essay were reviewed and commented on by four retirees; a senior training pilot, a technology staff leader, and two former senior company officers. I asked a friend to review/proof the essay. He is a professional technical writer retired from the pharmaceutical industry. He made the point that the considerable cross-referencing within the essay would benefit from a clear structure, a table of contents, and internal hyperlinking to assist reader navigation.

2 Qualifications and Experience

My experience relevant to this paper include the following:

1958 Assigned as a working level flight crew ground instructor to research, gather, assemble, prepare supporting illustrations and schematics, and present technical data about 707 airplane systems and performance to airline flight crews. I developed curricula for hands-on training in a 707 procedures trainer and supervised training in the device.

1958 – 1970 Authored technical reference and certification material for Flight Operations Manuals, FAA Approved Airplane Flight Manuals, Flight Training Manuals, a Jet Transport Performance Methods Text, the content of the Boeing proposed drafts of Master Minimum Equipment Lists and Dispatch Deviation Guides, and customer correspondence.

1966 Served as a performance engineer and later as first line supervisor in Flight Operations Engineering (FLOE), a group tasked with creating performance reference materials for flight crews, assisting airlines in the introduction of Boeing jet transports into commercial service, and managing technical correspondence with customers.

1970 Manager Flight Technical Section; which included flight crew ground training, FLOE, and graphics production supporting those organizations.

1972 737 Marketing Manager, assisting the Boeing sales department with technical support both at home and in the field.

1976 747 Marketing Manager, assisting the Boeing sales department with technical support both at home and in the field.

1978 757 Senior Project Engineer Flight Deck.

1982 707/727/737 Division (later “Renton Division”) Director Program Management.

1983 Director Boeing Commercial Sales Operations supporting sales and marketing activity.

1985 7J7 Program, Director of Program and Cost Management. This airplane model was never produced, however it developed and piloted many process and product technologies later introduced in the 777 program.

1987 Director of Customer Training and Flight Operations Support. This assignment encompassed the entire organization in which I had started 29 years previous. The pilot ground and flight schools staffs, simulator organization, graphics production, Flight Operations Engineering, and Maintenance Training organizations reported to me.

1995 & 1998 My last two assignments were as Vice President Boeing Center for Leadership and Learning for Boeing Corporate and Vice President People for Boeing Commercial; both of which involved immersion into Boeing leadership culture and practices, and considerable interaction with senior leaders of the corporation.

3 Boeing Culture

My first contact with Boeing engineering culture in 1958 was to discover that there were two independent engineering functions in the company, designated as “Project” and “Technology Staff”; the latter often called “Staff”. When I would research matters for presentation to pilots in classes during the 1958-1965 time period, through the time when I completed the engineering assignment as a Senior Project Engineer on the 757 in 1982, the breakdown of responsibilities was roughly:

3.1 Engineering Project

- Designs mechanical and structural elements of the product and releases engineering drawings to the factory for fabrication or to the procurement organization as technical specifications to purchase subcontracted parts, assemblies, devices and systems.
- Interacts with factory operations and suppliers to deal with production issues.

3.2 Engineering Technology Staff

- Creates Design Requirements and Objectives for each airplane product, establishes performance specifications and requirements for which the Project must design. These include regulatory certification requirements.
- Conducts applied research when necessary to support technology inclusion in the assigned program.
- Manages aspects of the design not directly associated with product geometry or components, such as aerodynamics, stress, and propulsion characteristics, weight and balance, etc.

This above is, fundamentally, a system of practices and procedures which proved over decades to be an effective way to produce airplanes that were safe, efficient, and productive for airlines. I provide more detail about the engineering ecosystem in a short treatise on corporate culture I wrote in October of 2019; see Appendix E. I do not know the origin of this structure, perhaps it came from legendary early engineering leaders like Ed Wells, George Schairer, and Bill Cook.

3.3 Related Company Functions

Engineering Project and Technology staff feed into and are supported by other division or company wide functions, including:

- A specialized function called Product Development interacts with Sales and Marketing Departments to evaluate new product opportunities and keep track of competitor activities. It prepares preliminary design with sufficient detail to assess technology maturity, estimate costs and schedules, and prepare material for hand off to a formal production division following a new or derivative product launch.
- Factory operations, the fabrication and assembly activity and facilities is an entirely different function involving very large numbers of factory workers who execute the engineering design against schedule and cost targets associated with the particular product.
- Procurement; managing the business of supplier relationships.
- Product testing and customer service; quasi-independent functions interacting with engineering to assure performance, compliance with regulations, training, and reliable service.
- Financial management, human resources, and other support functions establish relevant practices and measure business performance.

4 Description of Boeing Ecosystem

The above is a description of the ecosystem of Boeing when I was hired, most of which still prevailed through the 1995 777 program time period. With a number of progressive refinements along the way, its impact on how a product was conceived, launched, developed, engineered, fabricated, assembled, tested, delivered and supported was profound. It was Boeing "culture".

The 777 program is worth special mention. During the 777 program, "concurrent engineering" (we called it "Design Build Teams"), electronic drawings and mockups, and a number of other innovations, applied in a practice called "Working Together" emerged as powerful cultural elements of how people behaved, interacted and broke down barriers among classical "fiefdoms". They established formal, and some informal unwritten practices that I believe came to an apex in the 777:

- Checks and balances among Project and Technology Staff were strong, but not adversarial.
- A culture of transparency prevailed so that managers and senior leaders actually behaved to "welcome bad news", and never "shot the messenger".
- Leadership matters. Both the 757 (Phil Condit) and the 777 (Phil as 777 general manager and Alan Mulally as VP engineering, later general manager) had leaders who were comfortable roaming the design and factory floors, were accessible, did not feel like they had to be the first or loudest voice in the room or in a meeting, and welcomed and rewarded interactions with support organizations like Flight Test and Customer Services.
- Example of spirit over ego: Boeing tradition was to inscribe flight crew names under the pilots' windows on the first airplane of a model. With the concurrence of its pilots, the 777 #1 airplane was inscribed "Working Together". See Appendix A
- Example of inter-organizational Working Together intangibles: in 1994, my Customer Training organization was responsible for the operations manual for the 777. The 777 Operations Manual team completed the first draft of the manual, every technical writer signed the document, and insisted their supervisor take it to Everett and present it ceremonially to Alan Mulally, VP General Manager of the 777. Alan received the document with great respect, praised the work, and put it in a prominent location on the bookshelf behind his desk.
- Example of transparency: Karl Sabbagh, world famous author and film producer (https://en.wikipedia.org/wiki/Karl_Sabbagh) requested of Phil and Alan that he be allowed to film 777 engineering in action. They invited Karl to be "embedded" in the 777 program and the product was a video series and companion book called Twenty-First-Century Jet: The Making and Marketing of the Boeing 777 (1996) (See Appendix A). Phil had previously experimented with transparency as leader of the 757 program, inviting Seattle Times reporter Peter Rinearson into the organization without restrictions on who he could talk to or what he might write; his series of articles won a Pulitzer.
- "Working Together", more than a leadership slogan, was a way of life on the program.

