Taking Off in Africa: Critical Elements of Aircraft Engine Manufacturer Engagement That Can Affect Airline Safety Performance

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Taking Off in Africa: Critical Elements of Aircraft Engine Manufacturer Engagement That Can Affect Airline Safety Performance

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A Dissertation

Submitted to the PhD in Leadership and Change Program of Antioch University in partial fulfillment of the requirements for the degree of Doctor of Philosophy

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This dissertation has been approved in partial fulfillment of the requirements for the degree of PhD in Leadership and Change, Graduate School of Leadership and Change, Antioch University.

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- Mitchell Kusy, PhD, Committee Chair
- Elizabeth Holloway, PhD, Committee Member
- Rajiv Abhimanyu Bissessur, PhD, Committee Member
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Dedications

To my parents, Mike & Pam Woods

To my wife, Tisay

To my sons, Mohammed and Ismael
Abstract

Original Equipment Manufacturer (OEM) is a term used in many industries to describe a company that produces parts and equipment that may be marketed by another manufacturer. In the aviation industry, the aircraft engine OEM refers to the company that manufactures engines powering the aircraft. The OEM manufactures the engine, defines the required maintenance to operate the engines, and recommends product modifications. Product modifications are recommended to improve product safety, durability, reliability, and cost of ownership and are formally communicated through issuance of service bulletins. Properly performing the required maintenance and adopting service bulletins is an important element of maintaining a high standard regarding safety performance. The aircraft engine OEM is the source of knowledge regarding how to properly and effectively perform standard maintenance tasks. The OEM also has information related to service bulletins that is critical to properly assess and adopt service bulletins. This study identifies the critical elements of engagement between aircraft engine OEMs and airlines during two processes. The first process studied was the adoption of service bulletins and included how the airline becomes aware of a service bulletin, how they assess the need to perform the service bulletin, and finally how the airline prepares and executes on the adoption of the service bulletin. The OEM engagement was identified and analyzed during each phase of this process. The second process studied was how the airline identifies when they need support from the OEM to properly complete required maintenance and inspection tasks. OEM engagement was identified and analyzed during this process. Critical elements required for effective and efficient engagement identified in this study are then compared to existing literature on effective interorganizational engagement. Applying the learnings from this study to the more generic process maps developed in previous studies allowed for a specific process map
for ensuring effective and efficient engagement between aircraft engine OEMs and airlines, in this specific context. This dissertation is available in open access at AURA: Antioch University Repository and Archive, http://aura.antioch.edu/, and OhioLINK ETD Center, https://etd.ohiolink.edu/.

*Keywords:* Airline Safety, Interorganizational Engagement, Original Equipment Manufacturer, Knowledge Sharing, Interorganizational Trust, Aviation Industry
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Glossary

**Accident.** An accident in an event that happens after a person has boarded an aircraft, with intention for flight, and before all passengers and crew exit the aircraft after the flight and involves a fatal injury or substantial damage to the aircraft (Rodrigues & Cusick, 2011).

**Airline traffic.** Quantity of passenger and/or cargo service provided.

**Airline demand.** Quantity of passenger and/or cargo service desired or requested by customers.

**Airline revenue.** Income generated from airline traffic.

**Available seat kilometer (ASK).** The number of available seats on a flight multiplied by the distance flown. By summing the ASK for all flights the airline quantifies their output. An alternate to this unit of measurement is the Available Seat Mile (ASM).

\[
\text{ASK}_{\text{flight}} = (\text{number of available seats}) \times (\text{distance of flight})
\]

\[
\text{ASK}_{\text{total}} = \sum \text{ASK}_{\text{flight}}
\]

Example: If an aircraft with 100 seat operates a flight 500 kilometers from departure to destination, they have generated 50,000 ASK.

\[
\text{ASK}_{\text{flight}} = (100 \text{ available seats}) \times (500 \text{ km}) = 50,000 \text{ Available Seat Kilometers}
\]

**Airworthiness directive.** A formal communication from civil aviation regulating authorities, often the civil aviation authority of the country of the original equipment manufacturer, notifying the operator or owner of a known safety issue.

**Average leg load factor (ALLF).** The average load factor on a specific route or flight is the average of all load factors for the specific route or flight over a number of flights.

\[
\text{Average Leg Load Factor (ALLF)}_{\text{flight}} = \frac{\sum_{i=1}^{n} \text{Load Factor}_{\text{flight-i}}}{n}
\]
**Average load factor (ALF).** The average load factor for a network of routes which may utilize aircraft with different size capacities and operating longer or shorter routes is a ratio of the RPK to the ASK for each flight. The Average Load Factor is used in most airline financial statements.

\[
\text{Average Load Factor (ALF)} = \frac{\sum_{i=1}^{n} RPK_{flight-i}}{\sum_{i=1}^{n} ASK_{flight-i}}
\]

**Damage event.** A damage event is an event in which no person was killed or injured but in which a part 121 aircraft was substantially damaged (Rodrigues & Cusick, 2011).

**Fatal injury.** A fatal injury would classify any aviation event as an accident. Any death related to the aviation event that occurs within 30 days of the aviation event is considered a fatal injury (Rodrigues & Cusick, 2011).

**Fully reciprocal communication.** A method of communication, defined for this study, that allows for unrestricted back-and-forth communication between two individuals or organizations. This type of communication allows both organizations to drive the conversation based on what they determine to be important. Both organizations are able to introduce new topics to the conversation. An example of fully reciprocal communication includes face-to-face communication, communication over the phone, or internet communications service. Back and forth email communication is also categorized as fully reciprocal communication.

**Incident.** An incident is any event that is not classified as an accident but affects or could affect the safety of operations. An incident is loosely defined as a near accident such as a near mid-air collision, runway incursion, in-flight fire, and failure of flight critical equipment. There is a defined list of incidents that require reporting (Electronic Code of Federal Regulations, 2019). Most incidents are not required to be reported and coupled with the fact that the definition of an incident is highly subjective leads to high variation in incident reporting from airline to airline (Rodrigues & Cusick, 2011).
**Injury event.** An injury event is a non-fatal accident with at least one severe injury but without substantial damage to a part 121 aircraft (Rodrigues & Cusick, 2011).

**Interorganizational engagement.** Organized and coordinated activities between at least two self-governing organizations, each having independent organizational goals, to produce something.

**Load factor (LF).** A ratio that compares the amount of airline output available (either seats for passengers or capacity for cargo) to the amount of airline output consumed.

\[
\text{Load Factor} = \frac{\text{Airline output consumed}}{\text{Airline output consumed}}
\]

For example, the 100-seat aircraft that transported 75 passengers on a 500 km flight had a load factor of 75%.

\[
\text{Load Factor}_{\text{flight}} = \frac{75 \text{ seats purchased}}{100 \text{ seats available}} = 75\%
\]

**Major accident.** A major accident occurs when either a part 121 aircraft is destroyed beyond economical repair, a part 121 aircraft is damaged and there is one fatality, or any accident where there are multiple fatalities (Rodrigues & Cusick, 2011).

**Non-reciprocal communication.** A method of communication, defined for this study, as being characterized as one-directional in which the initiation organization defines the content, format, and distribution of information. There is no opportunity for the organization receiving the information to follow-up or respond.

**Part 121 aircraft.** Any aircraft meeting the criterion of Title 14 Part 121 of the Code of Federal Regulations.

**Partially reciprocal communication.** A method of communication, defined for this study, in which the initiation organization sends a request for information to the second organization. In
initiating organization defines the information requested, however the responding organization determines the content and format of the information to include in the response. In this study, requests for information using the original equipment manufacturer (OEM) website are categorized as partially reciprocal communication.

**Revenue passenger kilometer (RPK).** Airline output measured as the number of paying passengers transported by the distance transported. One RPK is defined as one paying passenger transported 1 kilometer. An alternate of this unit is Revenue Passenger Kilometer (RPM).

\[
\text{RPK}_{\text{flight}} = (\text{number of paying passengers}) \times (\text{distance of flight})
\]

\[
\text{RPK}_{\text{total}} = \sum \text{RPK}_{\text{flight}}
\]

For example, if an airline transports 75 passengers on the 100-seat aircraft a flight length of 500 km the airline has generated 37,500 RPK.

\[
\text{RPK}_{\text{flight}} = (75 \text{ paying passengers}) \times (500 \text{ km}) = 37,500 \text{ Revenue Passenger Kilometers}
\]

**Rotable program.** To accelerate embodiment of a service bulletin or airworthiness directive or to minimize disruption to an airline’s operation the aircraft engine OEM will release rotatable units. These rotatable units are used to replace affected parts or modules installed on engines that are installed on aircraft. The removed part or module can be sent to a designated repair facility for the repair or embodiment of the service bulletin or airworthiness directive. During this time the engine, and aircraft, can remain in operation due to the rotatable unit being installed.

**Rotable unit.** A part or module of an aircraft engine supplied to an airline that is used to replace the same part or module already installed on an aircraft engine.

**Serious injury.** A serious injury is any injury, harm or pain inflicted during an aviation event that requires at least 48 hours of hospitalization, or results in broken bones, injury to internal organs, or severe burns (Rodrigues & Cusick, 2011).
**Substantial damage.** Substantial damage is any damage requiring major repair or replacement of affected components or that affects the structural strength, performance, or flight characteristics of the aircraft (Rodrigues & Cusick, 2011).

**Serious accident.** A serious accident occurs when an aviation event either results in a single fatality but does not result in substantial damage to a Part 121 aircraft or when there is a single serious injury and a Part 121 aircraft is substantially damaged (Rodrigues & Cusick, 2011).

**Service bulletin.** A formal communication from a manufacturer, or OEM, notifying the operator or owner of a product improvement. The reason for the product improvement can range from reducing the cost of using the product to addressing unsafe conditions (Abbott, 2015). A sample service bulletin is presented in Appendix E.

**Yield.** Average fare paid by all passengers per kilometer transported on a route. This is calculated by dividing the total revenue of a flight by the RPK for the flight.

\[
Yield_{flight} = \frac{Revenue_{total}}{RPK_{flight}}
\]

For example, if an airline generated $15,000 USD in revenue transporting 75 passengers 500 km the yield would be $200 USD. This is essentially the average ticket price.
Chapter I: Introduction

Aviation will change the face of Africa and the rise of Africa will change the face of aviation across the globe.

—Hassan El-Houry (as cited in “How Aviation Can Help,” 2018, para. 5)

In 2012, the average economic growth for all African countries, at 15%, was much higher than the rest of the world. With this understanding, it is not surprising that six of the top 10 fastest growing economies in the world at the time are in Africa (General Electric, 2012). The African Development Bank has identified Africa as the world’s second fastest growing economy (African Development Bank, Organisation for Economic Co-operation and Development, & United Nations Development Programme 2017) with Ethiopia being the fastest growing country in Africa (Giles, 2018). Due to the historic and projected growth in the region, Africa has consistently been an opportunity for foreign direct investment. Despite a slowdown in foreign direct investment in other regions, in 2019 foreign direct investment in Africa increased by 11%. The biggest beneficiaries of this increased investment being Egypt, South Africa, Congo, Morocco, and Ethiopia (United Nations Conference on Trade and Development, 2019).

A natural side effect of increased foreign investment is an increase in passenger and cargo air traffic (Lubbe & Shornikova, 2017). However, despite the exponential growth of investment in Africa, 88% of the airline traffic in Africa is outsourced to international carriers outside Africa (Brophy, 2016). Norton Rose Fulbright (2015) stated that although the number of airlines in operation make up 15% of the global population, they represent less than 6% of the world’s commercial passenger and freighter traffic. Norton Rose Fulbright (2015) presented four reasons for this underperformance of African airlines:

- Protectionist policies that favor the national airline
- Discriminatory practices in favor of other continents carriers
• Severe restrictions placed on African airlines for many reasons, but primarily for safety.
• Non-physical barriers such as documentary requirements and shortage of foreign exchange.

Challenges Facing the Aviation Industry in Africa

Protectionist policies include a lack of de-regulation due to fears about the effect on the national flag carrier (“Africa’s Aviation Industry,” 2012). The government often supports such policies as they view the airline as a symbol of sovereignty and a tool for international diplomacy and not a for-profit business. In addition, many African governments use airline sales as a way to increase revenue through high taxes and fees. These types of policies have resulted in a very fragmented condition in the African continent where the only viable transportation routing within Africa may require traveling across the continent multiple times (African Development Bank, 2012). For example, for a business to send a shipment from Luanda, Angola to Malabo, Equatorial Guinea, a distance of about 1,500 km, would be about 90 minutes by direct flight. However, no direct flight exists, and the only option is to send the shipment to Malabo from Angola, via Addis Ababa. This routing needs about 24 hours of total shipping time, including transit time. In addition, the cost to send this shipment is increased due to the longer route required, handling costs in Addis, and taxes imposed by Ethiopia. The African Development Bank Group (2012) stated that better-connected African countries and cities is a key factor to increasing economic prosperity in Africa.

The Yamoussoukro Declaration of 1988 and the Yamoussoukro Decision of 1999 were agreements to take measures to deregulate air services and open the domestic and regional markets to transnational competition, liberalize tariffs and fees, encourage fair competition, and
ensure airlines comply with international safety standards (Schlumberger, 2010) as defined by the International Civil Aviation Organization (ICAO). However, there has been very little progress in adopting the agreements despite projections that liberalization, also called deregulation, could increase passenger volume over 100% in some countries. (Norton Rose Fulbright, 2015)

Also listed by Norton Rose Fulbright as a top driver of underperformance of the airline industry in Africa are the challenges associated with the lack of foreign currency exchange as well travel document requirements, such visa requirements, for intra-Africa travelers. There are 41 different currencies used in Africa, not counting the Euro or the U.S. dollar. In many countries with a struggling economy the U.S. dollar has become the de facto currency due to value stability. When an airline makes sales in another country, revenue is received and recognized in the currency of the country. Many currencies in Africa are difficult to convert to the Euro, U.S. dollar, or the currency of the airline’s home country. For example, if Ethiopian Airlines sells a ticket in Sudan the ticket would be paid in Sudanese pounds. Exchange of Sudanese pounds to any other currency is difficult due to restrictions imposed by the Ministry of Finance in Sudan.

Fortunately, the International Air Transport Association (IATA) Currency Clearance Service enables airlines to repatriate their world-wide sales revenue (IATA, n.d.). However, this is an added step in reclaiming earned revenue and ultimately increase costs and reduces the profitability of operating in some countries with tough foreign exchange policies.

Many African countries have very strict immigration policies that require obtaining a visa before departure from the home country and limiting where a visa can be issued to only an embassy in a country where the applicant is a citizen or a resident. The visa application can be
very difficult as well and may require multiple levels of approval both in the country’s Ministry of Foreign Affairs and the country’s Embassy or Consulate. This has an effect of reducing demand for intra-Africa air travel.

Another root cause of underperformance of the airline industry in Africa is inadequate infrastructure. Both the soft and hard infrastructure is severely lacking and cannot support the needs to an increased in the airline industry (“Africa’s Aviation Industry,” 2012). Soft infrastructure such as internet and mobile connectivity is vital to support airline operations. Reliable and fast internet is very limited in many African countries and continues to be a challenge even in some of Africa’s more developed urban areas. Aging infrastructure of airports and roads hinders further growth and expansion of airlines in Africa.

My position as a field service engineer, working for an aircraft engine manufacturer based in Africa, inspired me to understand what someone in my position can do to influence the growth of the airline industry in Africa. A field service engineer generally cannot influence economic or fiscal policy in the country he or she is working. A field service engineer does not engage in many of the areas that are critical to growth of the airline industry. A field service engineer does work in the area of engine maintenance and airline maintenance operations. Based on my own experience, working in this area allows a field service engineer to influence the adoption of service bulletins, compliance of airworthiness directives, and proper performance of maintenance and inspection tasks. These items directly address exposure to hazardous conditions that can result in accidents and incidences. Thus, the field service engineer has the ability to influence the safety performance at an airline, which is identified as a critical area for the growth of the aviation industry in Africa.
The purpose of this study is to identify and understand the characteristics of engagement between aircraft engine manufacturers and airlines in Africa that lead to successful outcomes, specifically with regards to adoption of service bulletins, compliance with airworthiness directives, and proper performance of maintenance and inspection tasks.

The Importance of Airline Safety in Africa

The final point discussed by Norton Rose Fulbright (2015) in their article on Africa as a major untapped market for the airline industry—and the inspiration and focus of this dissertation—is airline safety and airport security. In 2011 in the number of air traffic accidents in Africa was nine times higher than the global average (“Africa’s Aviation Industry,” 2012). As a result, the African Development Bank ranked safety and security as the number one most pressing challenge facing African airlines. The high number of air traffic accidents is due primarily to the lack of adoption of international safety standards and the lack of government regulations that strictly enforce these same international safety standards (“Africa’s Aviation Industry,” 2012).

The presence of global terror groups based in many African countries, such as Boko Haram in Nigeria, Al-Shabab in Somalia, and ISIL in many North African countries, is a major challenge for airport security organization. This challenge coupled with political and social instability in many African countries makes guarding the security of airports and aircraft an increasingly more important task.

Despite the many factors that hamper growth for airlines in Africa, there are shining examples of successful airlines. Most notable is Ethiopian Airlines, which has managed to reach over U.S. $800 million in profit in the last eight years while the other African airlines, including Kenya Airways, South African Airways, and EgyptAir had a combined loss of U.S. $1.5 billion
in the same period (Center for Aviation, 2016). A report from the African Development Bank pointed to factors of Ethiopian’s success being enlightened airline leadership, adequate infrastructure, and a government that is supportive but not meddlesome in the affairs of the airline (“Africa’s Aviation Industry,” 2012).

In response to the urgent need for increased safety and security standards, and with the support of ICAO and IATA, the African Union drafted a strategic action plan called The Africa Strategic Improvement Action Plan. This action plan targets increased safety and security for African aviation. The goal of this strategic action was to establish independent civil aviation authorities for each country, implement effective and transparent oversight systems, complete an IATA Operational Safety Audit for all airlines in Africa, implement accident prevention measures focused on runway safety and loss of control, and complete implementation of Flight Data Analysis (FDA) and Safety Management Systems (SMS).

**The Impact of Safety on Airline Operations and Passengers**

The African Development Bank advised that the average number of aircraft-related accidents in Africa was nine times higher in 2011 than the global average (“Africa’s Aviation Industry,” 2012). In the same year African airlines accounted for nearly one-third aviation related fatalities, which led the European Union to ban at least 108 African airlines from European Union airspace (“Departure Delayed,” 2016).

An example of the impact of safety, is the case of the crash of an Antonov AN-12 cargo aircraft into a nearby fishing village as it took off out of Juba, South Sudan in November 2015. This scheduled service was provided to transport local and international workers to the oil fields in Eastern Nile province in South Sudan. The death toll from this aircraft crash was officially listed as 37 but not all casualties may have been reported (“South Sudan Plane Crash,” 2015).
This aircraft was over 44-years-old and operated by Allied Services Ltd and is operationally based out of Juba but registered in Tajikistan. The reason for such an arrangement is that the fledgling government of South Sudan had not established a Civil Aviation Authority. The aircraft manufacturer completed its own investigation and advised the aircraft had not received required maintenance and was therefore had not been airworthy. In addition, the investigation found there to be excessive overloading of the aircraft (“Over 40 Killed,” 2015) and further learned that South Sudan security forces routinely place family members on board regional flights without placing them on the aircraft manifest (Bariyo, 2015).

This accident directly resulted from airline negligence regarding following the guidance from the aircraft original equipment manufacturer (OEM) on maximum take-off weight allowances and inspection and maintenance requirements. Tragically, around 40 people lost their lives. This includes passengers on the cargo airplane and residents of the villages where the aircraft unfortunately came down. Such a fatal accident means a loved one will be mourned and missed. The emotional impact on the family and loved ones of those killed in aviation accidents cannot be quantified. A more tangible effect of a fatal accident is that a family in Africa may no longer have a breadwinner to provide financial stability for the extended family.

For the airline, such a fatal accident has a significant impact on many aspects of the airline’s operations. The most immediate impact will be the loss of use of the aircraft. In the example above, the aircraft was damaged beyond economical repair. This means that repair was not even an option of the aircraft. The airline would have to decide whether to buy another aircraft to support operations or scale down operations to reflect the reduction in fleet size. This decision would have implications on long-term cost of the airline and the ability of the airline to generate revenue. Another cost that the airline would likely incur is the compensation paid out to
the families of those that suffered a fatality during the accident. This cost would likely vary depending on the country the fatal accident occurred. Regardless it would likely be substantial.

Lastly, the airline would likely suffer from irrevocable damage to their brand and reputation. This would make selling tickets in the future more difficult and might reduce future revenue. These types of costs coupled with the loss in revenue would be a difficult financial position for the airline to navigate and could lead to the airline ceasing operations and declaring bankruptcy. This would have a long reaching effect on the employees of the airline as they would now become unemployed. The cessation of operations could also impact the operations at the airports used by the airline and could cause the slowed operations at the airport and reduced need for staffing.

Finally, the customers of the airline and its service would be impacted; especially on routes with already limited service to remote destinations. In Africa, many rural or isolated destinations may only be served by a single airline. For example, SA Airlink is the only commercial operator to provide passenger air transport service to the remote island of St. Helena, a British overseas territory 1,200 miles off the coast of Angola. This is the island where Napoléon Bonaparte lived his final years in exile. Without this air transport service residents of the tiny island were connected to the outside world by a six-hour boat service that operates every other week (Buckley, 2017). Without this service, tourism would decrease, and local business will be impacted. Likewise, shipping goods to the island will be more expensive and take much longer. This would increase the cost of living for the residents of the island and could hinder emergency medical evacuations.

Individual incidents or incidents can impact an airline’s operations and their financial position. Poor safety practices can cause specific aircraft, airlines, or all aircraft and airlines from
entire countries to be banned to fly into other regions. For example, TAAG Angola was banned from flying into the European Union and the United Kingdom in 2007 citing safety concerns. TAAG Angola reported this ban on operating into the European Union cost the airline U.S. $5 million per month (Buyck, 2007). The reduction in air transport service meant that options for traveling or shipping cargo were reduced and resulted in less convenient and longer shipping times along with increased costs. This meant an increase in the cost of these imported goods for the residents of Angola.

The Definition and Measure of Airline Safety

In the United States, Title 14 of the Code of Federal Regulations governs all aviation related activities. Title 14 is further divided in to parts that focus on a specific activity. For example, Title 14 Part 137 focuses on activities related to agricultural aircraft operations. This study, and the terms used, focus only on aircraft that have a seating capacity of greater than 20 passengers and operates commercial flights that are public charter, meaning they can accept business from anyone will to pay and meet their criteria (Federal Aviation Administration, n.d.). Activities of aircraft meeting this criterion are covered in Title 14 Part 121. The well-known commercial airlines such as Emirates, Delta, United Airlines, and British Airways operate on a Part 121 certificate.

The accepted measure of airline safety performance is the accident rate. However, some studies also consider the incident rate (Rodrigues & Cusick, 2011). The following are terms used in the aviation industry to review to different events. The different events have different characteristics—with different reporting requirements. For example, the terms accident and incident may be used interchangeably by a layperson, but as described below terms refer to different events and the accident rate and incident rate are reviewed and analyzed as two separate
types of safety data. The terms below are formally defined by the National Transportation Safety Board (NTSB), which is an agency of the United States government responsible for leading civil and commercial transportation investigations (Rodrigues & Cusick, 2011). The following are terms commonly used in reference to airline safety, as paraphrased from Rodrigues and Cusick (2011):

*Accident:* An accident in an event that happens after a person has boarded an aircraft, with intention for flight, and before all passengers and crew exit the aircraft after the flight and involves a fatal injury or substantial damage to the aircraft.

*Fatal injury:* A fatal injury would classify any aviation event as an accident. Any death related to the aviation event that occurs within 30 days of the aviation event is considered a fatal injury.

*Serious injury:* A serious injury is any injury, harm or pain inflicted during an aviation event that requires at least 48 hours of hospitalization, or results in broken bones, injury to internal organs, or severe burns.

*Substantial damage:* Substantial damage is any damage requiring major repair or replacement of affected components or that affects the structural strength, performance, or flight characteristics of the aircraft.

*Incident:* An incident is any event that is not classified as an accident but affects or could affect the safety of operations. An incident is loosely defined as a near accident such as a near mid-air collision, runway incursion, in-flight fire, and failure of flight critical equipment. There is a defined list of incidents that require reporting (Electronic Code of Federal Regulations, 2019). Most incidents are not required to be reported and coupled with the fact that the
definition of an incident is highly subjective leads to high variation in incident reporting from airline to airline.

Major accident: A major accident occurs when either a part 121 aircraft is destroyed beyond economical repair, a part 121 aircraft is damaged and there is one fatality, or any accident where there are multiple fatalities.

Serious accident: A serious accident occurs when an aviation event either results in a single fatality but does not result in substantial damage to a Part 121 aircraft or when there is a single serious injury and a Part 121 aircraft is substantially damaged.

Injury event: An injury event is a non-fatal accident with at least one severe injury but without substantial damage to a part 121 aircraft (Rodrigues & Cusick, 2011).

Damage event: A damage event is an event in which no person was killed or injured but in which a part 121 aircraft was substantially damaged.

The terms listed and defined above reveal a fine line between an accident that is required to be reported, and an incident that may not be required to be reported. The difference between an accident and an incident depends on the severity of the event outcome and as well as the context of the event. Both accidents and incidents provide evidence of safety hazards. There is no empirical evidence that incident rate provide insight into the probability of accidents. However, some researchers and safety officials estimate the incident rate can be between 10 to 100 times the accident rate (Rodrigues & Cusick, 2011). However, incidents do reveal the hazards that also cause accidents (Rodrigues & Cusick, 2011).

Service bulletins are a formal communication from a manufacturer, or OEM, notifying the operator or owner of a product improvement. The reason for the product improvement can range from reducing the cost of using the product to addressing unsafe conditions (Abbott,
Airworthiness directives are issued by civil aviation regulating authorities, and not by the manufacturer. Airworthiness directives are issued when there is a known safety issue. As the name indicates, for an aircraft to remain airworthy it must comply with all instructions in the airworthiness directive per the deadline in the airworthiness directive. If an aircraft is not compliant with the airworthiness directive, the local civil aviation authority will revoke allowances for the aircraft to operate (Federal Aviation Administration, 2009).

Airworthiness directives and some service bulletins address exposure to hazardous conditions that can lead to an accident or an incident. Likewise, incorrectly performing routine and non-routine maintenance and inspection tasks can also lead to an increase in exposure to hazardous conditions that can lead to an accident or an incident.

**Purpose of Study**

As described in the previous section, safety is a critical area of focus for all airlines and an area of needed improvement for airlines in Africa. The effects of an accident or incident can have severe implications on airline itself, its employees, its passengers, and the communities where the airlines flies. When airlines operate with a lowered safety performance the airline employees, passengers, and surrounding community are exposed to unsafe conditions. These unsafe conditions can cause fatalities, personal injury, or loss of financial security.

Beyond the immediate effect that airline safety has on employees, passengers, and those living near airports, poor airline performance and practices can have a large economic impact. Airlines with poor safety records can have truncated operations due to regulatory actions (Kacou & El-Houry, 2017). These types of actions can cause reduced connectivity with trade partners and can reduce the overall trade of a country. This not only increases cost of living as imported items would need to be shipped by longer and more costly routes, but it also reduces the standard
of living since imported items are most expensive and not affordable to many people. For example, many people in Africa opt to purchase counterfeit medication since the real medication is more expensive than they can afford. These counterfeit and expired drugs account for nearly 100,000 deaths in Africa every year (Hirschler, 2017).

Improved airline safety alone will not immediately remedy the challenging economic conditions in Africa. As pointed out by Norton Rose Fulbright (2015), the aviation sector in Africa has many areas that need improvement in order for the aviation industry to flourish. Kacou and El-Houry (2017) also emphasized how impactful the development of the aviation industry in Africa would have on the economy of Africa but also on global commerce.

To support the need for improvements in safety, ICAO released a report that identified a series of actions required as part of the effort to improve aviation safety in Africa (ICAO, 2015). One action was “to increase the number of qualified personnel at the industry and oversight levels” (p. 12). The current study looks beyond having qualified personnel at industry and oversight levels and instead investigates the critical characteristics of their engagement.

The purpose of this study is to identify and understand the characteristics of engagement between aircraft engine manufacturers and airlines in Africa that lead to successful outcomes, specifically with regards to adoption of service bulletins, compliance with airworthiness directives, and proper performance of maintenance and inspection tasks. It is my hope that airlines, OEMs, and regulatory bodies can use the results of this study to develop effective engagement plans between airlines in Africa and the appropriate OEMs to drive an outcome of improved airline safety performance.

It should be noted that FAA regulation CFR 121.363 states that the airworthiness, and hence safety, of aircraft and their operation are solely the responsibility of the certificate holder.
The certification holder is the aircraft operator or owner. The purpose of this study is not to transfer airworthiness and safety responsibility to the OEM.

**Significance of Study**

The intent behind this study is to identify and understand the characteristics of engagement between aircraft engine manufactures and airlines in Africa that lead to successful outcomes, specifically with regards to adoption of service bulletins, compliance with airworthiness directives, and proper performance of maintenance and inspection tasks. It is in the best interest of the OEM, airline, and passenger that airline equipment such as aircraft and engines are operated in a safe, responsible, and efficient manner. Such actions would reduce the exposure of the OEM’s product to being involved in an accident or incident. Likewise, it would reduce the exposure of the airline to having a costly accident or incident and, as previously discussed, an improved safety record will open new destinations and regions where the airline may fly. Finally, the passenger benefits by being able to access needed air transport services without risking exposure to unsafe conditions. Ensuring safety of air transport services in Africa is a critical element that will allow the industry to thrive and which is projected to lead to increased economic growth in Africa.

The key to the economic success of Africa is the airline industry (Button, Martini, & Scotti, 2018). and one the keys to a developing the airline industry in Africa is improving the safety of airline in Africa (Norton Rose Fulbright, 2015). To support the need for improvements in safety, ICAO released a report that identified several actions required as part of the effort to improve aviation safety in Africa. One item identified was, “to increase the number of qualified personnel at the industry and oversight levels” (ICAO, 2015, p. 12). The current study took
inspiration from this recommended action item and seeks to identify the key characteristics of the relationship between qualified personnel from the OEM and the airline.

During preparation for this dissertation I discovered a lack of literature available on the airline industry in Africa. Likewise, there is a lack of literature available on effective airline support models or studies regarding OEM-airline engagement. I hope this dissertation will not only supplement the recommendations in the ICAO report but will also contribute to the existing literature, which is minimal. I also hope it this dissertation will spark a newfound interest on the topics of airline support, specifically in Africa, which will lead to an increase in academic publications on the topic.

**Research Questions**

This study is designed to answer the following research questions (RQ):

RQ1: What are the critical touchpoints between engine OEMs and airlines in Africa that lead to successful outcomes during the adoption of service bulletins and the compliance with airworthiness directives?

RQ2: What are the critical touchpoints between engine OEMs and airlines in Africa that lead to successful outcomes during the performance of maintenance and inspections tasks?

RQ3: What are the characteristics of the touchpoints that facilitate efficient transfer of needed information?
Author’s Background

Since I was young, I have had dual passions for aviation and business. As an 8-year-old, I was asking my father how to read the Dow Jones report from the newspaper. Although I did not have money to invest, I had my favorite stocks that I would follow from day-to-day and week-to-week. These stocks were companies I knew like Nike and Whirlpool, my father’s employer. I would ask why stocks go up and why do they go down, and who buys them.

My father traveled often for business, and so I also spent much time taking my father to the airport. I found myself fascinated by the aircraft and the engines. I would theorize why the aircraft can remain in the air and how the engines created thrust.

These two passions would eventually lead to my pursuit of a Bachelor of Science and Master of Science in Engineering before completing an MBA where I focused on international business and on change leadership. These two fields of study have fundamental differences. In engineering, the focus is holding fixed as many variables as possible to understand the singular relationship between a dependent variable and independent variable. This level of detail allows aircraft engines to be design, manufactured, and operated. Conversely, as an MBA student I learned the importance of considering all influencing factors when making a decision. This type of decision making allows businesses to enter new markets and develop new products. It taught me to understand the known-knowns, knowns-unknowns, and unknown-unknowns in managing risks and making decisions based on limited information. A business leader must always consider the strengths and weaknesses of the organization and people they lead. They must be keenly aware of threats, such as disruption technology, and opportunities such as emerging markets. None of these items are well defined. A leader must make calculated decisions on limited information. Finally, the MBA taught me the power and impact a leader can have. Either
for good or bad. My introduction to Change Leadership in the MBA led to my enrollment in the PhD in Leadership and Change at Antioch University.

Through the PhD program I learned more about what it means to be a leader and the need for leaders to drive positive change. For a majority of the time I have been in the PhD program, I have been a field service engineer for General Electric’s aviation business. I am based onsite with Ethiopian Airlines, the largest airline in Africa, where I provide technical and operational support as they use GE manufactured aircraft engines. I also remotely support many airlines in Southern Africa, West Africa, and African islands in the Indian Ocean. Through the PhD program I have been able to reconcile my personal and professional passion for the development of Africa’s aviation industry with the need to win a victory for humanity.

Study Assumptions

The study being completed as part of this dissertation will focus on first interviewing individuals employed by a wide range of African airlines. I collected data by engaging in semi-structured interviews with fourteen aviation professionals working for airlines in Africa. The interview data was transcribed before being coded. Analysis of the coded interview data was analyzed in order to identify critical factors of successful engine OEM engagement with airlines in Africa.

This study does not include an analysis of actual accident or incident data. Instead, the study relies on the expertise of the interview participants and considers them subject matter experts. This study assumes that the individuals who took part in the interview were knowledgeable about airline operations and had an expert level of knowledge regarding the function of the airline they worked in. This assumption is critical to establishing the validity of the responses, and hence the results of the study. To ensure the interview participants were
subject matter experts only individuals that had over one-year experience working in positions that directly engaged with OEMs were considered for inclusion in this study.

The current study assumes that airlines and OEMs alike will use the result to improve engagement with a common goal of reducing exposure to exposure to conditions that could lead to accidents or incidents. This study also assumes that both OEMs and airlines are risk adverse organizations who are continuously looking for opportunity to reduce exposure to the occurrence of accidents and incidents. I also assume it that both organization types are ready and willing to change their engagement strategies to minimize exposure to conditions that can lead to accidents or incidents.

**Study Limitations**

This study, like all studies, has several limitations. One of the primary limitations is that it uses self-reported data. The hierarchical structure of airlines often varies. This meant that individual roles and titles from airline to airline often not exactly the same. This interview targeted airline professionals working in engineering positions related to aircraft engine maintenance. The interview considers the participants subject matter experts in the area of airline maintenance operations. The data collection looks solely at the perception of the subject matter experts and does not compare the responses to airline operational data. I further discuss this in Chapter V as an area for future work.

I have taken great care to include as many different types of airlines in this study as possible. However, due to many airlines being in isolated regions with little knowledge of their existence it makes ensuring that all airlines are reached a significant challenge. This has a limiting effect on the generalizability of the results.
In 1951, at the request of ICAO, English was designated to be the universal language for aeronautical communication for pilots and air traffic control (“Aviation English,” 2017). Although this was only a recommendation and was only targeted at pilots and air traffic control, English has become the de facto official language of international aviation. For this reason, I conducted the interviews in English. Despite English being the de facto official language, many employees of airlines do not speak English fluently. And even if the participant was fluent in English, their use of colloquialisms, idioms, and direct translation from their mother tongue to English meant that I had ensure the points the participants were trying to make were accurately understood. To do this, I often would follow up with questions to ensure my understanding of their response was consistent with their intention. Most often, what I as the interviewer understood was the same as what the interviewee was communicating.

**Study Delimitations**

Besides study limitations there are several study delimitations. The interviews were only open to those employees working in a technical support or engineering position that regularly engages with the engine OEM. Furthermore, the interviewee was required to be in the role for at least one year to ensure they had sufficient experience engaging with OEMs. The purpose of setting minimum experience was to ensure the participants were knowledgeable with regards to the OEM support and engagement required. Thus, they could provide more insight into the support needed for the airline to reduce exposure to occurrences of accidents and incidents.

The two largest OEMs that engage with the airlines are the aircraft and engine manufacturers. However, there are many other companies that supply systems or assemblies to the aircraft. For example, landing gears and braking systems are part of the aircraft but supplied by a separate OEM. In this type of situation, the airline would engage with the aircraft OEM for
any technical or commercial issues on this assembly. This is similar for all systems or assemblies that operate as part of the aircraft. The only exception is the engine. In case of a technical or commercial issue on the engines the airline engages directly with the engine OEM. The management of the engine program differs from the aircraft program, and thus it is assumed that engagement with an engine OEM differs from engagement with an aircraft OEM. As such, this study focuses only on engine OEM engagement.

As pointed out earlier, FAA regulation CFR 121.363 states that the airworthiness, and hence safety, of aircraft and their operation are solely the responsibility of the certificate holder. The purpose of this study is only to identify how the OEM can best support the aircraft and engine operator to meet their obligations defined in FAA regulation CFR 121.363. The intent of this study is not to transfer any part of this responsibility to the OEM.

The current study only included commercial airlines that fly scheduled routes and include major airlines and regional operators. These types of airlines are categorized in FAA regulations as Part 121 operators. Aircraft operators that do not fall under the Part 121 category include business jet operators, training schools, commuter, and on-demand operators, as well as general aviation. General aviation can include individuals that operate private aircraft for leisure or for a person's business such as crop dusting. These types of aircraft operators were not included in the interviews. Likewise, operators of military aircraft or government use aircraft were not included in any portion of the data collection.

It is common for individuals to work at multiple airlines over the course of their career. It is likely that many of the participants had previously worked at another airline potentially in another region. The intent of this study is to identify the characteristics of OEM-airline engagement that lead to successful outcomes in the adoption of service bulletins, compliance of
airworthiness directives, and correct execution of maintenance and inspection tasks. Another delimitation of this study is that only the participant’s current role was included, and previous experience was excluded.