A caveat about the 777 program: The Project and Technology Staff organizations and reporting relationships differed from past programs. While functions persisted at the working, first-line, and mid-level manager levels, there was no longer a "Chief of Technology Staff" to whom all the functional Staff chiefs reported. Chief Engineers responsible for both Project and Staff activity for each function (i.e. electrical, propulsion, ECS, avionics, flight deck, etc.) reported to the VP engineering. I find it intriguing that the engineering processes and underlying integrity was so well embedded in team member behaviors that resolution of issues, disagreements, challenges, etc. were resolved seamlessly without the previous hierarchical organization model. Perhaps habits were engrained; perhaps Working Together Principles prevailed; perhaps Phil's and Alan's culture-by-design was sufficient. In any event, I maintain the 777 was "Boeing's Camelot", and submit that a future commercial program can select from its history to replicate its success.

4.1 What Happened and What Did Not Happen

The culture described above may appear wasteful from a resource and financial point of view. However, having two engineering departments "looking over each other's' shoulders" produced really high-quality results. The subtleties are important:

- Yes, there are more people (engineers) involved, and there are more managers involved, than the minimum to execute the design. This seems offset by long-term benefits.
- The Project and Staff relationship propagates down the organization for most engineering functions. For example, when I was assigned as the Senior Project Engineer for 757 Flight Deck, my counterpart was Delmar Fadden, Chief Technology Staff Engineer for Flight Deck.
- Del's group wrote the Flight Deck Design Requirements and Objectives which included the certification requirements for a myriad of areas of concentration. Examples:
  - Vision from the flight deck
  - Analysis and testing to confirm crew workload, vital for a two-person crew which is now the default crew complement on jet transports
  - Validate innovations we chose were sufficiently mature to incorporate into the design.
  - Conduct applied research to resolve implementation issues, such as display colors.
  - Develop the test plans that would validate and certify the design.
- My responsibility was to
  - Execute a design that met the requirements and objectives.
  - Release drawings to Operations for parts and assemblies.
  - Work with Operations to build mockups to validate and demonstrate flight deck ergonomics, lighting, emergency egress, control of ambient flight deck humidity, etc.
  - Release specification drawings for procurement of subcontracted items.
  - Work with my counterpart senior project engineers whose systems are controlled from the flight deck to manage crew workload to specified requirements. This involved creating a new Crew/Systems Interface Document to negotiate controls and indicators for hydraulic, electrical, environmental control, and fuel systems, among others.
  - Conduct Preliminary and Critical Design Reviews at approximately the time of 25% and 90% drawing release. To these reviews we invited other Boeing experts and retired senior engineers whose critique we valued and to whose questions we were obligated to respond in a timely fashion.
- I reported to the 757 Chief Project Engineer, my counterpart Staff Chief Del reported to the Chiefs of Technology for the 757 and 767 programs. The 767 was concurrently in design and had a common flight deck with the 757. Del chaired a Flight Deck Committee to resolve issues and differences between the designs; our objective was a common pilot type rating.
- The final authority was the Director of Engineering for the 757. In subsequent programs, this became a VP position, though the function was substantially the same.
  - In the 757, our first director of engineering was a seasoned veteran. On his retirement, Phil Condit assumed the position, and was later promoted to VP General Manager.
  - He presided over the Chief Project Engineer and Chief of Technology Staff and a Director of Costs and Schedules for the 757 and held weekly meetings to track design progress.
  - He resolved disagreements or problems that arose in design, emerged from design reviews or testing, suggestions on cost/weight saving, or technology failures.
  - I can cite numerous examples of such occurrences in my 757 Flight Deck experience.
  - Those of us at the working level strove to avoid such issues, so it was rare that a disagreement would rise to the Director of Engineering; but the existence of the structure was an incentive to work things out cooperatively.

- An example of a significant 757 challenge was when the mechanical linkage between the pilot's thrust levers and the engines was replaced by a "power-by-wire" system for the P&W 2037 engine. To describe how the Project and Staff interacted to assure equivalent safety would require a thesis-level document covering the thorough analysis. To my knowledge, this particular system has proven its integrity over the decades.
- Another less critical design example: provide appropriate lighting for the step down into the 757-flight deck, a condition produced by the geometry of the flight deck. Its similarity with the 767-flight deck which had a step up caused concern that a flight attendant might be injured when entering the flight deck. The thoroughness of the work seems to have avoided a reportable crew accident or injury, for which I am quite proud.

- It sounds like this is a thorough, though perhaps redundant system; however, it is carefully structured so there are few if any overlaps in assignments, and the process proved not to be competitive or adversarial. Responsibility, authority and accountability are clear.

It is impossible to know how many accidents in the 707, 727, 737, 747, 757, and 767 DID NOT occur because of this ecosystem and its effect on aircraft design. The accident rate trend from 1st to 2nd to 3rd generation jet transports is impressive, and I ascribe this evolution partly to engineering design, partly to other factors such as air traffic management, human factors improvements in training, etc. The Boeing design ecosystem was a factor in this trend.

- During and after the 777 program, the discreet hierarchy of the Technology Staff function was largely disbanded, its functions reassigned. The 737 MAX derivative did not have a Technology Staff Chief. There was a Director of Engineering and a Chief Project Engineer, but factors reported surrounding the MAX accidents suggest that the old culture did not prevail and check and balance was substantially weakened, to the detriment of engineering functions and products.
- After 1999, one Boeing first tier avionics suppliers told a Boeing retiree consultant they were scrambling to figure out how to cope with new specifications that did not have the detail of previous years; they did not have the engineering talent available to fill the gap.
- At about the same time senior management decided that managers of engineering groups did not need to possess detailed knowledge of areas they managed. This further reduced probability that technical issues would rise to a level of senior management attention.
- One consequence of these changes was rapid loss of corporate memory about why some things were done in a specific way, particularly why certain requirements were necessary.
- In 1987, after the 757, I was Director of Customer Training and Flight Operations Support. We instituted and established additional checks and balances to be certain of design "trainability" and reliability, in order to maintain operational integrity and flight crew workload of a two-person crew airplane of airplanes in use. I describe these practices in the Appendix D letter I sent to the Boeing CEO and shared with a number of fellow retirees.
- Whether intended or not, the level of interaction between training and engineering was dramatically reduced by a reorganization and separation of training functions in the early 2000s. No attempt was made to develop alternate paths for what had been highly effective Working Together. This was another factor reducing likelihood of catching and correcting the sort of problem posed by MCAS on the MAX before the airplane entered service.
- In our previous environment a more thorough investigation of MCAS alternatives and solutions would have been up for discussion at many stages of the design and testing evolution, as well as by the training pilots, and I believe would have been resolved.

4.2 Understanding the Impact of Corporate Culture

Note: Refer to Appendix E for additional details.

Culture in a corporation includes implicit behaviors that are expected of each other, but not always documented and formalized. I've described Boeing engineering culture evolution above.

Sometimes culture is published; a risky endeavor because people will hold leaders to it. If the "feet walk as the words flow", words can be powerful. If leaders' behaviors contradict the published principles, people's perceptions are honed to notice hypocrisy of deeds versus words, and organizational stratification and fear behaviors develop quickly. Example: I perceive a recent April 2020 publication of values (see Appendix B), does not meet this litmus test precisely because the leaders' actions don't appear to match the words. I've seen the following commentary on culture from a former Boeing company officer:

> If I have a passion in business, it is culture. I have studied, thought about, learned and practiced how culture works in an organization. I cannot overstate how important I believe culture is to success in any organization. Every grouping of people has a culture. Most of the time it is unintentional and the result of the actions of a number of leaders over many years. In many aboriginal tribes, culture was the responsibility of the Shaman. Frequently, the Shaman was not the group leader, but had great influence over the leader and the tribe. A key part of tribal culture was storytelling. Stories are far more powerful than a list or statement of culture.
>
> The culture of the 777 program was very, very intentional. The senior team struggled all day to come up with the statement *"People Working Together to Produce the Preferred New Airplane Family."* Every word (with the exception of *"to"* and *"the"*) had deep meaning. It started with *People,* the absolute key to a successful culture. *Working Together* was to be the definition of how the culture would operate. *Preferred* was a statement that only the customer could define the ultimate quality of the airplane. *New Airplane Family* was a statement that this would be an all new airplane and that there would be other members to the family.
>
> The statement was reinforced by several important things. The first was "Boot Camp." On the 757, we found that when people joined a new program they brought along the culture of their previous experience. So, we determined that each person coming onto the 777 would attend an indoctrination class where the culture was introduced. The next was frequent communication including all team meetings. The leadership team met offsite regularly under the guidance of our own organization development "Shaman" to focus on the culture of the organization.
>
> The idea of customer-in design meetings with explicit input from customers received considerable initial push-back. The complaint was that customers don't understand design. In fact, the customers did not want to design the airplane, they wanted to express what it was like to operate the airplane. There were thousands of customer ideas that made the 777 even better. The rollout events were another example of communication and employee involvement with thousands of employees attending with families. Nothing about the 777 culture was an accident.

When the 777 program was launched in 1990 with United Airlines as the first customer, Phil Condit, then 777 VP General Manager and the Executive VP Operations at United created an audacious document which became part of 777 Program culture; Appendix C. Read it and imagine legal interpretations! Fast forward to 1995; Boeing did indeed deliver a product that met all of these attributes, and the 777 benchmark in safety, reliability, and customer satisfaction has not been matched by any subsequent transport product, from Boeing or others.

Alan Mulally, then 777 VP Engineering, developed and published a set of Principles and Practices, which documented many expected behaviors; they are attached to this essay in Appendix A. Applied as part of a "Working Together Management System", they were embedded into a weekly Business Process Review with a medley of complementary cultural practices.

These artifacts: the program launch document, the one-line statement, the Principles and Practices, the Working Together Management System, collectively completed the underlying culture of the 777 program, and are part of why I refer to the 777 program as "Boeing's Camelot". There was no hypocrisy in how the systems worked, and the Program was a joy to work in or be associated with. Had this become the ongoing pattern for the Company, the 787 would not have been so many years late, and the 737 MAX MCAS problems would not have occurred, see my analysis that follows.

When Alan became President of Boeing Commercial, he refined these Principles and Practices as well as the Working Together Management System to lead all of Boeing Commercial. I reported directly to Alan as VP People and experienced first-hand the culture and effectiveness of the process. Alan left Boeing in 2006 to become President of Ford Motor Company, where he applied the same ideas. Wikipedia includes links to many of his contributions as a business leader. Read American Icon to fully understand the versatility and application of these ideas. Fortune listed him in 2014 as #3 leader in the world in an article on the subject; whether this is hyperbole or not, it is important to reflect on how these processes evolved, and think about how they might be applied once again to help resurrect the greatness that once was Boeing. If that sounds like lamenting the loss of Camelot, so be it. I'm told that in subsequent years, Jim McNerney made it a point to have "Working Together" signs removed from company premises.

4.3 Factors Leading to the MAX Accidents

I don't want this work to be simply an analysis of the 737 MAX accidents, yet composition of this essay was inspired by that question. It is risky to assign cause and effect to catastrophic events, because proximate cause is often not a root cause. Some in the media and pundits have published sensationalistic conclusions, and some facts and findings are still being released.

Connecting culture changes that in the aggregate led to MAX design and test issues not being recognized and corrected before the airplane went into service is itself very much like links in the chain leading to any accident. Any single element of the chain might have been handled differently resulting in a different outcome. No single element is exclusively the single cause, but in total they made the safety risk high enough that the set of circumstances leading to an accident were no longer "extremely improbable", a phrase that has explicit technical meaning at Boeing and the FAA, denoting the probability of an occurrence as less than 10^9. With these caveats, my analysis of factors leading to MAX accidents, are, listed as follows, in chronological order.

4.3.1 1996 McDonnell Douglas Merger – Resulting Cultural Shifts

The medley of stakeholders in Boeing and most companies includes:

- Community
- Customers
- Employees
- Shareholders
- Suppliers

I have listed them in alphabetical order; I have my opinion of which deserve preeminence above others, but no one denies all must be considered. Ignoring any one of them is a recipe for failure. Focusing excessive attention on any one of them at the expense of others may be a recipe for disaster depending on the product and how it intersects with society, and I believe the merger brought about an obsessive focus on shareholders; following the well-known "Jack Welch" values of:

- RONA above all else
- 10% of employees are incompetent, untrustworthy, or both, and should be shed every year
- Adversarial competition will cause the best to rise to the top.

So, I ascribe a leadership factor to the MAX accidents, starting with Harry Stonecipher. He was CEO of McDonnell Douglas and Boeing COO after the merger, and subscribed to this doctrine, as did many of his successors in Boeing and Commercial Airplanes leadership. Stonecipher was fond of saying "I am going to teach Boeing leaders to run a business, not an engineering hobby shop" or words to that effect. Dennis Muilenburg came through the ranks in Boeing Defense. He was not involved in the launch or development of the MAX. He was CEO during the MCAS evolution and presided over a culture that emphasized financial returns over engineering excellence; and must or should have been aware of issues in a number of product lines that have since shown shortcomings in meeting customer requirements. The emphasis on financial performance at the expense of a tradition of engineering integrity and customer focus continued and was, in my opinion, a factor to be considered in the chain of events that led to the MCAS solution of a minor airplane stability problem.

Another change observed by a retired Boeing Technology Staff leader was a tendency of some McDonnell Douglas managers to operate right at the edge of legally permitted behavior and well beyond the ethical bounds that had characterized the old Boeing. The most visible of these transgressions ended up with sanctions against Boeing. But the impact of the behavior was not lost on the rank and file well before the sanctions: "pressing the limit" was expected!

I believe these are root causal factors of behaviors, fears, and leadership that contributed to the culture surrounding the MAX. I include other historical events that illustrate the effect on the Boeing training pilot community that are related to the merger as Appendices D & F. There are probably other effects of which I am ignorant on other Boeing organizations and functions that took place as consequences of or were related to leadership decisions following the merger.

4.3.2 2003, 2004, Launch of the 787 Dreamliner

The 787 Dreamliner was launched with cost and schedule targets that were viewed as unrealistic and unattainable by many industry observers, including pundits, many aviation media, and retirees. As a Flight Deck designer, I was invited to the 787 Flight Deck Preliminary Design Review, and I said as much. When the airplane rolled out ceremonially in July 8, 2007 (7/8/7) to meet a customer promotion mandate, the airplane was a skeleton, and it was plain this was a cosmetic event. The subsequent lack of transparency in communicating delays to customers and the outside world was a surprising departure from Boeing tradition.