Chapter Overviews

Chapter II is written with the intent to describe previous studies and literary works on the subject of this dissertation. As previous efforts during the pre-candidacy portion of this PhD program have revealed, a lack of works and studies on the aviation industry in Africa but also on the relationship between OEMs and airlines, this chapter will focus on the critical success factors of support organizations in general.

Chapter III presents the data collection and analysis methodology. This study approaches the data collection and analysis from a perspective of systems analysis. An overview of systems analysis will be covered along with a detailed review of the data collection and analysis.

Chapter IV presents the analysis of the qualitative data collected through the interviews. The results of the analysis are organized and presented to address the three research questions identified previously in Chapter I.

Chapter V provides a summary and synthesis of the research completed as well as provides discussion of the results of the study. Recommendations for engaging the results of the study in to practices are included in the discussion as well as recommendations for future studies.
Chapter II: Literature Review

Africa, where the accident rate of airlines in Africa is nine times higher than the rest of the world ("Africa’s Aviation Industry,” 2012), is the last growth market within the aviation industry. One critical area that needs to be addressed is improved airline safety performance (Norton Rose Fulbright, 2015). As mentioned in Chapter I, to improve the safety of airlines, ICAO released a report identifying required actions to improve airline safety in Africa. One of the action items listed was to, “to increase the number of qualified personnel at the industry and oversight levels” (ICAO, 2015, p. 12).

The study presented in this dissertation seeks to understand the contribution of the collaborative relationship between OEMs and airlines towards the improvement of safety performance of airlines in Africa. To be consistent with previous studies (Y. Chang & Yeh, 2004) this dissertation will take the definition of airline safety performance to be the combined accident and incident rate. The condition that leads to both accidents and incidents is called a hazard (Cusick, Cortês, & Rodrigues, 2017). This dissertation assumes that OEMs are the center of gravity for knowledge with respect to proper operation, maintenance, and financial planning of their product. The OEM’s ability to sharing knowledge is critical to proper operation, maintenance, and support of their product. Despite the critical nature of knowledge sharing between OEMs and airlines, numerous literature reviews returned no studies focusing on the interorganizational collaboration between airlines and OEMs.

The current study approached the problem statement, defined in Chapter I, from the perspective of effectiveness of interorganizational collaboration between airlines and OEMs. This study focused on how OEMs can better engage with airlines to meet their needs the literature review was completed in two portions. First, to fully understand and summarize work
that has previously been completed a systematic literature review was completed on
interorganizational engagement. The second portion of the literature review presents a
background on the airline industry with respect to airline operations and performance metrics.

Chapter II starts by reviewing the factors that motivate organizations to engage, which
then leads to a presentation of the characteristics of different strategies of interorganizational
engagement. The benefits of collaborative engagement are discussed before presenting the
definition of interorganizational collaboration. This chapter then focuses on understanding the
characteristics of successful interorganizational collaborations. There is a duel focus on
characteristics at an interorganizational level as well as an interpersonal level.

Stakeholder engagement, trust, and knowledge sharing and their contribution to
interorganizational collaboration (IOC) outcomes are presented. Although these three
characteristics are presented separately, they are very much intertwined. Although each element
is presented separately, the other elements are referenced as part of the discussion due to the
nature of the relationship between them.

After defining and discussing the critical success characteristics of an IOC this chapter
then offers insight on the operations and management of an airline. Although there are many
aspects to an airline’s operation, this literature review makes every effort to understand those
operations and aspects of an airline relative to the OEM engagement. Finally, financial and
safety metrics by which airlines are measured are discussed.

This study views the safe operation of aircraft and engines as a common goal of both the
airline and OEM. Understanding how organizations successfully collaborate to meet a common
goal will provide input as to how OEMs can improve their engagement strategies with airlines in
Africa. Understanding of how airlines operate provides insight as to those functional areas where OEMs should engage those airlines.

**Interorganizational Engagement**

For this study, interorganizational engagement will refer to the organized and coordinated activities between at least two self-governing organizations, each having independent organizational goals, to produce achieve some outcome. This section will present the motivation for interorganizational engagement, types of interorganizational engagement, and the important of interorganizational engagement

**Motivation for interorganizational engagement.** Organizations, by themselves, exist to serve a purpose and achieve some type of defined outcome. Both external and internal forces may cause a change in an organization’s goal or ability to achieve that goal. One mistake that organizations often make is trying to develop a solution using only those resources internal to the organization. This type of siloed approach to problem solving can lead to redundant efforts and use of limited resources that result in solutions that are not effective at addressing the primary issue (Kania & Kramer, 2011). Reitan (1998) argued that for organizations to develop effective, sustainable solutions they to need to work collaboratively. It is inevitable that an organization will interact with other organizations in pursuit of achieving a desired outcome. An organization may need to interact with suppliers to negotiate contracts or communicate technical requirements for a new part. The same organization may need to interact with regulatory bodies to demonstrate how their new product meets regulations or how newly proposed regulations could potentially affect their business. The business might then engage with governmental or political organizations to discuss the impact of a tax increase has on their business. The organization could also engage with their customers to develop a product that better meets the customer’s
needs and to help the customer improve how they use the current product. The conditions that motivate organizations to collaborate are not limited to the examples provided above. However, the dynamics of the engagement often depend on the motivating factors. Ultimately, organizations interact because it is beneficial for them (Nathan & Mitroff, 1991) because different organizations have a different perspective of the common problem and, when there is constructive engagement, can devise better solutions (Gray, 1989).

**Types of Interorganizational Engagement**

There are different ways that organizations can engage. The engagement could be a one-time engagement or could be a long-term joint venture. The relationship could be defined as transactional or reciprocal (Gray, 1989). Hardy and Phillips (1998) sought to better understand interorganizational engagements by studying the interactions within the interorganizational domain. The interorganizational domain is made up of the individuals, acting on behalf of their parent organization, that directly engage with other individuals from different organizations (Tsasis, 2009). Tsasis (2009) goes on to refer to these individuals as actors in the interorganizational domain. These individuals differ from others in their organization in that they have direct contact or communication with individuals from external organizations.

McGuire (1988) described an interorganizational domain as a process of social construction. Gray (1989) continued and suggested that social hierarchy is established by this process. Through this social process stakeholders also communicate their values and a create a shared vision. The development of the domain and shared vision can be affected by the power distribution within the domain. The three aspects of power distribution within a domain are decision making ability, control of scarce resources, and discursive legitimacy (Hardy & Phillips, 1998; McCann & Gray, 1986). I have portrayed these three aspects in Figure 2.1.
Figure 2.1. Power distribution within a domain.

**Decision making ability.** Stakeholders that have the formal authority to make a decision (French & Raven, 1959) are considered to have decision making ability. This can be anyone in a hierarchal position whose decisions will be actioned by their subordinates. Additionally, a person with decision making ability can also be in a position that either holds a position or is recognized as being the responsible person for making decision on behalf of the organization. When considering an interorganizational domain between an airline and an OEM the decision-making ability most often would rest with the senior leadership of the airline as they have the decision to action recommendations from the OEM.

**Control of critical resources.** One of the primary benefits of participating in an IOC is the pooling and sharing of resources. By having control over one or more of the critical resources a stakeholder will have a power advantage over stakeholders that are dependent on that resource. Critical resources can include, but are not limited to, financial resources, intellectual property,
expertise, property rights, and physical assets. In the case of the OEM-airline relationship the OEM is the possessor of expertise on how best to operate and care for the specific equipment.

**Discursive legitimacy.** The final aspect of power discussed by Hardy and Phillips (1998) is the power to influence other stakeholders through the perception that one is speaking on behalf of the issues or those effected by the issues. People or organizations that have discursive power speak on behalf stakeholders that may not have a united voice. For example, an organization such as the People for the Ethical Treatment of Animals (PETA) or Greenpeace are perceived as speaking on behalf of those stakeholders without a voice. This aspect of domain power is termed discursive legitimacy.

The way that power is distributed among stakeholders and actors in the interorganizational domain can shape how stakeholders and actors engage. Hardy and Phillips (1998) introduced four types of interorganizational engagement strategies, based on the distribution of power among the stakeholders as well as the existence of a common goal. These engagement strategies are collaboration, compliance, contention, and contestation. These strategies are diagrammed in Figure 2.2.

![Figure 2.2. Four types of interorganizational engagement.](image-url)
Collaboration and compliance are engagement strategies that are established on the foundation of a cooperative relationship. Whereas contention and contestation are engagements build on conflict. Each strategy is discussed in more detail below.

**Compliance.** Compliant engagement is characterized by engagement of organizations that have a common goal but for which there is either a lack of voluntary participation or a lack of power distribution among stakeholders. A compliant engagement occurs when two organizations share a common goal, but one organization provides direction and instruction and the other organization complies with that instruction or direction (Hardy & Phillips, 1998). An example of a compliant type of engagement in the aviation industry is the when the Federal Aviation Administration (FAA) issues an Airworthiness Directive (AD). An AD is published to notify equipment operators of a safety deficiency that requires inspection, repair, or modification. The FAA has the authority to revoke certification of any operator that does not comply with the recommendations (FAA, n.d.). Before publishing an AD, the FAA sends notification the airlines and OEM for feedback, which can result in a modification of the AD. Once the AD is published the operators comply as they understand the actions address a safety deficiency and this is a common goal of the OEM, airline, and FAA.

The FAA has the authority to revoke certification of any operator that does not comply with the recommendations (FAA, n.d.). Before publishing an AD, the FAA sends notification the airlines and OEM for feedback, which can result in a modification of the AD. Once the AD is published the operators comply as they understand the actions address a safety deficiency and this is a common goal of the OEM, airline, and FAA.

**Contention.** Contentious engagement occurs between two organizations that do not share a common goal and are seeking to full different outcomes from the other stakeholders. In this
type of engagement there is a more equal distribution of power between the stakeholders. This allows the stakeholders to leverage their power during engagement with each other (Hardy & Phillips, 1998). In this manner, the interorganizational engagement may seem more like negotiations. An example of this type of relationship would be the relationship with a customer and supplier during the negotiation of contract. Both organizations have a goal to increase their profit margin and write the contract in terms favorable to themselves. They may leverage their power in the negotiation to put pressure on the other organization and meet their outcome.

**Contestation.** Contestation is an engagement strategy used by stakeholders looking to establish legitimacy or those stakeholders whose power position is based solely on discursive legitimacy. Like contentious engagements, engagements defined by contestation occur when the two organizations are working to achieve different outcomes. However, unlike contentious engagements, contestation engagements occur when the power within the domain is concentrated among one or few key stakeholders other (Hardy & Phillips, 1998). In this type of engagement stakeholders only source of domain power is through discursive legitimacy, however if unsuccessful at establishing themselves as a legitimate stakeholder they risk marginalization.

**Collaboration.** Collaboration typically occurs when two or more organizations engage to achieve a common goal. Reaching the final goal is of benefit to all stakeholders and thus the engagements will tend to be more cooperative and supportive. However, unlike compliance-based engagements, power is typically distributed more evenly amongst the stakeholders. Even those stakeholders that only hold power of discursive legitimacy still carry a great deal of influence, and unlike in contestation, their risk of being marginalized is low other (Hardy & Phillips, 1998).
The OEM-airline relationship can, at times, take on characteristics of either collaboration or contestation. While negotiating a purchase of new equipment or services agreements the relation may develop traits associated with contestation. This is due to a difference in the vision of the different organizations and each is focused on protecting its own position. However, ensuring the equipment operates without occurrence of accidents or incidences is a common goal of both the airline and the OEM. As a result, this aspect of the OEM-airline relationship is more collaborative in nature.

For this reason, this dissertation will focus on the collaborative aspects of the engagement between the OEM and airline and how it pertains to the mitigation of exposure to conditions that can lead to accidents and incidents. To better understand how OEMs and airlines can better engage in interorganizational collaboration (IOC), this chapter will review the defining characteristics of IOCs as well as those critical elements of the IOC that lead to successful outcomes.

A Description of Interorganizational Collaboration

In this section a definition of interorganizational collaboration is presented as well as some of the key elements. Basic characteristics of a collaborative interorganizational engagement were presented above. These characteristics aided in the discernment of collaborative engagement from other types of interorganizational engagement. This section will provide a more in-depth review of the defining characteristics of an IOC and well as the importance of IOCs to an organization’s ability to achieve some outcome.

Hardy, Phillips, and Lawrence (2003) define an interorganizational collaboration as “a cooperative, interorganizational relationship that is negotiated in an ongoing communicative process, and which relies on neither market nor hierachal mechanisms of control” (p. 323). A
more fundamental aspect of an IOC that can be added to this definition is that it is fundamentally an engagement between two or more organizations that have a common vision (Gray, 1989).

**Stakeholders.** It is clear that an IOC is a type of engagement between two external organizations, or stakeholders. This definition is meant to clearly delineate and IOC from an intra-organizational collaboration. In an IOC the collaborating organizations are autonomous with distinct leadership, organizational goals, and cultural values. An intra-organizational collaboration involves two organizations that ultimately reports to the same leadership and would have goals that are aligned as part of a higher-level strategy (Gray, 1989).

**Interorganizational domain.** When organizations decide to engage in an IOC, there will be several people from each stakeholder organization that will interact with members of the other organizations. Those individuals from each of the stakeholder organizations are called actors (Tsasis, 2009). Trist (1983) defines the IOC domain as a set of actors representing the interests of different organizations that become joined to address a common problem. As previously noted, the development of the domain is a process of social construction (McGuire, 1988). During this social process a hierarchy is established, and the actors establish the legitimacy of their organizations as stakeholders. In addition, the distribution of power within the domain is determined. The distribution of power within the domain will dictate how the actors engage.

**Motivation.** There are many reasons why different organizations would collaborate with other external organizations. Some organizations collaborated due to regulatory or political changes in the environment. These IOCs are generally due to external factors and are not voluntary, and so the engagement may take on the characteristics of a compliant engagement as opposed to a collaborative engagement. Other reasons organizations might collaborate is to
address a common problem or may be part of a long-term strategy aimed at developing a competitive advantage.

IOCs also facilitate increasing capacity, leveraging of expertise (Huxham, 1996) and pooling of resources (Hamel, 1991). In many cases IOCs are created to solve a common goal. Even if this is not the case, a successful IOC is one in where stakeholders in the IOC are able to learn what they need to support the vision of their organization.

In an IOC, the different stakeholders can communicate their interest in solving the problem as well as values internal to their organization. This ensures that the final solution meets the needs of the various stakeholders. The open communication that is typical of IOCs ensures that the values of the different stakeholders are respected within the IOC domain (Keast & Mandell, 2014).

**The Importance of Interorganizational Engagement**

Competition in nearly every global market is increasing. Once local firms are now forced to enter global markets with different customer demands where goods and services supplied to the new markets require more specialized and sophisticated knowledge to design, produce, sell, and support. In most cases it is not feasible for a single organization to have superior expertise in all functional areas related to a new product. One such example is the development of the CFM\(^1\) engine, a joint venture between GE Aviation and SNECMA Aircraft Engines (Doz, 1996). This collaborative relationship was based on a collaborative engagement where both organizations recognized the expertise of the other organization. The resulting product leveraged the most advanced technology from both organizations and became arguable the most success aircraft engine program in the history of the aviation industry.

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\(^1\) CFM International is the name of an engine manufacturer joint venture between General Electric and Safran Aircraft Engines (Aerocontact, n.d.)
Often organizations will encounter some problem that exceeds their capability or capacity to address. External factors can drive these types of problems (Gray, 1989). For example, an organization may want to establish operations in another county and regulations in the country may require that that foreign organizations must have a local sponsor. Perhaps an organization wants to compete in a new market but do not have technical expertise. These types of problems are described as large scale “messes” (Ackoff, 1979, p. 99) and “wicked problems” (Rittel & Webber, 1973, p. 155). Aldrich (1976) suggested these large problems lacked any means to segment or divide them into separate issues. Gray (1989) stated that interorganizational collaborations can address large problems that no single organization could solve alone. Gray went on to explain that through sharing of tangible resources, financial resources, and intellectual resources these indivisible problems can be addressed, and solutions developed.

However, the presence of an indivisible problem is not the only reason that organizations would seek to establish an IOC. Organizations may seek to engage in interorganizational collaboration if traditional adversarial methods of addressing problems are perceived to have sufficient limitations (Hardy & Phillips, 1998). If those other engagement strategies, such as those previously discussed, do not enable the organization to meet their intended goal the organization may adopt a collaborative strategy. Organizations may also seek to engage in interorganizational collaboration if the current independent actions taken by organizations creates an unstable and inharmonious operating environment for the different organizations in order (Trist, 1977).

So far, this chapter has presented different strategies of interorganizational engagement and explained how a collaborative engagement is fundamentally different from other engagement strategies. Then a definition of an interorganizational collaboration was presented
along with a description of the fundamental elements of an IOC. The importance of IOC as a strategy for achieving outcomes was also presented. The discussion will now focus on presenting those characteristics of a successful IOC, both from an interorganizational level as well as an interpersonal level.

**Characteristics of Successful IOC Domain Creation**

One of initial steps that occur when organizations engage is for people with the different organizations to be introduced and start working together and sharing information. Gray (1989) emphasized that for IOCs to be successful the stakeholder organizations need to develop an environment that facilitates the domain actors’ conceptualization of problems and empower them to organize solutions. After observing the development of teams in the interorganizational domain McCann (1983) presented three sequential phases for developing the domain that are critical to the success of the interorganizational collaboration. Those sequential phases are problem setting, direction setting, and structuring (Figure 2.3). McCann described this as a natural process as natural but did go on to advise that internal or external forces will influence the development of the domain. These additional forces can either have a positive effect on the domain, a negative effect, or no effect.

![Figure 2.3. Sequential phases of domain development. Adapted from “Design Guidelines for Social Problem-Solving Interventions” by J. E. McCann, 1983. Journal of Applied Behavioral Science, 19(2). Copyright 1983 by SAGE. Adapted with permission.](image-url)
Problem setting. Problem setting is the first of the three phases of domain development suggested by McCann (1983). In this phase of development stakeholders first agree upon what the common problem is that will be addressed or will agree upon a common goal. Unless the domain has a clear understanding of purpose it will not be successful. After understanding the common problem or common goal stakeholders will seek to be acknowledged and included in the domain. It is very possible that previously unrecognized stakeholders will then negotiate to have their positions and interests reviewed to confirm the legitimacy of their inclusion in the domain. Once the list of stakeholders to be included in the domain is finalized, the various actors in the interorganizational domain start to develop an understanding of the interdependence that exists.

A critical factor in accurately determining the common problem, identified above as being a critical element in determining the success of the IOC, depends on ensuring all relevant stakeholders are included. Vickers (1965) showed that allowing more stakeholders to share their perspective of the problem and its impact on them, enables improved understanding of the problem to all stakeholders. This broad understanding allows the domain to develop more appropriate and precise solutions. These solutions will then be more widely accepted, especially if those who must abide by the solution take part in the development of the solution (Van de Ven & Delbecq, 1974).

One may think that inclusion of stakeholders is a relatively easy task. However, Gray (1989) pointed out that stakeholders are not always easily identifiable because the timing of their concern with the situation may not coincide with all potential stakeholders. Hay (1983) pointed out that potential stakeholders will first need to be unsatisfied with the current situation and possibly have tried other approaches for improving the situation. Organizations and individuals
become aware of problems at different time and the problem begins to affect their operation or
daily life in different ways. For this reason, all stakeholder may not be aware of the problem at
the same time or may not have the same sense of urgency at the same time. To address this, Gray
(1989) proposed the inclusion and exclusion of stakeholders should be treated as a continual
process.

Collaboration does take an amount of effort and investment from the stakeholders. For
this reason, the various stakeholders need to firmly believe that collaborating will produce
positive outcomes before they invest in a collaborative problem-solving approach (Davidson,
will enhance their efforts if they expect the benefits of collaborating to outweigh the cost. This
indicates that stakeholders not only need to be aware of the problem but also need to be
convinced the benefits of collaborating outweigh the cost of collaborating. Gray suggested that in
the absence of positive expectations, there will need to be other incentives to attract stakeholders
to participate.

Another strategy for attracting stakeholders to collaborate is for them to understand their
interdependence on other stakeholders. Davidson (1976), Hooyman (1976), and Terreberry
(1968), all discovered an inherent need for stakeholders to recognize their interdependence with
the other stakeholders as fundamental requirement to establishing a collaborative relationship.
Gray (1989) postulated that the extent to which the stakeholders recognize interdependence with
other stakeholders is an indicator of success in the collaboration. As such, recognition of
interdependence is an important element when establishing a domain. Clear communication of
goals and openness on the topic of interdependence is absolutely required to ensure a deep
understanding of interdependence.
Recognizing interdependence among stakeholders is necessary for stakeholders to establish their legitimacy and for other stakeholders to recognize their legitimacy (Hooyman, 1976). Gray (1989) encourages the inclusion of all legitimate stakeholders as it leads to a more effective solution and positive IOC outcome. Gray also strongly warned against the exclusion of legitimate stakeholders as it will have a negative effect on the quality of the solution and the ability to execute on the solution. For this reason, open communication amongst potential stakeholders early in domain creation is important as it facilitates recognition of interdependence.

To facilitate the problem setting phase of a domain’s development a leader needs to be identified as a person that will initiate the collaborative problem solving (Gray, 1989). Selecting a leader of the domain may be easily based if amicable relations between all stakeholders exist (Provan, 1983) or could be chosen based on the power dynamics within the domain (Friend & Jessop, 1969). In the case that the stakeholders are unable to choose a leader from within the existing stakeholders a neutral party may be required to manage the actives of the domain. In this situation it is important that the convener possess respect and legitimate authority as well as appreciative skills to bring together the different stakeholders.

**Direction setting.** Once the common goal is established, the inclusion of stakeholders in the domain finalized, and there is a clear understanding of stakeholder interdependence, the stakeholders in the domain will discuss the values that will guide the behavior and actions of the individual organizations in the IOC domain (McCann, 1983). Knowing the values of all stakeholders in the domain will allow for either an informal understanding or a formal and published guideline that gives direction on how the domain will proceed forward. This guideline
provides guidance on how stakeholders can act and interact while ensuring their activities hinder the domain from achieving the stated goal (Gray, 1989).

Facilitation of the direction setting phase during the establishment of interorganizational domain is based on the ability of stakeholders to recognize the values of other stakeholders and is most effective when those values are coincidence with the values of the other stakeholder (McCann, 1983). Studies by Schermerhorn (1975) and Cheng (2011) showed evidence that stakeholders that had harmonious or common goals also had strong coordination when working together. Burns (1966) also showed that stakeholders that held similar beliefs and values about the problem could more easily agree to the root cause of the problems. This allowed them to develop solutions to address the problem. Having an agreed upon goal is important, but also having agreed upon values and being aligned with how to achieve the common goal is an important element in when establishing an interorganizational domain.

Direction setting is further facilitated by distribution of power among the stakeholders (McCann, 1983). It is very often in interorganizational domains that some stakeholders possess greater power than other stakeholders (Aldrich, 1976). This often arises as a direct result in unequal access to valuable resources such as financial resources or intellectual property. With limited or no access to critically needed resources, some stakeholders can become marginalized in this phase of the domain development (Pfeffer & Salancik, 1977). There is abundant data showing that effective collaboration cannot occur unless there is a sufficient distribution of power within the domain (O’Toole & O’Toole, 1981). It is recommended that mechanisms be implemented in the governance of the domain to ensure sufficient distribution of power (Pfeffer & Salancik, 1977). However, the mechanism should also avoid equal distribution of power within the domain as this will often lead to a stalemate and stagnation of process towards the
common goal. It is important in the establishment of an interorganizational domain that every stakeholder be given a voice. However, equal distribution of power should be avoided because it can lead to stagnation (Gray, 1989).

**Structuring.** Often in long-term collaborations the common problem and individual values of the stakeholders can be dynamic. As stakeholder leadership changes or actors change, the perception of what constitute correct values may change. Some stakeholders could leave the interorganizational domain and other could enter the domain. Because of these dynamics occurring over time it is necessary to have some time of governing system to support long-term problem-solving activities, govern stakeholder interactions in a systematic manner, and ensure tasks are properly assigned and executed (Kashyap & Sivadas, 2012). In long-term collaborations, the role of domain governance become more formal with previously information operating norms become institutionalized.

To facilitate the ongoing governance of the stakeholders in the domain requires continued recognition of interdependence of other stakeholders. This acknowledgement will drive the stakeholders to continually formalize the details of the domain governance (Van de Ven & Walker, 1984). It is also just as critical that as the structure of the governance changes that stakeholders are empowered to meet their obligations, as defined in the previous phase of domain development. Continued structuring is the preferred method of ensuring a stakeholder is not marginalized when there is a high level of interdependence among stakeholders. However, IOCs in which stakeholders that are less dependent on each other will tend to have less structured engagement (McCann, 1983).

Another facilitating factor in the structuring phase of domain development is the presence of external forces. Hall, Clark, Giordano, Johnson, and Van Roekel (1977) pointed out that
external forces will have a varied effect on the structuring of the domain based on the motivating factors that initiated the establishment of the domain. For example, coordination within domains that interact in more of a voluntary manner are closely associated with the stakeholders having a positive perception of the other stakeholders’ competence, compatibility of values, engagement frequency, and negotiated power distribution. However, when interorganizational engagement is mandated, or forced, many of those collaborative characteristics in the domain structuring are absent (Milward, 1982). In situations of mandated interorganizational engagement care must be taken to develop a framework of domain governance that ensure balance of power and recognition of interdependence amongst stakeholders (Gray, 1989).

It was discussed how in the direction setting phase, power distribution facilitates the establishment of operating rhythms and ensures the values of smaller stakeholders are not marginalized. However, the same power distribution that facilitated earlier phases of the domain development may not be the optimal power distributions in the structing phase. In the structuring phase it may become more desirable to concentrate the power within a few stakeholders if this proves to be more efficient at governing stakeholder interactions within the domain (McCann, 1983). Any change to the power distribution within the domain will likely see some stakeholders losing power. This could be perceived in a negative way and so additional incentives might be required to complete a redistribution of power (Gray, 1989).

Proximity of the stakeholders can facilitate collaboration during the structuring phase on the interorganizational domain (Schermerhorn, 1975). Geographic proximity increases the frequency of interaction and in many cases the critical understanding of interdependence is already established (Gray, 1989). Conversely, stakeholders that are geographically dispersed will have an increase in cost of engagement due to travel and living costs. Geographically dispersed
engagement can also be hindered by time zone differences as well as language and other cultural differences.

**Characteristics of Successful IOC Domain Dynamics**

After IOC domains have completed the development phase, they enter into the period where they are expected to perform. Majchrzak, Jarvenpaa, and Bagherzadeh (2015) studied the dynamics across the IOC life cycle. They observed that IOCs are exceedingly unstable. They defined instability as any change to the way participants in the IOC interact, exchange information, make decisions. Previous studies (Franko, 1971; Parkhe, 1996) have suggested that such instability is the result of a poorly managed IOC. However, Majchrzak et al. presented data indicating domain instability is actually a characteristic associated with positive IOC outcomes. These six categories of domain instability are presented in Figure 2.4. Those categories are goal dynamics, contracts frame dynamics, interactions style dynamics, decision making control dynamics, organizational structure dynamics, and actor composition dynamics. These categories of domain dynamics are further described below.
Goal dynamics. Throughout the duration of an interorganizational collaboration there may be a change to the common goal or set of common goals. Goal change may be described as either the adjustment to current goal, inclusion of an additional goal, or exclusion of a goal due either to completion of the goal or a goal becoming irrelevant (Majchrzak et al., 2015).

As goals change, are added, or are excluded, the participation of stakeholders in the domain will need to be reviewed and some stakeholder may be removed from the domain while other may be added. When goals change, and stakeholders are added or removed the power distribution will need to be reassessed and new mechanisms developed to ensure efficient power distribution (Gray, 1989).

Contract frame dynamics. Majchrzak et al. (2015) described the contract frame as how the collaboration is defined in terms of a combination of transactional and relational based...
governing mechanisms. Dynamics in the contract frame are often driven by change in level of trust. In some situations, trust can be lost (Ariño & de la Torre, 1998). However, trust can also be increased (Inkpen & Pien, 2006). Trust between stakeholders can evaporate as when transactional elements of the relations, such as price, start increasing in importance. Likewise, when organizations demonstrate to other stakeholders that they act in the best interest of collaboration the level of trust improves and the contract governing mechanism begins to adopt relational characteristics founded in trust and respect. Majchrzek et al. (2015) identified relational based contract frames as a factor of success in interorganizational collaborations. Hence, establishment of trust and respect is a critical success factors for IOCs.

**Interaction style dynamics.** Majchrzek et al. (2015) referred to the transparency of engagement, motivation, and openness of data sharing, as the *interaction style dynamics*. This category really refers to the style of interpersonal engagement the actors have, although the interaction style can be influenced by the attitude of the stakeholder. Lack of open in sharing data can be a result of lack of trust, misaligned values, common goals developed without sufficient stakeholder input, or preference of one or more stakeholders to not share sensitive information. Conversely, interorganizational collaborations that adopted a more cooperative interaction style based on trust and mutual respect were more likely to success achieve their goals. In this aspect it is important for stakeholders to adopt a positive attitude with regards to the IOC, this will impact how the actors in the organization approach working in the interorganizational domain. It is also important to select the people who have a positive disposition towards IOC, from within the organization, to participate within the interorganizational domain.

**Decision making control dynamics.** This point refers not only to how the decision-making process occurs within the interorganizational domain, but also, to the level of
empowerment of the actors from the different stakeholder (Majchrzak et al., 2015). IOCs in which the domain actors are empowered can propose and even test potential solutions without review and approval from leadership. Actors that are not empowered to make decision are required to engage internally within their organization before suggesting a new solution or agreeing to a proposition from another stakeholder (Tsasis, 2009). This can cause the interactive process to become very slow. Slow processes will be slow to deliver any type of result and could affect the moral of those actors in the interorganizational domain. Decision making control dynamics, or the level of empowerment, can also change over time (Majchrzak et al., 2015). The ability to make decisions can move in one of two directions. Either the senior leadership at a stakeholder will empower its technical team working in the interorganizational domain or they will themselves become more involved in making decisions. Majchrzak et al. (2015) showed that interorganizational collaborations that empowered the technical team to have direct input and control over decision making had increased chances of achieving positive and successful outcomes.

**Organizational structure dynamics.** Majchrzak et al. (2015) used the term *organizational structure dynamics* to refer to the degree by which processes and roles within the interorganizational domain are standardized and formalized. Standardizing the formalizing the roles and processes within the domain provides an opportunity to clearly communicate expectations from all actors. With standardized and formal roles and processes the actors understand what they are expected to do or the standard process to use. This will ensure there is no dropped communication or missed assignments. Majchrzak et al. concluded that increasing the structure within the interorganizational domain with regards to processes, rules, and role development had a significant impact on the success of the interorganizational collaboration.
When changes to the scope of the interorganizational collaboration and the number of participants from the stakeholders occur, the domain will also benefit from having standardized and formal roles and processes. For example, the alliance between General Electric and SNECMA developed new sets of organizational processes in parallel with the increased engagement of the partner firms (Doz, 1996). In this example, the collaboration between two organizations increased and the standardized and formal roles and processes increased to accommodate the change in engagement.

**Actor composition dynamics.** The actors within the interorganizational domain are those individuals who are either stakeholders themselves or are working as part of the stakeholder organization and are working together within the interorganizational domain (Majchrzak et al., 2015). Often, especially in the cases of long-term interorganizational collaboration, that individuals working within the domain may take new positions within their organization or leave the organization (Salk & Shenkar, 2001). This will force the stakeholder organization to either replace them as an actor in the domain or continue with few actors representing their interest. Likewise, an entire organization may remove themselves from the IOC for voluntary or involuntary reasons. White (2005) provides an example of a ruling by the European Union that forced the Dutch government to withdraw from a joint venture with NedCar. In this case, a legal ruling forced a stakeholder to withdraw from the IOC.

**Characteristics of Successful Stakeholder Engagement**

The previous section identified those elements of domain establishment and dynamics associated with successful IOC outcomes. This section looks more closely at the interpersonal engagements within the domain to understand the characteristics and collaborative patterns that drive successful IOC outcomes. When organizations collaborate individuals, acting on behalf of
their organization, will engage with other individuals from different organizations. As one of the primary benefits of IOC is the sharing and creation of knowledge, it understood that the individuals interacting will have expertise in different areas and will have different experiences. If all actors in the IOC domain have the same knowledge, interpret the knowledge in the same way, and have the same experience then there is little to no opportunity benefit from knowledge sharing (Majchrzak et al., 2015). Nonaka and Takeuchi (1995) identified one of the most valuable types of shared information as **tacit knowledge**. Tacit knowledge, or implicit knowledge, can be very beneficial to an organization; however, it is very difficult to transfer this knowledge to another person or organization.

There can be many challenges faced when two organizations engage. One challenge can materialize while trying to communicate. Collaborating organizations often use different jargon and it may actually seem like they speak a different language (Majchrzak et al., 2015). To avoid confusion, actors in the interorganizational domain need to use clear language when communicating across organizational boundaries. This means using phases and full terms instead of acronyms. Also, organizations should seek to eliminate the use of colloquial or informal words or phrases.

Organizations participating in an IOC may have different internal processes (Majchrzak et al., 2015). This is particularly important with regards to compliance or financial approvals. Organizations based in different countries may have different regulatory and audit requirement that require different processes. An actor in an IOC domain should not assume the other stakeholder organizations use the same internal processes as their organizations. Cross-boundary communication should not focus on following a process but achieving specific outcomes and
allowing the respective actors to work with their internal processes to achieve those specific outcomes.

Organizations and individuals can also interpret information and assign value to information in different ways based on their knowledge, experience, and desired outcome (Majchrzak et al., 2015). In this type of situation organizations within an IOC may see the same information and interpret it differently. Fisher and Ury (1981) help to illustrate this point. In their example, two individuals are fighting over an orange. Only after open and transparent discourse do they realize the orange has different value to each of them. One of the individuals is a chef who wants the skin of the orange to add orange zest to a dish they are working on. The other just wants the fruit of the orange because they are hungry! This is a great example about how individuals, acting on the interest of their organization, can assign different meaning and value to the same information.

In the example describe above, through a pattern of engagement the individuals were able to share information as well as the value of the information with each other. Stakeholder and actor engagement require the same time of open engagement to avoid stagnation of process and facilitate successful outcomes. This section will focus on the characteristics and elements of this engagement that help lead to successful outcomes.

Tsasis (2009) interviewed directors and managers with IOC experience and asked them to identify critical factors of the inter-stakeholder relationship that facilitated a collaborative relationship. The results from the 41 interviews showed that having complimentary goals, a shared vision, and clearly negotiated roles were critical to creating a collaborative environment.

Goal alignment. Common or complementary goals allows for reciprocal exchanges among individuals and organizations (Tsasis, 2009). A shared vision enables the different
individuals and organizations to learn how to work together more effectively and helps them understand or predict actions of the other stakeholders and actors. These findings are consistent with Dougherty (1992) who showed one critical aspect of the team in the interorganizational domain is having the ability to create a shared perspective.

**Clear roles and responsibilities.** Tsasis (2009) highlighted that having clearly negotiated roles within the IOC domain are a factor critical to the success of the IOC. Dougherty (2017) also confirmed that undermanagement can result in confusion in the roles of others and expectations of others in the group. People collaborate to complete what is expected or demanded of them. For this reason, the actors inside the interorganizational domain need to know what is expected of them and what they should expect from others.

**Social interaction.** Social activities and engagement do play an important role in knowledge sharing and knowledge creation (Tsasis, 2009). Social activities facilitate the development of trust within the interpersonal relationships found in the IOC. Tsasis found that, even in situations where engaging organizations had differing agendas, trust improved the engagement of the stakeholders as the individuals felt confident that the others would respect each other’s interest. The development of trust between engaging organizations and actors is facilitated by social interaction.

**Characteristics of Unsuccessful Stakeholder Engagement**

In addition to the characteristics of stakeholder and actor engagement that are associated with positive IOC outcomes this chapter will also consider characteristics associated with negative IOC outcomes. Black (2002) identified knowledge inaccessibility, discrepancies among the collaborators in role-specific experience, and perception of threats from working outside of expected roles as critical elements of engagement that negatively impact collaborative patterns.
Stakeholders and actors within the IOC domain should continually review the IOC domain for these characteristics as presented below.

**Knowledge inaccessibility.** The first characteristic of uncollaborative engagements is lack of access to shared knowledge for some stakeholders (Black, 2002). Lack of sufficient access may not be the result of one stakeholder intentionally restricting the access of another stakeholder, but rather through the use of inappropriate knowledge sharing mediums. A medium, in this context, is any object or technology that aids in communication.

For example, when giving directions, one person may point to a building as reference or motion with their hand to indicate the correct direction to turn. However, when the topic being discussed becomes more detailed or more technical the knowledge transfer medium needs to support the transfer of knowledge. Communicating design requirements for a new aircraft requires much more than hand gestures. A discussion about details of a new regulation would likely benefit by the use of a visual aid, such as a series of PowerPoint slides. These aids can visually highlight the main points and help others understand the connection between the different points. A PowerPoint slide may not be as useful during a discussion of the ability of an aircraft part to be manufactured. In this case, a 3D model may be more appropriate.

It should be recognized that access to mediums may not the same for all stakeholders (Black, 2002). For example, some regions of the world have very unreliable internet while other regions take for granted a reliable and fast internet connection. Those stakeholders that have a fast and reliable internet connection may not understand the internet connectivity problems of the other stakeholders. This can result in an uneven amount of knowledge transfer among different stakeholders.
**Role-specific experience.** A second characteristic of uncollaborative engagements is having a large discrepancy in the knowledge or experience of the stakeholders. In IOCs in which there are mismatches in knowledge or role experience, those stakeholders with more knowledge or role experience would likely take control of the domain (Black, 2002). Those stakeholders with less experience or less knowledge often feel intimidated by the more knowledgeable and experienced stakeholders. As a result, they are less likely to provide input into the discussions and the resulting outcomes of the IOC do not fully address the needs of some of the stakeholders.