4.3.3 2011, Launch of 737 MAX

Airbus launched the A320 NEO (New Engine Option) with a major sale to American Airlines, and Boeing launched the MAX as a defensive action. Installing a higher bypass lower fuel consumption engine on the 737 was a challenge. Boeing applied ingenious engineering solutions to maintain adequate ground clearance for the MAX, including an extended nose gear for all variants and a clever levered main landing gear design for the 737 MAX -10.

Previously Boeing had been considering a new airplane design to replace the 757 and 767 market segment, and it could not do both this New Middle Market Airplane (NMA) and the MAX concurrently. Many pundits assign the MAX crashes to the decision to forgo the NMA. I agree that decision showed a lack of long term financial thinking but am convinced it was possible to bring the MAX safely to certification and market while maintaining commonality with the 737 NG. So, while Boeing demonstrated engineering prowess in adapting a larger engine to a derivative airframe, it also demonstrated engineering naiveté and poor judgement in executing solutions to the resulting stability problems that were encountered in both wind tunnel and flight testing.

4.4 Analysis of Max Accidents

NOTE
On April 10, 2020 I was asked by Amelia Green Dove who is working on a Ron Howard Netflix production on the MAX, to provide my opinion on the subject. We had an extended telephone conversation, which I later documented from memory; an edited version follows: I told Amelia that the usual take by many pundits was that the root cause was Boeing decision to make another derivative of the 737 to compete with the A320 NEO. I told her I disagree and that the accidents resulted, like any accident, from a series of independent factors that can be enumerated and could have been avoided by proper execution; some of them Boeing design decisions, some of them pilot decisions. The following is my analysis based on information on those causal factors I have extracted from public sources, I have no “inside knowledge”. In our conversation, I assigned each factor to either “Boeing” or “Pilot” as enumerated below.

4.4.1 Factor #1 Boeing

The decision to build a derivative rather than launch the NMA was certainly the first factor, but while the 737 is low to the ground, it was perfectly feasible to install a larger higher bypass more efficient engine with comparable fuel burn benefits to the A320 NEO, and doing so was a plausible business decision if executed properly. A great deal of ingenuity went into making that configuration work.

4.4.2 Factor #2 Boeing

Wind tunnel and flight test data showed a tendency toward an un-certifiable pitch characteristic, Boeing used an expedient fix by adding an MCAS function to the existing flight control computer.

- This design was intended to resolve the problem by deliberately applying an out-of-trim condition through movement of the stabilizer, a very powerful pitch axis control surface.
- This decision violated a high integrity design feature installed since the 707 days on all Boeing airplanes including the 737 (all 737s until MAX), namely that instinctive movement by the pilot of the elevator control column countering an unwanted airplane pitch would preclude or stop stabilizer movement in the direction contrary to pilot input.

- There were other solutions available: aerodynamic and equipment alternatives. While Boeing may have explored aerodynamic fixes to the unwanted pitch stability, I am not convinced they did so exhaustively. A simpler fix, applied to most T tail airplanes including British certified 727/707s, is to install a stick pusher/nudger, possible within the available space envelope of the 737 structure. Axiom: use a stick solution for a stick problem.

4.4.3 Factor # 3 Boeing

Boeing nonetheless decided to use a "simple software" change to the flight control computer and added a MCAS function. It was to use angle of attack sensors data, which is subject to many failures: 1) AOA sensors are in the pathway of a utility stand used to clean pilots' windshields, 2) bird strikes, and 3) a history of poor reliability. Axiom: There is no such thing as a simple software solution".

- The authority and functional applications of MCAS underwent changes during design and test evolution. MCAS authority was initially limited and thus not viewed as a significant safety risk. During the test program it was determined that additional authority would be needed. That change in design was not subjected to an additional and adequate level of scrutiny considering the now higher level of safety risk.
- The software developers should have studied failure modes and turned off the MCAS function if an improbable or extreme angle of attack signal occurs.
- Given the effect of the stabilizer trim as a pitch control system, Boeing should also have used comparison signals of the two angle of attack sensors in the software and turned MCAS off if there is a disagreement.
- In some airplanes there are three angle of attack sensors, which would have allowed ability to "vote out" a discrepant signal. The 737 has only two, and adding a third is expensive.
- The detailed design of MCAS becomes insidious for pilot interpretation of faults due to poor consideration of human factors and not consistent with Boeing failure analysis in a number of ways that laid the potential for the accidents.

4.4.4 Factor #4 Boeing

Boeing committed to Southwest there would be no simulator training required for a 737 NG pilot to transition to 737 MAX; it is widely published that the penalty to Boeing would be $1M per airplane if it did not succeed. Designers believed with inadequate human factors analysis/testing that an MCAS fault would be immediately diagnosed by any 737 pilot as a runaway stabilizer and turn off stabilizer switches. They did not consult adequately with external or internal pilots in this decision.

- Since all 737 pilots are trained to manage a runaway stabilizer, Boeing decided not to describe or familiarize 737 MAX pilots with MCAS at all. MCAS was not included in the manuals or in the iPad familiarization differences training from the 737 NG to the 737 MAX.
- This element of the factor tree was complicated by a decision in about 2012 that Boeing made to decentralize all Boeing Training Center Seattle functions, move the Seattle based training simulators to Miami, and change Boeing Training to a profit center reporting to a new organization with aggressive profit targets. A component decision motivation was to reduce engineering and pilot labor costs. Previous collaboration among Training, Flight Test, and Engineering were adversely affected; as was morale of those impacted.
- Two years later, in 2014, the company moved over 1,000 engineering jobs, including Flight Operations Engineering, to Southern California, further fracturing the relationship between the organizations responsible for supporting the airplanes and training pilots from those responsible for developing them.

4.4.5 Factor #5 Pilot: ACCIDENT #1

Lion Air: The underlying cause was the angle of attack sensor miscalibration at an overhaul center in the USA, complicated by the convoluted design whereby MCAS took information alternating from the left angle of attack sensor on the first flight of the day, and from the right on the second, etc. There are reasons to create such sequencing, but they were not properly thought through in the failure analysis of MCAS. On this accident, pilots did not know of the existence of MCAS functions. The MCAS failure presented itself in a high-pressure environment starting with a stall warning stick shaker at the moment of takeoff and followed by an insidious sequencing of events in which cause-and-effect is not obvious to the pilot.

- Airspeed and altitude comparator crew advisories take place immediately at takeoff.
- Simultaneously, pilots experienced stick shaker stall warning, itself is confusing and alarming.
- MCAS is armed to operate only when flaps are fully retracted. The pilot could have left flaps where they were at takeoff position and returned to the airport, perhaps by declaring an emergency, or just by requesting a clearance to do so.
- If the flaps were not retracted, MCAS would never have been armed or operate.
- There is an insidious latency aspect when the pilot moves the flap control to the UP position, MCAS does not immediately operate; it starts to trim the stabilizer several seconds later after the flaps fully retract. The pilots may not connect moving the flap lever with the MCAS operation because of this time delay; especially considering they are under extreme stress with the stick shaker and other warnings continuously present and demanding their procedural attention.

4.4.6 Factor # 6 Pilot: ACCIDENT #2

Ethiopian pilots were aware of MCAS but had no practice training in a simulator. Hypothesis is the angle of attack sensor was hit by a bird during takeoff. Again, pilots did not immediately return to the airport with flaps at the takeoff position. Instead they retracted the flaps and MCAS operated repeatedly. The initial accident report is incomplete, and the final accident report has not been released. It was reported that pilots never reduced engine thrust from initial climb setting.

4.4.7 Max Accident Factors Conclusions

Boeing responsibility has always been to design failure-tolerant airplanes, and design for both seasoned and new pilots. We know how and did not on the 737 MAX MCAS.

Amelia asked if the root cause might have been the MDD merger, and I agreed that was a plausible root cause and have hypothesized on that above. Obviously, no one immediately connected the 1996 merger with eventual relaxation of Boeing traditional design practices in favor of RONA. I said there were opportunities to return to a balanced treatment of all stakeholders. We discussed Stonecipher and his comments that Boeing was an engineering company and he was going to turn it into a business. I mentioned to Amelia that there was an opportunity for Boeing to rebalance its attitude was when it selected a new CEO; it could have been Alan Mulally, but instead they chose James McNerney, another disciple of GE's Jack Welch.

Ron Howard has a reputation for responsible work, avoiding hyperbole or sensationalism. This situation is a "Harvard Business Case" opportunity that we can learn from, not just for Boeing, but the nation and the world. I view my conversation with Amelia as motivated by the notion that a responsible documentary or journalistic reporting can contribute to a restoration of past Boeing culture. I cited to her my disappointment with journalists like William Langewiesche, who picked pilots as a singular cause in a N.Y. Times article, and other reports that focus solely on the decision to forgo the NMA in favor of the 737 MAX derivative. I mentioned journalists who had a more balanced and nuanced approach. Amelia asked me if Bloomberg journalist Peter Robison was one of those, and I affirmed that in my experience he was. I would also cite Peter Rinearson's work on the 757 as an example of responsible journalism.

At the close of our call, I also told Amelia that there are two things I recommend that producers and directors in the project attempt to personally experience:

1. Must read: Boeing 737 The World's Jetliner by Captain Dan Dornseif and suggest a talk with Dan (I provided contact info). That will provide a balanced view of 737 history.
2. Go up in a general aviation airplane and learn what pitch control and trimming feels like firsthand before writing a script for production. The experience is tactile and highly kinesthetic, and difficult to describe in writing; just a little hands on exposure will go a long way toward understanding. I suggested the airplane they fly should have electric trim so that it approximates the behavior of the 737. I have demonstrated this in a Cirrus. Or rent an airline full flight simulator for team member exposure to the flight deck environment of a jet transport aircraft.

The above covers the substance of my telephone call with Amelia; I have edited it for clarity.

5 Another Observation

This completes a long exposition on Boeing culture and my take on how it evolved to be a causal factor in the MAX accidents.

I will close with another observation from a retired Boeing Company Officer:

> To the point of "root cause" I would be reluctant to place singular blame. From a cultural standpoint, the root cause could well be Wall Street and the financial press. By rewarding short term performance and making Jack Welch a "hero" they promoted a culture focused on short term results.
>
> I also need to weigh in on the fundamental fact that accidents are the result of multiple factors. It is impossible to assign a specific value of "blame" to each of the factors. With that as background, I see several critical factors in the MAX case. The first is a flawed Boeing design, particularly data coming from a single sensor. The second is pilot training or lack thereof. As the airline industry expanded the need for pilots outgrew the supply. As a result, there is a set of pilots with capability to operate an airplane but with little capability to handle complex failure situations.
>
> Bottom line for me is that the only truly serious failure in an accident is the failure to learn and find ways to assure that the accident will not be repeated. To this end, there should have been a more aggressive response to the Lion Air crash.
>
> Finally, I believe that culture is absolutely the key. It is not organizational structure. A strong culture deals with issues and seeks to produce a "preferred" product. Project and Staff has both advantages and disadvantages. Having both with a culture focused on quarterly return is likely not a solution.

Respectfully,

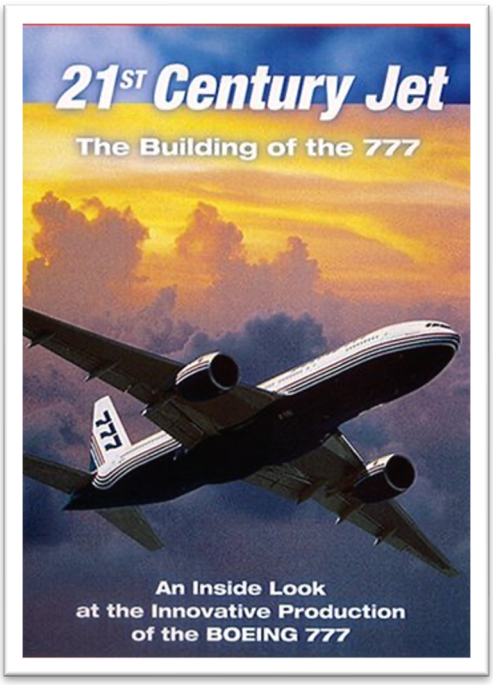
Peter M Morton
pmminc@earthlink.net 360-730-1064

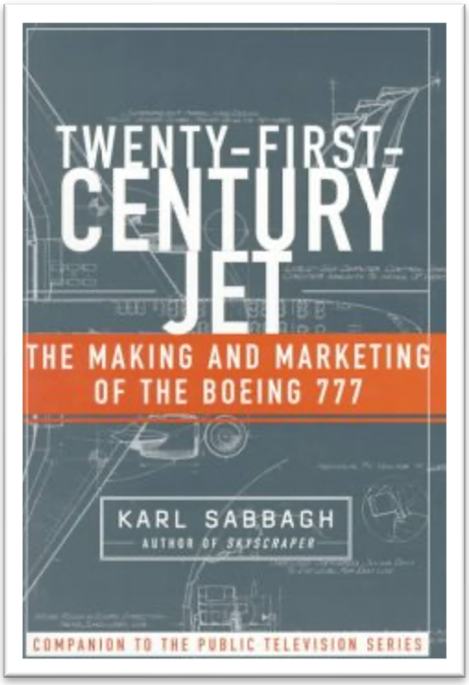
Appendices:
A: Mulally's Principles and Practices; Working Together on WA001, 777 Program Transparency
B: 2020 Boeing Values Statement
C: 777 Launch document
D: 2019 05 29 Letter to Dennis Muilenburg
E: 2019 10 26 A Short Treatise on Corporate Culture
F: Merger impact on the Boeing Training Pilot Community & Board Makeup

Appendix A: Mulally's Principles and Practices, Circa 1990 – 2000 777 Program & BCA, 777 Program Transparency, WA001

(Similar document used when Mulally became Ford Motor CEO in 2006)