An organization can only control who they send as actors into the IOC domain, they do not have influence who the other stakeholders send into the IOC domain. For this reason, it is difficult to manage the actual experience or knowledge of the other actors in the domain. Organizations can prepare for this by coaching actors on how to engage someone that has less knowledge or experience as well as someone with more knowledge and experience (Black, 2002).

**Working outside of expected roles.** A third characteristic of uncollaborative engagements occurs when different stakeholders feel threatened by other stakeholders. As actors in the IOC domain and share knowledge is it possible that some actors will learns skills that other actors feel to be in their domain (Black, 2002). Black provided an example were hospital technicians experienced with using a new CAT scan technology had learned how to interpret the results of the CAT scan. Many of the doctors new to this technology felt threatened when the technicians interpreted the result. The doctors viewed analysis of test results as being within their area of ownership and having a technician explain the result to them felt threatening.

Black (2002) also identified elements of the stakeholder interactions that can be used to change the engagement from uncollaborative to collaborative. These elements consist of the
artifact, action, location, and timing associated with the interactions. The key to using these elements to change the direction of the collaboration, lies in the ability of the stakeholders to self-review the effectiveness of the ongoing collaborations and identify areas of improvement.

As two stakeholders engage, they must review their knowledge of the collaboration and determine if they are receiving sufficient knowledge from the other stakeholder. If they are not, they must assess the engagement in terms of location of the engagement, timing of the engagement, use of knowledge sharing mediums, as well as the activity that occurs during the engagement. Stakeholders must also seek to understand if the other stakeholder is able to access and understand the information being discussed sufficiently for them to meet their commitments. The engaging stakeholder need to be able to provide feedback so that the cross-boundary design of the cross-boundary engagement can evolve to facilitate and not hinder the transfer of knowledge between the stakeholders (Black, 2002).

Black (2002) also highlighted the importance of trust though social interaction as a means of transforming a noncollaborative engagement into a collaborative one. Trust can be defined as the willingness of actors to engage with each other is strongly influenced by trust and trust is strongly influenced by a history of successful outcomes (Tsasis, 2009) and positive engagement (Vangen & Huxham, 2003). Hardin (2001) described the synergy between trust and engagement as a type of positive cycle in which each element continually compliments the other. Luna-Reyes and Andersen (2007) studied the relationship between trust and stakeholder engagement. Figure 2.5 provides a visual representation of interconnected process of stakeholder engagement and trust development in an IOC.
The progress of engagement is an iterative process. Therefore, it is difficult to choose a starting point in the process. Considering the case of two organizations with little or no history of interaction it is reasonable to assume that these organizations would initially rely solely on institutional trust (Luna-Reyes & Andersen, 2007). When organization enter into an IOC, they will have a formal agreement or contract that details the arrangement. The contracts can add clarity to the expectations of each stakeholder as well as how the profit will be shared. Institutional trust refers to the penalties written into contracts for not meeting expectation or commitments. Institutional trust can also refer to regulatory consequences imposed by a governmental organization.
Institutional trust is often the first type of trust developed simply because it is not dependent on a relationship. Institutional trust also organizations to predict the behavior and actions of another stakeholder. Repeated engagements allow the relationship two develop between two organizations (Luna-Reyes & Andersen, 2007). This relationship will facilitate trust between the organization, especially if the organizations demonstrate that they act in the best interest of the IOC and not themselves. Trust another organization is a combination of the reputation of the other organizations, an assessment of the risks and rewards of engagement, as well as experiences of previous engagements.

Once an organization is comfortable with the level institutional trust established their willingness to engage will increase and the organizations will perform some level of work together. The act of engaging with another organization has two effects. First, each organization will understand the project from the other’s perspective. In other words, each organization will begin to understand how the other stakeholder interpret and value data. This common understanding will facilitate knowledge transfer and understanding of the organization’s needs with respect to the project (Luna-Reyes & Andersen, 2007). The common understanding of how stakeholders interpret, and value information is visualized by the smaller circle in Figure 2.5.

The second effect of the interorganizational engagement is that each organization will have experience collaboration with the other. A positive collaboration experience will increase the perception of trustworthiness in the other organization. A positive collaboration experience can be a collaboration that successfully achieved a common goal or desired outcome. A positive collaboration experience can also be one in which the goal or outcome was not achieved, but the stakeholders and actors demonstrated they are willing to work in the best interest of the IOC. In this case trust between the stakeholders is established. Increased perception of trustworthiness in
Characteristics of Successful Knowledge Sharing in an IOC

One of the primary motivations for an organization to engage in collaborative relationships with other organizations is to develop a competitive advantage through the pooling and sharing of resources (Luna-Reyes & Andersen, 2007). As previously described, one of these resources that is often shared is knowledge. The benefits of interorganizational knowledge sharing are widely acknowledged (K.-H. Chang & Gotcher, 2007; B. Chen, 2010; Selnes & Sallis, 2003). It is also widely agreed that a critical characteristic of successful IOCs is their ability to effectively and efficiently share knowledge in order to create competitive advantages (L.-Y. Li, 2006; Liu, 2012). A great example of interorganizational knowledge sharing is the example of the CFM engine program, which is arguably the most successful aircraft engine program in the history of aviation (Doz, 1996). This engine program is the result of a joint venture between GE Aviation, an aircraft engine manufacturer based in the United States, and Safran Aircraft Engines, based in France. Both parent organizations brought their knowledge and ability into the joint venture domain to complement the knowledge and ability of the other organization (Doz, 1996). The purpose of this section of Chapter II is to understand the facilitating factors for interorganizational learning (IOL).

Wang and Noe (2010) defined knowledge sharing as providing “task information and know-how to help others and to collaborate with others to solve problems, develop new ideas, or implement policies and procedures” (p. 117). The interactive process of knowledge sharing is termed interorganizational learning (Huang & Chu, 2010). IOL is defined as a joint activity where parties share information, interpret it, and integrate it (Selnes & Sallis, 2003). The process
of interorganizational learning allows organizations to have access to new knowledge, techniques, and resources (Fang, Fang, Chou, Yang, & Tsai, 2011). It is agreed that knowledge exchange is required for IOL, however there is no consensus what actions result in IOL. This section of Chapter II provides insight from previous studies on the factors and conditions that facilitate knowledge sharing and IOL.

The number of studies and publications addressing interorganizational learning is quite limited. The gap in research has been identified by other researchers (Crossan, Lane, White, & Djurfeldt, 1995; Easterby-Smith, Lyles, & Tsang, 2008; Lane, 2001; Mariotti, 2012). However, the limited information available does reveal that interorganizational learning is complex. Mariotti (2012) developed a framework for understanding IOL as a series of underlying processes. Those processes were identified as learning how to collaborate, learning how to share knowledge, and how to create knowledge. This view of IOL as a series of processes is consistent with the perspective of IOL as a series of interorganizational engagements that lead to the establishment of interorganizational relationships (Y. H. Chen, Lin, & Yen, 2014). The following section will present and discuss critical aspects of the IOL process that are associated with successful IOC outcomes.

**Type of Knowledge Being Transferred and Type of Engagement**

Fundamentally, there are two different types of information. Explicit knowledge is easily communicated and does not require context (Collins, 2010). An example of explicit knowledge in the aviation industry would be the knowledge communicated between pilots and air traffic control (ATC) during take-off and landing. This information exchanged is clear. ATC communicates the path the pilot should follow. This will include speed, direction, and altitude.
There should be no need for reciprocal discussion for the pilot to understand what the ATC is communicating.

The other type of information exchanged is tacit knowledge. Tacit knowledge heavily contextual and based on experience. It is not easily codified and communicated (Collins, 2010). An example of tacit knowledge in the aviation industry would be how to share technical information within an airline organization. Engine manufacturers provide best practice information on performing inspection and maintenance tasks. Best practices are experience-based knowledge that cannot easily be included verbalized or textualized. To effectively share this information a demonstration needs to be performed and reciprocal communication allowed in which the intended audience can ask clarifying questions.

Due to the fundamental difference between tacit and explicit information, the transfer and communication of these different types of information is facilitated by different methods. Explicit information can be communicated using one-way communication such as manual, public service announcements, or customer portals. Conversely tacit knowledge, which is highly contextual, may require engagement included back-and-forth communication to be effectively transferred (Collins, 2010). Tacit knowledge may have a different meaning for different functional groups and as such would be interpreted differently from stakeholder to stakeholder.

As discussed before, understanding the value of information to each organization is a critical step to understanding how best to communicate. Scott (2000) defined interorganizational transfer of explicit knowledge as lower-level IOL. In lower level IOL, an organization communicates explicit knowledge while the receiving organization adjusts operations and behavior accordingly. This is one-way data sharing. Scott went on to define interorganizational transfer of tacit knowledge as higher-level IOL. Higher-level IOL requires increased engagement
from different functional groups and internal changes within each organization to interpret, internalize, and disseminate the acquired knowledge within the organization.

To facilitate IOL it is important that the type of information being transferred is understood as either tacit or explicit knowledge. Appropriate engagement is optimized based on the type of data being shared. Scott (2000) also identified information technologies that facilitate the different types of data sharing. Explicit knowledge that requires one-way communication can be shared through web portals or one-way emails. However, tacit knowledge cannot be communicated by the same use of information technologies. Instead, communication of tacit knowledge requires more engagement and reciprocal communication. Information technologies that support informal communication are well suited to facilitate higher-level IOL. These types of information technologies include emails, phone calls, teleconference, and video conference.

**Relational factors.** Relational factors refer to the characteristics of the relationship between stakeholders in any type of interorganizational engagement, including an IOC (Das & Teng, 2001). As stated earlier, the similarities or dissimilarities in the goals, stratifies, and values of the collaborating organization will influence how engage with each other. Likewise, the power distribution within the IOC will also affect the way organizations interact with each other. There are generally two types of governance mechanisms used to manage interorganizational engagements: trust and contract (Das & Teng, 2001).

Contract is a type of relational engagement used when the relationship between two stakeholders is transactional in nature or the stakeholders do not share either common values or a common goal (Das & Teng, 2001). Stakeholder engagement that is based on equal power distribution, common values, or common goals is more often based on trust between the stakeholders and trust between the actors. These types of stakeholder holder engagements are
governed by relational governance (Cheng, 2011). Interorganizational knowledge sharing is facilitated by IOCs that develop a strong social relationship and mutual trust at an interorganizational level. The use of trust as a mechanism of governing stakeholder relations in an IOC is shown to facilitate interorganizational knowledge sharing (Hoejmose, Brammer, & Millington, 2012). Likewise, having a common goal, organizational values, and similar strategies are facilitating factors of IOL (Morgan & Hunt, 1994).

The ability of individuals to understand each other, by use of a commonly understood language, is a critical element to effective knowledge sharing. Likewise, the ability of an individual to establish themselves as trustworthy as well as establish trust in the those they are engaging with is critical to IOL (Soekijad & Andriessen, 2003). The establishment of trust between individuals is a key factor in determining the amount of knowledge shared as well as the nature of the knowledge sharing (Panteli & Sockalingam, 2005).

**Trust.** “Interorganizational trust is the cornerstone of business partnerships and nurtures the intention of knowledge acquisition and sharing outside organizational boundaries” (Panteli & Sockalingam, 2005, p. 599). Organizations approach opportunities for interorganizational knowledge sharing from a perspective of risk versus benefit perspective (Ke, Liu, Wei, Gu, & Chen, 2009). The greater the benefit, relative to the risk, the organization perceives the engagement the more likely they will enter in to a collaborative and reciprocal relationship. A high degree of trust, whether due to contractual or relational reasons, reduces the perceived risk and facilitates the interorganizational exchange of information (Cai, Jun, & Yang, 2006).

**Factors of Successfully Establishing Trust in an IOC**

The importance of trust as a critical element in the sharing of knowledge across interorganizational boundaries and improving stakeholder engagement has been discussed
previously in this chapter. This section will focus on those critical elements that helps to establish an organization as trustworthy and sets the foundation for engagement governed by trust. When organizations engage and share of knowledge across boundaries there is an amount of risk that each organization accepts. This risk could be related to financial exposure or exposure due to a loss of intellectual property or competitive advantage. For example, an organization may allocate fund to develop new facilities physically closer to the organizations they are engaging. In this case, the organization may not receive a return on their investment into the IOC. Organizations also take a risk when sharing information with other external organizations (Rajala, 2018). The risks they accept is that the other organization, once having received information, may act in an opportunistic manner (Williamson, 1991) by using acquired knowledge to complete against the former organization.

With regards to its importance in an IOC, trust encompasses two aspects of the relationship. The first aspect of trust refers to the stakeholder’s competence to meet their commitments to IOC (Nelson & Cooprider, 1996). This aspect is fundamentally focused on whether the organization can do what is expected of them. The second aspect of trust refers to the assertion that an organization has the intentions fulfill commitments and act in the best interest of the IOC without the need to be monitored. In other words, this aspect is fundamentally focused on whether the organization will do what is expected of them. Being able to assess an organization’s trustworthiness is affected by several factors. Lewicki and Bunker (1996) identified three relationship phases that are primarily driven by trust: calculus-based trust, knowledge-based trust, and identification-based trust.

**Calculus-based trust.** Lewicki and Bunker (1996) described calculus-based, or calculative trust (Luna-Reyes & Andersen, 2007), as solely dependent on an economic analysis
of the cost of maintaining an interorganizational engagement and the projected benefit. This type of trust is based on clear, explicit expectations defined in contracts and penalties for breach of the contract. Using contracts as a basis for stakeholder engagement gives organizations the ability to calculate the exposure they are accepting by entering into a relationship. They can also build safeguards into the contract to mitigate their risk. This provides stakeholders with institutional trust (Luna-Reyes & Andersen, 2007).

**Knowledge-based trust.** As organizations engage and collaborate, they develop knowledge of each other. This knowledge allows an organization to assess the trustworthiness of the other organization (Y. H. Chen et al., 2014). This view of trust development as a process of continued interorganizational engagement is consistent with the interorganizational trust development model developed by Luna-Reyes and Andersen (2007) in Figure 2.6. This model describes the process for developing interorganizational trust.
This iterative process depends on re-occurring engagement for organizations to understand the needs of the other organization as well as their own needs. Through these repetitive engagements organizations also determine the trustworthiness of the other organization. Previous engagements, where positive or negative, impact the desire of the organizations to engage in future collaborations.

Organizations collaborating for the first time will rely primarily on calculative trust, which is founded in institutional trust, as well as a priori perceptions (Luna-Reyes & Andersen,
A priori perceptions are biases or stereotypes that affect the development of interorganizational and interpersonal trust. A priori perception can have a very strong influence in the trustworthiness of the other individuals as well as organizations. As a result, this influence may be stronger than the knowledge and calculative based trust mechanisms early in the relationship (Kanter, 1994). This could lead to a lack of trust early on in the relationship and would have negative impact on the collaboration and development of trust (Powell, Koput, & Smith-Doerr, 1996).

**Identity-based trust.** The third characteristic presented by Lewicki and Bunker (1996) focuses on similarities of the engaging organizations with regards to value, strategies, and common goals. Morgan and Hunt (1994) presented a definition of shared values as a common belief with regards to what is right and what is wrong. Common values also include a common belief on the importance and appropriateness of items or actions. Common values, goals, and strategies act as a guide to understanding the other stakeholders in the IOC (Pavlou, 2002). Based on this understanding organizations can better predict the behavior of other stakeholders; this allows a better understanding of the risk of engagement. Shared goals have been identified by previous studies as critical to the establishment of trust and effective collaboration (Chow & Chan, 2008; L. Li, 2005).

**Background on Airline Management and Performance**

The first part of this chapter focused on the nature of interorganizational collaboration and those critical elements that lead to successful outcomes. This portion of the literature review was important as it identifies those characteristics of the OEM-airline engagement that the dissertation focuses on to understand better those strategies that OEMs can use to drive more effective engagement with airlines, particularly in Africa. Understanding how airlines operate
and how their performance is measured is critical to understanding their goals, values, as well as how they likely would interpret data such as maintenance requirement communicated from either an OEM or regulatory entity. As discussed earlier in this chapter, two of the fundamental elements associated with successful IOC outcomes are having aligned goals and values and understanding how the other stakeholder interprets information.

Airline management and performance are each a driving factor in the way that airlines make decisions and interpret data. Airline management consist of the day-to-day activities needed to ensure the airline is providing the services that customers have paid for. Airline management include cleaning and maintenance of aircraft. In the case aircraft are delayed or unavailable the airline must recover from the disruption by reassigning aircraft to different routes and by rebooking passengers on different routes. Airline operations also include the selling of tickets and the setting of a price for a specific ticket.

After reviewing airline operations, I then focus on performance metrics used to assess how well the airline is performing both from a financial and safety perspective. Financial metrics will drive actions by airline leadership because these metrics communicate to potential investors and lenders the financial health of the airline. An airline that wants to grow its operations in terms of fleet size or wants to upgrade the equipment being used by the airline would need to raise capital. The interest rate on bank loans or the required dividend the airline would need to pay is affected by the financial metrics of the airline. To keep an airline’s cost of capital low, its leadership must ensure that financial metrics are achieved. Likewise, an airline that wants to grow its fleet by adding up service to other countries will find that safety performance is a factor is being approved to fly and land in many countries. Ensuring the airline has sufficient safety record to increase operations is also another priority of the airline leadership.
**Airline management.** The focus of this dissertation is to understand how OEMs can better engage with airlines, particularly in Africa, so that critical information regarding maintenance and operation of the aircraft or engine is transferred effectively. The desired outcome of this improved engagement would result in reduced exposure to accidents and incidents. Understanding the other stakeholders in an IOC is a fundamental, yet critical, element in the establishment of effective engagement and collaborative engagement. Understanding how airlines operate, what they value, and how they interpret data will improve an OEM’s ability to effectively engage and transfer knowledge. Fundamental elements of airline management are presented in detail below.

Like any business, airlines incur cost through business operations. The ability of an airline to manage costs in such a way as to maximize profit is an important measure of the leadership of an airline. For this reason, it is important to understand how costs are reported on required financial reports. Knowing how to read and parse out relevant data from an airline’s financial report and interpret these data is critical to understanding the financial health and profitability of the airline. Financial reports are the primary indicator of success for airline operations. In addition, the cost data can be compared to other airlines for purposes of comparison.

Most airlines are required to provide financial data to the United States Department of Transportation (US DOT), for airlines registered in the United States, or ICAO for all other airlines. There are two techniques used for categorizing costs. The first is method for categorizing data is to categorize the airlines costs as production costs that result in an output of the airline, or what would be considered direct costs. This method is considered an administrative categorization. Administrative cost categorization is typically used in financial
reports but can be difficult to analyze. A detailed review of administrative cost categorization would provide little benefit, in terms of dissertation preparation since data categorized in such a way is not usable. As such, this chapter will not include a detailed review of administrative cost categorization.

Aircraft and engine maintenance costs, along with the cost required to maintain other equipment, are categorized in flight operations costs (Belobaba, 2009). All aircraft, engines, components, and systems on the aircraft must follow a strict maintenance program in order to meet airworthiness certifications. Without these certifications the respective equipment cannot be operated. For example, the typical aircraft has inspection requirements on various structural and systems related components. These repetitive inspection inspections have intervals that are based on aircraft utilization in terms of cycles or flight hours. Likewise, engines and other components on the aircraft also require regular inspections and component replacement. Airlines generally schedule the engine and other maintenance to coincide with the aircraft maintenance to maximize the availability of the aircraft to generate revenue.

During the airline schedule optimization process a careful and detailed planning review is completed to ensure aircraft are allowed time for required periodic maintenance checks (Barnhart, 2009a). All aircraft are required to complete periodic maintenance checks, and if they are not able to complete the maintenance checks they must be grounded until the maintenance is performed; grounded aircraft can result in flight cancellations and other major disruptions to operations.

Unplanned maintenance, such as maintenance caused by issuance of service bulletins and airworthiness directives, disrupts this carefully optimized airlines schedule and can cause the airline to pull aircraft out of planned service to perform the maintenance tasks. Pulling an aircraft
from service reduces the availability of the aircraft to support operations and can cause an aircraft to be grounded until the maintenance is performed.

When the carefully optimized schedule is disrupted, the airline must engage in schedule recovery efforts. The goal of this effort is to reschedule, re-allocate, and reassign aircraft and crews in order to return to optimal network schedule, fleet type assignment, and crew pairings. Schedule recovery efforts require a great deal of effort and engagement with operations controllers, crew planners, customer service coordinators, dispatch, and air traffic control.

To manage normal operations and disruptions, known as irregular operations, airlines utilize an Airline Operations Control Centers (AOCC), commonly called Integrated Operations Control Centers (IOCC). The purpose of the IOCC is the ensure safe airline operations; they constantly communicate with Air Navigation Service providers as well as other airlines to monitor network operations and intervene where there is a disruption in the schedule. If a disturbance does occur it is the responsibility of the IOCC to manage aircraft, crew, and passenger recovery efforts, to recover from irregular operations (IROPs). IOCC is comprised of the following functional groups (Barnhart, 2009b) operations controllers, crew planners, customer service coordinator, dispatch, and air traffic control.

**Airline safety performance.** In 2011, the number of air traffic accidents in Africa was nine times higher than the global average (“Africa’s Aviation Industry,” 2012). As a result, The African Development Bank ranked safety and security as the number one most pressing challenge facing African airlines. The high number of air traffic accidents is due primarily to the lack of adoption of international safety standards, as well as the lack of government regulations that strictly enforce these same international safety standards.
In response to the urgent need for increased safety and security standards, the African Union drafted a strategic action plan, the Africa Strategic Improvement Action Plan (ASIAP), with the support of the ICAO and IATA that targets increased safety and security for African aviation (ICAO, 2012). The goal of this strategic action was to establish independent civil aviation authorities for each country, implement effective and transparent oversight systems, complete an IATA Operational Safety Audit for all airlines in Africa, implement accident prevention measures focused on runway safety and loss of control, and implementation of Flight Data Analysis (FDA) and Safety Management Systems (SMS).

In 2015, ICAO released a report (ICAO, 2015) that identified actions required as part of the effort to improve aviation safety in Africa, one of which was “to increase the number of qualified personnel at the industry and oversight levels” (p. 12). Based on the input from previous academic, industry, and regulatory reports and studies it is exceeding clear that one critical aspect improving safety conditions in airline industry in Africa is the strategic engagement of original equipment manufacturers (OEM) and the individual airlines. As such, my dissertation focuses on critical success factors of the OEM-airline engagement in terms of reducing exposure to accidents and incidents and improving airline safety.

Before engaging in an exercise to identify the critical elements of the OEM’s engagement with the airline that facilitate improved safety performance it is important to understand the topic of airline safety and become familiar with the internationally recognized reporting standard. A systematic literature review revealed that accident rate is the accepted metric for airline safety performed. However, an overwhelming number of academic publications also included incident rate as an indicator of airline safety. Some researchers and safety officials estimate the incident rate can be between 10 to 100 times the accident rate (Rodrigues & Cusick, 2011). There is no
empirical evidence that incident rate provide insight into the probability of accidents. However, the occurrence of an incident reveals the hazards that can also lead to accidents (Cusick et al., 2017). This dissertation investigates how OEMs can improve their engagement with airlines to reduce hazards, which can lead to occurrence of accidents and incidents.

Folasade Odutola, former Airworthiness and Safety Director Nigerian Federal Civil Aviation Authority and now independent consultant to ICAO in Montreal, pointed out that one of the most challenging safety issues in Africa is the attitude and approach to maintenance (F. Odutola, personal communication, December 16, 2017). Maintenance for aircraft and engines is one of the largest operational costs that an airline must financially plan for. Often, smaller African airlines purchase older aircraft and engines to reduce cost. However, it is often not well understood that older aircraft, although less expensive to purchase, could result in much greater financial commitments later, when heavy maintenance is required. The lack of understanding of a concept called maintenance reserve, an accounting method used to save money to cover the cost of the required maintenance, can lead to shortage of financial resource to pay for needed maintenance.

Creating an appropriate maintenance reserve requires a technical support team to understand the incremental maintenance cost incurred during every flight cycle and flight hour. Folasade continued by pointing out that often the smaller airlines lack trained and qualified personnel to understand the short-term and long-term maintenance tasks required on the aircraft (F. Odutola, personal communication, December 16, 2017). It is very easy, and very common, to underestimate the actual cost of the maintenance and thus will not have sufficient funds available when maintenance is due and will cut costs as the determine of the aircraft.
Chapter Summary

This literature review first focused on those characteristics and elements of interorganizational engagement that are associated with positive outcomes of IOCs. The review sought to differentiate collaborative engagement from other types of engagement strategies that organizations utilize. Collaborative engagement occurs when engaging stakeholders have common values and goals that are aligned. Collaborative engagement was focused on because this type of engagement closely matches the engagement of an airline and an OEM when the motivation for engagement is the common goal of safe operation aircraft and engines.

After identifying the type of interorganizational engagement that best describes the relationship between the airline and OEM with regards to maintaining safe operations, the literature review focused on critical characteristics of IOC. The critical characteristics fell into two categories, interorganizational characteristics and interpersonal characteristics.

The critical characteristics from an interorganizational perspective focus on the establishment and management of the interorganizational domain. When first establishing the domain, it is important that the collaborating stakeholders take time to clearly define the problem the IOC is being established to address. Without this clear understanding, the interorganizational engagement will have no hope of a successful outcome. After all stakeholders have agreed upon the problem statement, the next step is to agree upon the values that will guide the stakeholder engagement, this step is called direction setting. The final, critical step required to establish an IOC is to agree how the IOC will be governed. This step allows for the provision of some type of leadership within the IOC domain.

Previous studies indicated that at least some level of dynamic instability within the IOC is associated with successful outcomes. Instability is considered as any change to the way
stakeholders communicate or share information. Instability can be caused by the addition or reduction of stakeholders or actors from the IOC. It can also be driven by changing goals or changes to the environment of the IOC. Intuitively this make sense. If an IOC is working on the same goal, and there are no changes to the way the stakeholders or actors interact than the IOC has likely stagnated. If goals are changing, because goals are being accomplished, this suggests the IOC is successful.

The literature review also considered the IOC from an interpersonal perspective. Previous studies have highlighted the value of trust and respect between stakeholder as well as actors. The aspects of trust were presented and defined as they relate to both interorganizational and interpersonal engagement. Calculative-based trust is typically the basis for initial engagements. Based on this type of trust, organizations depend on penalties written into contracts to mitigate their risks and to govern interorganizational engagement. The experience gained by engaging with another organization will add to the knowledge-based trust that the organizations have in each other. When organizations act in the best interest of the IOC, and not necessarily in their own best interest, they are perceived as a trustworthy organization. The third type of trust is identity-based trust. This is trust established between organizations and actors who share certain values.

Finally, in the discussion of collaboration, the review surveyed the elements required for an IOC to ensure sufficient stakeholder engagement, knowledge sharing, and establishment of trust as all three were shown to be associated with successful IOC outcomes. Important to establishing effective stakeholder engagement is the need to ensure all stakeholders have access to the same information and ensure that actors are aware of the experience of the other actors and can engage with them appropriately. Effective knowledge sharing depends on the ability to
classify the data to be shared as either tacit or explicit, and this using the most effective means to communicate this information. Above all, establishing trust between stakeholder and actors is the most important element needed to establish effective stakeholder engagement and facilitate knowledge sharing. Trust, as described above, is a result of multiple engagements between stakeholders and actors in which they prove themselves to be trustworthy. Having common goals and values also act as catalyst in establishing trust between organization and actors.

The purpose of then presenting background on airline management and performance was to introduce the challenges that airline leadership faces daily. The airline leadership have a priority to maintain operations and ensure that people and cargo arrive at their destinations on time and with no disruptions. When disruptions do occur, as they often do, it is the responsibility of leadership to mobilize their teams to recover from the disruption while minimizing delays to scheduled passengers and cargo. One of the primary metrics in schedule disruption recovery is ensuring minimal costs are incurred because of the disruption. The leadership also has the responsibility to assess the overall industry and project those markets that will be profitable and how the airline can enter into these markets. The leadership must also consider if changes to the fleet are needed and how to finance those expansions. However, one of the most important priorities airline leadership must focus on is maintaining a superior safety record. Safety not only affects the brand of the airline; it can also avoid costs. Maintaining a superior safety record will ensure the airline is restricted from flying into certain airspace. This allows increased options for network expansion.

The review then focused on the safety performance of an airline. It was pointed out that accident rate is the standard measure by which an airline’s safety performance is measure. However, very often studies also included the incident rate as a measure of airline safety. An
ICAO report attributed the occurrence of both accidents and incidents to similar condition. These conditions are called hazards. This dissertation focuses on how the OEM can improve its engagement with airlines to improve airline safety through minimization or elimination of hazards.

Chapter II has focused on understanding the airline industry to highlight those functional areas the OEM should consider engaging with airlines. Chapter II also focused on effective strategies and tactics for engaging. This will help OEMs understand how better to engage with airlines. Still required is a method to quantify and measure the different aspects of the engagement. To address this question Chapter III discusses the methodology and research design used in this study.
Chapter III: Methodology

The overarching question this study is designed to address is how engine OEMs effectively engage with airlines in Africa to successfully drive reduced exposure to conditions that otherwise could lead to accidents or incidents. In order to address this question, I designed a study that identifies and analyzes the key OEM touchpoints during four critical maintenance processes. I also designed the study to analyze the key engagement characteristics of these touchpoints. The primary source of data came from interviews with experienced airline professionals working for airlines in Africa. I framed this research as a study in effective interorganizational engagement within the context of the airline industry in Africa.

Despite the abundance of literature on the study of interorganizational engagement and collaboration, numerous literature searches did not return any studies that focused on OEM engagement with airlines. Interorganizational engagement and collaboration has not been studied for this niche application; as such this study is exploratory in nature. This exploratory study applies system analysis to examine individual experiences of airline employees engaging with OEMs throughout the processes of service bulletin adoption, airworthiness compliance, and sharing of best practices for performing inspection and maintenance tasks. These items can directly affect the accident and incident rate, which are the standard measurements of airline safety.

This chapter first presents the research questions developed to address the overarching study question. The chapter then presents the study design before providing a more in-depth review on the method for data collection, interview protocol, and data analysis.
Research Questions

To understand the critical factors that facilitate successful outcomes I have designed a study based primarily on semi-structured interviews with experienced airline professionals working for airlines in Africa. This study analyzes the characteristic of the needed touchpoints an engine OEM has with an airline during the adoption of service bulletins, compliance with airworthiness directives, and proper completion of maintenance and inspection tasks. The following research questions were developed to identify the critical touchpoints and analyze the characteristics.

RQ1: What are the critical touchpoints between engine OEMs and airlines in Africa that lead to successful outcomes during the adoption of service bulletins and the compliance with airworthiness directives?

RQ2: What are the critical touchpoints between engine OEMs and airlines in Africa that lead to successful outcomes during the performance of maintenance and inspections tasks?

RQ3: What are the characteristics of the touchpoints that facilitate efficient transfer of needed information?

To answer these research questions a study was designed to understand the elements and interconnections of those elements that exist in interorganizational engagement between aircraft engine OEMs and airlines in Africa during the adoption of service bulletins, compliance with airworthiness directives, and completion of maintenance and inspection tasks. I sought to approach and interview airline professionals in positions that, based on my experience working for an aircraft engine OEM supporting airlines in Africa, are directly involved in the aforementioned processes. The use of semi-structured interviews allowed participants to discuss
topics they find important. Giving participants the space to take the interview in the direction they felt most relevant was critical to this exploratory study.

**Overview of Study Design**

This study has been designed to provide understanding about how engine OEMs and airlines in Africa engage during the adoption of service bulletins, compliance with airworthiness directives, and during the performance of maintenance and inspections tasks. The primary source of data was collected by performing semi-structured interviews with experienced airline professionals working at airlines in Africa. During these interviews, the participants reported on their own experiences working with engine OEMs during the course of service bulletin adoption, airworthiness directive compliance, and the performance of maintenance and inspections tasks. The study assumes the interview participants are experts in the field of aircraft engine maintenance and airline maintenance operations. Thus, they have an accurate knowledge of the support the airline needs from the engine OEM in order to drive successful outcomes.

A secondary source of data included in this study is my accumulated knowledge working as a field service engineer for one of the largest engine OEMs. In this role I have gained experience working with small regional airlines as well as large international airlines, all based in Africa. This experience has given me exposure to airline maintenance operations, airline financing, and engine maintenance. While this accumulated knowledge did not directly contribute to the primary data collected, it did provide context to understand the interview data.

During the coding of the transcribed interview data, my accumulated knowledge did provide insights in how to analyze and categorize the data. As I collected and analyzed the interview data, I reflected on it using my accumulated knowledge. The reflexive process allowed
for the creation of relevant tacit knowledge. This tacit knowledge was not explicitly stated during the interviews but was created through this reflexive process.

The PhD in Leadership and Change program at Antioch University in an interdisciplinary program. Neither the business of aviation, nor aviation safety are fields of study included in the program. However, organizational development and organizational leadership are areas of study for which Antioch University does have expertise. For this reason, this study has been developed and framed as a study in effective interorganizational engagement in the context of the African aviation industry.

**Systems Analysis**

This study has been developed to understand the critical engagements between engine OEMs and airlines in Africa that lead to successful outcomes during the adoption of service bulletins, compliance of airworthiness directives, and execution of maintenance and inspection tasks. To identify, understand, and analyze these engagements I approach this research study using a methodology of systems analysis.

System analysis is "the process of studying a procedure or business in order to identify its goals and purposes and create systems and procedures that will achieve them in an efficient way" (Systems Analysis, n.d.). Systems analysis uses a problem-solving technique that breaks down a system into its component pieces for the purpose of the studying how well those component parts work and interact to accomplish their purpose (Bentley, Whitten, & Randolph, 2007).

To understand systems analysis, it is first required to understand the concept of systems theory and, even more fundamentally, what a system is. A system is an entity with interconnected, yet independent elements that serve a purpose or function (Rutherford, 2018). A
system can be man-made or natural (Katz & Kahn, 1978) and can even be used to understand organizational behavior (Miller, 1978).

According to Rutherford (2018), the elements of systems are typically tangible. For example, a basketball team has players. These players would be considered elements of the team whose goal is to score. There would also be intangible elements of the team such as relationship and respect for each other. All of these elements work together to for the team, the system, to achieve its goal of scoring. Interconnections are flows of material or information. One element requires an output from another element. If the output is not received it can affect the ability of the system to function.

Systems theory was first presented by von Bertalanffy (1968), one of the founders of general systems theory, as a complex interaction of elements that should not be viewed as a sum of the individual elements, but rather holistically (Katz & Kahn, 1978). The elements of the whole interact through a mutual feedback process that corrects or enhances the system. Changes to either elements or the connections of the elements can affect other parts of the systems, either directly or indirectly (Mele, Pels, & Polese, 2010).

Von Bertalanffy (1968) went on to describe organizations as living organisms and suggested they should be viewed holistically. This approach to organizational management helped to introduce the concept of equifinality into discussions of organizational management. Equifinality is the principle that similar organizational outcomes can be achieved in numerous ways based on the competencies of the organization and environment in which it is operating (Cummings & Worley, 2005). This was a deviation from classical management theory that viewed organizations as mechanical in nature and that could be studied as if they were machines (Cole, 2004). Frederick Taylor (1911), one of the founders of classical management theory, also
introduced the concept of scientific management. Scientific management is based on the fundamental belief that there is one best way to perform any task or process (Bookwalter, 2013).

A system has been defined as any entity with independent elements that are working together to achieve outcome. The activities of the separate elements have a direct or indirect effect on the other elements in the system and the ability of the system, as a whole, to achieve the desired outcome. Systems theory tells us that organizations can be analyzed as complex systems. Systems analysis is simply the method of studying a system, such as an interorganizational collaboration, in order to learn more about the system and how the individual elements interconnect to achieve the desired outcome.

The use of systems analysis brings a unique perspective to the analysis of organization engagement, or achieving outcomes, and especially to this study. Classical management theory asserts organizational leadership must create changes to the organization in order to achieve outcomes in the most effective and efficient way (Bookwalter, 2013). Systems theory, conversely, stresses the importance of leadership to understand the potential of the system in which they are working, and to understand strengths and weakness of the organization. Meadows and Randers (2004) stressed the importance of learning about the behavior of a system before making any changes to the system. With this understanding of the system, strategic changes in the elements and interconnections can be made to adjust to changes in the systems purpose or an external operating environment (Rutherford, 2019).

**Conclusion on Systems Theory and Analysis**

Systems analysis is adequately suited for this study because, as opposed to confirming generic elements of successful interorganizational engagement and collaboration, it allows for a holistic understanding of the process that airline personnel experience when complying with an
airworthiness directive, embodying a service bulletin, or completing maintenance and inspection tasks. Using a systems analysis approach allows for the identification and analysis of the key elements and interconnections that work together to during the process of complying with an airworthiness directive, embodying a service bulletin, or completing maintenance and inspection tasks. This knowledge allows for the development of effective and efficient engagement strategies for both the OEM.

Data Collection

The primary source of data collected for this dissertation was interviewing airline professionals working at different airlines in Africa. Basic demographic information of the airlines represented was gathered for each of the airlines during the interview. The primary demographic data collected was the number of engine OEMs with which the participant engages. The number of OEMs the participant engages with was assumed to be a critical factor in their ability to engage with engine OEMs. An individual engaging with only one OEM would likely have more time to focus on OEM specific communications and information, while those who must engage with multiple OEMs would need to split their time between OEMs.

Selecting participants. Interview participants were selected from individuals currently employed by any airline operationally based in the continent of Africa. For this study, Africa is considered to include the 54 sovereign states, two disputed states, two dependent territories, and eight territories of non-African states. It is important to include all these territories as there are airlines based in these areas. Employees of airlines based in Africa, but whose operations extend outside the continent of Africa, were also be considered for inclusion in this interview.

Individuals employed by airlines based in Africa were eligible for inclusion in the study if they had worked in a position that directly engages with an engine OEM. This study only
considered engagement with an engine OEM as qualifying experience. Although there are many OEMs that supply other, different parts and components, the engine OEMs stand out from other OEMs for several reasons. Primarily, the technical complexity and financial investment and planning required to operate aircraft engines leads to a need for OEM support to manage the engine program, especially at larger airlines.