Example of 777 Program Transparency





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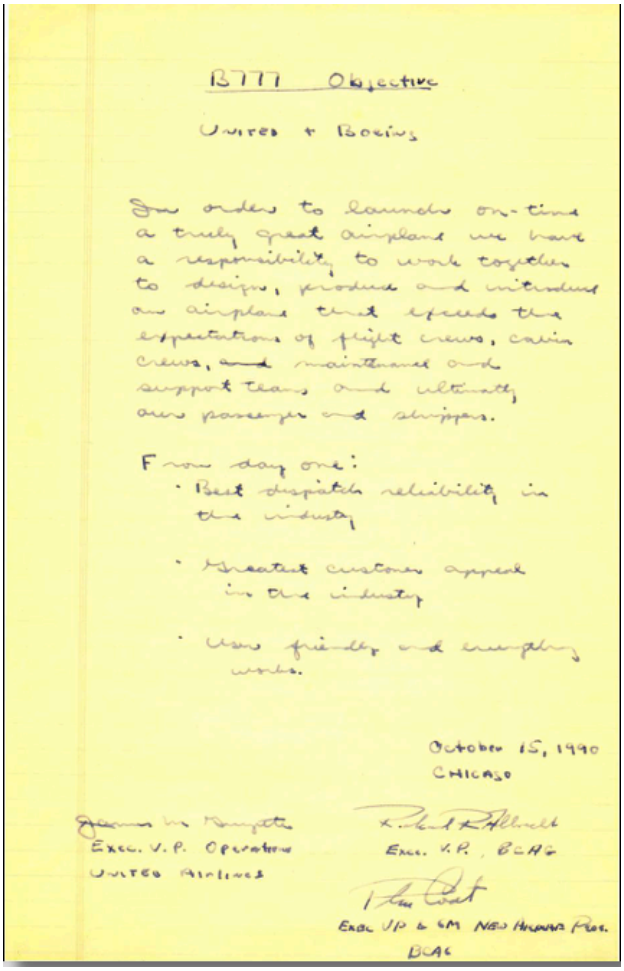
Appendix B: 2020 04 Values Published by Boeing CEO David Calhoun

Enduring Values

We're committed to a set of core values and **principles** that not only define who we are, but also serve as guideposts to help us become the company we'd like to be. We all must aspire to live these values every day.

Appendix C: 777 Launch Document



B777 Objectives
United + Boeing

In order to launch on-time a truly great airplane we have a responsibility to work together to design, produce and introduce an airplane that exceeds the expectations of flight crews, cabin crews, maintenance and support teams and ultimately our passengers and shippers.

From day one:
- Best dispatch reliability in the industry
- Greatest customer appeal in the industry
- User friendly and everything works.

October 15, 1990
Chicago

Exec. V.P. Operations
United Airlines

Exec. V.P., BCAG

Exec VP & GM New Airplane Prog.
BCAG

B777 Objectives
United & Boeing

In order to launch on-time a truly great airplane we have a responsibility to work together to design, produce and introduce an airplane that exceeds the expectations of flight crews, cabin crews, maintenance and support teams and ultimately our passengers and shippers.

From day one:
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- **User friendly and everything works.**

October 15, 1990
Chicago

James M Guyette *Richard R. Albrecht*
Exec. V.P. Operations **Exec V.P. BCAG**
United Airlines

Phil Condit
Exec V.P. and GM
New Airplane Prog.
BCAG

Appendix D: 2019 05 29 Letter Morton to Dennis Muilenburg

May 29, 2019

Dear Dennis,

Last year you responded to my request to preserve Boeing history by encouraging BCA to convene Mike Sinnett, Mike Carriker, Randy Neville, and Craig Bomben and produce a "787 First Flight" celebration at the Museum of Flight. Perhaps you will find time to read this reflection and suggestions on the state of Boeing leadership in the function of airline flight crew training.

I know you are incredibly busy working through a crisis; I have confidence the company I love will muster the skills and resolve necessary to that end. In this note, I focus on restoring reputation, develop and deliver world class flight training, and influence airplane design to support flight crew operations and facilitate training.

In these suggestions, I use "we" and "ours"; even after 19 years of retirement, I will never shed that pronoun as a descriptor of the Company to which I committed my professional life.

In the 1990's, culminating when BCA created a purpose-built Longacres Training Center, Boeing became the unquestioned leader of jet transport customer training and flight operations support. I know, because I was the Director of Customer Training. It was a "Camelot" period in customer service supporting 737, 747, 757, 767, and 777 customer introductions worldwide; training 4000 pilots, technicians, engineers, and flight attendants every year. Subsequently, ill-conceived organizational changes, outsourcing, and complicated functional insourcing of training, flight crew manuals, operations engineering, customer introduction services, and internal coordination, fragmented the way we interfaced with Boeing engineering organizations, and our airline customers, to the ultimate detriment of both our product and our services.

The flight simulators were moved to Miami, the engineers and tech writers to Seal Beach, pilots to diverse locations, and leadership to Texas. Training identity changed back and forth to Flight Safety Boeing, Alteon, and other brands. Technical training pilots and flight test pilots no longer worked together as partners in design. There was an illusion that virtual processes are equal to "being there", that military and commercial training and publications are the same, that being locked out of the Boeing intranet does not handicap development of training and manuals, and that "trainability" as an airplane design factor can be achieved without formal coordination processes. The resulting organizational structure was flawed and led to a dysfunctional silo mentality, broken lines of communication, and potential for misunderstanding and confusion.

Boeing can restore functionality and excellence of airline training services by returning to the 1990's paradigm of excellence. It will take investment and serious organizational leadership to define and execute a long-term strategy that re-creates a world class organization adapted to today's business; recognized again as industry leader in aviation safety and customer service.

We need a clear definition of what "right" looks like. It starts with a well-defined vision and mission statement that supports corporate and customer objectives, around which to craft organizational relationships. It re-creates an organization that promotes collaboration internally and cooperation with the airlines, customers, and Boeing product divisions, and clearly defined roles, responsibilities, and both hard and dotted line relationships.

This is an inflection moment that calls for Boeing to think big, and not be bound by existing organization constraints. Evidence Based Training is not a panacea. It's an important outcome from an ecosystem that provides our customers with the essential support needed to safely operate their airplanes. I personally know there is the necessary talent and wisdom to bring about this change; both internal to Boeing, and among recent retirees. I suspect all of us would be willing to advise and assist an initiative that recaptures the reputation we enjoyed in 1994.