To be included in the study, individuals must have had at least one year of experience engaging with an engine OEM in their current role. This criterion was applied to ensure the participant has sufficient experience working with engine OEMs in order to establish themselves as an expert in airline maintenance operations and in what support is required from an OEM. This criterion was also used as a method to prevent experience in previous roles or engagement with other types of OEMs from influencing the participants response. Individuals not working in roles that directly engage with OEMs were excluded from participating in the interview. Likewise, individuals that have had less than one-year experience engaging directly with an OEM were selected to participate due to lack of qualifying experience.

Participants were selected from two pools of individuals. As an aviation professional working directly with several airlines in Africa, I have developed a professional network of engineers, managers, and senior leaders at several airlines in Africa. My professional network served as the first pool of potential participants. My professional network also included individuals working for OEMs and supporting other airlines in the region. The second pool of potential participants came from professional networks of other individuals working for OEMs in Africa.

Africa is home to thousands of languages. I do speak basic Arabic, Amharic, and Swahili but I am not proficient enough in these to facilitate an interview in each language. I am fortunate
that the de facto language of aviation is English, which is my native tongue. Therefore, for a participant to qualify for inclusion in the study they had to be sufficiently fluent in English as to clearly communicate. For those in the first pool of participants, those that I am very familiar with, I proactively applied this criterion and only extended invitations to those I knew were sufficiently fluent in English. For participants in the second pool, whom I was not previously acquainted with, I assessed the ability of the participants' fluency during the interview. If I was able to understand the participant and the participant demonstrated that they were able to understand me then the interviewee was considered to sufficiently fluent in English. Any interview with a participant that did not demonstrate sufficient fluency in English would be eliminated. All participants that I interviewed spoke English well enough that we were able to understand each other. In fact, no interviews had to be eliminated due to lack of fluency in English.

**Contacting participants.** All potential participants received an email detailing the study and inviting them to participate. All email communication was completed using my Antioch University email account. Strictly limiting communication with potential participants to the Antioch University email served to separate research study-related communications from regular professional engagements. Using the Antioch University email address also helped to underscore that the study was performed as part of a dissertation program and not as an assignment or project for my employer.

When I sent the introductory email, I initially include a copy of the consent forms as a PDF attachment. There were three different consent forms: one form for phone interview, one for face-to-face interviews, and one for video conferencing. The reason for the three types of consent forms was due to the different methods for information transmission.
I changed my practice of initially sending the consent form due to confusion of which form should be filled out. Subsequent email requests advised the participant to confirm the preferred method of interview. A follow up email was then sent with the appropriate consent form attached as a PDF file. The email instructed the individual to review the consent form (Appendix A). I advised the participant to return a signed copy of the consent form to me before I could proceed with the interview. In lieu of a signed copy, I also advised the participants that they could respond to me by email, attaching the consent form and stating that they agree with all details and contents in the consent agreement. All participants were able to provide a signed consent form prior to the interview.

I sent follow-up emails to individuals who did not immediately respond to the initial request after two weeks. If a response was still not received after a third week, I sent a second follow up. If an individual did not response after a fourth week, a third and final follow up was sent one week later. I do work with many of the participants. As such, I needed to ensure that the line between work discussions and interview discussions were kept separate. Again, to underscore that my research was being performed independent of my work position or my employer, I did not initiate any discussion regarding the dissertation or the interview with participants during times that we would normally meet for work purposes. However, on occasion, individuals did ask questions about the dissertation process, interview, or results during our normal working hours. In those situations, I did answer individual questions but did not ask follow-up questions or try to drive the conversation. When appropriate, I suggested we could the interview more in depth at another time and would make an appointment with them. I took this approach to again highlight that this study is being performed independent of my professional
position. Follow-up questions and discussions sent by email, even to my work email address, were returned using my Antioch University email address.

**Interviews.** With the study participants dispersed across the second largest continent on earth, the natural approach would be to use technology such as teleconferencing or video conferencing to facilitate the interviews. However, internet connection and telecommunications in Africa are notoriously unreliable, so I took the opportunity to conduct interviews face-to-face whenever possible. Of the 14 interviews completed, three were in a face-to-face setting while the remaining 11 were completed using Zoom video conferencing services. While using Zoom, the video capability of the tool was disabled in order to minimize the internet requirements and ensure the interview proceeded smoothly.

Two of the face-to-face interviews were held during a business trip in which I visited an airline, and the third was performed in Ethiopia during the work-related trip of one airline professional. Immediately prior to the interviews, I reiterated that the interview and research study were being performed independent of my professional position. The face-to-face interview held in Ethiopia was at my work office in Addis Ababa, Ethiopia. I used my work office as it was the only space that allow for privacy in a quiet and comfortable space. However, I did make it clear that the office space was being used for convenience and that the study was independent of my employer. The face-to-face interviews performed onsite at an airline were held in different locations. The first interview was held in the participant’s office. The second participant did not have an office, so we sat in the technical documentation library. The library is considered a public space, but during the interview there was no one else in the room.

All interviews started with a kind greeting and pleasantries. I then reviewed the purpose of the study and why the participant was selected. I again thanked the participant for their
participation and reviewed the highlights of the consent letter, which can be found in Appendix A. I did not engage in any interview until both sections of the consent form were signed. After receiving consent to audio record the interview, I began recording the conversation.

For face-to-face interviews, I used a commercially available app on my iPhone called VoiceRecorder. For Zoom interviews the audio recording capability of Zoom was used. Video was disabled for all interviews and no video data was recorded.

The interviews each lasted between 30 and 75 minutes. Once the it was completed, I thanked the participant for their time. The audio file from the interview was immediately submitted to rev.com, a transcription company, for transcription. Three of the audio files were reported to be low quality and transcription was not completed. Those three files were submitted for automated transcription using a service from Temi.com. I then manually reviewed the transcription of all 14 transcribed files while listening to the corresponding audio file. I made corrections as needed. After the manual corrections were made, the file was sent to the participant for their review and comments. Only three participants provided any feedback to the manually corrected file.

The interview followed a semi-structured interview format. The initial questions focused on how many OEMs the participant engages during the normal course of their work. I then asked the participant about their experience engaging with engines OEMs to adopt service bulletins and comply with airworthiness directives. Once this topic was exhausted, I asked about performing maintenance and inspections tasks and the use of best practices. Finally, I asked the participants to describe the characteristics of effective OEM engagement. The specific questions progressively changed during the overall interview process. As previous interviews provided additional insight, they influenced the questions being asked and the wording of those questions.
Interviews were transcribed, corrected, and coded in parallel to other interviews being performed. In most cases, the interview transcript was coded prior to the next interview. In some cases, the interviews were performed consecutively, before the coding could be performed. The reason for performing another interview before the previous interview had been coded was due to availability of the participants.

**Data Analysis**

This research study utilized a system analysis methodology to drive the collection of interview data. As described in the section on systems analysis, this approach allows elements, and interconnections of those elements present during adoption of service bulletins, compliance of airworthiness directives, and completion of maintenance and inspection tasks. A thematic analysis of the interview data was completed using grounded theory techniques for coding, constant comparison, and saturation. Following the guidance of Glaser and Strauss (1967) the collection and analysis of interview data was completed simultaneously. Doing so allowed the ongoing comparative analysis to provide feedback that allowed me to include, remove, modify, or re-word questions based previous feedback and experiences. Questions were also modified to further explore emerging ideas and topics.

After each interview, the audio file was transcribed, corrected, and sent to the participant for confirmation. Once the corrected transcript was confirmed, a method of data analysis known as coding was used to identify the different ideas and themes in the data. Coding is a strategy used to understand qualitative data and assign a grouping of data some meaning (Maguire & Delahunt, 2017). As described by Charmaz (1996), using a constant comparative approach allowed the codes and themes to be defined by the data. Going into the data collection portion of this study I expect that, initially, additional interviews would identify new categories and later
interviews would identify and strengthen trends in the data. Interviews continued to be conducted until the interview data does not identify additional categories or trends, a condition referred to as saturation (Charmaz, 2006).

**Coding.** Open coding is a critical step because in this step the data categories are developed and refined (Maguire & Delahunt, 2017). Open coding was the first coding method to be applied in the analysis of the collected interview data. During open coding, I read through the manually corrected transcripts to understand what the participant was trying to say. Many of the initial interviews contained repeated occurrences of filler pauses and other type of verbal cues that indicated the participant was thinking and had not completed their statement. Likewise, due to occasional poor connections, the participant often had to repeat themselves or ask the question to be repeated.

I performed a thematic analysis of the transcribed interview data, using an incident-by-incident coding approach to create categories that were later grouped together as themes. I then identified four overarching domains. I relied on my expertise and experience with airline maintenance operations to ensure I remained sensitive to subtle nuances in participant responses.

To facilitate the coding, I used NVIVO qualitative data analysis software purchased online. This software package allowed me to create codes, group them together, and identify relationships between codes.

Early in the coding process I identified the process for adopting service bulletins and complying with airworthiness directives as very similar. Instead of analyzing these as two separate processes, I analyzed them as the same process with small deviations. The common process for service bulletin adoption and airworthiness directive compliance has four distinct
phases. Likewise, I confirmed that the process for ensuring maintenance tasks are properly
performed and best practices are received from the OEM when there is a need is the same
process used for inspections. As such, I analyzed performance of maintenance tasks and
inspections as the same process with four fundamental phases. I established these a priori phases
based on the initial review of the data and my own industry experience. I chose to organize the
codes within these predetermined phased based on the interview data and my industry
experience.

Coded responses from the participants were identified as relating to one or more of these
phases, for the specific process being discussed and depending on what the participant said—and
the context of when they said it—during the course of the interview. The coded response was
moved, in the software graphic user interface, to be associated with the specific phase.

**Memoing.** Memoing, a data analysis strategy described by Charmaz (1996), is used by
the interviewer to make note of their interpretation of the participants responses or potential
connections to other interviews. Memoing is a way for the researcher, or the researcher’s coding
team, to document any ideas or thoughts with regards to the data, categories, emerging trends,
and potential connection between them. The memos are used to identify emergent trends and
identify connections between the difference categories, much like the work described by

I had initially entered the data collection phase of this study with the intention to take
memos during the interviews. Following the example of Valicenti (2012), I had written the
memos after each interview and during the constant comparative process. However, after the first
two interviews I felt the memos that I had taken did not provide insight beyond what was
extracted during the coding phase. Memoing had required me to interrupt focus on the interview.
After two interviews I stopped memoing so that I could always stay present to the discussion, knowing that whatever information was extracted from the coding would be the same as what I would capture during memoing.

**Constant comparison.** Constant comparison is an iterative method for analyzing qualitative data as described by Strauss (1987). Glaser (1965) presented the constant comparative method for analyzing qualitative data in which interview data is coded and analyzed immediately after being collected. Insights from the analysis are used to inform both the data collection as well as coding. Watling and Lingard (2012) further described the constant comparative method as an iterative process in which newly coded data and the memos recorded are compared to previously coded data, memos, and emerging categories. This process of comparison creates new insights and helps guide the interviewer on how to amend the data collection process in order to focus on areas of interest as well as adapt the coding based on the data already coded.

During this study, newly collected data was compared to previous data, the existing coding, and relationships between codes. The new data was either added to existing codes or new codes were created. When driven by the data, new code relationship was created.

**Data saturation.** The end of open coding is marked by data saturation. As I read through additional interviews the number of codes and the number of occurrences of existing codes increased initially. However, the more interview data introduced eventually began to return fewer and fewer new codes. Once additional interview data started returning no new codes, I understood that I had reached data saturation.

**Chapter Summary**

This chapter identified the methodology used during the collection and analysis of the primary data. Primary data was collected by coding transcriptions of semi-structured interview.
Secondary data, in the form of acquired industry knowledge and airline maintenance operations of the interviewer and author, was used along with the primary data to perform a systems analysis of the engagement between engine OEMs and airlines in Africa.

Chapter IV presents the results of the data analysis. The topics covered will include the four phases of the process for service bulletin adoption and airworthiness directive compliance, as well as the four fundamental phases of the process for correct execution of maintenance and inspection tasks.
Chapter IV: Results

The intent of this study is to understand engagement between aircraft engine manufactures and airlines in Africa during critical processes that can influence the safety performance of the airline. The processes considered during this study include adoption of service bulletin adoption, airworthiness directive compliance, and proper performance of maintenance and inspection tasks. The goal of this work has been to better understand the critical success factors of OEM-airline touchpoints during the processes. Investigation and analysis of the interorganizational engagement that occurs throughout these processes allowed for identification and analysis of the critical elements of this system that lead to successful outcomes. The following research questions were developed to address the overarching question this study was designed to answer.

RQ1: What are the critical touchpoints between engine OEMs and airlines in Africa that lead to successful outcomes during the adoption of service bulletins and the compliance with airworthiness directives?

RQ2: What are the critical touchpoints between engine OEMs and airlines in Africa that lead to successful outcomes during the performance of maintenance and inspections tasks?

RQ3: What are the characteristics of the touchpoints that facilitate efficient transfer of needed information?

Semi-structured interviews were conducted with 14 aviation professionals currently working for airlines in Africa. The participants work in positions primarily focused on engineering or technical support related to engine maintenance. The interviews were recorded, transcribed, and then coded. The interviews were analyzed applying an emergent coding process similar to grounded theory coding principles. This information was supplemented by the
interviewer’s knowledge of airline commercial and maintenance operations from working as a field service representative for an aircraft engine OEM. The interview data were then coded using procedures aligned with grounded theory. The findings from the interview analysis and the interviewer’s knowledge of this field of practice, were the basis of the systems analysis.

The findings from the analysis of the coded interview data are presented in Chapter IV. The presentation of the findings is aligned with the research questions. The research questions focused on the adoption of service bulletins, compliance with airworthiness directives, and proper execution of maintenance and inspections tasks. The process of adoption of service bulletins and compliance with airworthiness directives were very similar as they both had four primary phases in the process. Those phases, which are presented in detail in Chapter IV, are Awareness, Assessment, Preparation, and Execution. The similarity in these two processes is not unexpected since very often airworthiness directives are based on existing service bulletins. The primary difference is that compliance with airworthiness directives is mandatory and enforced by regulatory bodies while service bulletins are recommendations from the aircraft engine OEM.

After the findings related to the adoption of service bulletins and airworthiness directives are presented, I present findings related to ensuring proper execution of maintenance and inspection procedures. The process of service bulletin adoption and airworthiness directive compliance was reported to be very similar across airlines. The process by which airlines and aviation professionals identify a need for support from the aircraft OEM, engage with the aircraft engine OEM, and disseminate the best practices with the airline organization, varied greatly from airline to airline and person to person based on the interview feedback. Finally, the interview data related identifying the elements of successful interorganizational engagement is presented.
Select quotes from interviews are presented to support the findings. Each quote is identified with a code that represents the different interviewees. For example, a quote followed by “(P05)” indicates that this quote was from the interview with Participant #05. Participants were provided a number based on the order in which they were interviewed. For example, Participant #01 was the first participant interviewed and Participant #14 was the 14th, and final, participant interviewed.

**Overview of Research Findings**

The 14 participants were asked to describe their experiences engaging with engine OEMs through the processes of airworthiness compliance, service bulletin adoption, sharing of best practices for performing inspections, and sharing of best practices for completing maintenance tasks. The research question initially considered service bulletin adoption and airworthiness directive compliance as separate processes. However, after the first three interviews it was clear the basic process for airworthiness directive compliance and service bulletin adoption are similar, with some minor differences between the two. This is expected given that an airworthiness directive is often generated based on an existing service bulletins from the respective OEM (Abbott, 2015).

The findings related to both airworthiness directive compliance and service bulletin adoption are organized and presented according to the common process of airworthiness directives compliance and service bulletin adoption, shown in Figure 4.1.

![Figure 4.1. Process for Airworthiness Directive (AD) compliance and Service Bulletin (SB) adoption.](image)

Chapter III provided detail on the benefits of using a systems analysis approach for investigating this process and highlighted the analysis will focus on identification and analysis of
the elements and interconnections that work together during the process of complying with an airworthiness directive and adopting service bulletins.

As discussed in Chapter III, interconnections are flow of material or information between two elements in the system. In this study, transfer of information, or request for information, between the aircraft engine OEM and airline are referred to as touchpoints. The presentation of the touchpoints includes details regarding the point in the process the touchpoint occurred, the type of information exchanged, the type of engagement, the type of engagement required to transfer the information, and the specific roles of the elements within their respective organization.

The touchpoints are categorized based on which phase the touchpoint occurs, which organization initiates the touchpoint, the type of information transferred, and the type of communication used. The type of information transferred is classified as either explicit knowledge or tacit knowledge. Explicit knowledge is easily codified and communicated. An example of explicit knowledge in the context of service bulletin adoption and airworthiness directive compliance is the affected engine serial number, utilization threshold, or deadline for adoption or compliance. This information can be clearly understood without context or interpretation. Tacit knowledge is not easily codified or communicated. An example of tacit knowledge in the context of service bulletin adoption and airworthiness directive compliance, is understanding the operations of the airline and how to facilitate internal communications to drive faster action. Another example of tacit knowledge is understanding how disruptions in an airline’s commercial operations will affect aircraft availability, and thus the schedule by which material is needed.
The type of communication is also identified as one of three categories. Those three categories are nonreciprocal communication, partially reciprocal communication, and fully reciprocal communication. For this study, these categories are defined in Figure 4.2.

*Figure 4.2. Categories of communication used for this research study.*

Nonreciprocal communication is used to categorize communication that is one-directional and does not allow for follow-up. When using non-reciprocal communication, the initiating organization defines the knowledge to be communicated as well as the format of the communication. They also determine who the information is sent to. An example of this type of communication is sending email notifications to distribution lists.

Partially reciprocal communication, for the purpose of this study, is defined as communication requesting knowledge. The initiating organization or individual will identify the information needed and send a request to the second organization. The second organization provides a response to the initial request but there is no further communication. An example of partially reciprocal communication is when the airlines sends a request to the aircraft engine OEM. The aircraft engine OEM will review and respond through a function email address. After responding the case is closed and no further communication can occur.

The final category of communication defined for this study is fully reciprocal communication. This type of communication allows for unrestricted back-and-forth communication between two individuals or organizations. During fully reciprocal
communication both the individuals or organizations can direct the conversation as they feel is important and can introduce new topics of discussion. An example of fully reciprocal communication, as used in this study, is the communication that occurs when a field service representative visits an airline and discusses open items and challenges with individuals at the airlines. Fully reciprocal communication can also take place by using the phone, online chat services like Skype for Business, or even email.

The findings are organized by following the process for airworthiness directive compliance and service bulletin adoption that was presented in Figure 4.1, which shows the four primary phases of the service bulletin adoption and airworthiness compliance process. The touchpoints, and characteristics of these touchpoints, are presented based on the particular phase during which the touchpoint occurs.

**Process for Airworthiness Directive Compliance and Service Bulletin Adoption**

As described in Chapter III, OEMs publish recommendations for the equipment they manufacture. These recommendations introduce product improvements that address product safety, product reliability, product durability, or produce cost of ownership. The process regarding how an airline becomes aware of a service bulletin, assesses it, prepares to embody it within their fleet, and executes the embodiment plan, is presented. Critical to this process is the support provided by the aircraft engine OEM during this process.

As discussed in Chapter III, airworthiness directives are issued by regulatory bodies but are often based on existing service bulletins. Any engagement between the aircraft engine OEM and airline during the process of complying with an airworthiness directive is also presented.

**Awareness: Airworthiness directive and service bulletin.** The first phase of the process of adopting service bulletins and complying with airworthiness directives is ensuring the correct
individual at the airline is aware of the existence of an airworthiness directive or service bulletin a very critical step in the respective compliance and adoption process. An airline operating a specific type or model of engine would need for the right person in their organization to be aware of the recommended improvements from the OEM in order to initiate the process shown in Figure 4.1. Likewise, an airline would not take action to comply with an airworthiness directive unless the right person at the airline is aware that an airworthiness directive exists.

When asked how they become aware of service bulletins and airworthiness directives, the participants responses highlighted three strategies used by the airline professionals for knowing if there is an airworthiness directive for service bulletin applicable to the type of engine at their airline. These three strategies, presented in Figure 4.3, are signing up with the OEM for automated email notifications, proactive online searches, and communication with the assigned field service representative.

![Figure 4.3](https://publicdomainvectors.org/en/free-clipart/Airport-pictogram-symbol/83493.html)

*Automated notification.* The source of automated communications depends on the entity that issues the document. Service bulletins are issued by the OEM while airworthiness directives are issued by the regulatory authority overseeing the country where the OEM is based. Although the airworthiness directives are typically based on existing service bulletins, the respective
regulatory body does not need to have the OEM’s approval or awareness before releasing an
airworthiness directive. This can lead to the release of airworthiness directive without the OEM
being aware such action will take place. Participant #05 highlighted that the process for releasing
an airworthiness directive is solely the authority of the respective regulatory authority and the
OEM itself may not be aware of the details of the release.

There were three, four or five ADs which [the OEM] was not expecting to be released at
a certain time but then the European Aviation and Safety Agency decided to release in
this directive on a certain date. Then the ADs came, they were surprise for us, they were a
surprise to the OEM. (P05)

The release and communication of an airworthiness directive is done so at the direction of
the respective regulatory body. OEMs, at least on occasion, are not aware of when the AD will
be released.

Although automated communications of airworthiness directives are not considered as
OEM touchpoints, the release of an AD does immediately get attention from senior leadership
and the affected airlines, as the following quote from participant #10 highlighted this.

But recently I'm not sure if I need to come up to the engineer, because it's right now, they
are running with that and I know it gets escalated very quickly to the RPA, the
responsible person for the aircraft, and that goes straight to the CEO. (P10)

When senior level and executive leadership at the airline become aware that their fleet is
exposed to an airworthiness directive, they instruct their teams to take immediate action. This
results in immediate engagement with the respective OEM, since airworthiness directives are
often based on an existing OEM service bulletin. The OEM will have touchpoints with the airline
after the AD is released, particularly to understand technical and commercial support details.
This can see understood based on the following response:

I know the engagement process happens immediately as soon as we see the
[airworthiness directive] of which they would most likely be at the facility during the
week to discuss more details into it and how else it can be done. (P10)
Overwhelmingly, the participants identified automated emails as the primary means by which they are notified of impending service bulletins. An automated email is an OEM touchpoint in which airline is notified of the existence of a service bulletin. During this initial touchpoint the OEM sends an email to an email distribution list. Participant #5 advised that in order to be included on this distribution list an individual must sign-up on the OEM’s website: “They sign in and they subscribe to the notification from the OEM websites and that's how they receive the revision and the release of SBs [service bulletins]” (P05).

The OEM sends an automated email, which notifies individuals on the distribution list that an SB has been released. At this point there is a transfer of information, the information being primarily that an SB has been released. The automated notification will also contain a copy of the service bulletin, which contains additional details regarding the condition being addressed and applicability.

The feedback from the interviews indicated there is a process for setting these automated notifications. The process requires the individual to log-on to an OEM’s portal and select the engine type and model for which they need to be notified of new or updated service bulletins. The ease or difficulty of this process has a direct effect on the ability of the airline professionals to correctly sign-up for the correct email distributions. Participant #5 described some of the challenges they have experienced when navigating OEM portals. They clearly stated that with some OEMs it is not easy and can lead to some confusion on the selection of the appropriate engine model or engine type.

Out of confusion sometimes they subscribe into a totally different engine model than the one we do, they sometimes send us service bulletins, which are not directly related to our work. The problem is, the way you search for service bulletin or you subscribe for service bulletin is not as simple as OEM's because they manufacture and support so many small engine models, so choosing between the engine models and following a particular engine model is not very easy between websites. (P05)
In addition to the challenge of selecting the correct engine model or engine type, airline professionals reported that often they feel overwhelmed with the quantity of automated emails being received from the OEMs. Participant #7 described their experienced being overwhelmed with automated notifications from a single OEM. “I can tell you, for [specific OEM], we receive a piece, one, or two, or three, or four emails per day concerning document modification or technical variant. It's incredible” (P07).

Receiving many automated emails can overwhelm the individual at the airline responsible for reviewing these communications. This can result in service bulletins being reviewed or in reduced quality and time spent reviewing each service bulletin notification. Delays in reviewing service bulletins and the potential for reduced review quality and time spent reviewing them can be increased for airline professionals working with multiple engine OEMs or airframe OEMs.

**Online search.** Airline personnel reported also proactively searching the OEM’s portal for newly release service bulletins. The feedback from these participants indicated that these proactive online searches were used only when automated emails were not available or when the airline personal didn’t feel comfortable that they had signed-up correctly. Participant #10 described their weekly rhythm of reviewing the OEM portal for new service bulletins. “I check weekly on the websites regarding the [specific engine model] in the latest revisions and updates to both SB’s related on engines” (P10).

Airlines searching the OEM website for recently issued service bulletins would be considered an airline-initiated touchpoint, whereas automated email notification would be considered an OEM-initial touchpoint. However, the same explicit information is shared through both touchpoints.
The airline personnel also mentioned the responsible section at the airline would also search for new airworthiness directives on the respective regulatory websites. This is highlighted in the response from Participant #4: “And if it’s AD, we go through faa.gov. There is a site through which we receive all ADs” (P04).

As described earlier in this section, searches of the regulatory websites are not considered OEM touchpoints. However, awareness of an airworthiness directive can lead to OEM touchpoints during the airworthiness directive compliance process.

**Engagement with assigned field service engineer.** When asked how they become aware of the service bulletins and airworthiness directives, the participants overwhelmingly highlighted the importance of engagement with the field service representative assigned by the respective OEM. Responses by Participant #5 and Participant #10 highlight the importance of engagement with the assigned field service representative in the awareness of service bulletins: “[SB Adoption and AD Compliance process] depends on the excellence of the OEM representative” (P05). “We also have a field service engineer who would send me [the service bulletins] and [airworthiness directives]” (P10).

The method of communication varied. Nearly all respondents advised that the field service engineer would send an email, bringing the participants attention to either a recently released SB or impending SB. The FSE would also ensure if the airline personnel were aware of recently released or impending airworthiness directives. For airlines that had a field service representative onsite with them, the participants advised the field service representative would follow-up the email with a face-to-face reminder. Participant 09 described how the onsite field service representative follows up with additional details of the importance of adopting a specific service bulletin as well as details on how to action the recommendation.
For example, we had a fleet issue for engine fleet, and the onsite rep sent me an email with the SB attached and said the SB will solve the suspected problem and the SB should be embodied like this. (P09)

The results from the interview revealed that the intervention of the Field Service Engineer in the process of notifying the airline personnel of both service bulletins and airworthiness directives is critical for airlines to first become aware of the service bulletin or airworthiness directive and to prioritize appropriately for follow-up. Participant 04 indicated that a field service representative intervention in this process is critical. “We very much engage with the rep. And the rep give [sic] us instruction when there is a new service bulletin, which is critical” (P04).

**Notification from maintenance service provider.** Airlines often outsource maintenance support and activities to airlines maintenance service providers. Much like notification from the respective regulatory body, communication from maintenance service providers is not considered as an OEM touchpoint for the purposes of this study. However, the communication from the maintenance service providers can lead to OEM touchpoints later in the process.

**Assessment: Service bulletin and airworthiness directive.** After the airline becomes aware that a service bulletin or airworthiness directive has been released an assessment is required to confirm if any of the aircraft engines in the airline’s fleet are affected by the service bulletin or airworthiness directive. The assessment also is used to identify the timeframe to act and if any engines should be prioritized. The assessment process is very similar for both service bulletins and airworthiness directives, as highlighted by Participant #09: “There's not much, any difference” (P09).

The difference in the assessment processes is primarily due to the priority placed on compliance of airworthiness directive since compliance is compulsory and enforced by regulatory bodies. For this reason, airworthiness directives are reviewed on an expedited
timeline. Participants #11 described this as follows: “With airworthiness directives we have a hard timeline. What we do is, the moment an airworthiness directive is issued we evaluate it within the same day to be sure we meet the timeline which has been set” (P11). Participant 13 commented, “Once the AD is released, our company policy, is to take a decision within 48 hours” (P13).

The results from interviews help identify the critical inputs the airline needs when performing the assessment and highlighted that assessment occurs in two parts. The first part of the assessment focuses on identifying the extent to which the airline’s fleet is affected. I have termed this the technical assessment. Although airline may need to engage with the OEM to clarify fleet exposure, as presented later in this chapter, the fleet exposure is clear. An engine or a part is either affected or it is not affected. It is binary.

Airworthiness directive compliance is compulsory, and so additional analysis is not required. Participant #14 stated that if the fleet is affected by an airworthiness directive, the next step is to implement the airworthiness directive. There is no additional analysis required. The participant stated: “The [airworthiness directives] at least are mandatory that. So, if the [airworthiness directive] affect my fleet, I should implement this [airworthiness directive] within the compliance date mentioned in the [airworthiness directive]” (P14).

Likewise, service bulletins that address potential flight safety or operational disruptions are often implemented immediately, by policy, without additional analysis. However, some service bulletins address conditions that can reduce cost of operations or avoid minor inconveniences, such as a delayed departure. In these cases, the airline may opt to perform a cost-benefit analysis of the service bulletin. The outcome of this analysis will be used to
determine if the service bulletin should be adopted. Participant #11 discussed the need to use a cost-benefit analysis to justify the embodiment of some service bulletins:

That works well in terms of adoption of that service bulletin. If there's no commercial support than we have to go back and create a business case to justify that we need to improve the availability or reliability by embodying the service bulletin. (P11)

Interviews with the 14 airline professionals identified several inputs included during the technical assessment and the cost-benefit analysis of service bulletins. These different inputs are presented in Figure 4.4. The inner circle shows information taken into consideration during the technical assessment. The outer circle shows information taken into consideration during the cost-benefit assessment.
Figure 4.4. Inputs considered by airline professionals during technical assessment of both service bulletins and airworthiness directives. This shows airworthiness directives and mandatory high priority service bulletins as the inner circle (blue) and cost-benefit assessment of optional service bulletins as the outer circle (green).

**Technical assessment.** Detailed analyses of the participants responses related to the technical assessment of service bulletins and airworthiness directives is now presented.

**Compliance location during shop visit or on-wing.** Some service bulletins and airworthiness directives can be completed with the engine still installed on an aircraft or sitting at the airline facility as a spare engine. Other service bulletins and airworthiness directives require
the engine to go to a repair facility. Knowing where the compliance can be completed is a critical piece of information when assessing service bulletins and airworthiness directives. As Participant #07 pointed out, in many cases it is preferable if the service bulletin or airworthiness directive should be carried out at a repair facility. “It's different if this SB can be applied on the wing or during overhaul because it will more difficult for us to apply SB on-wing than during an overhaul” (P07).

Part of the reason why service bulletin adoption and airworthiness directive compliance at a repair facility is preferred is because the specified work can normally be performed during a scheduled visit to the repair facility. Service bulletin adoption and airworthiness directive compliance performed on-wing often had not been included in the original maintenance plan and thus results in unscheduled maintenance. Unscheduled maintenance increases the time the aircraft is pulled from commercial operations. Unscheduled maintenance causes disruptions to the airline’s maintenance operations that can spill over into the commercial operations. Recovering from these operational disruptions can take days or weeks and result have associated costs. Participant #11 highlighted this as a reason why compliance of service bulletins and airworthiness directives during a scheduled visit to a repair facility is preferred.

There is a cost of availability that is never factored in. That's a challenge. Having an aircraft down for maintenance. Yeah. And especially mostly if things don't fall under scheduled maintenance that becomes a maintenance cost that is not compensated for. (P11)

*Deadline for completion.* The deadline for completing the service bulletin or airworthiness directive is normally stated in the respective document. The timeline for completion is usually related to the location where the service bulletin or airworthiness directive would be completed. For tasks to be completed on-wing, the timeline is much shorter than for
work to be done in a repair facility. Participant #08 described that deadlines in both service bulletins and airworthiness directives are taken very seriously.

The timelines are really, really strict to be clear that we understand what is needed to get this accomplished and any kind of support that we need, we're able to ask of it and agree on how we can get us done. (P08)

As described earlier in this chapter, not complying with an airworthiness directive can have severe consequences, such as grounding the aircraft and revocation of certifications. Service bulletins recommendations, although not mandated by regulatory bodies, are taken very seriously by airlines. In some cases, if the deadline defined in the service bulletin would be a significant burden for the airline operations, someone in a technical or planning position may approach the aircraft engine OEM for an extension to the timeline. Participant #08 described how they often approach the aircraft engine OEM for deadline extensions: “So usually our first approach is to go the OEM and try to request for a more friendlier [sic] accomplish by time. So maybe extension of the time or something of the sort” (P08).

*Engine or part applicability.* The previous sections on timeline and location for completion focused on parameters of the service bulletin or airworthiness directive related to when or where the maintenance defined in the service bulletin should be performed. This section will focus on inputs related to the engine or part, which are used to determine if an engine or part is affected by the service bulletin or airworthiness directive. The engine and part parameters mentioned as being important to identification of affected parts or engines include the part number and serial number, the part utilization, the engine type, the engine model, the engine serial number, and the engine utilization.

Engine parameters that are relevant to the applicability service bulletin or airworthiness directive are explicitly stated in the text of the service bulletin or airworthiness directive. With regards to OEM engagement, the service bulletin serves as the touchpoint with the airline. The
service bulletin is one-way communication of explicit knowledge initiated by the OEM. As discussed above, airworthiness directives are issued by regulatory bodies and thus the issuance of an airworthiness directive is not considered an OEM touchpoint. However, if the airworthiness directive references the service bulletin and the airline refers the service bulletin than this is considered an OEM touchpoint. This section will not discuss the details of every engine or part number in depth but will present participant feedback regarding occasions the text of the service bulletin was not clear and additional engagement with the OEM was required to clarify applicability of the service bulletin.

*Engaging the OEM for clarification.* The text of the published service bulletin or airworthiness directive is meant to be very clear. However, in some instances the information provided may not be easily located or there may be some misunderstanding the airline would like to resolve. Many participants advised their first strategy is to re-read the service bulletin to ensure they did not miss a critical piece of information. As participant #14 pointed out, their first approach is to read through the SB: “I review [service bulletins and airworthiness directives] myself” (P14).

If, after reading through the service bulletin, there is any detail still not clear the airline will act to engage with the respective OEM. The method for engaging with the OEM depends on if a field service representative is available. Participant #02 describes the preference and standard process would be to engage with the onsite field service representative as a preference but will send an email if not able to contact a field service engineer. “But if we have any doubt, we will need a second option. We speak with the rep, if we don't have a rep onsite, we would send an email for the OEM engineering department” (P02).
Sometimes the applicability of the service bulletin is not clear. For example, if the part number listed in the service bulletin is part of an assembly, the assembly part number may be listed on all official engine documents and not the individual part number. This makes confirming applicability difficult. Likewise, sometimes the information given in the service bulletin may not be clear or may be conflicting. In cases where simply reading the service bulletin is not sufficient to confirm applicability an individual at the airline will reach out to the OEM. The preferred method of engagement for this touchpoint is through the field service representative, but if one is not available the airline individual will reach out to the OEM engineering via email. In both cases, the type of knowledge shared will still be explicit but will use reciprocal communication to ensure all points are fully clarified.

**Additional assessment.** Airworthiness directives are mandated by the respective regulatory authority. Service bulletins are not mandatory and is up to the discretion of the airline to adopt them. Only when a service bulletin becomes an airworthiness directive does it become mandatory (Abbott, 2015). The interview participants described additional inputs used to decide whether to adopt a service bulletin. Those criteria are described below.

**Service bulletin category.** To help airlines understand the urgency or importance of a service bulletin, OEMs will include the category within the service bulletin. This category is a number that indicates the seriousness of the condition addressed. There are no strict rules for how to categorize the service bulletin, this is done at the discretion of the OEM. Participant #07 described how important this piece of information in the decision to adopt a service bulletin.

Of course, I have also to determine, because you have, on an [service bulletin], you have a number which determines the level of the [service bulletin]. So, this is also very important to determine if it's really important or not to apply this [service bulletin]. (P07)

In many cases the airline will, by policy, decide to adopt the service bulletin based on the severity of the service bulletin. Participant #01 explained that per their airline policy, action may
be required based on the OEM category of the service bulletin: “Actually, when I receive a Category 2 [service bulletin], I know that I have to take action” (P01).

If the airline doesn’t have such a policy of airline’s policy doesn’t apply to a service bulletin than further assessment of the service bulletin will need to be completed using the additional inputs are required to complete the assessment of the service bulletin.

*Service bulletin background.* When an airline is notified that a service bulletin or airworthiness has been released one of the first questions asked is regarding the underlying engine condition being addressed and circumstances that led to the release of the service bulletin. This is referred to as the background of the service bulletin. As Participant #14 pointed out, understanding this background of the service bulletin is a critical input in the decision-making process.

And after that, [I] study category of the SB and description and the background of this SB and . . . its effect on the engines and how it is important or no based on the category and the background on this SB on other fleets. After that, I study the cost of the SB [sic]. (P14)

The airline will also need to understand the operational impact of adopting the service bulletin or complying with the airworthiness directive. The operational impact can refer to two types of impact. The first type refers to the potential operational disruptions that can occur if the service bulletin is not adopted. These operational impacts can range from small delays that occur when a part needs to be replaced unexpectedly up to major disruption, such as an aircraft being unserviceable for days or even weeks. “I know a small thing in a certain engine can make the whole engine to cause in-flight shut down” (P03).

The service bulletin document typically contains information regarding the underlying condition being addressed. To understand the background of the service bulletin, some participants stated they read the through the service bulletin document, while others mentioned
they would reach out to the assigned field service representative for this type of information. Reading through the service bulleting document is an OEM-initiated touchpoint used for nonreciprocal communication of explicit knowledge. Reaching out to the field service representative is an airline-initiated touchpoint that uses reciprocal communication to communicate both explicit and tacit knowledge.

**Effect on global fleet.** Understanding how this condition addressed by the service bulletin will affect airlines globally is also a consideration when deciding to adopt a service bulletin. This piece of information is important as it allows those performing the service bulletin assessment to understand if their airline fleet is more exposed to the condition than other airlines. Participant #12 described how this information can influence the decision to adopt the service bulletin.

“Maybe our reliability is worse in this area, is worse that is worldwide. In this case we will be willing to do this SB” (P12).

Depending on the specific data needed to perform a comparative review, the data could be found in the service bulletin document, which is an OEM-initiated touchpoint used for nonreciprocal communication of explicit knowledge. Participant #12 described that in order to determine the effect on the global fleet they would contact the OEM either through contacting the field service representative or raising a request on the OEM website. Reaching out to the field service representative is an airline-initiated touchpoint that uses reciprocal communication to communicate both explicit and tacit knowledge. Submitting an inquiry on the OEM’s website is a partially reciprocal airline-initiate touchpoint that can used to request both explicit and tacit knowledge.

**Experience at airline.** Airlines will review their own experience to confirm if the root cause has adversely affected them in the past. If an airline has already been affected by a
condition for which a service bulletin exists, they are motivated to quickly address this condition in their fleet to avoid additional operational disruptions for the same reason. Participant #07 described during their experience assessing service bulletins that a history of previous occurrences of the service bulletin affecting the airline’s fleet is an important input for making the decision to adopt a service bulletin: “In fact, I will check on our IT system, because when I analyze an SB, I have to check on our system if we already have some issue regarding this [service bulletin]” (P07).

Based on the responses from the interview participants, and the nature of this information, the airline would engage internally to confirm this information. Although this is an important piece of information, the primary source of this information is not the OEM and thus not a required touchpoint.

The second type of operation disruption considered is related to how long the task takes to perform. This point also takes into consideration if the task can be performed whilst the engine is installed on the aircraft, on-wing, or if it would need to be removed from the aircraft and sent to a repair facility. Generally, tasks that can be completed on-wing are less disruptive than engines that require engines to be sent to a repair facility. “It's different if this SB can be applied on the wing or during overhaul because it will more difficult for us to apply SB on wing than during an overhaul” (P07).

Cost and commercial support. Another critical aspect of the assessment phase is understanding the cost to adopt a service bulletin as well as understanding the commercial support the OEM is willing to provide. It should be noted that commercial analyses are typically only performed on service bulletins that address cost of operating the engine, such as improving
fuel efficiency. Service bulletins addressing safety issues or major operational disruptions are typically adopted without the need for a cost benefit analysis.

The commercial support the OEM will provide to the airline if they chose to adopt the service bulletin, is a critical input. The lack of commercial support can be a big challenge for the airline technical teams to get approval to implement the service bulletin. Participant #11 provided insight in this review process, stating that without commercial support from the OEM they would have to create a business case to support adoption of the service bulletin. “If there's no commercial support than we have to go back and create a business case to justify that we need to improve the availability or reliability by embodying the service bulletin” (P11).

The inclusion of commercial support can avoid the need for the approval request to be escalated to airline senior leadership. Participant #10 pointed out that at their airline the total cost will dictate the level of approval needed.

If it's over a certain amount, then it would have to go to certain people in management to get approval. Like I know if it's over [a specific threshold], then management can approve it. If it goes over [another specific threshold], then it would have to go CEO level of which, if it goes beyond that, it will go to board of directors and it will be discussed with the board of directors of the company. (P10)

The commercial support provided to the airline is defined is often in the text of the service bulletin, and would be categorized as an OEM-initiated, nonreciprocal communication of explicit knowledge. If the commercial support is not defined in the service bulletin, the airline employee would then reach out to the OEM. Based on feedback from the interview participants, reaching out to the OEM can include contacting the assigned field service representative or submitting an inquiry on the OEM’s website. Both of these touchpoint types have been described earlier in this chapter.

If the airline believes the cost of adopting the service bulletin is too high or the commercial support already provided is not enough to offset the original cost of the service bulletin, they will
request additional support from the OEM. The airlines know they will need to justify their
request for additional support. Participant #11 described that this process not only includes a
review of the airline’s fleet but also challenges OEM’s assumptions and calculations.

Yeah, sometimes we go back to the OEM to try and justify the need for support because
the OEM will come and tell you that if you replace this specific part, you’re going to see
reliability go up by a certain factor, or a certain percent. Then we go back to the OEM for
more details as to how? We asked for how they're going to add value the reliability
figures and to how they arrived at it, the numbers they've arrived at in the service
bulletin. So that's the kind of support we need when doing the business case, So, if
someone has said the reliability will go up, we challenge that and ask by how much so
that can calculate and see if there is value. (P11)

To influence the OEM to provide additional commercial support the airline participants
describe that they need to engage with the OEM to communicate these challenges. Participants
mentioned approaches they use to request additional commercial support are related to previous
operational impact caused by the underlying condition as well as costs not accounted for by the
OEM. Participants responded that to raise this request with the OEM they would approach the
field service representative and explain the need for additional support. The airline employee and
field service representative would then work together to put the request in the right context so as
to get the needed attention and understanding. Participant #08 described their experience
requesting additional support.

The first point of contact would be our field rep who directs us to the [customer support
manager] and he would sort of help us in packaging the request in a way that would draw
attention of the [customer support manager]. (P08)

This example highlights the role of the field service representative as a facilitator of
communication. Given the subjective nature of requests for additional commercial support and
the need to include context of the request, the knowledge shared during this engagement is
classified as tacit. The OEM initiates this touchpoint and utilizing fully reciprocal
communication to resolve the request.
Once all the relevant information is collected, the airline staff responsible for making the decision to adopt the service bulletin will make a complete assessment. The result of the assessment will be used as input in determining if the airline will adopt the service bulletin. Assuming the airline decides to adopt the service bulletin, the process would then enter the next preparation phase.

**Preparation: Service bulletin and airworthiness directive.** Once the airline personnel responsible for assessing the service bulletin have decided to adopt the service bulletin, the responsible people and teams within the airline organization will need to act to prepare to ensure the airline is ready to complete the service bulletin. The same type of preparation will be required for airworthiness directives. As mentioned earlier in this chapter, compliance with airworthiness directives is mandatory and enforced by the appropriate regulatory body.

During the course of the interviews, participants were asked to describe how they worked to ensure the airline was prepared to adopt service bulletins and comply with airworthiness directives. Their feedback is presented along with quotes from the interview.

**Compliance location.** Completing a service bulletin or airworthiness directive at an engine repair facility can be easier for the airline than performing the required actions while the engine remains installed on the aircraft. Maintenance on an aircraft engine is scheduled during maintenance checks. The exact amount time the aircraft is removed from service depends on the time required to perform all required tasks. Removing an aircraft from service creates an additional burden on the rest of the airline’s fleet to support operations until this aircraft returns to service. If adopting a service bulletin or complying with an airworthiness directive requires a longer time to complete than the aircraft is scheduled, then the maintenance scheduled will need to be amended and this will likely affect the airline’s commercial operations. If the actual time
required to complete the service bulletin or airworthiness directive exceeds the time allocated in the maintenance plan this will cause a disruption to the maintenance operations and likely the commercial operations.

Removing the engine and sending it to a repair facility also ensures the assigned airline individual or team will not need to acquire the parts, consumables, and tooling. Likewise, there is no need to review the training and certification of the airline technicians since they will not be doing the work.

There are some reasons why the airline would prefer to complete the service bulletin or airworthiness directive without the need to send the engine to a repair facility. Sending the engine to a repair facility can be more expensive due to shipping cost and additional maintenance items that may need to be performed. While the engine is at the repair facility it is not available for airline use if needed. Some airlines may not have a spare engine and sending an engine to a repair facility would mean they pull the aircraft out of service until the engine returns or lease a spare engine, which can increase operational costs.

If the airline decided to lease a spare engine to support the commercial operations, the interview participants indicated that engaging with the respective aircraft engine OEM would be the first step. Participant #10 stated that is very important to work closely with the aircraft engine OEM during this process, although no specific point of contact was identified. Leasing an engine will require approvals, documents, and agreement on price. The documents and approvals would be considered explicit knowledge using partially reciprocal communication while negotiations on price would involve tacit knowledge and require fully reciprocal communication. “We would have to start procuring the lease engine for the time being or otherwise with something else which then OEM engagement would be very important” (P10).
Once the decision has been made to send the engine to a repair facility there remains only one action item. They responsible parties at the airline must ensure the repair facility is approved for the airline to use. If the repair facility is approved, then no other action is needed.

We do have depending on the [service bulletin], because like I know, know that normally, he you we say that the [maintenance task] has to be carried out be an [OEM] authorized facility. So, I know there's like only three, all I know, so technically we won't be able to do that onsite. (P10)

But if the facility is not approved then the airline would need to contact the repair facility. Participants’ responses indicate the first point of contract would be the assigned field service representative, who would be asked to provide the relevant contacts at the repair facility. The initial contact with the field service representative would not be considered a touchpoint, instead the contact with the repair facility would be considered the airline-initiated touchpoint.

If the airline decides to complete the service bulletin or airworthiness directive while the engine is still in the airline facility, there are additional steps the airlines needs to take to ensure the tasks can be completed onsite at the airline. Those tasks require OEM touchpoints and a further discussed.

**Airline maintenance capability.** The capability of an airline to complete a service bulletin or airworthiness directive depends on if it has the needed materials and tools to perform the specific task. The capability also includes whether the technicians performing the task have the required training or required certification. One critical part of preparing to complete a service bulleting or airworthiness directive is confirming the airline’s capability to complete all tasks. Participant #07 described how their airline had a limited capability; so, confirming the airline’s capability was a priority. “We have a limited scope of work, and so it will be the most important thing to check.” (P07)
The experience of Participant #07 is with an airline that has limited capability. Some of the participants worked for airlines with greater capabilities, but the feedback from them was consistent. Before scheduling the service bulletin or airworthiness directive the responsible individual or team would confirm the airline had the needed capability. Confirming the capability available is a review process internal to the airline. The needed capability is communicated through the service bulletin. Additional airline-initiated touchpoints are based on a need to clarify the required capability. The participants indicated they engaged directly with the assigned field service representative to clarify the required capability.

Based on the outcome of the internal airline capability review, there may be a gap in capability that would require the responsible person at the airline to engage with the aircraft engine OEM for support to acquire need parts, tools, or training. The participants’ feedback is presented on this engagement is now presented.

*Procurement of required materials.* In aviation the terms “part,” “expendable,” and “consumable” refer to different types of material. A part is an item that can be repaired and if removed can be reinstalled. Expendables and consumables both refer to one-time use materials. Where the term extendable refers to items such as bolts or seals and consumables refers to lubricant of fluids (Mansour, 2011). Service bulletins and airworthiness directives often will require the use of all types of materials.

As Participant #05 pointed out, acquiring the needed material to perform a service bulletin or airworthiness directive can be big challenge especially if there are many airlines trying to acquire the same material.

One of the biggest challenges for airlines in adopting service bulletins is availability of modification parts. Parts to be used for modification are not usually easily available because once a service bulletin is released, operators all over the world need to build it based on the priority of the service bulletin both based on the effect it has on the safety of
operator. All over the world will want the parts to be available for them, they want to modify the affected engines as urgently as possible so that honestly, creates problems. Sometimes, you want to modify your engine and parts may not be easily available. (P05)

For urgent service bulletins and airworthiness directives with short compliance deadlines, the demand for material might exceed the available supply. If this happens, delivery of the material may be delayed to the airline, and the needed material will not be available during the scheduled maintenance time. The airline can either adjust the maintenance schedule to accommodate the late arriving part or they can engage the OEM to ensure the needed material is allocated in order to meet their maintenance schedule. Participant #04 indicated that their company reaches out to the OEM, through the field service representative, in order to request support in getting needed material. “We go through the rep and then we say, okay, can you help us only getting this part? Okay, because we are facing this problem” (P04).

Participant #05 also stated the preferred method to engage the aircraft engine OEM for support on material requests is through the assigned field support representative. Participant #05 stated that even though it is not the field support representative who will allocate the part, there is confidence the field support representative will notify the correct people or teams within the OEM organization and will be able to put the request in the right context in order to attract the needed attention within the OEM organization.

Usually, the best way is to use a one-point contact. Then, that contact OEM representative assigned, if you need to negotiate or send for some information, or contact for further information, they will create a contact for you. They will initiate a contact then after that, you can go ahead with research. That's usually the best way to do it, has been and we always do it this way. It has been and it still is using the OEM representatives at site. (P05)

Sometimes, despite the best efforts of the field support representative, the request of the airline cannot be fulfilled. If this happens, the airline team responsible for completing the service bulletin or airworthiness directive will inform senior leadership at the airline. The airline senior
leadership will then engage directly with the aircraft engine OEM senior leadership to impress
the importance of their request and ask for resolution. Participant #05 described how the airline
escalates matters internally and directly engages with senior leadership at the aircraft engine
OEM.

But sometimes because, like I said, all the operators around the world want to comply
with the required modification or instruction at the same time, the OEM will decide and
will prioritize some operators, the big operators or the more demanding operators or the
financially stronger operators. When this happens, when you feel like you have been
given less priority, what we do is, we escalate to our higher management and our higher
management will escalate it to higher management of the OEM. They will ask why we
are given less priority than other operators and they will ask to be given a better
treatment, a better priority. (P05)

Procurement of required tooling. Just as airlines need to have access to required material
to complete service bulletins and airworthiness directives, often specialized tooling is also
required. The aircraft engine OEM generally does not manufacture or selling the tooling, but
often the engine OEM has the technical drawings for the tooling. The responsible team or
individual at the airline will reach out to the aircraft engine OEM for access to these drawings.
The airline can then contract with a local manufacturer to make the tooling or the airline can
build the tooling on their own.

To request the technical drawing, Participant #07 stated they first approach the field
support representative or to the customer support manager through email. This is consistent with
the responses from other participants. “I sent a mail, an email through fleet support engineer or
customer support manager” (P14).

Participant #12 highlighted that another strategy used by the airline to acquire needed
tooling is to engage the field service representative and ask them to use their network of
connections with other airlines to check on availability of tooling at other airlines. If the tool is
available, the two airlines can work out lease arrangement. Contacting the field service
representative is a touchpoint previously noted in this chapter. Airlines using the broad network
of field service representatives to facilitate inter-airline communication is very common.
However, this was the only mention of this during the 14 interviews. “Sometimes the local rep
. . . they go to [another airline]. He can contact the local rep there, they have already easy to
contact there and they ask [for support]. [sic]” (P12).

**Procurement of required training.** If the tasks in the service bulletin or airworthiness
directive require the technicians performing the task to have specialized training to perform the
task, then the responsibility party at airline would need to make arrangements to have the
technicians trained. The training could require the technicians to travel to the OEM’s facility for
training or the OEM may send instructors to the airline facility.

If training is required, the responsible person at the airline will first reach out to the OEM
to understanding the availability of the training, location of the training, and timing of the
training. Participant #05 discussed this process and identified that, at their airline, the closest
training facility is preferred.

The usual way of communication we communicate to the OEMs is, we ask for available
slots, how many people we can send and when they can get the certification. When the
tools will be available, then based on that complication, we get our paper from our bosses
and send the technicians and they go to, possibly, the most nearby place, and they take
that training. (P05)

Participant #11 specified to arrange training they reach out to the customer support
manager. Many of the other participants indicated the reach out to the field service
representative. Both of these airline-initiate touchpoints have been described earlier in this
chapter.

Regarding training, we contact the [customer support manager]. Like in our case we
contacted the regional customer support manager and a we ask them approach training
and then they find a way to engage the OEM training school. The training slots are
booked, the airline makes the payment, and we then we attend the training. (P11)
If an airline completes the review of internal capability and identifies gaps in the capability, they may work to develop the capability. If the senior leadership of the airline decides that developing capability is not in the best interest of the airline than the responsible individuals or teams would contract with the aircraft engine OEM or other maintenance service provider to complete the service bulletin or airworthiness directive.

**Review of current services agreements.** Airlines often contract with the aircraft engine OEM, or other maintenance, repair, and overhaul facilities, for engine maintenance. Long-term and exclusive contracts are entered as cost reduction strategy. If the airline has decided they want to outsource the work, instead of building capability, the current maintenance contracts are reviewed to confirm if the airline has a service agreement with any maintenance service provider to perform the work. Participant #07 describes how their first response is to ask the respective aircraft engine OEM for support, but also mentions that they have a contract with specific MRO service manufacturer. “If fact, most of the case, we ask [the respective aircraft engine OEM]. We also have got [sic] a contract with [specific maintenance service provider] and they are able to assist us onsite” (P07).

This contract with the maintenance service provider gives the participant an additional option to consider if the work cannot be completed by airline technicians.

**Contracting work to the OEM.** If there are existing service agreements with the aircraft engine OEM, or if there are no service agreements, the airline can work with the OEM to provide maintenance services. Participant #08 mentioned an occasion at their airline when the senior leadership decided to outsource the work to the OEM rather than develop the capability. “On one of our fleet, yes, we actually had such a scenario where we had to develop capability and we did not go pick that option. So, we opted to outsource [to the OEM’s technicians]” (P08).
If the airline decides to outsource the work to OEM technicians, the responsibility parties at the airline will reach out to the assigned field service representative to help arrange the aircraft engine OEM technicians to perform the work. Participant #04 stated during their interview that they deal with the assigned field service representative. This was a common response from all participants. “We have been dealing with the rep. Through the rep is fast, is more effective with the rep. We tell him and then he look [sic] for help from the [OEM technician team]” (P04).

*Create a compliance schedule.* For service bulletins and airworthiness directives completed on engines still installed on aircraft, the maintenance planning team at the airline must plan to remove the aircraft from commercial operations. The planner will request for the aircraft to be provided ground time based on the respective deadline and time needed to perform the task. Participant #10 highlighted the primary concern of both the maintenance planning and commercial planning teams are the impact to the commercial schedule. “I have to check how it’s going to affect our flying schedule” (P10).

As Participant #06 pointed out, finding available ground time to perform the maintenance tasks specified in the service bulleting or airworthiness directive. “A challenge would be to have available aircraft ground time” (P06).

The aircraft engine OEM cannot change the compliance deadline for an airworthiness directive. However, if the timing of the service bulletin will cause a disruption to the commercial schedule the airline will approach the aircraft engine OEM to for additional time to perform the service bulletin. “If you need an extension on an [service bulletin], it has to come from OEM” (P10).
Feedback from the interviews also confirm that prioritization of specific engines is also very valuable for the technical teams and maintenance planning teams at the airline. This information allows for a schedule to be created that reduces exposure to hazardous conditions that can result in operational disruption more rapidly. Information on engine prioritization is often included in the service bulletin or airworthiness directive. However, the responsible person at the airline will still engage with the OEM to ensure the recommendations are fully understood and being properly followed. The need for engagement with the OEM on this topic was highlighted by Participant #12.

Maybe with this problem comes at before, we have according the performance of the engine, the OEM send a report, a report to tell us the priority of the maintenance of the SB on the engines. Maybe in some cases, the performance of the engine will affect which engine will perform the first. (P12)

The feedback from the interviews indicated that the OEM engagement was accomplished by contacting the assigned field service representative. The field service representative would review the compliance schedule with the airline technical and planning teams to ensure the high priority engines were completed first.

The need for material to complete service bulletins and airworthiness directives was discussed earlier in this chapter, along with the challenge that is often present in acquiring the required material. Feedback from the interviews highlight that the technical and planning teams communicate with the assigned field service representative to coordinate the allocation of required material with the project maintenance schedule for the affected engines.

In the section on service bulletin and airworthiness directive assessment, the airline planning team may find it needs additional time to complete the service bulletin. Based on feedback from the interviews, in this type of situation, someone from the planning or technical teams at the airline will contact the assigned field support engineer to request an extension of the
service bulletin deadline. This does not apply to airworthiness directives as the deadline is enforced by the appropriate regulatory body and not the aircraft engine OEM.

**Service bulletin and airworthiness directive execution.** The final phase in the process for adopting service bulletins and complying with airworthiness directives, after the airline has been notified, performed an assessment, and completed preparations, is to actually perform the tasks defined in the service bulletin or airworthiness directive. The completion of the step is dependent on the schedule developed for completion of the service bulletin or airworthiness directive. The feedback from the 14 interviews highlighted the significant need for OEM engagement during this final phase of the process.

**Adjusting to schedule changes.** While planning for completion of a service bulletin or airworthiness directive, the airline technical and planning teams also must manage the scheduled maintenance on the airline fleet of aircraft and engines as well as deal with unplanned maintenance. Unplanned maintenance can disrupt both the airline’s maintenance and commercial operations resulting in a need to reschedule the service bulletin or airworthiness directive. Likewise, if there is a change in the availability of material, tooling, or human resources, the airline will need to know immediately so the maintenance schedule can accommodate the change. Participant #04 pointed out that as soon as materials or other requirements are available the airline will plan to complete the service bulletin or airworthiness directive.

No sooner than the parts are with us, we incorporate the [service bulletin]. Rapidly. We don't need to wait for reaching the deadline, I mean. Yes. We don't need to wait for this deadline. No sooner we have order materials with us, we accomplish the service bulletin. (P04)

Although Participant #04 did not specify the point of contact with the OEM organization, the general feedback from the interviews was that this type of engagement would be with the assigned field service representative.
Providing feedback to the OEM. When a service bulletin or airworthiness is completed on a specific engine, the airline will make sure to inform the respective OEM as mentioned by Participant #04. “We inform the manufacturer that we have accomplished the serviceability. [The assigned field service representative] is first to know about that accomplishment” (P04).

Participant #04 went on to describe that this information is shared primarily with the assigned field service representative who then shares the information within the OEM organization. This response was consistent with the general feedback from the other participants that the completion of service bulletin adoption and airworthiness directive compliance is done primarily thought the field service representative.

OEM follow-up. For particularly urgent or otherwise high priority service bulletins or airworthiness directives, the respective aircraft engine OEM will proactively follow up with the airline to understand the progress on completing the service bulletin or airworthiness directive. This point was highlighted by Participant #08.

The OEM is always keen to understand on a routine basis our accomplishment status. So be it's weekly, biweekly or monthly, they are interested in knowing how far we are with accomplishment of the airworthiness directive compared to the service bulletin. (P08)

This OEM-initiated engagement is, based on general interview feedback, initiated by the assigned field service representative and directed to the airline technical teams.

Requesting clarification on findings. When the airline performs the service bulletin or airworthiness directive they may need to engage with the OEM for clarification if there is conflicting guidance in the service bulletin and airworthiness directive. Recall that a service bulletin is a recommendation issued by the respective OEM. An airworthiness directive may be based on an existing service bulletin but may have small conflicts. As described by Participant #05, if this happens the airlines will immediately engage with the OEM and ask the OEM to clarify with the appropriate regulatory body.
One of the common problems with airworthiness directives related to a certain operative inspection is the disposition of inspection results. Some airworthiness directives will have the same requirements as service bulletins. If the service bulletins or the particular aircraft maintenance manual or the engine shop manual limitation tells you to accept a certain kind of finding with a certain limit, some airworthiness directive will directly just go for that. But some errors airworthiness directives put on their own disposition on certain type of findings. When that happens, sometimes there is a conflict of interest, a problem is defining what actually should be the decision based on the findings we have. (P05)

Although not specified in this response, previous responses from Participant #05 suggest they would raise the request directly with the assigned field support representative. Participant #05 went on to advise that sometimes when completing a service bulletin or airworthiness directive there can be additional findings not addressed in the service bulletin or airworthiness directive. If this happens, the technician performing the task will need clear guidance on how to proceed. The technician will report the issue, which will be escalated to the responsible person on the technical team. The assigned field service representative will then be notified directly and asked to provide clarification.

Sometimes the particular airworthiness directives will give you some disposition for some findings but when you do that inspection you will other findings which are directly mentioned in the airworthiness directive or in the service bulletin. Then that will lead you to wait for disposition to be advised usually the OEM because regulatory bodies do not have as many contact points as OEMs. (P05)

**Managing vendor repairs.** Some service bulletins and airworthiness directives require a specific part to be removed from the engine and shipped to a repair facility to have the specific maintenance task completed. To support airline operations, the respective OEM will offer a single unit to be used to allow the engine to operate when the removed part is at the repair facility. Once the repaired unit is returned the airline, it will be used to replace and affected unit on another engine. With this type of rotable program, the airline must manage the repair time to ensure the repair part will be returned based on the maintenance schedule of the next engine to
have the part replaced. Participant #14 identified that the airline will engage directly with the
OEM and ensure the OEM manages the operations at their facility.

   We make a plan with the OEM. And based on the turn-around-time of the component and
the how many components we have at—how components affected I have—we do a plan. Through
this plan, we do a plan and agree and mutually agreed with the OEM. And all, we start to
implement this plan on our fleet [sic]. (P14)

Although the point of engagement within the OEM organization is not specified, previous
responses from Participant #14 suggest the primary point of contact would be the assigned field
service representative.

   Alternate method of compliance. When a regulatory body issues an airworthiness
directive, the maintenance burden may significantly affect their commercial schedule or create
an unmanageable maintenance burden. In this case the OEM may provide instructions to the
regulatory body for approval for an alternate method of compliance with the airworthiness
directive. The alternate method of compliance often relies on the use of operational data or
inspection data to monitor the underlying condition. The alternate method of compliance is often
used to manage the cost and maintenance burden associated with the primary method of
airworthiness directive compliance.

   If we have an [alternate method of compliance] related to the service bulletin after we
inspect, we perform a postponed inspection. We provide this data to the OEM. If they
have any recommendation, we follow their recommendation. So, after performing the
borescope [an instrument for conducting a visual inspection through a small aperture],
we're done with [alternate method of compliance] recommendation, we provide this data
to the OEM. (P14)

   During the assessment of the service bulletin and airworthiness process, the airline
reviews the technical aspects of the service bulletin or airworthiness directive. During this
technical review the airline professionals advised, they initiate engagement with the respective
engine OEM to determine the engines in their fleet that are affected, the condition being
addressed, the deadline for accomplishing the recommendations, and the maintenance burden
associated with the recommended maintenance task. This information is typically included in the text of the service bulletin, but when it is not clear the interviews show that the airline professional’s first point of contact is the assigned field service representative. Often the clarification that is requested, is communicated as explicit data. For example, a service bulletin might state the time required to perform the recommended task. This time will not include the time to perform the additional tasks required to gain access to the subject part. The airline may ask the field service engineer what the OEM’s experience with performing all tasks is, and how much time should they schedule to perform the service bulletin or airworthiness directive.

This section reviewed the process for adoption of service bulletins and compliance with airworthiness directives. The OEM touchpoints identified by the interview participants were presented based on the phase of the process they occurred, the organization that initiated the touchpoint, the type of communication, and the type of knowledge shared within the touchpoint.

**Touchpoints Leading to Successful Performance of Maintenance and Inspection Tasks**

Aircraft engine OEMs, like all OEMs, provide documented instruction and guidance on how to perform required inspection and maintenance tasks. These instructions are published in regulatory approved manuals, which are provided to the airline. The manual provides detail on all maintenance and inspection tasks that should be carried out on the engine. When performing any type of maintenance task, the technicians executing the tasks are required to complete the task as detailed in the manual. Tasks in the manual can often be challenging to perform.

Tasks not properly performed can affect the operation and performance of the engine, which can lead to increased maintenance cost, operational disruptions, or can impact the safety performance of the engine. To reduce the chance of tasks being performing improperly, aircraft engine OEMs share best practices for completing critical and complex tasks. Best practices are
industry accepted methods or techniques that demonstrates superior results (Bretschiender, Marc-Aurele, & Wu, 2004).

Interview participants were asked to describe their experience working with aircraft engine OEMs to identify and adopt best practices. All 14 participants provided detailed responses. Based on their feedback, and the coding analysis, the process for the adoption of best practices was identified as containing four critical elements. These critical elements, presented in Figure 4.5, include the awareness for the need of a best practices, strategies for engaging the aircraft engine OEM, effective medium for sharing best practices, and strategies for disseminating the information within the airline.

**Figure 4.5. Process for adoption of best practices.**

**Awareness of need for a best practice.** The use of best practice is not required by a regulatory body, nor is there a standard method for aircraft engine OEMs to make airlines aware of their existence. To be open to including a best practice in their operations, the airlines needs to first be aware of the need for a best practice. Feedback from the interview participants identified four primary conditions that highlight the need for a best practice.

**Lack of comfort or experience with the task.** One of the primary conditions that leads to the awareness for the need of a best practice, as reported by the interview participants, was inexperience with performing the task. Lack of familiarity with performing a task can result in uncertainty that the inspection was performed properly. Participant #05 described that the airline does not perform tasks perfectly if the tasks are new to the airline. With developed expertise, the airline becomes more comfortable performing the tasks. “And so, airlines do not a perform
inspections as perfectly as required the first time they do it, they will need some kind of expertise developed through time” (P05).

When there is uncertainty that the maintenance or inspection task was not correctly performed, the responsible person at the airline would reach out to the airline to ensure it was performed correctly. The response from Participant #06 confirmed this. “So normally when we do an inspection we're not used to, and we would contact OEM to make sure we did it correctly” (P06).

Most of the participants indicated their first point of contact within aircraft OEM organization in the assigned field support representative. An airline-initiated touchpoint with the assigned field support engineer is described earlier in this chapter.

**Trend of negative inspection or task outcomes.** Responses from interview participants revealed that a trend of negative outcomes related to the performance of inspection or maintenance tasks can highlight a need for best practice. Participant #05 described their experience on three separate engine types, with three different OEMs. The airline has been performing a specific scheduled maintenance task to remove accumulated moisture from a component call the EEC. Despite having performed the correct maintenance task, the airline reported still receiving maintenance notifications for moisture accumulation in the EEC. The airline recognized that the way they had been performing the moisture removal procedure was not effective, and, so, engaged with the OEM for recommendations, specifically best practices.

Let me tell you three particular cases where this has been extremely efficient. For [three specific aircraft engine OEMs], there has been a new technology where we didn't use to do, there is a moisture removal from EEC. For about the first three, four, five, six months of our operations my airline was not doing this moisture removal correctly. We collected best practice videos from [the three aircraft engine OEMs]. and those best practice videos contained details of how to use the tools, how to [correctly perform the task], the tools correctly removed, the tools correctly store and things like that. After getting that best practice videos of these practices, a number of [maintenance notifications] and alerts
received on all three engine models significantly decreased because the onsite representatives participated in giving the training. (P05)

Based on feedback from the interview participants, the primary point of contact with the airline, as highlighted in Participant #05’s response, is the assigned field service representative. Airline initiated touchpoint with the assigned field support engineer is described earlier in this chapter.

Participant #05 described this experience as having a positive outcome, citing the reduction in maintenance notifications and alerts as proof the best practices were effective. They also specified that their initial and only engagement with the aircraft engine OEM was with the assigned, onsite field service representative. They also described the assigned, onsite field service representative engagement as leading training. This topic is related to engagement strategies and will be discussed further in the section on engagement strategies.

*Feedback from aircraft engine OEM.* Airlines often share details of the maintenance procedure performed or visual media from inspection tasks that have been performed. The aircraft engine OEM review this information, and in many cases can provide feedback on if the task had been properly accomplished. Interview responses confirmed OEM feedback, based on data shared by the airline, often identifies needs for best practices.

Participant #05 described a process of sharing pictures and videos captured during an inspection with the OEM. The assigned field service representative reviews these data, and confers with their technical team if needed, and provides feedback to the airline if they observe the inspection was performed incorrectly or if the assessment of the inspection data is consistent with how the aircraft engine OEM assesses data.

And in addition to that, for some particular inspections, which are not very easy to understand, the OEMs representatives will receive the videos, the pictures and review the findings our inspectors have done. And they will look at it, evaluate it, and they will get it evaluated by their expert engineering team and they will comment on it. (P05)
Feedback from the aircraft engine OEM, in this situation, is dependent on the airline first sharing data with the OEM. Some interview participants stated their airline proactive provides inspection data to the OEM, while other participants stated inspection data is shared only if there is a need for feedback from the OEM. Other participants stated their airlines do not share data with the OEM. While feedback on shared data was reported as helping to identify need for best practices, it applies only to those airlines that share inspection and maintenance task data with the OEM.

Based on feedback from the interview participants, the primary point of contact with the airline for this type of feedback is the assigned field service representative. Airline initiated touchpoint with the assigned field support engineer is described earlier in this chapter.

**Written instruction is not clear.** The final condition that leads airlines to be aware there is a need for a best practice, as reported by the interview participants, is when the written instructions in the manual are not clear. Participant #12 described that if the written procedure is not clear than they will reach out to the OEM for clarity. “But in this case if the finding is clear compared to the manual, there's no problem we'll follow the manual. If it is not clear for us, we'll send the case to the OEM” (P12).

Other participants also indicated they would reach out to the aircraft engine OEM if the instructions in the manual were clear but difficult to follow. Airline initiated touchpoint with the assigned field support engineer is described earlier in this chapter.

**Engagement strategies.** Once the need for a best practice is confirmed, multiple strategies were identified by interview participants, for engaging both within the airline organization and with the OEM to learn best practices for correctly and effectively performing inspection and maintenance tasks. Feedback from the interviews suggest that airline
professionals first reach out within their airline organization to understand if the needed information can be acquired without the need of reaching out of their organization. The interview participants suggested that a review of the current manuals and previous training material is completed before reaching out to the OEM.

**Airline review of the engine manual.** Airline professionals reported referring to the appropriate manual clarifies the details of a maintenance task. Participant #02 discussed how they find the aircraft maintenance manual helpful. “Sometimes we go to the aircraft maintenance manual and it helps us” (P02).

**Airline reviews internally.** The interview participants indicated that before contacting the aircraft engine OEM the relevant members of the airline organization will review the issue. Participant #07 stated that by reviewing internally, they can often address the issue without the need to contact the OEM. “Okay, in that case we will contact, I will contact because the mechanic will come and see our office, so they will explain what happened, so maybe sometimes I can give an answer without contacting [the OEM], for example” (P07).

**Airline reviews material from previous training.** Aircraft engine OEMs provide training to those airlines that operate and maintain their products. Through these trainings the airline participants are provided training materials. Interview participants, particularly those that had attended OEM training, advised that before contacting the respective OEM they would review the relevant training material.

I personally went to the U.S. [for OEM provided] training. I know [from this training] that [this OEM] has a channel on YouTube, where you access information on LPT change and other tasks. If there's something that you need help on, you can go to the channel. There are some additional things you can do on the [OEM] website. (P03)

**Airline searches the OEM website.** Aircraft engine OEMs, like many OEMs, have portals that individuals at the airline can use to access information and raise queries. Responses
from the interviews confirm that someone airline personnel will review the OEM website for clarification on how to perform specific tasks. Participant #08 described their proactive efforts searching an OEM website. “And then the other item I will talk about is on best practices, usually we get to share, you get to know about best practices in two forms, number one is, my old pro activeness trying to reach out to the website to gather whether there is any new industry information” (P08).

Review of the OEM website is initiated by the airline. The explicit knowledge is shared using non-reciprocal communication if the airline only uses data posted to the website. However, the individual raises an inquiry the communication would be classified as partially-reciprocal.

**Escalation within the airline.** Many of the interview participants’ responses confirmed that they directly contact the OEM for support, sometimes after exploring other resources. However, Participant #03 stated that contacting the aircraft engine OEM was not within the scope of their position and that issues requiring engagement with the OEM were escalated to their direct manager. “As a maintenance supervisor, every problem that I've got, I will escalate it to my manager. So, my manager is the one who deals with the OEM” (P03).

This response was interesting given that all other interview participants indicated they were empowered to discuss these matters directly with OEMs, and in this case contact with the OEM has to be escalated beyond the maintenance supervisor.

**Continuous proactive engagement with OEM.** Feedback from the interviews confirmed that continuous practice sharing of best practice knowledge was a critical engagement between the airline and the aircraft engine OEM. Responses from the participants indicated there are two primary forms for continues proactive sharing: OEM-hosted conferences with the airlines and the day-to-day engagement with the assigned field service representative.
Aircraft engine OEMs typically host conferences that operators of their products can attend with the goal of building relationships and learning more about the product. The frequency, format, and content of these meetings can vary between the aircraft engine OEMs. Feedback from the interviews was consistent that airlines see these meetings as opportunities to learn more about the product they are operating, including associated best practices. “If there are best practices, we normally find out about this during the monthly calls with the fleet team” (P08). These meetings, commonly called “all operators meetings,” are initiated by the respective OEM. Given that typically a large number of airlines join the call, there is very little opportunity for reciprocal communication. As such, explicit knowledge is communicated using a non-reciprocal approach. These calls are use a teleconference service that allows screen sharing.

Another form of proactive sharing discussed during the interviews was based on continuous and on-going engagement with the assigned field support representative from the respective OEM. During this engagement field service representatives begin to develop an understanding of the challenges and needs at the airline. They can then review internally, within the OEM organization, for information to support the airline. Participant #08 described their experiences with the day-to-day engagement with the assigned field support representative.

And number two, we get them shared to us by the field rep. However, on the second point this is already done on reactive phase, on the sense that whenever we have an event that has happened then we are trying to trouble shoot, that's when, say the rep would stumble upon some best practice. Of course, both of us will be the looking here, there and everywhere to see if there is any information that is relevant. Then for the time that we realize, oh there is some best practice that we've been shared and that's when we get to share that with our team and make them aware of this. And so, I think there is a significant gap there because had we been doing this for a routine then we'd be able to identify the opportunity earlier and to continuously share the best practices. (P08)

The day-to-day engagement between the assigned field service representative and airline is defined earlier in Chapter IV.
**Request training or support from OEM.** If a sufficient number of airline personnel lack basic familiarity with or understanding of a specific task, or if the specific task is especially critical, that the airline and the aircraft engine OEM may work together to provide formal training. The formal training would also include a review of any relevant best practices. Participant #08 recalled their experience engaging the aircraft OEM for formal training, in this specific case the request was for borescope inspection training.

We request for a training to be performed to our team. Especially specific training would be on borescope inspection. An inspection task like inspection, so if there's a significant gap that we've noted from our field then we engage with the OEM to see if they can come down and train our staff, make them aware of what to look out for and the important steps in the project. (P08)

After the OEM has been contacted and the need for training has been communicated, the OEM and the airline will work together to determine the most convenient timing and location of the training. The training is often offered at the respective aircraft engine OEM facility but can also be arranged onsite with the subject airline or even a third-party facility if both the OEM and airline agree. Participant #14 highlighted this point during their interview. “We have two options; send our team outside to have this training or ask the OEM to train our own support team to do this task in [the airline’s home country] and do a training for our maintenance team to perform this task after that by themselves” (P14).