May 29, 2019

My suggestions:

1. Re-establish the 25-01 building at Longacres as a Boeing aeronautical "Center of Excellence." It's a purpose-built facility designed by people who had a vision to build a "world class Customer Services Training Center." (see attached picture)
2. Strengthen inter-departmental relationships by restoring formal committees, structures and procedures that support collaboration and cooperation. Leadership should be visible and accessible as we reinvent ourselves to achieve corporate goals. It should be led by a President or Senior VP who is "mission qualified," a pilot, and in my opinion, best be a part of or have strong formal ties with BCA. Maintaining collaborative relationships with BDSS and internal financial ties to BGS makes sense; but is secondary to two-way relationships with the airplane product divisions.
3. Skill codes and staffing requirements need to reviewed and updated. Our customers' flight departments are led by type-rated pilots, so should ours. Safety and Technical Pilots on flying status should be allowed to fly with BT&E, goodness knows we need the talent pool for production flight test. Leadership/SME positions responsible for training development programs should be qualified instructors, supported by instructional design specialists. Moreover, we aren't going to attract the talent we need to support this effort without adequate compensation and the intangible benefit of flying actual airplanes for pilots.
4. Flight Training, Flight Standards and Regulatory Affairs should have travel authorization and budget to support campus and education alphabet groups that are the future source of pilot talent for the entire industry. Industry conferences for safety, standardization flight education, and compliance must be supported. Boeing has always viewed safety as transcending competitive interests; that's an absolute mandate in our industry.
5. Bring simulators and advanced flight training devices back to the 25-01 building. In my last visit to the facility, I saw open bays that could support the major models in current or future production, including the 787, 737 MAX, 777X and future models. This would provide capability for internal training, support program development, allow instructor currency and mentor programs (internal and external) and customer demonstrations and training. We can do this and also maintain Boeing training centers around the world.
6. In my day, the Training Center was a source of education for product division senior engineers; with formal programs familiarizing them with realities of airline operations as they progressed through careers. Formal classes and extensive coordination through committees for each model airplane assured training, "trainability", and consultation on type rating considerations were part of daily interchange and integral to flight deck design.
7. Media support needs to be available on site for our efforts. Training and reference are two sides of the same information management coin for pilots, whether delivered by paper or tablets. Standardized graphics for both training and reference were a hallmark of the Boeing Training Center in 1994, produced and maintained by the same teams. Tech writers and Flight Operations Engineers need to be physically co-located with pilots.
8. Formal committee structures provided interaction with the product design organizations to establish and maintain crew workload standards inherent in our airplane certification. New designs and design changes were thoroughly vetted as satisfactory for airline use by Customer Training pilots and Flight Operations Engineers.

Respectfully,

Peter M Morton, retired July 2000 as BCA VP HR; previously VP Boeing Center for Leadership and Learning, Director of Customer Training, Chief Engineer 757 Flight Deck.

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Customer Services Training Center dedication plaque

Appendix E: Referenced from Section 4.2

A Short Treatise on Corporate Culture by Peter Morton 10/26/20

DRAFT 10/26/19

A Short Treatise on Corporate Culture, Ecosystems, and Forgetfulness.

Culture: It has been said that corporate culture, or any culture for that matter, are those unwritten rules that everyone knows about but does not bother to articulate, and organizations seldom document.

The Boeing 737 MAX debacle was not solely a software failure, a stability and control fix gone awry, a regulatory lapse, or a takeover of traditional Boeing values by McDonnell Douglas. It was all of those, but more insidiously, a failure to respect tried and true processes that had not been documented. Generations subsequent to those who invented high integrity processes safeguarding design and support have no reference to learn about these historical values.

Let me start with ecosystems, many originated by Ed Wells, George Schirer, and Bill Cook; others evolving by applying similar values to disparate functions. The underlying ethos's: "check and balance" has value; "none of us is smarter than all of us"; diversity of education and experience yields better answers; independence of authority is a good organization tool; and almost never stated, "we don't need whistleblowers but we will always welcome them".

Ecosystem 1: Project and Staff:

1. Back in the days of the 757 and 767, and before that back to the 707, each program had an Engineering Project and a Technology Staff. Among many other facets, it was quite simple really:
    a. The former executed a design, committed it to drawings released to the factory and detail specifications released to Procurement. This activity was schedule driven.
    b. The latter wrote or adopted previous requirements (DR&O), made certain technologies were mature enough, rode herd on the Project, and managed test and certification. This activity was function-driven.
2. The organization was equally simple.
    a. Each discipline (structures, electrical, flight deck, etc), with some variations, had a Project and a Staff.
    b. Each Project group reported up to the Chief Project Engineer.
    c. Each Staff group reported up to the Technology Staff Chief
    d. The Chief Project Engineer and Technology Staff Chief reported to the Director of Engineering.
    e. Ancillary functions also reported to the Director of Engineering, like Cost and Schedules.
    f. The Director of Engineering, Finance, HR, Director of Operation reported to the VP GM of the Program.
3. Everything usually went smoothly, and when it didn't, recourse was also simple.
    a. If a Staff engineer thought there was an issue in how Project was executing the design requirements, a discussion ensued between equals.
    b. The issue could be bumped up to the respective Project and Staff supervisors.
    c. If necessary, the issue found its way all the way up the line to a meeting between three parties: the Director of Engineering listening to the Chief Project Engineer and the Technology Staff Chief.
4. There were always resources available from the sidelines in the form of company-level senior functions.
    a. "Functional Fathers", as we called them managed the engineering resources. They assigned the Project and Staff people to Programs, managed underlying applied research that enabled maturity of designs and processes, and were sometimes asked to referee a particular issue within a Program. Accessing this "help" was rare, almost an admission of leadership failure on the part of managers within a Program.

But wait, there are more ecosystems. For example, I'll cite the independence of the testing organization, which I witnessed but did not ever live in. Flight Test, later "Test and Evaluation", was an ecosystem adding great value to our airplanes.

My Ecosystem: Customer Training and Flight Operations Support (CTFOS) was an organization that evolved from the early days of introducing the first Boeing jet transport, the 707. I'll credit Peter Gallimore with its design; he partnered with Tom Layne, chief training pilot, a person committed to flight safety to take responsibility for safely introducing and monitoring customer flight operations, and being a proxy for them serving Project and Staff. Its constituent parts:

1. The Training Pilots. These are pilots who trained customer pilots, then later went into the field flying the line sometimes as actual uniformed airline pilots putting our airplanes in service, more often as check pilots. This

Page 1 of 3

cohort became knowledgeable about airline operational environments, and could be a resource for airplane design decisions and managing crew workload imposed by non-normal equipment events. They created the Flight Crew Training Manual, which communicated techniques and training protocols recommended by Boeing.

2. The Flight Crew Training ground school and operations manual tech writers. Originally two separate groups with different background personnel, under Peter Gallimore's supervision I merged these groups in the 1960's so that training media and operations manuals presented a common depiction of airplane systems to the customer.
3. The Maintenance Training group. By far the largest population of the 4000 annual visitors to the "Boeing College of Jet Knowledge", this function trained maintenance technicians for the task of keeping Boeing airplanes productive and on-line. We pioneered industry use of maintenance training simulators for hands-on training.
4. Flight Operations Engineering (FLOE). This was the customer services "aero group", publishing performance data, managing publication of the FAA approved Airplane Flight Manual with data provided by Program Aero Staff units. FLOE engineers partnered with flight training pilots to help customers introduce Boeing airplanes, tailoring technical information to customer needs. Sometimes, FLOE took responsibility for helping customers develop and publishing dispatch, flight operations, and other policy materials. FLOE managed the development of the Master Minimum Equipment List for each Boeing airplane in deep collaboration with Project engineers.
5. The Simulator Engineering and Technician function. When 737 and later models emerged, airplane flying for training decreased, replaced by simulation using flight training devices up to and including Level D simulation.
6. A media production group supported these functions, producing training media (CBT) and documents.
7. Committees for each airplane model worked with Project, Staff, Flight Test, and regulatory organizations to write procedures, checklists (Quick Reference Handbooks/QRH), influence design, adapt to in-service product experience, etc. These committees tapped into the deep experience within CTFOS to serve Project and Staff with an accurate proxy of the operational environment of our airplanes flying in customer service.