Participant #14 also pointed out that airlines may also request the OEM to train their training team. This will allow the airline to provide future training without the need to engage the OEM.

Although not specifically mentioned in the responses, the participants would likely approach the assigned field service representative based on their responses throughout the interview. The airline-initiated engagement with the OEM was described and categorized earlier in Chapter IV.
**Sharing inspection and operational data with the OEM.** One strategy the interview participants advised that they use to engaged aircraft engine OEMs is sharing inspection data with the OEM. Some indicated that they provided inspection data to the OEM proactively, and others said they only provided inspection data when they felt the inspection or maintenance task was not correctly performed or there was an unexpected result. The expectation of the airlines, as described by Participant #05, is that the OEM will review the data and provide feedback confirming the procedure was performed properly.

They will get it evaluated by their expert engineering team and they will comment on it, they will tell us that we have taken these pictures from these angles and taking these pictures from this angles will not give you the correct view of the inspection so you will not be able to define or to give disposition correctly. (P05)

Participant #05 touched on two aspects of the inspection task the airline expects feedback on. First, they mention if the images are taken from the proper angles. This relates to whether the procedure was followed properly. Participant #05 then mentions if the airline correctly dispositions the findings. Incorrect disposition of a remark can affects the operation of the engine. For this reason, the airline needs input from the OEM to ensure they are correctly identifying, assessing, and acting upon remarks.

The primary means for engaging with the OEM for clarity on performing maintenance tasks and inspection tasks, as well as proper disposition of inspection remarks is through the assigned field service representative.

**Airline avoids engaging the OEM.** The responses were overwhelming positive regarding engagement with the aircraft engine OEM in order to access best practices and get general feedback. Airline professionals reported they actively sought our aircraft engine OEM when they felt maintenance and inspection tasks were not performed properly. However, Participant #13
advised that if a “silly mistake” were made or if the task was rushed, potentially resulting in the task not being completed properly, they would not engage with the OEM.

If the staff is making maybe silly mistakes or mistake because of a time or something like that. Uh, of course in this case, I will not communicate with the OEM. But I can highlight this to the hanger manager or the observing engineer. I will try to make this unofficial. (P13)

When asked to further explain why they wouldn’t engage the OEM if they felt the tasks were not being performed properly, Participant #13 responded that if the OEM knows the procedures are performed improperly there may be commercial repercussions. This feedback highlights the significance of trust between the individuals in the airline and the OEM.

**Mediums for sharing best practices.** Responses from the interview participants revealed three mediums for sharing best practices. These are verbal instruction—given by the assigned field support representative that is typical onsite—written instruction, and video instruction.

*Verbal instruction* Verbal instruction is provided via the assigned field service representative, who is typically onsite with the airline. Best practices provided verbally are provided reactively when the respective field service representative identifies a procedure step or inspection assessment performed incorrectly. Participant #05 described verbal feedback received from the field service representative and confirmed that this feedback is very helpful in avoid future challenges.

[The OEM] defines it and they tell us this is what you did and this is where you got it wrong, from now on you have to do it this way, the limits should be defined like this, you say this is cracked but this is not cracked, you say this is a scratch but you have missed the crack at this point, you have to look at the root or the tip or at the front, so you have to start doing this. I can tell you that our powerplant inspection department has used best practice recommendations for the past three, four years and it does help us a lot. We have avoided so many problems because of that. (P05)

The feedback provided by the interview participants, including Participant #05 assumes proactive engagement, either initiated by the OEM or the airline. In the example provided by
Participant #05, the feedback was based on shared data, in this case images taken during the inspection of an engine.

**Written instruction.** Many of the participants responded that best practices and other similar guidance are effectively provided in written form. Written instructions for performing best practices often include images to supplement text. Using text and images OEMs can provide explanation on how to perform challenging or critical tasks. Participant #10 explained how they had previously received best practice recommendations in written form from an OEM to perform a particularly challenging inspection.

So, they sent us a procedure for that, and they sent us as to exactly how to open it of which we identified tools that we had actually had. And they sent us step-by-step processes and we opened it, then we just used the borescope machine, we took some pictures. (P10)

The ability of the any type of written instruction to be effective is based on the clarity of the written instruction. Clarity can be increased by using a visual aid in the written document. Written documents are often not created based on an individual airline request, but rather the OEM creates the document based on a wide spread need. Written documents, even those containing visual aids, are non-reciprocal forms of communication that transfer explicit knowledge. The written instruction is primarily an OEM initiated engagement, but in some circumstances could also be initiated by the airline through requesting for a best practice.

**Video instruction.** The final medium for communicating best practices as reported during the interviews, was instructional video. The uses of an instructional video were identified as the most effective way to communicate best practices and other types of guidance. Participant #05 highlighted that use of instructional videos are very efficient.
Often best practices would be categorized as tacit knowledge. Tacit knowledge is difficult to communicate using verbal or written mediums as the nature of tacit knowledge means it is difficult, as best, to codify the information.

Another interesting point raised during the interviews, highlighted in the response from Participant #09, is that information communicated through video is retained longer by the individuals watching the video than information communicated otherwise. This is consistent with the common saying attributed to the Chinese philosopher Confucius, “I hear, and I forget. I see, and I remember. I do, and I understand.” This is an important point to consider when developing a strategy to disseminate the best practice information within the airline organization. “But the thing you watch on video whether you ever come up having to do it in real life or not it sticks with you because you're going to sit there and see the equipment” (P09).

**Strategies for sharing within airline.** The engagement between the airline and aircraft engine OEM is typically limited to a few key positions within the airline. This is to ensure information and recommendations communicated from the OEM flow through the correct channels within the airline organization. Once the OEM shares best practice and similar types of recommendations are with the airline, it is the responsibility of the airline to make sure this information is disseminated correctly. The OEM also has an interest in the ensuring the information is disseminated and actioned accordingly. For this reason, the interview participants were asked how this information is communicated within their organization. They were also asked if they could provide recommendations for improving how this information is communicated internally at the airlines. Their responses are categorized as formal strategies and information strategies.
**Formal engagement.** Most of the responses from the interview participants described formal steps the airline can take to facilitate the communication and adoption of best practices. The reason for this is because best practices are not strictly a regulatory requirement. As Participant #07 pointed out, there little to no organizational support to communicate best practices or follow up to ensure they are actioned.

But I don't know how to explain, sorry, you know this is the mechanical engineer responsibility, not responsibility, but . . . because the engineer, if he doesn’t want to check on the IT system or there is no new video . . . nobody [from the airline organization] will take care of us. (P07)

Based on interview feedback, formal communication of availability or release of a best practice is the first step in formalizing the process of best practice communication and adoption. Once the existence of the best practice has been formally communicated it will gain leadership visibility. “Because if we think it's very important, it's a major issue, we will use a technical notice” (P07).

Interview participants indicated that requiring the airline senior leadership and middle management to formally acknowledge their awareness of best practices and order a directive for them to be adopted is critical for those recommendations to actually be adopted. “It means that each mechanic or engineer will receive a technical notice, and must acknowledge the receipt of these documents, it is very important” (P07).

To support formal training requirements, the assigned field service representative can participate in these training sessions. Feedback from the participants indicated engagement of the field support representative was critical to the thorough understanding of best practices and other similar recommendations. Participant #04 detailed the effectiveness of the field service representative’s role in participating and leading training with the airline.

[The assigned field OEM service representative] did this job here with us. Has given us the training, took us to the shop engine, he gave us the training, and we do have four...
more technicians doing [correct] borescope inspections on the contrary to last year. We just had two inspectors doing this. Now we already have six people doing it. Two inspectors and four mechanic. And this whole job thanks to the [assigned field OEM service representative]. (P04)

Formal training can be reinforced by requiring individuals that will be performing the task to review the video again shortly before performing the task. Interview participants believe that completing a refresher review shortly before performing the task will ensure the best practice is properly adopted. “If he will perform this task, first time to perform this task, he should take . . . see the video before performing this task” (P14).

Many of the participants indicated that currently their training departments are not sufficiently staffed to support additional training on best practices. Also, the frequency at which training is presently provided is not able to accommodate best practices that are released. These points were clearly described by Participant #07:

Unfortunately, we are a smaller company. So, we have just one guy who in charge to the training for technical people, and this guy will either edit technical notice according to what you send to use, or maybe during the next training, he will take time to explain the best practice. So, this is the way we try to use, but, you know, it's not easy to do . . . because there is only few training, and all training happens only every two years for engineers, so the best will be to organize, maybe, every six months, to organize dedicated training for these guys for information, but engineer or mechanics are not available as we like. (P07)

Participant #07 described how their airline training team consists of a single person. This person is responsible for training on multiple engine types. Keeping up with updated training information on multiple products is challenging for a limited staff. Participant #07 also discussed how the current training frequency only offers courses every six months. This presents a challenge as best practices release is not coordinated with the airlines training schedule.

**Informal engagement.** Interview participants discussed the current methods used. Since there is no formal organizational or leadership support to facilitate the adoption of best practices the methods used by the interview participants is categorized as informal. These approaches
include influencing team leaders and managers to include the best practice in their team’s work, playing instructional videos where technicians take breaks, and ensuring open access to best practice instructional videos.

Participant #13 described their approach of influencing the team leader, or manager, based on the merit of the best practice. This can be an effective approach if the team leader is open to performing the task and the team has time to include the work. However, without the support of the senior leadership to make adoption of best practices a formal requirement, simply influencing team leaders and managers will have limited success. “I send it to the concerned manager and the responsible engineers, which most of them are my colleagues, and I will communicate with them the importance of watching this video and how it will help to perform as task and address the problem” (P13).

Another informal method for communicating and facilitating the adoption of best practices was to play instructional videos provided by the OEM in the technician breakrooms. This approach attempts to use an effective medium in a location where technicians often visit throughout the day. “And we have been showing to our technician through TV this is something that is always there. When mechanics are having a rest, they start watching this video while they are having lunch or rest” (P04).

This approach may find limited success because when technicians enter the breakroom their primary focus is either on eating their meal or chatting with their friends. In the aviation industry, break times are regulated. Playing instruction videos, with the expectation that the technicians will watch them, may not be allowed by some airline human resource policies. So, while this may seem like a promising approach, the effectiveness is limited and may not be allowed by airline policy.
Feedback from the interviews identified that ensuring open access to best practice instructional videos was a critical factor in facilitating informal use of the best practice recommendations. Interview participants advised that best practice videos stored on internal servers at the airline, or on the OEM’s website, often require password and approvals to access. This is an added barrier to accessing this important information and can dissuade people from trying to access these data. Participant #09 suggested that available the instruction videos on a social media site like YouTube is a preferred method. “[Accessing video from some OEMs is difficult] based on that password issue, I think if they made it more simple like the way [one OEM] uses YouTube” (P09).

Making such information available on YouTube or other social media platforms allows for public access, is great for technicians who want to view the video. However, the aircraft engine OEM must determine it is comfortable and permitted to share this type of information publicly.

**Critical Elements of OEM-Airline Engagement**

In the interviews, participants were asked about OEM engagement during the processes of service bulletin adoption and airworthiness directive compliance. Feedback from this portion of the interview was used to identify and analyze OEM touchpoints that occurred during this four-phase process. Then participants provided feedback on the important OEM touchpoints used to identify the need for best practice sharing and OEM touchpoints used to facilitate this transfer of knowledge, both from OEM to airline and within the airline.

The final topic discussed with the interview participants focused on better understanding what facilitates engagement between the airline and OEM. Participants were asked to discuss the characteristics of engagement they felt were effective, efficient, and through. Through the data
analysis process the participant responses fell into three categories. These categories were the engagement strategies used by the OEM, the engagement topics, and engagement facilitators.

**Engagement strategies.** The first category that emerged from the interview data was the engagement strategy used by the aircraft engine OEM to engage the airline. The interview feedback identified two fundamental approaches to airline engagement. The first strategy includes at least one assigned individual, specifically a field service representative, to support the airline. The assigned support individuals could be co-located with the airline or could support the airline from a remote location. With this strategy, the airline has at least one person they can contact for any issue and the OEM has at least one dedicated person to engage the airline. In the second strategy, the OEM takes a more passive stance to airline engagement. Using this approach, the OEM provides airline personnel access to a web portal where important information can be accessed and questions, both technical and commercial, can be submitted. Feedback on both strategies is presented.

**Assigned field service representative.** Interview participants provided feedback on an OEM engagement model that utilizes an assigned field service representative. Many of the critical elements of this model were identified regardless if the field service representative is located onsite with the airline or based at a different location. Those elements are presented as critical elements common to both onsite and offsite field service representative. Some elements applied only to field service representative based onsite or offsite and are presented as such.

There were many elements of the assigned field service representative model, common to both onsite and offsite field service representatives, identified from the interviews. The first element of this support model is that field service representatives provide a confirmed
connection, as stated by Participant #12: “By going to the [field service representative] you feel that, that connection is automatically made” (P12).

Most people have had the experience submitting a question online. Many of those people were left with the uncertainty on whether the question was actually received and how they can follow up if they do not receive feedback. Airline professionals are the same, and since they are often working under pressure, they need for them to have someone, a person, they can follow up with is extremely important to developing confidence in the support model.

Beyond acting as the dedicated contact point, interview participants identified that field service representatives act as all-inclusive support, Participant #05 stated that they do everything. “But when you talk to the [field service representative], they do everything” (P05).

The question then becomes, what is “everything”? Based on additional feedback from the interview participants, field service representatives are perceived as knowing their organization. Those working for the airline trust that the field service representative knows the subject matter experts to contact to answer their question. Likewise, the field service engineer is perceived as having the ability to escalate critical issues to the appropriate leadership to drive a faster or more favorable response.

But when it comes to onsite support of a certain operator, the onsite representative has a better view of who they can go to because they know the hierarchy, and they will contact some of their own ranks, the responsible people in all areas of OEM capability support network and they will try to make the parts. Obviously, airlines do not expect to receive final responses, or they don't expect their own onsite support engineer to know everything, but they want online support engineer. They want that person to know where to go for a particular type of question. (P05)

An interesting point brought up by Participant #12 is that field service representatives assist in arranging alternative support. In the example provided, the participant described how in the field, “Sometimes I get the parts from other operator if it is not available on the OEM. I get this help from the local rep sometimes” (P12). Service representative helped to identify
alternative sources of needed parts. Participant #12 described how their team had placed an order for needed parts with the aircraft engine OEM and were informed the parts were not available. The field service representative then reached out to counterparts at other airlines and determined those airlines had the needed parts. In this case, the field service representative utilized their network of contacts at other airlines to facilitate a solution that the OEM was not able to support.

A critical element of engagement identified by the interview participants is that field service engineers have direct, relevant experience and knowledge that can benefit the airline.

No, if I've got some question with [an] AD, and I used to have a lot of question regarding AD, I contact [a nearby field service representative], so I often send an email with some images to be sure I am well understood at the meaning of the AD. I have got also [support from our maintenance service provider], but for the specific case [this AD], due to the fact that [the maintenance service provider] don't have any aircraft fitted with [these types of engines], I prefer also to contact [the OEM field service representative], because they [have experience with this AD]. (P07)

Participant #07 discussed that their airline had contracted with maintenance service provider to support maintenance on their engines. Instead of engaging with this contracted entity, Participant #07 preferred to reach out to a field service representative they knew because the representative had direct experience. This is despite the fact the specific field service representative was not even assigned to their airline.

Interview participants also identified the field service representative’s knowledge of airline operations and airline culture as a critical element of successful support. Participant #05 stated:

You tell them you have a problem on a certain [aircraft], they know that aircraft had certain maintenance a week ago, the engine was removed months ago or things like that. When you tell them that this engine which was removed at this time has this problem and remember that we have done this and this, we need a certain support, then the onsite engineers will better understand the situation you are in, what you need, if you have a response time or if it is urgent, they will act on it. (P05)
Participant #05 provided further detail on how the field service representative understand the technical and operational history of the engines. This acquired, and often tacit, knowledge enables the representative to more clearly understand technical issues on the engines. This allows the OEM to provide better recommendations to the airline.

Engagements with the field service representatives were described as more efficient than writing emails or submitting requests online. In the fast paced, high pressure environment of airline operations efficient communication becomes critical. Participant #01 highlighted that communication via email and submitting cases can takes hours or even days. But, conversely,

When you are with someone, five seconds, you post a doubt that you have before on some publication, but you question some part of publication and you get a reply on that two seconds and the communication is more efficient when you are face-to-face. (P01)

This efficiency in direct engagement, and a perception of always being available, leads the interview participants to believe that contacting the field service representative is the fastest way to get an answer and resolve a technical issue. “If we are in vacation especially in Saturday or Sunday, I'm afraid that maybe the response for maybe delayed [by sending an email or online request] especially. I think [the field service representative] will help us in this time” (P12).

Interview participants discussed the availability of field service representatives during critical moments and outside of business hours as a critical element of this engagement. Having a strong routine engagement was also identified as a critical element of successful engagement with an aircraft engine OEM field service representative. Both the airline employees use the regular engagement to discuss operational and technical items.

So, we have our routine engagements, for our case it's weekly. So, every week we are discussing items that affect us and during this meeting the agenda is mostly operational items that require industry support and we haven't gotten the support already or any matters that come about during such a sitting. (P08)
They primarily focus on open item and emerging issues. The benefit of these face-to-face engagement initiated by the OEM is that it creates a break in the routine for the airline employees. It forces them to dedicate time to review the technical program for the associated OEM’s product. In doing so, the airline employees can identify discrepancies in their data, open technical items, open requests for support, and identify exposures on their fleet. These items are used to drive the discussion with the field service representative during scheduled engagements.

Beyond the ad-hoc engagements and the scheduled engagements, interview participants identified that informal engagements with the field service representative are a critical to establishing successful engagement with the aircraft engine OEM. Informal engagements occur without being scheduled or without a pressing need. Participant #08 described informal engagements as occurring outside of work hours and in social settings.

Oh, like discussions out of work, phone calls outside work. What I would call formal of course is within the work environment whereas what I would call informal [include] conversations over lunch hour, phone calls, or even meet-ups in social events. I would say is that during this sitting there is a lot of information that can be shared during these sittings. (P08)

Interview participants reported they had different experiences with assigned field service representatives. Some reported the representative was based onsite and others reported the representative was not based onsite. Those respondents that reported engagement with a representative not onsite, identified the single most critical element of their engagement were onsite visits. The value in an onsite visit was identified as disrupting the normal day to day routine of the airline employees. This made the airline employees focus on engine related items and refresh themselves on the technical items. “But I think nothing replaces the fact that a rep comes and visits us” (P07).

Frequent face-to-face engagement, while unanimously preferred, may not be feasible for representatives not based onsite with the airline. Some of the participants highlighted strategies
that field services representatives not based onsite with the airline can take to improve the effectiveness of engagement. “If they must work remotely then they can do better by scheduling frequent calls. Just teleconferences that we can have more frequently as compared to waiting for the monthly face-to-face visit” (P08).

Many of the respondents highlighted that using a facilitating technology, such as Skype, to hold more frequent calls is very helpful. Participant #08 made this point, and even suggested that sharing a presentation is very helpful. Other participants stated that, in addition to maintaining frequent virtual engagements, timely follow-ups to emails and phone calls is critical to facilitating effective engagement. Interview responses from participants who reported engagements with field service representatives based onsite with the airlines, identified that access to airline information, possessing an understanding of that airline operations, and understanding the airline organization are critical to having effective engagement with the airline.

Although frequency of engagement was identified as a critical element of the engagement by representatives not based onsite with the airline, frequency of engagement was not mentioned as a critical element of effective engagement for onsite representatives. In fact, frequent engagement with an onsite representative runs the risk of becoming part of the routine and can actually hinder effective engagement.

Participants who had engaged with representatives not based onsite recognized that these representatives were based onsite at other airlines. They voiced their concern that due to this arrangement the representative may prioritize host airline needs over their needs. Participant #07 summarized: “You can't compare the value of having an onsite support compared to making calls and writing emails” (P11).
The preferred form of aircraft engine OEM engagement, as described by the interview participants, was through dedicated support personnel. Aside from having dedicated personnel to engage the airlines, some interview participants noted that aircraft engine OEMs have websites that can be used to access information and raise inquiries with the OEM. Interview responses relating to the use of OEM websites as a strategy for airline engagement were analyzed. Elements of this method of engagement were identified either as facilitating engagement or hindering engagement.

Use of the OEM website is very much a passive approach to airline engagement as it depends solely on the airline to initiate engagement. The airline employee must get some type of value out of using the website in order for them to continue using it as a primary means of engaging with the OEM. Responses from the interview participants revealed that one of the biggest facilitators of engagement with the portal is that communication on portals is formal and a record is kept. Participant #07 explained that when submitting a request on the website, a tracking number is generated that can be used to check the status of the request. Other elements of using the OEM website to submit inquiries is that the airline can identify the urgency of the request and the individual raising the request can attach relevant documents to the case as well.

Another aspect of the OEM website that participants reported as facilitating engagement, is the ease of navigating the website. This seems logical given that individuals working for airlines in positions that are directly supporting commercial or maintenance operations need to be able find the needed information quickly. They do not have time in their day to meander around the website hoping to find the information. Likewise, participants explained that to use the website they need to be reasonably certain the data they need will be found on the website.
Ease of navigation and certainty that the website has the needed information, are developed over time and over a multitude of occurrences using the OEM website. If individuals have positive experiences with the website, they will be more likely to use the website the next time there is a need to ask a question or access information. If an individual has a poor experience and cannot find what they are looking for or it takes them a great deal of time than they will be less likely to visit the website for needed information.

The final element that facilitates engagement via the OEM website is the airline culture. Participants who indicated they used the OEM website frequently stated that use of the portal was enforced by the airline leadership. This was described by Participant #07. “Yeah, it is obligatory. Every day we open the portal. If the rep is onsite, we use the portal. But if the rep is on vacation, we continue to use the portal. The portal we need to use every day” (P02). Leadership motivation for using the website is due to the fact that the requests and documents are recorded. The leadership also sees requests on the portal as being more formal and thus require their teams to use this method.

However, it should be noted that the same participants who indicated that they use the website for submitted requests also stated they always contact the assigned field service representative when submitting a case. They also indicate that the field service representative will direct them to provide feedback using the website. The field service representative will also identify critical information the airline needs to review and instruct the relevant person at the airline to access the data on the OEM website. This shows that prior engagement with the assigned field service representative is also a facilitator of OEM engagement via their website.

Interview participants were also asked to identified elements of the OEM website that hindered engagement. Responses from interview participants identified a number of elements of
the OEM websites that hinder or dissuade the use of it. The first element identified was that use of the OEM website is very cold and emotionless engagement. Participant #01 described using the OEM website as engaging with a robot. “Sometimes you feel like it's kind of robot is giving you the answer. But what I'm saying is, the way that I feel like, a computer answering me, giving me the solution” (P01). They described the interaction as being uncomfortable because there is no relationship. When asked further what the importance of a relationship is in this transaction, Participant #01 replied that with a relationship you know that the other person cares about the airline and providing the best solution. The cold, emotionless ambiance of engagement using the OEM website, can be a hindrance in other ways. Participant #01 described how they would be uncomfortable raising up “every little question” that popped into their head. They would only submit an inquiry for big issues. A definition of a big issue was not provided but can be understood that if the airline personnel does not fully understand an issue, they also may not fully understand the importance or severity of this issue.

The lack of a relationship was also identified by other interview participants as hindering the process of submitting an inquiry. The OEM website doesn’t have the operational and technical background, knowledge of airline specific issues, or doesn’t understand the current pressure for rapid responses. This puts the added burden on the airline employee to add these complex details to a request. As mentioned previously in this section, airline employees working in positions that support operations have many high priority items competing for their time. When tasks become more complicated, they have less, and less priority placed on them.

An additional and related element that hinders engagement with the OEM using the website, is poor internet connection. While developed countries have high internet speeds, many developing countries have very slow connections in comparison. For example, the United States
offers broadband service to Americans that averages 3.9 Mbps (Foresman, 2010) while many countries in Africa struggle with broadband speeds less than 0.7 Mbps (Kazeem, 2017). Such slow internet speeds impair an airline employee’s ability to use a website. This hindrance is magnified when the website is not easy to navigate or requires large amounts of data to be downloaded. Interview participants reported that disrupted connections, operation time-out errors, and other challenges associated with slow and unreliable internet connections affected their propensity to even attempt to use the website.

A report by the International Telecommunications Union (2013) identified that the number of internet users as a percent of population for all countries. The study showed that the number of users in African countries is by far the lowest when compared to other regions. Most of the countries in Africa were reported as having less than 20% of the population as internet users, and many countries had less than 10% of their population identified as internet users. Although not specifically discussed in the interviews, the poor internet connection combined with the low number of internet users can create a culture where use of the internet is not a primary means for communication and could result in less propensity to use the OEM’s website.

Engagement topics. Interview participants were also asked to describe the topics they discussed with aircraft engine OEMs. Responses from the interviews were categorized as technical topics, commercial topics, or operational topics during the coding of interview data. It should be recalled from Chapter III that participant inclusion in this study was restricted to airline professionals working in positions related to maintenance. These positions are primarily technical positions, although some of the participants did have experience with commercial and operational aspects of the airline. As such, the topic of discussion naturally gravitates towards technical discussions. Some responses did highlight non-technical topics.
**Technical topics.** Interview participants reported that engagement with aircraft engine OEMs included many items related to the technical aspect of the products. These topics were highlighted by Participant #13: “I use the OEM portal, of course for engine condition monitoring for, for submitting inquires, and for the technical presentations, the technical manuals” (P13). Interview responses also revealed that airline professionals also engage with the OEM to receive feedback on maintenance actions that had been accomplished: “Then afterwards we provide feedback of the troubleshooting to the OEM” (P06). This engagement referred to airline professionals asking for additional guidance on troubleshooting or seeking clarification on inspection findings. Airline professionals also stated they engage with the aircraft engine OEM to report that certain maintenance tasks had been completed or to share inspection results the OEM would then use to provide additional operational allowance.

A topic of engagement that was also mentioned by many of the interview participants as being very important is reviewing known and emerging fleet issues. “So, we can improve by being proactively on the lookout for any relevant information and making sure that during the routine meetings that we have, we talk about these emerging issues” (P12).

As aircraft engines are in operation, technical issues arise for which the OEM will develop a repair plan and, in some cases, a containment plan. Fleet issues rarely affect every operator, but the feedback from the interview participants is that airline professionals what to be aware of known fleet issues as well as emerging fleet issues even if their airline is not directly affected.

**Commercial topics.** Although all of the interview participants worked in airline positions that were technical in the nature of the work, a few of the participants did indicate that they engage with aircraft engine OEMs on topics commercial topics. The primary commercial support
topic that interview participants discussed with the aircraft engine OEM related to support
provided to airline to accomplish service bulletins or airworthiness directives.

If the support is clarified and the warranty, as per support in the [service bulletin] please
provide these [substantiating documents]. But in the second case, if the support is not
clarified [in the service bulletin], I had to get some approach with the OEM and make
some negotiations [sic]. (P13)

Service bulletins and airworthiness directives often require the airline to replace one or
more parts on the aircraft engine with new, re-designed parts. Purchasing the specific parts, as
well as additional consumable parts, result in a cost to the airline. The responses from the
interview confirmed that airline professionals engage with OEM to request additional support in
order to minimize the cost of adopting service bulletins and complying with airworthiness
directives.

Operational topics. Interview participants also responded that they engage with aircraft
ingene OEMs to address topics related airline operations, specifically maintenance operations.
Airline professionals often engage with the OEM, through the assigned field service
representative, to align the shipping schedule parts with the planned aircraft maintenance
schedule. This engagement was predominantly used during critical service bulletins or
airworthiness for which there were limited parts available.

Interview participants also provided insight that they engaged with the aircraft engine
OEM to expedite shipment of needed parts, regardless of if the spare parts were needed for to
support the adoption of a service bulletin or airworthiness directive. Participant #12 described
how they reach out to the OEM if a part that has been ordered has an excessively long lead time
which can drive an aircraft on-ground (AOG) situation. “You asked at the beginning if there is
actually any chance to improve this lead time. Otherwise, you will be pushed to ask for the part
on AOG situation” (P12).
An aircraft is AOG when specific maintenance tasks are required to be completed before the engine can be allowed to return to service. If there is a long lead time for acquiring a needed part, the airline may need to remove the affected engine and aircraft from service until the part is available. Removing an aircraft from service will have a significant negative impact on the airline’s financial performance. For this reason, the responsible person at the airline will engage with OEM to find a way to avail in order not to disrupt airline commercial operations.

Another item discussed that falls within the category of operational topics is when parts are sent for repair. Replacement parts or aircraft engines can be very expensive, both for the OEM and the airline. To save cost, the suppliers of these parts have developed approved repair procedures for specific parts. The airline will send the parts to either the aircraft engine OEM or the specific part supplier for repair. It is in the best interest of the airline that the repaired part be returned to the airline as soon as possible. Participant #14 described how they engage with the OEM, through the field service representative, to ensure the airline’s part receives high priority and is returned as soon as possible.

We make a plan with the OEM. And based on the turnaround time of the component and the how many components we have at . . . how component affected I have, we do a plan. Through this plan, we do a plan and agree and mutually agreed with the OEM. And all, we start to implement this plan on our fleet. So, we manage this program with [field service representative]. (P14)

Interview participants also stated that they engage with the OEM if the repair process required time cannot be reduced. In such cases, the interview participants indicated they would request for a part exchange in order their stock of serviceable parts to be replenished as soon as possible.

Engagement facilitators. The final question asked of all interview participants was to describe the characteristics of OEM engagement that they felt facilitated better understanding of the topic being discussed and faster resolution of open issues. Participants identified key
characteristics of the OEM that result in improved engagement. Some participants also identified characteristics of the airline that, in their view, directly influence the effectiveness of OEM engagement.

**Airline characteristics.** Interview participants identified critical characteristics of the airline organization that both facilitate improved engagement as well as characteristics that hinder effective engagement with aircraft engine OEMs. The identified characteristics are directly under the control and influence of the airline leadership.

As new airlines enter service, their leadership and technical teams may be inexperienced and not fully understand the support available to them. In the excitement of starting operations, they may not even be aware that they would need support in the future. Participant #09 highlighted this concerning situation and advised that the aircraft engine OEM needs to take this as a call to action and intensely engage new airlines to ensure they are aware of how to contact the OEM for support.

Yeah, the [OEM] has always been there, but I think they need to radically . . . especially now in Africa [where] aviation is growing . . . they need to radically approach these airlines because at the end of the day it's going to be a win-win situation. The operator wins, you win at the end of the day. Secondly, I'll put it as well, lack of awareness again on the operator side [of available OEM support] because many of them, especially here in Africa, start up these aviation companies not fully aware. Yeah, they might be excited, airline business, but they need, that's why I said radically on the part of the OEM to approach these airlines. (P09)

Interview participants also reported high employee turnover in critical positions made maintaining effective engagement with the aircraft engine OEM challenging. This point was raised by Participant #03, who went on to explain that high employee turnover can result in inexperienced, untrained employees filling in the slots. “Okay because recently, remember, we've got a lot of guys who left us, so we've got a lot of new guys who are not trained” (P03). When this happens the topics of engagement with the OEM will revert to more fundament
discussions, as opposed to advanced, detailed discussions. In other words, any engagement from the OEM will need to start over with very basic topics. This becomes a challenge for both the airline and the individuals newly assigned to the position.

The participants also highlighted the importance of the airline’s organizational structure as it relates to engagement with the aircraft engine OEM. Participant #03 described how their airline created a department that focused only on aircraft engine related topics. The participant stated that, prior to the establishment of this department, the process to adopt service bulletins was problematic; but having a department focused only on the engines significantly improved the process and engagement with OEM. “We created this department for engine performance and analytics, I think it was one year and six months, that's when things got easier. But before that, it was a little bit of a problem because there was no one dedicated to [service bulletins] from the engine section” (P03).

Interview participants also identified that alignment and preparedness of all relevant individuals within the airline organization are critical to engaging with the OEM and to effectively adopting service bulletins and complying with airworthiness directives. Participant #10 described their experience when they described the engagement from the OEM was received very well, but the effectiveness of the engagement was significantly reduced due to internal misalignment and miscommunication at the airline.

I know from our side it went quite well from the engagement we had. It's just internally, I think we let ourselves down as the company, because there were certain processes and procedures not followed internally which could have ran smoother if everyone in his or her departments were involved at all times. (P10)

Making structural changes in the airline organization, and ensuring the priorities of leadership are aligned, require clearly communicated support from airline senior leadership.
Interview participants also identified that support from both direct managers as well as senior leadership was critical in facilitating effective engagement with the aircraft engine OEM.

**OEM characteristics.** Interview participants were asked to identify characteristics that facilitate effective engagement between their airline and aircraft engine OEMs; they also identified characteristics of the OEM. They indicated the need for OEM policies that make accessing technical information, such as manuals and technical presentations, easier. Many of the interview participants stated that making important documentation available on the OEM website is a good gesture but remembering login information for different websites can be difficult. “What they have actually, before we can use their manuals, we need to pay them first. Recently we had an audit where it was a finding that we don't have access to [specific OEM] manuals” (P03). Participant #03 also described how one OEM required the airline to pay for access to this critical information. They went on to state how an audit found no one at the airline had access to these manuals. It was not clear if the lack of access was a direct result of the fee the OEM had required; certainly, the need to pay for access to critical documents does create an impediment for those who need access to the documents.

Proactive engagement from the OEM was identified as a critical characteristic of effective OEM engagement. *Proactive engagement* refers to the propensity for the aircraft engine OEM to initiate engagement with the airlines operating their engines. This response is consistent with input presented in the preceding section, where Participant #09 highlighted the need to proactively engage new airlines to ensure they were aware of support available to them. Participant #09 also described a situation at their airline, which they attribute to the lack of proactive engagement on the part of the aircraft engine OEM. “We have almost six aircraft that
are AOG and I bet if we had gotten involved much earlier, this equipment being monitored, most of these issues where we are right now would have been avoided” (P09).

Frequency of engagement was also identified by many of the participants as a critical characteristic of the successful engagement. The most mentioned characteristic of the OEM that facilitated effective engagement were those characteristics that have been shown in previous research (Luna-Reyes & Andersen, 2007) to be critical in establishing trust between separate organizations. This point was highlighted by Participant #05, who stated that effectiveness of engagement first and foremost depends on having a trust-based relationship between the airline and the aircraft engine OEM.

The first thing is the relationship. The effectiveness depends on the relationship, the onsite support team creates with the airline team. If the onsite support team has a good relationship, trust-based relationship with the airline engineering and technical department, things always go smooth. Some OEMs like for example, engine OEMs have very good relationship with engineering and every department. (P05)

All interview participants responded that a relationship between the airline and OEM, rooted in trust, was critical for effective engagement. Interview participants were asked to describe the elements which lead to the establishment of trust in the context of engagement between their airline and an OEM.

Many of the interview participants pointed to the human connection as a facilitator of trust between airlines and aircraft engine OEMs. Participant #01 described that connecting with a person leaves them assured that someone who cares about the airlines is working on getting a response. In contrast, submitting a request through the OEM website is like talking to a robot. Participant #14 elaborated that when two people work together a connection is made. That connection makes communication easier and grows with repetitive engagement.

You know, sometimes if we know the person you communicate with him, if you know the person personally, it is easier to communicate and get data and information from him. For me, if I know that the person I communicate with personally, it is easier for me to get
data and information that I need. For me, if I know the person, I communicate with them, it will be easier and more effective. (P14)

Trust, and its ability to facilitate effective engagement, is affected by the accessibility and availability of the OEM. The responses related to accessibility and availability were provided in reference to the interview participants engagement with the assigned field support representative. The ability of the airline to easily contact the field service representative directly influenced the feeling of trust for the specific OEM. Participant #09 described how they would walk to the representative’s office and have an informal discussion about whatever was on the mind of the interview participant.

Using the [OEM] rep here [at my airline] as reference, let's say for instance we have an issue. You walk straight into his office, you can sit down, chat, get solution immediate, much faster than having to first send a mail and probably waiting for three, four, five hours or probably even a day for reply, but you have them on ground. Exactly. Which makes things much easier. (P09)

This type of openness and accessibility created a sense of trust that the representative would be available whenever needed. Conversely, some interview response highlighted negative experiences with representatives. One interview participant stated that it seems like whenever they tried to reach the OEM, the representative was not in the office or was on vacation. This left the them feeling frustrated as they did not know how to have their inquiry address. If also undermined the interview participant’s feeling confidence that the representative really cared about helping the airline.

In additional to accessibility and availability of the field service representative, interview participants also identified timeliness or rapidness of responses as critical to the development of trust. Many of the participants discussed how timely responses positively influence trust.

An experienced [onsite field support representative] will take very short time to identify the problem and to define which team in his own loop of supporting teams, he or she will know, they will know where to go, what kind of case to create, whom to contact in order to get quick responses. Whenever airlines contact onsite support team and when they get
a quick response because of technical proficiency or because of the communication skill of the onsite support engineer. (P05)

Quick responses positively influence the development of trust between the OEM and airline as quick responses are an indication of the competence, both technically and regarding organizational acumen, as well as showing that the representative and OEM prioritize requests from the airline. If an airline submits a request, and the request takes a few days before it is addressed, the airline is left with a feeling that their issues are not a priority for the OEM.

Consistency of engagement was also identified as critical to developing trust between OEMs and airlines. Consistent engagement refers to frequency of engagement as well as the topics of engagement, as pointed out by Participant #08. Establishing a rhythm of regular engagement, whether virtually or face-to-face, ensure that the items of importance related to a specific OEM remain a priority for the airline and ensure visibility to airline senior leadership.