Co-located at the Longacres training facility, CTFOS' functions worked together with synergy and efficiency. Recent outsourcing and fragmentation of these functions was a bad decision; however, there was no documented counter that described the ecosystem and its effectiveness, so in the interest of "efficiency", the simulators were moved to Miami, the engineers and tech writers to Seal Beach, and the flight training pilots dispersed to many locations. I was no longer at Boeing, but coordination with Project, staff, and Flight Test must have been significantly impaired.

Part of this ecosystem, CTFOS had a whimsical practice integrated with engineering succession management; the "executive engineering training program". It was not in any work statement or budget; but a part of our culture with Project and Staff to reduce yellow pages in our manuals; the traditional vehicle for publishing temporary procedures brought about by in-service problems. Yellow pages almost invariably increased crew workload, which in a 2-crew airplane, is a formal component of Part 25 certification. There is a yellow page revision now out on the MAX MCAS.

The training program: we felt that Project and Staff upcoming leaders should have first-hand experience before taking a Senior Project or equivalent rank Staff position, especially CPE or higher positions. These promotions are seminal career events where a specialist with leadership potential is given an assignment that, perhaps for the first time, gives them generalist responsibility. We produced a special course, and invited Project and Staff "Functional Fathers" to send freshly minted leaders to us for three weeks. They got a one-week abbreviated exposure to flight crew and maintenance ground training, including simulators. A FLOE expert would lecture on the operational environment of our products. They would fly in a small Cessna (with an instructor) to experience actually flying an airplane. To make it transferable to transport airplanes, one flight took them on instruments into "the system". Lesson learned: the airplane systems are but a small portion of what occupies a pilot's attention.

As a capstone, they flew in the cockpit of a Boeing airplane to a customer's main base, were hosted by the Boeing field service engineer for three days, and returned to Seattle in the cockpit of a non-Boeing customer airplane.

Graduation: we cut off their shirttail, I signed it with felt pen, and it may still reside in an album someplace at Longacres. Desired result: manage initial design and design changes so as to respect the real-world pilot workload and competency, and have fewer or no yellow pages in our manuals.

DRAFT 10/26/19

Forgetfullness. In a sense, Boeing has no one to "blame" about the MAX situation, because the fault is cultural, and inherent in the failure to pass on the unwritten ecosystem practices cited above, and possibly many more about which I am ignorant.

One can cite a company whose leaders focused on financial performance to the exclusion of other outcomes, but nowhere in those actions was a there a deliberate or conscious sacrificing of safety for schedule or cost on the part of leaders. It would not have been difficult to preserve the above ecosystems that provide design integrity and improve financial performance; indeed, the current leadership is probably ignorant of these ecosystems. In retrospect, of course, the financial losses emergent from the MAX will dwarf the costs of retaining independence and redundancy of Staff and Project, keeping the CTFOS functions and equipment as a unit in the Customer Training purpose-built facility in Tukwila, and maintaining the committee structures cited above.

It is not necessarily so that had we documented all of this, said documents might not have been gathering dust in Boeing archives. I only ask, where are the "industrial anthropologists" who would serve us now explaining what is inherent in complex industrial entities that causes this fall from Grace.

And perhaps, just perhaps, figuring out for the benefit of Boeing and its current employees and its customers, and for the solace to retirees who remember our erstwhile culture, just how to "put Humpty Dumpty back together" again in the most effective and efficient way possible.

Peter Morton 10/26/19

Appendix F: Merger impact on the Boeing Training Pilot Community & Board Makeup

First example – the saga of Boeing's Instructor Pilots.

The first example of the cracking of Boeing Training's "Humpty Dumpty" occurred within a few months of the merger. The merger was announced on December 16th, 1996. (https://www.nytimes.com/1996/12/16/news/boeing-to-buy-mcdonnell-douglas.html). Less than three months later, Boeing entered into it's ill-fated partnership with FlightSafety International, creating Flight Safety Boeing Training International, (FSBTI); later named Alteon Training, announced on March 10th, 1997. (https://boeing.mediaroom.com/2002-09-23-Boeing-To-Acquire-Flightsafety-Internationals-Interest-In-Its-Aviation-Training-Joint-Venture)

Within ten days of that announcement, the IAM filed a complaint on behalf of the 600 Customer Training employees impacted by the creation of FSBTI. This dispute was the genesis of the unionization of the flight training instructor pilots, originally unionized under the name of the Lazy B Pilots Association (to be renamed a year later as the Aircraft Manufacturer's Pilots Association (AMPA)). History shows that the attempt to spin-off the training business was a failure and Boeing reacquired its share of the joint venture from FSI in 2002. Nonetheless, the damage was done, and the cracks formed from the FSBTI fiasco have never healed.

In 2012, the AMPA petitioned the National Labor Relations Board to include all of the "simulator only" instructors, Flight Technical Pilots and Safety Pilots, citing the application of an Armour-Globe precedent.
(http://www.speea.org/Join_Our_Union!/LegalBriefs/AMPA_SPEEA_ReopeningBrief2012.pdf)

While the company will never acknowledge the connection between the unionization of the instructor pilots and the decision to relocate the simulators to Miami (announced March 9, 2012), it was quite clear to all involved this was a direct response.
(https://www.rentonreporter.com/news/boeing-moving-flight-simulators-from-renton-training-center-to-miami/). In an ironic twist, the announcement of the decision was made during the disastrous grounding of the 787 due to the battery issues with that airplane, so it received very little press coverage. In ordinary times, this would have been front-page news.

Second example – the dilution of the capabilities of Board members.

Historically, Boeing's Board of Directors included industrial giants with knowledge and skills appropriate for managing large teams and manufacturing complex products. In 1995, for example, the Board included, Charles Piggot (CEO PACCAR), George Weyerhaeuser (CEO Weyerhaeuser), Stanley Hiller (CEO, Founder, Hiller Helicopters), George Keller (CEO Standard Oil) and Don Petersen (CEO Ford) among other luminaries.

Once Harry Stonecipher took over as Chairman of the Board in 2003, a slow transition began; technical expertise and leadership skills ceased to be the prerequisite, replaced by political connections and/or a history with General Electric. Early examples include former White House Chief of Staff Ken Duberstein, Former Assistant Secretary of State Rozanne Ridgway, Former Chairman of the Teachers Insurance and Annuity Association John Biggs.

By the time of the disastrous MAX decisions, the Board included no outsider members with backgrounds in engineering and only one member with a background in aviation. Their backgrounds are predominantly in insurance, pharmaceuticals and politics.

To the best of my knowledge, the company has not had a Jet Transport qualified pilot as a Board Member or Company Officer in more than twenty years; something that I consider highly short-sighted. Previously, the company valued the first hand knowledge of pilots in its leadership; an example: the pervasive presence of Richard W Taylor as a vice president who changed the face of commercial jet flying http://jdasolutions.aero/blog/dick-taylor-aviation-icon/ Taylor's contributions started as a B47 test pilot, was the Director of Engineering of the 737 in 1968, and later in his career established the current and future default design and certification basis to a two engine two-person crew configuration. He was so recognized by Aviation Week's prestigious Philip J. Klass Lifetime Achievement Award in 2010.