Just letting us know that I'm aware that this is happened, I believe, I hope you guys are working on [a specific topic]. A summary of that would be constant engagement through phone calls and Skype teleconference and follow up on emerging issues through email. (P08)

Ensuring a regular rhythm with the airline also provides an opportunity for the OEM to follow up on open items. All of this demonstrates that the OEM cares about the success of the airline. This demonstration of concern for the airline positively influences the development of trust between the airline and the OEM.

Based on the interviews, the development of an airline’s trust in an aircraft OEM is also influenced by the representative’s situational knowledge of the airline. Having a situational awareness of the struggles the airline is going through allow the field support representative, and any additional support personnel from the airline, to better understand the airline challenges and even empathize with their situation. The ability of the OEM to understand the situation of the airline goes a long way in developing trust between the airline and the OEM. Participant #13
described that the support individual who acts like the airline’s agent within the OEM organization, demonstrates concern and empathy for the airline. “If I have a justification, if [my airline] is really affected by a specific event or fleet issue. So, I like the customer support that believes in my request and escalates it, like they were my lawyer, within the OEM” (P12). This is a critical factor in the development of trust.

Chapter Conclusions

The study was designed to identify and analyze the critical engagement with aircraft engines OEM during the adoption of service bulletins and compliance with airworthiness directives. OEM engagements, called touchpoints in this study, were analyzed and categorized based on the phase of the process during which they occurred, the organization that initiated the engagement, the type of information shared, and the type of communication. The type of information shared was categorized as either explicit knowledge or tacit knowledge. The type of communication was categorized as either non-reciprocal, partially reciprocal, or fully reciprocal.

Findings from the interviews indicate that notification of service bulletin release—initiated by the OEM and occurring in the Phase 1 of the process—and communication of completion of service bulletins and worthiness directives—initiated by the airline and occurring at the end of Phase 4—communicate explicit knowledge. This explicit knowledge is best communicated using a non-reciprocal form of communication such as one-way emails or communication using the OEM portal.

Communications during Phase 2 (review of the service bulletin or airworthiness directive) and Phase 3 (preparing for the service bulletin or airworthiness directive), include both explicit and tacit knowledge. Airlines may raise a question for which response is classified as explicit knowledge. In such a situation, an airline can make a request with the field service
representative or using the OEM website. Use of the OEM website is classified as partially reciprocal because it allows for customized questions to be asked and facilitates the response but does not facilitate additional conversation.

Many of the topics that airlines discuss with OEMs during Phase 2 and Phase 3 are detailed and tacit in nature. As such, the only type of communication effective for discussion this information is fully reciprocal communication. Fully reciprocal communication required the engagement of a field service representative, either based onsite with the airline or based offsite.

The findings from this study highlight that during the adoption of a service bulletin and compliance with an airworthiness directive, the OEM and airline engage frequently to ensure awareness and understanding of service bulletins and airworthiness directives. Likewise, the airline and OEMs frequently engage during the preparation and execution stages of the process as well. Throughout the engagement there is a great deal of both explicit and tacit knowledge communicated between the two organization. While automated emails and an OEM website can be used for communicated explicit knowledge, they are not suitable engagement tools for communication of tacit knowledge. Any support or engagement model developed by an aircraft engine OEM must consider the role of the field support representative as absolutely critical to leading fully reciprocal communication with the airline.

This study also investigated the critical elements in the process of airlines and aircraft engine OEMs engaging to share best practices relating to maintenance and inspection tasks. Interview participants identified that awareness of a need for the best practice is required to establish the required motivation to seek out and learn best practices. Feedback from the OEM, a trend of negative outcomes from a maintenance or inspection task, lack of clarify in the manual, inexperience with a specific task, and a feeling of not being comfortable performing the task,
were identified as the top reasons that motivate airline employees to actively seek out best practices from the OEM.

Interview participants also identified strategies the airline employees are likely to use to engage with the OEM. Initially airline employees may re-read the tasks, as they are written in the manual, or search through old training material for guidance on how to better perform a specific task. If they are unable to find the needed guidance, airline employees are likely to either ask their manager for support or directly reach out to the OEM. Engagement with the OEM is facilitated by a trusting relationship with the assigned field service representative. The field service representative can then assist with provided known best practices or other type of aids to assist in the correct performance of a task. If the relationship between the airline employee and OEM representative is not based on trust, the airline employee may take steps to intentionally not share their need for a best practice out of fear the OEM may consider any errors made during commercial negotiations.

Although best practices can be shared in written form and verbally, the interview participants overwhelmingly identified video recording as the most effective medium for sharing best practices. Review of these videos can be through formal training, included as required preparation for performing the specific task, or played where the technicians who perform the tasks take their breaks.

Finally, interview participants were asked to describe effective engagements with aircraft engine OEMs based on their experiences. Their responses were categorized as relating to the method of engagement, the topic of engagement, or characteristics of the engagement.

Two primary types of engagement emerged from the interview responses. The first method of engagement, which was preferred by all interview participants, was human
engagement. Some of the interview participants described engagement with a field service representative based onsite with their airlines, while others described their experience engaging with a field service representative who was not based onsite with the airline. The feedback on both onsite and offsite representatives was that frequency and proactive engagement was perceived as critical to facilitating beneficial engagement.

The other method of engagement that interview participants reported aircraft engine OEMs using is engagement solely via the OEM website. Although some of the interview participants identified benefits of using the website, such as accessibility of information and the fact that all communications are recorded and stored, not one interview participant stated a preference for engagement using the website over dedicated support personnel.

Responses from participants stated that airline trust in the OEM, developed through engagements with the field service representative, is absolutely critical to establishing effective and productive engagements between the airline and OEM. Elements critical to the development of trust between the airline and OEM are similar to elements identified by previous studies that focus the development of trust during interorganizational engagement.
Chapter V: Discussion

The motivation for this study can be found at the intersection of my interest in business development in Africa, passion for aviation and driving improved safety in aviation, and experience as an aircraft engine OEM Field Service Representative (FSR) supporting airlines in Africa. It is here where I began to see the FSR not only as a position within the organization of the OEM, but also as an opportunity to drive positive change for the OEM, the airlines, as well as the populations served by the airline.

To understand better the processes of OEM engagement with airlines in Africa, I interviewed 14 aviation professionals who had been working in a maintenance organization at an airline in Africa and had at least one year of experience engaging with aircraft engine OEMs. Three primary, open-ended questions were asked to understand the adoption of service bulletins, compliance of airworthiness directives, and proper performance of maintenance and inspection tasks. The interview participants came from both large and small airlines as well as airlines the flew international routes and those that operated regional route structures. Through the interviews and systems analysis, I was able to identify critical engagement touchpoints and critical characteristics of these touchpoints that led to successful outcomes.

This chapter reviews the findings presented in Chapter IV and presents the takeaways and conclusions that were observed and created through the analysis of the data. When applicable, the findings from this study are related to existing literature. Limitations of the study are then discussed along with a review of the author’s background. Finally, practical application of the findings and recommendations for action are presented in the context of opportunities for leadership and change.
Addressing Research Question 1: Touchpoints for Adoption of Service Bulletins and Airworthiness Directives

The first research question in this research study was, “What are the critical touchpoints between engine OEMs and airlines in Africa that lead to successful outcomes during the adoption of service bulletins and the compliance with airworthiness directives?” This question was asked to better understand the process of engagement between aircraft engine OEMs and airlines in Africa during the adoption of service bulletins and the compliance with airworthiness directives, which can directly affect the safety performance of the airline.

The engagement between the airline and OEM during this critical process was analyzed by reviewing the characteristics of the touchpoints. The touchpoints were characterized by identifying the phase of the process during which they occurred, the organization that initiated the communication, the type of information exchanged, and the type of communication used. Analysis of the interview data identified four primary phases of the process of adopting service bulletins and complying with airworthiness directives. Those primary phases, in order, are titled awareness, assessment, preparation, and execution. The type of information was identified as either explicit knowledge, easily codified and communicated, or tacit knowledge, which cannot easily be communicated. The three types of communication were identified were nonreciprocal, partially reciprocal, and fully reciprocal. Engagement initiated was identified as either the airline or the OEM.

Nonreciprocal communication is one-directional communication for which there is no opportunity to respond. Nonreciprocal communication includes automated emails and information found through using the OEM’s website. Partially reciprocal communication, as defined in this study, occurs when the airline submits a question via the OEM’s website and
receives a response. In this case, the OEM provides feedback based on the inquiry raised by the airline, but communication ends when the OEM provides feedback. Fully reciprocal communication, as defined in this study, as communication method that facilitates back and forth knowledge transfer and unstructured conversation. Fully reciprocal communication allows for individuals to discuss complex topics that involve transfer of tacit knowledge.

Figure 5.1 presents the phases of the process of service bulletin adoption and airworthiness compliance along with the touchpoints, touchpoint initiator, characteristics of each touchpoint, and content communicated during each touchpoint. The key findings are presented according to the phase of the process.

**Awareness: Airworthiness directive and service bulletin.** During the first phase of the process, the awareness phase, the communication between the airline and the aircraft engine OEM is very one-directional as the information being communicated is limited to notification of new service bulletins or changes to existing service bulletins. This transfer of explicit knowledge can easily be facilitated by techniques using nonreciprocal communication, such as automated emails or searches of the OEM’s website, as shown in the left column in Figure 5.1.

The effectiveness of automated emails can be limited when those receiving automated emails start receiving an excessive number of automated emails, such that they are unable to fully review all emails. It is critical that aircraft engine OEMs ensure that distributions lists are as focused as possible to ensure that communication is always relevant for all members of the distribution list. If the distribution list is broad and communication not always relevant to everyone, then the importance of reading the emails can become lessened from the perspective of those receiving the emails.
Likewise, another limitation inherent in the use of automated emails is that the critical information is shared only with individuals on the distribution list. Care must be taken to ensure distribution lists are frequently updated and that the aircraft engine OEM is aware when new airlines begin operating their aircraft engines.

When an airline starts operating new equipment, they might not be aware of the support that is available to them through the aircraft engine OEM. Furthermore, they may not know the importance of registering for these distribution lists. The aircraft engine OEM needs to take care and engage airlines that are new to operate their product to ensure the personnel at the airline are aware of the support and communication provided by the OEM.
Figure 5.1. OEM and airline touchpoints during the process of service bulletin adoption and airworthiness directive compliance.
Assessment: Airworthiness directive and service bulletin. During the assessment phase, the number of airline-initiated touchpoints increased. As discussed by the interview participants, these touchpoints were raised primarily to request clarification on applicability criteria provided in the service bulletin. Engaging with the OEM to receive clarification on the applicability of the service bulletin was most often reported to have occurred by engaging with the assigned FSR. Typically, discussions with the FSR would be classified as fully reciprocal, however the knowledge being transferred is explicit. For this reason, these engagements were classified as partially reciprocal communication, with the understanding this partially reciprocal communication occurs often by asking the assigned FSR. Interview participants also identified that questions regarding commercial support can arise at this phase in the process. Some service bulletins do include detailed information on commercial support while others, even from the same aircraft engine OEM, do not. The interview participants indicated they will engage the OEM for additional support regardless if the commercial support is explicitly defined in the service bulletin or not. This engagement, as reported by the interview participants, takes place by contacting the FSR. Raising the request for additional commercial support and building the case to justify the request, require the communication of tacit knowledge, which is facilitated by fully reciprocal communication. This is consistent with the feedback from the interview participants.

Preparation: Airworthiness directive and service bulletin. During the preparation phase, the touchpoints, as reported by the interview participants, focus on identifying acceptable repair facilities, developing the needed capability, contracting with the OEM to do the work, ordering and allocating needed parts, and further discussing commercial support. Except for requesting extensions to the operating limits, which is a technically oriented question, the content of the topics discussed involved the transfer of tacit knowledge between the OEM and the airline.
The type of communication utilized during this phase, according to the interview participants, is categorized as fully reciprocal.

**Execution: Airworthiness directive and service bulletin.** The final phase of the overarching process is the phase when the plans to adopt the service bulletin are put into action. At this point, the airline has made the decision to adopt the service bulletin and has taken the needed action to prepare. Communication during this phase of the process primarily focuses on the airline providing feedback to the OEM, requesting feedback on unexpected findings, and requesting changes in the parts allocation due to schedule changes. Advising the OEM that the service bulletin or airworthiness directive has been completed was reported to occur by advising the assigned FSR, however the information being communicated is explicit knowledge.

Clarification on findings refers to questions raised by the airline regarding the procedure that was completed. In such cases, the responsible person at the airline would typically contact the assigned FSR, but, occasionally, would submit a request through the OEM website. The interview participants often reported they would continue to ask commercial support during the final phase of the service bulletin adoption process.

**Addressing Research Question 2: Touchpoints Leading to Successful Performance of Maintenance and Inspection**

After discussing the OEM-airline touchpoints through the process of service bulletin adoption and airworthiness directive compliance, the interview moved to the second research question, which was: What are the critical touchpoints between engine OEMs and airlines in Africa that lead to successful outcomes during the performance of maintenance and inspections tasks? The second research question delved into the process by which airline personnel develop the understanding that guidance or support is needed from the aircraft engine OEM to correctly
perform standard maintenance or inspection tasks. Unlike the process discussed for Research Question 1, the process discussed in regard to the second question, presented in Figure 5.2, is not a formal process within the airline or the OEM. For this reason, there was a great deal of variation found from airline to airline and individual to individual.

The process for an airline professional to recognize that they need support from the aircraft engine OEM can vary significantly from person to person. The motivation to seek support comes from either an internal source, such as a lack of comfort performing a process, or an external source. The external source includes both proactive and reactive motivations. Reactive motivations for seeking support from the OEM include a single negative outcome that resulted in an operational disruption for the airline or a trend of negative outcomes that may not cause operational disruptions; such an outcome does increase the operational cost incurred by the airline. In both cases, the airline leadership would likely initiate the request for support. Some airlines have a policy of engagement with the aircraft engine OEM that includes the proactive sharing of inspection data and feedback from maintenance tasks. As reported by interview participants, the airline takes the responsibility of sharing the data and the aircraft engine OEM, through the assigned FSR, will review the data and identify areas for improvement.

Interview participants identified that the first action taken when a support need was identified was to review the applicable maintenance manual as well as to discuss the procedure with more senior and experience engineers and technicians. If the airline personnel were unable to acquire the needed support from the engine manual, or from internal discussions with the airline, then participants indicated that the next step would be for to review content on the OEM website as well as existing training material previously acquired from the aircraft engine OEM. If the required information had still not been identified, then the responsible personnel at the
airline would reach out to the OEM directly. The feedback from the interviews confirmed that requesting support, such as best practices, is primarily done by contacting the assigned FSR.

All 14 participants were asked how they reach out to the aircraft OEM for guidance on performing maintenance and inspection tasks. Not one of them indicated that best practices were requested using the OEM website. This indicates that the willingness of airlines to reach out to the aircraft engine OEM for support is greatly influenced by the personal and professional relationship that has been developed by the assigned field service representative. This is consistent with additional interview data highlighting the importance of trust between the aircraft engine OEM and airline in facilitating transfer of knowledge and information.

One of the interview participants shared that if they felt the task was being performed incorrectly, or if there was a need for a best practice, then they would not advise the aircraft engine OEM of this support need. The interview participant went on to clarify that admitting the task had been completed incorrectly in the past may have resulted in punitive actions by the airline on the specific individual. Likewise, the aircraft engine OEM may use this information to withhold commercial support from the airline.

One of the interview participants shared that if they felt the task was being performed incorrectly, or if there was a need for a best practice, then they would not advise the aircraft engine OEM of this support need. The interview participant went on to clarify that admitting the task had been completed incorrectly in the past may have resulted in punitive actions by the airline on the specific individual. Likewise, the aircraft engine OEM may use this information to withhold commercial support from the airline.
Figure 5.2. Process of identifying needed OEM support, engaging OEM for needed support, and internal strategies for communicating the OEM support to ensure engine maintenance tasks are properly completed and assessed.
Ensuring that maintenance tasks are completed properly is of vital importance both to the airline and to the aircraft engine OEM. Reporting challenges experienced while completing maintenance actions and inspections is critical for the OEM to develop product and procedural improvements. To ensure this information is provided freely and openly the individual reporting the feedback must feel comfortable that no negative actions will be taken against them. Other interview participants echoed this sentiment, advising that trust is a critical element in developing the engagement between the airline and OEM.

**Addressing Research Question 3: Touchpoints Facilitating Efficient Information Transfer**

The final topic of discussion focused on Research Question 3, which was, “What are the characteristics of the touchpoints that facilitate efficient transfer of needed information?” This question asked the interview participant to provide insight, based on their individual experiences, regarding the characteristics of the touchpoints that result in effective communication.

Despite an extensive literature review on both airline operations and interorganizational engagement (Chapter II) there were no studies identified that investigated the details of the engagement between the aircraft engine OEM and airlines in the context of maintenance operations. For this reason, the research performed regarding Research Questions 1 and 2 was exploratory in nature. The same cannot be said about the topic of Research Question 3. There was a great deal of literature available on the topic of interorganizational engagement as summarized in Chapter II of this dissertation.

RQ1 and RQ2 investigated internal processes at the airlines and how OEM engagement, analysis as touchpoints, supported and facilitated these processes to ensure positive outcomes for both the airline and aircraft engine OEM. RQ3 probed the critical elements of successful engagement between aircraft engine OEMs and airlines in Africa. The feedback from the
interview participants related to the critical elements of successful engagement between aircraft engine OEMs and airlines in Africa, was compared to the process of interorganizational engagement presented by Luna-Reyes and Andersen (2007; see Figure 2.6 in Chapter II). The purpose of comparing the interview data to this existing model was to identify the specific details of how to apply this model to interorganizational engagement between aircraft engine OEMs and airlines in Africa within the context of maintenance operations.

The process of interorganizational engagement, as discussed by Luna-Reyes and Andersen (2007), is widespread in engagement between all types of organizations. This section will focus on combining the feedback from the interview participants with the engagement process defined in this model to identify a model for effective engagement between aircraft engine OEMs and airlines in Africa.

The iterative model presented Luna-Reyes and Andersen (2007) contains eight separate elements comprising two feedback loops. A ninth element, Establishing Institutional Trust, is not included in either of the two feedback loops but does directly influence Luna-Reyes and Andersen’s element of Calculative Trust (as discussed below). Three of the elements are found in both feedback loops.

The responses to RQ3, which asked about characteristics of the touchpoints associated with effective transfer of knowledge, can be compared to the existing model by Luna-Reyes and Anderson (2007). The result is a model specific to interorganizational engagement between aircraft engine OEMs and airlines in Africa within the context of maintenance related. The elements of the process have been renamed in Figure 5.3 to underscore that they are specific to the engagement of the aircraft engine OEM and the airline. In order to help present the data in contact of the model, the elements have been numbered 1 to 9, and feedback specific to each
Element #1: Establishing institutional trust. Feedback from the interview participants confirmed that airlines are keenly aware of the entitlements contained within the various contracts they have with a specific aircraft engine OEM. When faced with a pending service bulletin to adopt or support needed to ensure maintenance and inspection procedures are properly being performed, airline personnel often revert to the contractual entitlements as a starting point for discussions with the aircraft engine OEM. According to Luna-Reyes and Anderson (2007)

*Figure 5.3. Process of airline-engine OEM engagement. Adapted from “Towards a Theory of Interorganizational Collaboration: Generic Structures Of Cross-Boundary Requirements Analysis” by L. Luna-Reyes & D. Andersen, 2007, from Proceedings of the International Conference of the System Dynamics Society. Copyright 2007 by Luis Luna-Reyes & David Andersen. Adapted with permission.*
this element of engagement is based solely on the language in the contracts various contracts and there is no other influence on this element. However, this element of engagement does directly affect the element of engagement called calculative trust.

Element #2: Calculative trust. Calculative trust is directly influenced by the outcome of reviewing the various contracts that the OEM has with the airline within the context of the applicable regulations the OEM and airline must adhere to. Calculative trust is solely based on an economic analysis of the challenge and solution options. In the case of service bulletin adoption, which is simply a recommendation from the aircraft engine OEM, interview feedback indicated that airlines often perform a cost-benefit analysis regarding the decision to adopt a service bulletin.

Element #3: Airline trust in OEM. Airline trust in the OEM can be seen during the assessment phase of the service bulletin assessment. Many of the interview participants indicated that often adoption of high priority service bulletins was made solely on the OEM categorization of the service bulletin. In this example the OEM recommendation is actioned according to airline policy, based the category the OEM assigns.

In addition to the organization trust that is developed between the airline and the OEM, interpersonal trust was also mentioned by interview participants as critical to the open and transparent engagement between the two individuals. Additional feedback from the interviews highlighted that trust between the aircraft engine OEM and the airlines is influenced by the availability and accessibility of the assigned FSR and other support staff. Furthermore, timely and accurate follow-up were identified as contributing to the development of trust with the airline. When asked what airlines define as trust in the relationship with the aircraft engine OEM,
interview participants responses all indicated that it meant feeling that the person supporting them cared about the success of the airline and ensuring a positive outcome.

Part of caring about the airline’s success includes understanding the challenges the airline is facing. Interview participants stated that along with availability and accessibility, having the FSR have situation awareness of the issues at the airline is a critical element to developing trust. The final point highlighted by the interview participants points less to the FSR’s intent, but rather concerns their experience and training. In order to develop trust, the FSR needs to possess the technical knowledge and experience to provide support. Airlines often look to the assigned FSR to provide technical support without the need to consult with the OEM’s engineering team. Without the technical expertise the airline will not likely trust the support provided by someone they perceive as unqualified.

**Element #4: Airline willingness to engage with the OEM.** As the airline develops trust in the aircraft engine OEM, they will be more confident to engage with the OEM, particularly with regards to sharing data. As discussed in Chapter IV, some interview participants stated that airlines and personnel at these airlines may be hesitant to share data out of fear that the OEM may use the data against them in future commercial negotiations. As the assigned FSR develops trust with the team members working for the airline there will be a greater sense of confidence that shared information will not be used against airline employees personally or against the OEM.

**Element #5: Airline and the OEM doing work together.** As the airline and OEM work together, during the process of service bulletin adoption, the OEM and airline identify and assess different options regarding the development of capability at the airline, availability of induction slots at a repair facility, adjustments to the material allocation schedule based on changes in the
airline’s operation, and allowances to extend the deadline of the service bulletin. Feedback from
the participants was very clear that willingness from the OEM to work with the unique and often
changing needs of the airline is a significant contributor to the development of trust with the
airline. The result of the aircraft engine OEM and the airline working together, influences both
the airline’s knowledge of its need and the airline’s collaboration experience with the OEM.

Element #6: Airline knowledge of airline’s needs. Interview participants identified that
during the process of engaging with the OEM and during the process for the adoption of service
bulletins, the airline identifies its needs in terms of technical support, operational support, and
commercial support. The technical support needed by the airline can only be defined by the
airline; the aircraft engine OEM does not define the needed support. Likewise, as the airline
operations change, the need for deadline extension and adjustment to material allocation evolve,
and, with this, the needed support changes. This can affect the commercial support needed for
some service bulletins to make the adoption economical viable and is why commercial support is
identified as a topic of discussion during three of the four process phases.

The feedback from the interviews was clear. If maintenance or inspection tasks were
being performed incorrectly the responsible airline personnel would engage the OEM for
guidance and best practices on how to perform the task correctly. The purpose of these
airline-initiated requests was not to analyze why the task was performing incorrectly, or to
evaluate how the task was being performed incorrectly; rather, it was a request simply for the
OEM to provide guidance on how to perform the task correctly. The airline personnel, through
engagement with the OEM, are able to identify the what improvements need to be made to
ensure maintenance and inspections tasks are properly completed
Once the airline understands the technical and operational aspects of what they need, they are able to identify the commercial support needs. Improved understanding of their needs then feeds into Element #2, which is development of calculative trust.

**Element #7: Airline collaboration experiences with OEM.** The outcomes of working with the aircraft engine OEM can leave a long-lasting impression. Many of the interview participants, in one way or another, discussed the importance of previous experiences on the development of trust between the OEM and airline. Participant #08 identified that critical elements of a successful engagement include consistency in sharing information. Other participants pointed to successful outcomes as being critical to a positive collaboration experience. Many respondents reported that positive collaboration experiences with the OEM occurred even if the intended outcome was not met. Desire of the OEM to provide the support needed by the airline, and making the effort to consider alternative solutions, demonstrated that the OEM cares about the airline’s success. Demonstrating that the OEM cares about the success of the airline was also identified as a critical element of a positive collaboration experience. “Mostly the constant engagement and through that the consistent sharing of information and of course both formal and informal. That makes the relationship really awesome, and a good enabler to perhaps wanting to reach out to them” (P08).

Although the interview participants identified critical elements that led to positive collaboration experiences with the aircraft engine OEM, the collaboration experience can also be negative. Whether positive or negative, the collaboration experience directly influences the airline’s perception of the trustworthiness of the aircraft engine OEM.

**Element #8: Airlines perception of OEM trustworthiness.** As the OEM and airline engage multiple times over the course of weeks, months, and even years, the airline’s perception
of the aircraft engine OEM trustworthiness continues to evolve. Previous engagement experiences that had a positive outcome increase the perception of OEM trustworthiness while negative outcomes reduce the perception of OEM trustworthiness. As the OEM and airline continue to engage over time the perception of trustworthiness of the aircraft engine OEM becomes more refined. If the airline has a positive perception of OEM trustworthiness, then future positive engagements will serve to reinforce the positive perception of the OEM and if there were to be a negative experience it would most likely have a very minor impact to the airline’s perception of the OEM.

**Opportunity for Leadership and Change**

In a 2012 report, the African Development Bank Group identified the top challenges facing the aviation industry in Africa and specifically point to safety as the most pressing challenge facing the aviation industry in Africa (“Africa’s Aviation Industry,” 2012). This report went on to note that the average number of aircraft related accidents in Africa was nine times higher in 2011 than the global average, while in the same year African airlines accounted for nearly a third of all aviation related fatalities; this has led the European Union to banning at least 108 African airlines (“Departure Delayed,” 2016).

The accident rate reported by African airlines is about 8 to 11 times higher than the global average. It should be noted that most of the accidents are on smaller propeller and regional aircraft while the safety performance of larger, international African carriers is the same as that of their global counterparts (“Departure Delayed,” 2016). Airlines that have poor safety records find it increasingly difficult to operate in countries or regions with strict safety regulations. This leads to a reduction, or potentially elimination, of safe air transportation
alternatives for populations living in regions with limited air service. Passengers are then exposed to increasing unsafe conditions if they fly with these airlines.

The key to the economic success of Africa is the continent’s airline industry (Button et al., 2018). In support of the need for improvements in safety, ICAO released a report (ICAO, 2015) that identified a number of actions required as part of the effort to improve aviation safety in Africa, one of which was “to increase the number of qualified personnel at the industry and oversight levels” (p. 12).

The motive for improving airline safety performance, and hence this study, is to ensure safe conditions for the passengers, employees, and communities served by African airlines. This study looked specifically at how aircraft engine OEMs engage with African airlines, in the context of performing airworthiness directives and service bulletins as well obtaining support to ensure maintenance and inspection tasks are performed correctly. Based on the collected data and the analysis of these data, recommendations for improving and maintaining effective and efficient communication between the OEM and airline are presented. These recommendations are summarized in Figure 5.4 and detailed in this section.

**Leadership recommendations for . . .**

<table>
<thead>
<tr>
<th>OEMs</th>
<th>Airlines</th>
</tr>
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<tbody>
<tr>
<td>1. Know the airlines operating your engines</td>
<td>1. Organizational structure</td>
</tr>
<tr>
<td>2. Proactively engage those airlines</td>
<td>2. Individual goals and objectives</td>
</tr>
<tr>
<td>3. Ensure frequent, face-to-face engagement</td>
<td>3. Formalize OEM recommendations</td>
</tr>
<tr>
<td>4. Establish and maintain a relationship with the airlines</td>
<td>4. Open communication and data sharing</td>
</tr>
<tr>
<td>5. Remove barriers to accessing technical information</td>
<td>5. Hold OEM accountable for support</td>
</tr>
<tr>
<td>6. Ensure support staff are qualified.</td>
<td>6. Retain employees in keep positions</td>
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*Figure 5.4. Recommendations to OEM and airlines leadership.*
Recommendations for OEM Leadership. These recommendations focus primarily on engagement strategies for proactively engaging airlines.

Awareness of new airlines. Interview participants identified that the primary means by which they became aware of issuance of new service bulletins, or changes to existing service bulletins, is through automated emails. It is therefore critical that OEMs ensure that distribution lists for such notifications are updated frequently. Knowing the proper contacts at an airline requires the OEM to proactively reach out to and engage with the airline. It is recommended that OEMs maintain acute awareness of airlines’ use—and changes in use—of their product. Only then can they ensure that critical information is being communicated to the correct contacts. Only then can they ensure that critical information is being communicated to the correct contacts.

Proactive engagement. Interview participants identified a critical element: OEM engagement can actually disrupt the routine at the airline. OEM engagement forces airline personnel to review technical aspects of the engine that they might otherwise not. Proactive OEM engagement, through the use of dedicated support individuals, ensures that OEM-related topics maintain a priority for the airline technical teams and have the visibility of airline senior leadership.

Frequent engagement and visits. For airlines in Africa without dedicated support individuals onsite, participants identified frequent use of teleconferencing software (e.g., Skype) as a critical element of successful engagement with aircraft engine OEMs. However, internet connections in Africa are generally very unreliable, and the daily operational demands of the airline often result in the meeting having less priority. It is critical that dedicated staff be
allocated sufficient travel budget to support frequent onsite visits. Visits should be of sufficient
length to allow for meaningful discussions.

*Access to technical information.* The interview participants identified lack of access to
technical data such as manuals, fleet highlights, and technical presentations as a significant
hinderance to their understanding of technical issues on the OEMs fleet. Access to such technical
documents may require passwords or even special fees imposed by the OEM to attain this critical
information. It is recommended that the OEM leadership minimize or eliminate fees to technical
information and, when possible, allow access to information without the use of a password.

*Qualification of support staff.* Airlines see dedicated support individuals, particularly
field service representatives (FSRs), as the first line of support. They expect the FSR to have a
degree in a field related to aircraft engines, such as mechanical or aerospace engineering. The
airline also expects the FSR to have significant experience and technical understanding of the
engines as well as understanding how to expedite responses within the OEM organization. The
FSR needs to understand the unique challenges and priorities of the airline and be able to clearly
communicate this within the OEM organization to drive solutions unique to the airline. Finally,
one qualification of an FSR that was mentioned by nearly every participant was that FSR needs
to demonstrate the desire to support the airline. Individuals in an FSR position directly support
airline operations. Since airlines’ operations are non-stop it is not uncommon to be called for
support during off hours, or even when sleeping. The FSR must be ready to provide support no
matter what time of day they are called. In addition to the education, knowledge, and
experience-based characteristics mentioned in this section, the OEM should ensure that FSRs
and support individuals have the right type of personality for supporting an airline.
Airline relationship. In Africa, business is done through relationships. The same can be said for engaging airlines; it requires a trust-based relationship. This is much different from working with airlines in American or European cultures, in which engagement is more transactional than relational. This is an important point for aircraft engines OEMs, all of whom are either based in the U.S. or Europe, when working with airlines in Africa.

Recommendations for airline leadership. These recommendations focus primarily on how leadership can manage the organization to facilitate effective engagement and communication with OEMs.

Organizational structure. The interview participants identified that having dedicated individuals or groups, within the airline organization, dedicated to supporting aircraft engines and engaging aircraft engine OEMs had significant benefit to improving operational performance of the aircraft engines. Airline leadership should identify a product focal for each type of engine operated by the airline. This focal product would serve as the primary point of contact for the OEM.

Individual goals and objectives. In a similar manner, engagement with the OEM has shown to be a critically important to acquiring needed information on technical aspects of the aircraft engine. Airline leadership should formally recognize OEM engagement as part of an individual’s professional role with the airline.

Formalize OEM recommendations. The interview participants identified that one of the biggest challenges of adopting technical recommendations from OEM, such as best practices, is that adoption of recommendations is not formally recognized as part of an individual’s role or part of the documented task. Participants identified the performing recommendation, such as best practices, may increase the time needed to perform a specific task. The maintenance planning
team will schedule maintenance and ground time based on the time required to perform the task. The technician, in turn, will be under pressure to perform the task in the allotted time. If the OEM recommendations increase the time needed to perform the task that it is likely the recommendations will not be actioned. To avoid such scenarios, it is recommended that airline leadership provide formal support, including updating the task time, to ensure OEM recommendations are actioned.

*Open communication and data sharing.* Participant responses demonstrated that data sharing between the OEM and airline is critical to understand if the correct maintenance and inspection tasks are being performed as well as confirming they are being performed correctly. It is recommended the airline leadership empower their teams to share technical data with the respective OEM. The airline leadership should minimize internal barriers for sharing data.

*OEM support accountability.* OEM support is critical support required to manage the technical program and safety performance related to the specific OEM engine. Airline leadership are recommended hold the OEM leadership accountable for providing the needed support. This can be completed by clearly communicating support expectations. Airline leadership, when possible, are recommended to ensure adequate support is included as contractual entitlement during negotiations. Another area the airline needs to hold to OEM accountable for support is with regards to providing timely feedback on any data provided.

*Employee retention.* The final recommendation for airline leadership is to minimize employee turnover in critical roles that require engaging with the OEM. Providing stability in these positions ensures that the relationship between the OEM and airline can grow over time. If the individual in a position that engages with the OEM changes too frequently that the process
for developing trust will restart as a result. Likewise, reducing employee turnover in these critical positions helps ensure retention of accumulated knowledge in these key positions.

**Recommendations for Further Study**

As pointed out in Chapter II, despite the abundance of literature on interorganizational engagement there are limited studies within the context of the aviation industry. Among the very few studies conducted in the aviation industry, none of them were found to focus on the engagement of OEM with the airlines, let alone in the specific context of maintenance operations. As such, this study was exploratory in nature and allows for follow-up in multiple areas.

This study investigated the engagement between aircraft engine OEMs and airlines in Africa in two specific contexts. Those two contexts being during the completion of service bulletins and airworthiness directive and during the informal process of airline personnel identifying, obtaining, and disseminating best practice information from the OEM. One of the limitations of this study is that only professionals working in technical roles were considered. Furthermore, care was taken to ensure that those aviation professions were also working in similar roles even though their titles may not be similar.

The organizational structure of airlines can vary significantly among airlines. As this study focused on the experiences of 14 aviation professionals, it is quite possible that despite their individual experiences there were some aspects of the engagement that were not reported if they are not directly involved. Recommended future work would be to perform exhaustive interviews with all airline employees and leadership that have experience engaging with aircraft engine OEMs. Similar interviews can be performed within the aircraft engine OEM. The results from all interviews could be analyzed together to build a communication and engagement map.
Since the organization structure and technical expertise can greatly vary between airlines, it would be recommended to select a few airlines based on key criteria, such as size and airline type. Comparing the communication maps, the knowledge shared, and communication type, technology used, and other facilitating factors.

This study focused on two engagement contexts in which the airline and OEM have a shared goal of reducing exposure conditions that can result in accidents or incidents. This is achieved through adoption of service bulletin adoption, compliance with airworthiness directives, correct execution of maintenance tasks, and accurate assessment of inspection data. Both the airline and OEM are driving for the same outcome. The engagement of an aircraft engine OEM and airline during the adoption of service bulletins most reflects the characteristic of a collaborative engagement in Figure 2.2. The engagement starts to look more like a compliant engagement in the case a regulatory body creates an airworthiness directive based on the service bulletin. During sales and commercial negotiations, the engagements takes on the characteristics of contestation, as described in Chapter II and illustrated in Figure 2.2. Since the type of engagement fundamentally changes, future studies could also investigate and map out communication between the airline and OEM in the context of different types of engagements.

An assumption made during this study was that the aviation professionals interviewed were experts in knowing the critical needs of the airline and what elements of engagement with the aircraft engine OEM were successful in meeting these needs. A final recommendation for further research is to validate this assumption. After mapping the communication between the airline and the aircraft engine OEM, it is recommended to compare the accident and incident rate of those airlines to the characteristics of OEM engagement. It is critical that only the accident
and incident rate related to products the specific aircraft engine OEM supplied and supports, are considered.

**Review of Researcher Position**

I have four years of experience working for a major aircraft engine OEM supporting airlines in Africa as a field service representative. During this time, I have supported numerous airlines across the region. I have also had a strong interest in the business development in Africa since before I moved to the Africa region. In fact, it is my interest and desire to lead business development efforts in Africa that attracted me to the role.

While working as a field service representative, one of the airline employees I worked with stated that the support I provided was better than any other OEM. Based on this humbling feedback, I asked myself two questions. The first was, “What do I do that makes my support better?” The second question I asked was, “Does this better support make any difference.” The second question was asked in the context of making air transportation safer for passengers in Africa as well as in the context of business development in Africa.

My experience and passion for working with airlines in Africa, desire to lead business development in Africa, and the need to win a victory for humanity, have provided the motivation for me while working on this dissertation. All of the interview participants during this study were aviation professionals I had engaged with in my professional role working for an aircraft engine OEM. Many of the examples the participants referenced were from experiences working with me. The benefit of using examples that I was part of meant that I was clear on the details of the event and I was able to focus on the experience of the participant in the engagement. Given that I was interviewing people I had a history of working with, I projected that they would bring up examples that included me. To avoid a situation in which the participant felt uncomfortable to
say something critical about my support to me, I gently reminded the participants that this interview was separate from our professional relationship and that criticism of the support I provided is encouraged if that is how they truly felt.

**Concluding Statement**

This study focused on the lived experiences of aviation professionals that work for airlines in Africa and engage with aircraft engine OEMs are part of their day-to-day job requirements. The feedback of the interview participants confirmed the importance of the engagement of the field service representative in terms of developing trust, facilitating communication, and developing creative solutions to drive positive outcomes. Through the engagement of the field service representative, the OEM can help reduce the airline’s exposure to conditions that can cause accidents and incidents. This is not only a benefit for the airline’s passengers, but improved safety has been identified by many consultancy groups as an area critical for the growth of the airline industry in Africa. The growth of the airline industry in Africa is also a critical element leading to the greater economic growth across the continent of Africa.

The leaders of aircraft engine OEMs are faced with an immense challenge on how to allocate field service representatives to support airlines across the world. As the OEM produces and sells more engines, they are faced with pressures on how to support more airlines and more engines without a proportional increase in headcount. Given this pressure, it may be tempting for leadership of OEM organizations to see roles such as the field service representative, and other customer support roles, simply as a cost. To minimize cost increase associated with hiring additional headcount, they may consider strategies that include transitioning some airlines from
personal support to support based at a central location or even pursue self-help strategies that see the OEM less engaged with the airlines.

The findings from this study are clear. Effective support of airlines in Africa is contingent on the ability of an assigned field service representative, or other assigned support personnel, to develop and foster a relationship based on trust. In this context, trust is developed through proactive engagement, timely responses, and demonstrating that the OEM cares about the success of the airline. Trust is a vital element of the engagement between aircraft engine OEMs and airlines in Africa and facilitates the sharing of information.

Feedback from the interviews highlighted that fully reciprocal communication and sharing of tacit knowledge is required during the adoption of service bulletins, compliance with airworthiness directives, and proper execution of maintenance and inspection tasks. This type of communication and knowledge transfer is not suited for engagement through a website.

Effective support of airlines in the context of maintenance operations can result in improved safety performance of the airlines. Improved safety performance has a direct benefit on the passengers that patronize the airline by ensuring safe options for air transportation services. Improved safety performance of the airline can also lead to reduced costs and opportunity to grow their business by expanding into additional markets. Expansion into additional markets result in new opportunities for local business owners to expand their business, for local merchants can access new customers, and individuals to travel to new destinations. This increased demand for air transport service will drive an increase in demand for aircraft and aircraft engines.

The concept of social justice addresses the economic inequality and access to wealth (Banai, Ronzoni, & Schemmel, 2011). Better-connected African countries and cities are a key
factor to increasing economic prosperity in Africa (‘Africa’s Aviation Industry,’ 2012). Due to the size of the African continent the most feasible option for increasing connectivity of African countries and cities is through passenger and cargo airline service. The ability of the airline to sustain growth is by ensuring the safety of performance remains a priority. Engagement with OEMs, and the assigned field service representative, are a critical to ensuring that important modifications are completed on schedule and maintenance and inspection tasks are done properly.

The position of the field service representative should be viewed not as a cost, but an opportunity to ensure safe air transport service and grow the airline industry in a very challenging region. Based on the findings of this research study, it is imperative that support teams, which include a field service representative, be assigned to airlines in Africa at a minimum to ensure service bulletins are adopted, airworthiness directives are complied, and maintenance and inspection tasks are performed correctly. The OEM support team, including the assigned field service representative, should be viewed as position used for supporting safe growth of the airline and potentially safe growth of the industry in the Africa region, which in turn, results in increased opportunity for future business with the airline.


Center for Aviation. (2016, June 2). *Africa outlook: Ethiopian Airlines and Air Mauritius grow, but others face strong headwinds*. Retrieved from


Appendix
Appendix A: Antioch University Institutional Review Board Application

From: https://irb.antioch.edu/application.php?appid=3617

1. Name and mailing address of Principal Investigator(s):
   Nathan Woods
   City Plaza Apt #3C,
   Bole Rd, Bole-Olympia

2. Academic Department
   PhD in Leadership & Change

3. Departmental Status
   Student

4. Phone Numbers
   +1 513 240 8741
   +251 935 987 013

5. Name & email address of research advisor:
   Dr. Mitchell Kusy
   mkusy@antioch.edu

6. Name & email address(es) of other researcher(s) involved in this project:
   N/A

7. Title of Project:
   A Study of the OEM-Airline Engagement as a Significant Contributor to Improved Airline Safety in Africa

8. Is this project federally funded?
   No
9. Expected starting date for data collection (Start date cannot be prior to IRB approval.)
   January 30th, 2019

10. Anticipated completion date for data collection
    January 29th, 2020

11. Project Purpose(s): (Up to 500 words) Describe: 1) the question or phenomenon you are investigating, 2) the project purpose, and 3) how the research will be disseminated or used.

    In 2011 the number of air traffic accidents in Africa was nine times higher than the global average. As a result, The African Development Bank ranked safety and security as the number one most pressing challenge facing African airlines. In support of the need for improvements in safety, ICAO released a report that identified a series of actions required as part of the effort to improve aviation safety in Africa. One of those identified actions was “to increase the number of qualified personnel at the industry and oversight levels.” Based on my experienced working for a large engine manufacturer (OEM) as onsite technical support for an airline in Africa, I believe the quality of those interactions is also important. The proposed study looks beyond having qualified personnel at industry and oversight levels and instead investigates the critical characteristics of their engagement. The purpose of this research is to develop an understanding of how OEM’s can improve engagement with airlines in Africa to reduce conditions that can lead to accidents or incidents.

12. Describe the proposed participants- age, number, sex, race, or other special characteristics. Describe criteria for inclusion and exclusion of participants. Please provide brief justification for these criteria. (Up to 500 words)

    Age, gender, race, and special characteristics are not considerations in the selection of participant. Participants will be identified solely on their role within an airline in Africa. Participants will be selected from senior leadership, middle management, and execution roles within organizations that directly engage with OEMs. Examples of senior level roles would be Chief Operating Officer or Vice President. Examples of middle management roles would be Director or Manager. Examples of execution roles would be anyone without a direct report. Examples of an organization that engages with the OEM would be maintenance organizations or engineering organizations.

    Individuals that are not currently working for airlines based in Africa will be excluded from participating, even if they have worked for an African airline in the past. These
individuals will be excluded as their more recent experience could bias their responses. In addition, individuals currently working for an airline in Africa, but working in an organization that does not engage with an OEM will be excluded. An example of such an organization would be Marketing or Employee Affairs.

13. Describe how the participants are to be selected and recruited. (Up to 500 words)

Potential participants would come from three pools. The first pool would be my first-degree network. My first-degree network is made up of aviation professionals working for airlines in Africa that I know directly. I would reach out to these individuals directly. The second pool of participants would come from my second-degree network. This network is made up of the direct contacts of those within my first-degree network.

The physical location of my current professional role is based with Ethiopian Airlines in Addis Ababa, Ethiopia. Ethiopian Airlines provide maintenance and repair services for many of the smaller airlines in Africa, and those airlines send representatives to Ethiopian Airlines while their aircraft or engine is being repaired. Those airlines representatives would also be included as potential participants would be used to identify other potential participants within their airlines. This would be the third pool of participants.

Potential participants would be contacted via email (Ref. Appendix A). The email will contain a background and purpose of the study. The email will explain why the recipient has been identified as a potential participant to participate in an interview and the interview will focus on understanding the needs of the airline related to the OEM. A copy of the informed consent letter will be included in the email as PDF attachment (Ref. Appendix C-D). All emails will be sent from my Antioch University email address.

14. Do you have a prior or current relationship, either personal, professional, and/or financial, with any person, organization, business, or entity who will be involved in your research?

Yes

14a. If yes, describe the situation that presents a potential personal, professional, and/or financial conflict of interest in the proposed research study, (e.g., if you are or have been employed at the research site, have received compensation from a participating organization have a personal or professional relationship with any participants).

I have an existing professional relationship with many of the potential participants. The type of information that will be discussed during the interview would be very similar to
information discussed in a professional setting. The intent of the interview is to collect only the participants’ professional opinions regarding their interactions with engine OEMs. They are not being asked to reveal confidential information about the airlines they work for or personal opinions about management strategies.

In my professional role I have been tasked with leading an effort to hire an engineer within the Africa region. To avoid potential conflict of interest I did not contact any candidates to participate as interview participants before or during the hiring process. I also took intentional measure to minimize my own influence on the hiring decision by including five additional individuals in the first round of interviews and two more individuals for the final round of interviews. Getting multiple inputs ensured that no one person was able to have overwhelming influence. I also designed the hiring process to include a set of checks to compare opinions of candidates without being influences by previous interviews.

The individual that was offered and accepted the role was also someone I wanted to interview for this research study. Since I have a working relationship with him, I intentionally did not attend any of his interviews to preserve the working relationship and avoid the appearance of conflict of interest in the hiring process. After providing detail on the interview process, and specifically detailing how I took measure to minimize my own influence on the hiring decision, the Antioch University IRB Chair approved this person for inclusion as an interview participant in this research study.

14b. Describe how you will mitigate the bias caused by any conflicts of interest in your study and how you will protect the participants against real or potential bias (e.g., you will not recruit anyone who works directly for you or in your direct team, results will be reported in the aggregate so that participants will remain anonymous, any compensation received is independent of the study and its results).

The study focuses on the relationship between OEMs and airlines and as I, the interviewer, work for a large OEM there is a concern the participants could develop an expectation that their responses will be provided as direct feedback to the leadership of the company I work for. To properly set expectations, I will clearly communicate that the research is being perform independent of my employer and they will not see any feedback. I will also limit all email communication regarding the interview, and other aspects of the study, to my Antioch University email address.

15. Describe the process you will follow to attain informed consent.

Informed consent form will be provided as a PDF file attached to the recruitment email. I have consent forms tailored for face-to-face, video conference, and tele-conference interviews. I will attach the consent for that is relevant to the type of interview that will most likely be used. I will review the informed consent form at the beginning of every interview to ensure the participant fully understand. After verbally reviewing the content of the document I will
ask them for verbal confirmation. Please note a sign consent for is required to schedule an interview.

For interviews that take place using a teleconference of video conference I will ask the participant to review the informed consent form and return a signed copy before the interview. Before the interview I will verbally review the informed consent agreement. The participant would verbally indicate their willingness to continue with the interview.

16. Describe the proposed procedures, (e.g., interview surveys, questionnaires, experiments, etc.) in the project. Any proposed experimental activities that are included in evaluation, research, development, demonstration, instruction, study, treatments, debriefing, questionnaires, and similar projects must be described. USE SIMPLE LANGUAGE, AVOID JARGON, AND IDENTIFY ACRONYMS. Please do not insert a copy of your methodology section from your proposal. State briefly and concisely the procedures for the project. (500 words)

A semi-structured interview will be used as the format for the interview. The questions and protocol for the interview can be found in Appendix B. Due to unreliability of telecommunication services across the continent of Africa in-person interviews will be preferred. However, this may be challenging given the geographic location of the interviewer and the participants. Therefore, tele-conferencing or video-conferencing may be used if in-person interviews are not possible.

17. Participants in research may be exposed to the possibility of harm physiological, psychological, and/or social please provide the following information: (Up to 500 words)

   a. Identify and describe potential risks of harm to participants (including physical, emotional, financial, or social harm). NOTE: for international research or vulnerable populations, please provide information about local culture that will assist the review committee in evaluating potential risks to participants, particularly when the project raises issues related to power differentials. For international research provide information about the regulatory environment (for reference see the International Compilation of Human Research Standards https://www.hhs.gov/ohrp/international/compilation-human-research-standards/index.html).

   The type of information that will be discussed during the interview would be very similar to information discussed in context of their professional engagements. The risk of any type of harm to the participants is minimal to none.

   b. The type of information that will be discussed during the interview would be very similar to information discussed in context of their professional engagements. The risk of any type of harm to the participants is minimal to none.
The benefits of the research include improved OEM support and improved safety performance. This would benefit both the airline and the OEM financially and with respect to their brand reputation. It also ensures improved safety conditions for air transport passengers in Africa.

c. The content of the interview will focus on the professional opinions of airline professionals and would be similar to discussions they would have during the course of their normal work day. For this reason, there is very little to no risk for participants. The benefit of taking part in this study is improved understanding on effective OEM engagement with airlines, which can lead to improved safety performance, reduced cost associated with accidents and incidents, and improved safety conditions for passengers. The benefit is improved safety for passengers and there is very little to no risk for the participants. I strongly believe the benefits outweigh any risks.

d. Explain fully how the rights and welfare of participants at risk will be protected (e.g., screening out particularly vulnerable participants, follow-up contact with participants, list of referrals, etc.) and what provisions will be made for the case of an adverse incident occurring during the study.

To ensure the rights and welfare of participants are protected I will not include the participants names nor the name of the airline the participant is employed by. I will include the position of the participant and key characteristics of the airline in the data collection. However, as stated previously, the content of the interview will focus on the professional opinions of airline professionals and will be similar to discussions they would have during the course of their normal work day. In addition, I will also contact the senior leadership at the airlines to obtain their consent for to approach individuals working within their airline. The interview will be conducted in an office setting or using tele-conferencing or video conferencing technology. Neither the environment nor the interview is expected to result in any adverse medical conditions. An adverse event is extremely unlikely to occur, but if an event were to occur, I will use the form for reporting Unanticipated Problems Involving Risk to Participants and Others.

18. Explain how participants' privacy is addressed by your proposed research. Specify any steps taken to safeguard the anonymity of participants and/or confidentiality of their responses. Indicate what personal identifying information will be kept, and procedures for storage and ultimate disposal of personal information. Describe how you will de-identify the data or attach the signed confidentiality agreement on the attachments tab (scan, if necessary). (Up to 500 words)

To ensure the rights and welfare of participants is protected I will not include the participants names nor the name of the airline the participant is employed by. I will include the position of the participant and key characteristics of the airline in the data collection.
19. Will audio-visual devices be used for recording participants? Will electrical, mechanical (e.g., biofeedback, electroencephalogram, etc.) devices be used? (Click one)

Yes

If YES, describe the devices and how they will be used:

Yes, I will use a device, such as an iPhone or tablet, to record the interviews. The audio files will be stored in an online Box folder. A commercially available transcription service will be used to transfer the audio file to a text tile.

20. Type of Review Requested

Expeditated

Please provide your reasons/justification for the level of review you are requesting.

The content of the interview will focus on the professional opinions of airline professionals and would be similar to discussions they would have during their normal work day. Permission to approach employees from any airline will be approved by airline senior leadership. Interviews will take place in an office setting (if in person) or by teleconference or video-conference. These safeguards ensure the participants is not exposed to any risks, mental psychological distress, or physical requirements beyond what would be experienced during their normal work day.

The interview does not include psychological intervention, physiological intervention, or deception. Employees of the airline would need to have post high school education, and this would ensure that no minors are included in interview population. Participants by subjects will not place them at risk for criminal or civil liability. Furthermore, participating in the interview will not damage subjects’ financial standing, employability, insurability, reputation, or cause them to be stigmatizing.

21. Please attach any recruitment flyers, letters, recruitment scripts, or other materials used to recruit participants. Attach informed consent, assent, and/or permission forms. If a consent form is not used, or if consent is to be presented orally, state your reason for this modification below. In cases where oral consent will be used, include the text to be used for the oral consent. *Oral consent is not allowed when participants are under age 18.

See Recruitment Email in Appendix B
See Dissertation Interview Consent Forms in Appendix C

22. If questionnaires, tests, or related research instruments are to be used, then you must attach a copy of the instrument at the bottom of this form (unless the instrument is
copyrighted material) or submit a detailed description (with examples of items) of the research instruments, questionnaires, or tests that are to be used in the project. Copies will be retained in the permanent IRB files. If you intend to use a copyrighted instrument, please consult with your research advisor and your IRB chair. Please clearly name and identify all attached documents when you add them on the attachments tab.

See Dissertation Interview Protocol in Appendix D
Appendix B: Recruitment Email

Hello:

I hope this email finds you well. I am a candidate in the PhD in Leadership and Change program at Antioch University. As part of this program, I am performing research to better understand the critical elements of successful engine OEM engagement with airlines in Africa, specifically in the context of AD & SB compliance as well as sharing of best practices for both maintenance and inspection tasks.

I am reaching out to invite you to take part in an interview. You were selected to take part in this study based on the fact you work for an airline in Africa, specifically within a maintenance organization. Also, due to the responsibilities of your position, you interact with engine OEMs on a regular basis. I am interested in understanding your experiences interacting with engine OEMs.

The interview will take place over the phone and will take between 30-60 minutes. I would like to focus on your experiences working with engine OEMs with regards to SB adoption and AD compliance as well as knowledge transfer of best practices related to maintenance and inspections tasks. I am interested in understanding how engine OEMs can improve engagement with airlines in Africa. I look forward to learning from your experience of what works and what does not work.

If you choose to take part in the interview, please do revert and we will set up a time to have the interview via phone call. I will also send a consent form for your review and signature. Thank you for your time. I truly hope you chose to take part. If you know anyone else who may be interested as well, please feel free to forward this invitation or provide me with their contact information.

You will find attached an interview consent form. Please complete the form, sign it, and return a scanned copy to me. Please let me know a specific date and time so I can schedule the phone interview.

Thank you

Best regards,

Nate Woods
Leadership and Change Program, PhD Candidate
Antioch University

M + [Redacted] | M +1 513 [Redacted]
Appendix C: Dissertation Interview Consent Forms

Consent Form (In-Person Interview)

You are being asked to take part in a research study aimed at understanding how OEM engagement with airlines in Africa reduces exposure to conditions that can lead to accidents and incidents. The interview will focus on effective elements of the OEM support during compliance with airworthiness directives, embodiment of service bulletins, sharing of best practices for inspection tasks, and sharing of best practices for maintenance tasks. You are specifically selected as you work for an airline in Africa and work in a role that requires engagement with an engine OEM. Please read the form carefully and ask any questions you may have before agreeing to take part in this study.

What the study is about: The purpose of this study is to better understand how engine OEMs effectively engage with airlines in Africa to facilitate compliance with airworthiness directives, embodiment of service bulletins, sharing of best practices for inspection tasks, and sharing of best practices for maintenance tasks. Proper and timely completion of these tasks can directly affect exposure to conditions that can lead to accidents or incident.

What is asked from you: If you agree to take part in this survey, I will conduct an interview with you in-person. The interview will include questions about experience with OEM support in the context of compliance with airworthiness directives, embodiment of service bulletins, sharing of best practices for inspection tasks, and sharing of best practices for maintenance tasks. During the interview you are encouraged to drive the discussion and discuss areas that you think are important elements of OEM engagement. The interview will be scheduled for 60 minutes but can go shorter or longer as needed. The interview location will be in an office setting, in a reserved conference room or office.

Risks and benefits: I do not anticipate any risks to you participating in this study other than those encountered in normal day-to-day life. There are not immediate benefits to you as a participant. Working for an airline is a very demanding job and I hope to learn how OEMs engagement can better support you.

Compensation: There is no compensation for taking part in this study.

Your answers will be confidential. All records of the interview, including interviewer notes, audio records, transcriptions of audio records, as well as this consent form will be kept private. Any report out made public, including the dissertation publication, will not include any information that identifies you. Physical research records, such as written notes, will be stored in a locked file. Digital research files, such as the audio recording, will be stored in a password control file on my computer. I am the only one that will have access to the records. After the audio file has been transcribe, it will be permanently deleted. I expect the audio file to be transcribed within three months of the interview.
Participation in voluntary. Taking part in this study is completely voluntary. You may skip any question that you do not want to answer. You may elect not to participate. If you decide to take part, you are free to withdraw at any time.

If you have questions: The researcher conducting this experiment is Nathan Woods. Please ask any question you have now. If you have questions later, you may contact Nate at +251 [redacted] or [redacted]@antioch.edu. If you have questions about your rights as a research participant, you may contact Lisa Kreeger at [redacted]@antioch.edu

You will be given a copy of this form to keep for your records.

Statement of consent. I have read the above information and have received answers to all questions I asked. I consent to participate in the study.

Your signature _________________________________ Date __________________________
Your name (printed) _____________________________________________________________

Recording the interview: With your permission, I would like to create an audio recording of the interview. As this is an in-person interview I will record the interview using my iPhone. The purpose of the audio recording is to make a written transcript of the interview using commercially available transcription software. Once the transcript has been created and checked for accuracy the audio file will be deleted. No identifying information will be included in the written transcript. This file will be used for reference and analysis. The digital file will be stored in an access-controlled folder. Please acknowledge your approval for the interview to be recorded by signing the second statement of consent at on the next page.

You will be given a copy of this form to keep for your records.

Statement of consent. I have read the above information and have received answers to all questions I asked. I agree to an audio recording of the interview.

Your signature _________________________________ Date __________________________
Your name (printed) _____________________________________________________________
Consent Form (Phone Interview)

You are being asked to take part in a research study aimed at understanding how OEM engagement with airlines in Africa reduces exposure to conditions that can lead to accidents and incidents. The interview will focus on effective elements of the OEM support during compliance with airworthiness directives, embodiment of service bulletins, sharing of best practices for inspection tasks, and sharing of best practices for maintenance tasks. You are specifically selected as you work for an airline in Africa and work in a role that requires engagement with an engine OEM. Please read the form carefully and ask any questions you may have before agreeing to take part in this study.

What the study is about: The purpose of this study is to better understand how engine OEMs effectively engage with airlines in Africa to facilitate compliance with airworthiness directives, embodiment of service bulletins, sharing of best practices for inspection tasks, and sharing of best practices for maintenance tasks. Proper and timely completion of these tasks can directly affect exposure to conditions that can lead to accidents or incident.

What is asked from you: If you agree to take part in this survey, I will conduct an interview with you over the phone. I will call you at a mutually agreed upon time at your preferred phone number. The interview will include questions about experience with OEM support in the context of compliance with airworthiness directives, embodiment of service bulletins, sharing of best practices for inspection tasks, and sharing of best practices for maintenance tasks. During the interview you are encouraged to drive the discussion and discuss areas that you think are essential elements of OEM engagement. The interview will be scheduled for 60 minutes but can go shorter or longer as needed. The interview location will be in an office setting, in a reserved conference room or office.

Risks and benefits: I do not anticipate any risks to you participating in this study other than those encountered in normal day-to-day life. There are not immediate benefits to you as a participant. Working for an airline is a very demanding job and I hope to learn how OEMs engagement can better support you.

Compensation: There is no compensation for taking part in this study.

Your answers will be confidential. All records of the interview, including interviewer notes, audio records, transcriptions of audio records, as well as this consent form will be kept private. Any report out made public, including the dissertation publication, will not include any information that identifies you. Physical research records, such as written notes, will be stored in a locked file. Digital research files, such as the audio recording, will be stored in a password control file on my computer. I am the only one that will have access to the records. After the audio file has been transcribe, it will be permanently deleted. I expect the audio file to be transcribed within three months of the interview.

Participation in voluntary. Taking part in this study is completely voluntary. You may skip any question that you do not want to answer. You may elect not to participate. If you decide to take part, you are free to withdraw at any time.
**If you have questions:** The researcher conducting this experiment is Nathan Woods. Please ask any question you have now. If you have questions later, you may contact Nate at +251 ___ or ___@_______. If you have questions about your rights as a research participant, you may contact Lisa Kreeger at ___@_______.

You will be given a copy of this form to keep for your records.

**Statement of consent.** I have read the above information and have received answers to all questions I asked. I consent to participate in the study.

Your signature __________________________________ Date ______________________
Your name (printed) _______________________________________________________

**Recording the interview:** With your permission, I would like to create an audio recording of the interview. As this is a phone interview, I will record the interview using my iPhone. The purpose of the audio recording is to make a written transcript of the interview using commercially available transcription software. Once the transcript has been created and checked for accuracy the audio file will be deleted. No identifying information will be included in the written transcript. This file will be used for reference and analysis. The digital file will be stored in an access-controlled folder. Please acknowledge your approval for the interview to be recorded by signing the second statement of consent at on the next page.

You will be given a copy of this form to keep for your records.

**Statement of consent.** I have read the above information and have received answers to all questions I asked. I agree to an audio recording of the interview.

Your signature __________________________________ Date ______________________
Your name (printed) _______________________________________________________
Consent Form (Zoom Interview)

You are being asked to take part in a research study aimed at understanding how OEM engagement with airlines in Africa reduces exposure to conditions that can lead to accidents and incidents. The interview will focus on effective elements of the OEM support during compliance with airworthiness directives, embodiment of service bulletins, sharing of best practices for inspection tasks, and sharing of best practices for maintenance tasks. You are specifically selected as you work for an airline in Africa and work in a role that requires engagement with an engine OEM. Please read the form carefully and ask any questions you may have before agreeing to take part in this study.

What the study is about: The purpose of this study is to better understand how engine OEMs effectively engage with airlines in Africa to facilitate compliance with airworthiness directives, embodiment of service bulletins, sharing of best practices for inspection tasks, and sharing of best practices for maintenance tasks. Proper and timely completion of these tasks can directly affect exposure to conditions that can lead to accidents or incident.

What is asked from you: If you agree to take part in this survey, I will conduct an interview with you using a video conferencing service called Zoom. There is no charge to use this software and requires you only to follow a secured link. We will schedule the interview for a mutually agreed upon time. The interview will include questions about experience with OEM support in the context of compliance with airworthiness directives, embodiment of service bulletins, sharing of best practices for inspection tasks, and sharing of best practices for maintenance tasks. During the interview you are encouraged to drive the discussion and discuss areas that you think are essential elements of OEM engagement. The interview will be scheduled for 60 minutes but can go shorter or longer as needed. The interview location will be in an office setting, in a reserved conference room or office.

Risks and benefits: I do not anticipate any risks to you participating in this study other than those encountered in normal day-to-day life. There are not immediate benefits to you as a participant. Working for an airline is a very demanding job and I hope to learn how OEMs engagement can better support you.

Compensation: There is no compensation for taking part in this study.

Your answers will be confidential. All records of the interview, including interviewer notes, audio records, transcriptions of audio records, as well as this consent form will be kept private. Please note that while the audio of the interview of the interview will be recorded, there will be no video recording or recording of images from the interview. Any report out made public, including the dissertation publication, will not include any information that identifies you. Physical research records, such as written notes, will be stored in a locked file. Digital research files, such as the audio recording, will be stored in a password control file on my computer. I am the only one that will have access to the records. After the audio file has been transcribed, it will be permanently deleted. I expect the audio file to be transcribed within three months of the interview.
Participation in voluntary. Taking part in this study is completely voluntary. You may skip any question that you do not want to answer. You may elect not to participate. If you decide to take part, you are free to withdraw at any time.

If you have questions: The researcher conducting this experiment is Nathan Woods. Please ask any question you have now. If you have questions later, you may contact 251 [redacted] or [redacted]. If you have questions about your rights as a research participant, you may contact Lisa Kreeger at [redacted]@antioch.edu.

You will be given a copy of this form to keep for your records.

Statement of consent. I have read the above information and have received answers to all questions I asked. I consent to participate in the study.

Your signature _________________________________ Date ____________________________
Your name (printed) ___________________________________________________________

Recording the interview: With your permission, I would like to create an audio recording of the interview. As this is a video conference interview, I will record the interview using the Zoom conference software. The purpose of the audio recording is to make a written transcript of the interview using commercially available transcription software. Once the transcript has been created and checked for accuracy the audio file will be deleted. Please note that video of the interview will not be recorded, nor will any still images be captured. No identifying information will be included in the written transcript. This file will be used for reference and analysis. The digital file will be stored in an access-controlled folder. Please acknowledge your approval for the interview to be recorded by signing the second statement of consent at on the next page.

You will be given a copy of this form to keep for your records.

Statement of consent. I have read the above information and have received answers to all questions I asked. I agree to an audio recording of the interview.

Your signature _____________________________________ Date ______________________
Your name (printed) ___________________________________________________________
Appendix D: Interview Protocol

The following protocol will be used during interview. Please note that interviews will not be scheduled until a signed consent form is provided. The consent form will include permission to audio record the interview.

At the beginning of the interview I will re-state that the purpose of this research is to better understand the critical elements of successful OEM-airline engagement in the context of AD & SB compliance as well as sharing of best practices for both maintenance and inspection tasks. I will reiterate why the interviewee was selected. Then I will explain that the interview is a semi-structured interview and that the interviewee is encouraged to discuss anything they feel is important. There is no right or wrong answer. I will start the interview by asking the pre-determined interview questions below.

Opening interview questions and probing / deepening questions

Q1: Describe your experience with engine OEM engagement in compliance of airworthiness directives.

Q2: Describe your experience with engine OEM engagement in embodiment of service bulletins.

Q3: Describe your experience with engine OEM engagement with the adoption of best practices related to inspection tasks

Q4: Describe your experience with engine OEM engagement with the adoption of best practices related to maintenance tasks.

Follow-up questions will be used to probe for the following purposes:

- Engage deeper discussion and exploration of a participant’s response
- Return a previous response or topic (for further exploration of the topic)
- Ask the participant to discuss the connection or relationship between two topics or responses previously discussed.
Appendix E: Sample Service Bulletin

SERVICE BULLETIN No. 31

DATE: 18 December 2000

REVISION: Orig.

AIRCRAFT: PITTS SPECIAL

SUBJECT: Propeller Accumulator

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Engineering aspects are FAA Approved.

1. EFFECTIVITY

Pitts S-2B equipped with Hartzell HC-C3YR/7690C Propeller (3 blade composite)
S-2C S/N 6001-6041 inclusive

2. PURPOSE

Accumulator Relocation

3. BACKGROUND

Hartzell Service Bulletin HC-HB-61-247 requires the relocation of the accumulator from
the bottom of the engine to an airframe location. The vibration level associated with the
engine has caused through bolts on the accumulator to fail. This bulletin provides
instructions for relocation.

4. COMPLIANCE

Within 10 flight hours or 30 days.

The current location of the accumulator must be changed to prevent damage and/or
possible failure of the accumulator and loss of engine oil and propeller control.
SERVICE BULLETIN No. 31

AVIAT AIRCRAFT INC.

5. INSTALLATION INSTRUCTIONS

NOTES: Refer to Appendix A for parts list.
Refer to figures in Appendix B for additional information.

A. Removal.
1. Remove engine cowling for access. Remove right side panel aft of firewall.
2. Remove 24" hose between propeller governor and accumulator. Hose will not be reused.
3. Remove accumulator and brackets from engine. Replace bolt through engine splint line. It will be necessary to use additional washers in order to tighten the bolt properly.
4. Remove attaching brackets from accumulator. These brackets will not be reused.

B. Preparation for Installation
1. Remove the nuts from the bottom bolts attaching the oil system inverter valve to the firewall. Pull the bolts back through the firewall.
2. Slide template #DT-7892 between the firewall and forward fuselage truss tubes in lower right quadrant. Labels on the template should be aft. Match the curve of the template to the curve of the firewall. Align the two holes that match the bolts removed from inverter valve. Slide the bolts through the firewall and template.
3. Position the SS-126-JJ-10 clamps on the inboard tube, and SS-126-JJ-12 clamps on the outboard tube per fig. 1. Assure that the holes in the clamps match the holes in the drill template. If the holes do not align properly, remove the inverter valve bolts from the template and slide template up or down slightly to obtain proper fit.
4. Drill 4 #10 holes through firewall at the points marked with DT-7892 template.
5. If the accumulator is not identified as P/N 8907-040, this should be changed per Hartzell Service Letter HC-SL-61-200. Apply placard B-6507-1 and adjust pressure to 15-25 psi.

C. Installation:
1. Install accumulator to brackets 2-9000-62 and 2-9000-63 as shown in fig. 1. Use AN507-1032R10 bolts with AN960-10 washers and AN365-1032C nuts.
2. Wrap electrical tape (2 wraps) around fuselage tubes to cushion JJ clamps. Bolt accumulator brackets to clamps through the firewall, heads fwd. Use AN3-13A bolts on the outboard bracket and AN3-12A bolts on the inboard bracket. Use AN960-10 washers on both ends, secure with AN365-1032C nuts.
3. Replace bolts and nuts removed from inverter valve.
4. Install AN823-6D fitting in fluid end of accumulator with flare end pointing up.
5. Install 00624-624040-6-0514 hose. Straight fitting attaches to fitting on accumulator. Route over top of engine intake pipes, through existing grommet on fwd. Baffle. Attach 45 degree end to governor fitting.
6. Secure hose with cushion clamps at engine mount tube, rear intake pipe and front intake pipe. Use MS21919-14 clamps on hose, -12 on engine mount tube, -28 on rear intake pipe and -35 on fwd intake pipe boss. Existing fuel hose may prevent use of the -35 clamp. In this case plastic tie wraps may be used. Secure clamps with AN526-1032R9 bolts, AN960-10 washers and AN365-1032C nuts.
E. Completion.
   1. Check all connections for proper fit and safety.
   2. Replace panels and cowling
   3. Run engine, cycle propeller and check for leaks.
   5. Make aircraft log entry to note maintenance performed referencing this service bulletin.
   6. Prior to return to service perform the requirements of FAR 91.407(b) including test flight of the aircraft to verify proper propeller operation, operational check of maintenance and log of the flight in the aircraft records.
6. ADDITIONAL INSTRUCTIONS

A. Weight and balance

The weight of the accumulator and brackets is 4.64 lb. The original location is 45” aft of Datum, the new location is 63.75” aft of Datum. Add 87 in-lb. to the moment weight of the aircraft, and divide by the empty weight to obtain new Empty Weight Center of Gravity.

B. Airplane flight manual

No changes.

C. Repetitive Inspections

None required. This is terminating action to Hartzell Bulletin HC-SB-61-247

E. Continuing Maintenance

## Appendix A
### Parts List

The following materials are required to accomplish this bulletin (Kit # S-2-525) and are available from Aviat Aircraft.

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<th>Part No.</th>
<th>Description</th>
<th>No. Rqd.</th>
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Appendix B
Illustrations

Figure 1
Accumulator Installation
Appendix C
COMPLIANCE LETTER

This is to certify that I have relocated the propeller accumulator in accordance with Aviat Service Bulletin 31.

Pitts S-2B/S-2C Serial Number: ____________

Registration: ____________

Date: ____________

Aircraft Total Time: ____________

Signed By: ________________

Title: ________________

Return one copy to: Chief Engineer
Aviat Aircraft Inc.
P.O. Box 1240
Afton, WY 83110

Fax # (307) 885-9674

and second copy to: Federal Aviation Administration
Denver ACO
26805 East 66th Avenue, Room 214
Denver, CO 80249-6361

Fax # (303) 342-1088
Appendix F: Permissions to Use Copyrighted Material

Figure 2.3

Dear Nathan Woods,

Thank you for your request. I am pleased to report we can grant your request without a fee as part of your dissertation.

Please accept this email as permission for your request as you’ve detailed below. Permission is granted for the life of the edition on a non-exclusive basis, in the English language, throughout the world in all formats provided full citation is made to the original SAGE publication. Permission does not include any third-party material found within the work. Please contact us for any further usage of the material.

If you have any questions, or if we may be of further assistance, please let us know. Good luck on your dissertation!

Kind Regards,
Mary Ann Price
Rights Coordinator
SAGE Publishing
2600 Virginia Ave NW, Suite 600
Washington, DC 20037
USA

From: Nathan Woods
Sent: Thursday, October 31, 2019 4:10 AM
To: permissions (US)
Subject: Fwd: Request for use of copyrighted material in dissertation (McCann, J. E. (1983))

SAGE Publications

By way of introduction, I am a PhD candidate in Antioch University’s Graduate School of Leadership and Change. I am currently writing my dissertation and would like to use a figure I created/adapted from the findings presented in the referenced publication in the literature review section of my dissertation. I have included the adapted figure (see below)

This dissertation will appear in the following locations:

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2. OhioLink Electronic Theses and Dissertations Center and that OhioLink ETD Center is an open access archive https://etd.ohiolink.edu/
3. AURA: Antioch University Repository and Archive and that AURA is an open access archive. http://aura.antioch.edu/

Publication:

Figure to be used:

Best regards,
Nate Woods
Leadership and Change Program, PhD Candidate
Antioch University
Figure 2.4

Nate Woods
Senior Customer Support Manager
GE Aviation

From: permissions (US)
Sent: Tuesday, November 12, 2019 10:40 PM
To: 
Subject: EXT. Rightslink ticket 501523441

Dear Nathan Woods,


Please accept this email as permission for your request. Permission is granted for the life of the edition on a non-exclusive basis, in the English language, throughout the world in all formats provided full citation is made to the original SAGE publication. Please indicate that the material was adapted. Permission does not include any third-party material found within the work.

As permissions have been granted via this email, we will cancel your Rightslink order. If you have any questions, or if we may be of further assistance, please let us know.

Kind regards,

Mary Ann Price
Rights Coordinator
SAGE Publishing
2660 Virginia Ave NW, Suite 600
Washington, DC 20037
USA

SAGE Publications

By way of introduction, I am a PhD candidate in Antioch University's Graduate School of Leadership and Change. I am currently writing my dissertation and would like to use a figure I adapted from the following publication in the literature review section of my dissertation. I have included the adapted figure (see below)

This dissertation will appear in the following locations

a. Proquest Dissertations and Theses Database and that Proquest is a Print on Demand Publisher
http://www.proquest.com/products-services/podt.html
b. Ohiolink Electronic Theses and Dissertations Center and that Ohiolink ETD Center is an open access archive https://etd.ohiolink.edu/
c. AURA: Antioch University Repository and Archive and that AURA is an open access archive.
http://aura.antioch.edu/

Publication:


Figure to be used:
For Figures 2.6, 2.7 and 5.3.

Hi Nathan,

Thanks for your interest in our work, and I am glad that you find our thinking useful. Figures in that paper are free to use with the proper reference. The owners of the copyright of that paper are David and myself.

I hope this helps,

Luis

_________________________
Luis F. Luna-Reyes
Associate Professor
University at Albany
Departments of Public Administration and Information Science
Faculty Fellow, Center for Technology in Government
135 Western Avenue
Albany, NY 12222, Mline 315
Ph.
Email: 

From: Nathan Woods <>
Sent: Saturday, October 26, 2019 11:13 AM
To: Luis Felipe Luna Reyes < >; 
Subject: Fwd: Request for use of copyrighted material in dissertation

Dear Luis,

Dear David,

By way of introduction, I am a PhD candidate in Antioch University’s Graduate School of Leadership and Change. I am currently writing my dissertation and would like to use a figure from the below reference, for which you are the authors, in the literature review section of my dissertation. I would also like to use an adapted version of this figure in Chapter 5 of my dissertation. I have included the adapted figure (see below).

This dissertation will appear in the following locations

a. Proquest Dissertations and Theses Database and that Proquest is a Print on Demand Publisher

   http://www.proquest.com/products-services/psdt.html

b. Ohiolink Electronic Theses and Dissertations Center and that Ohiolink ETD Center is an open access archive

   https://etd.ohiolink.edu/

c. AURA: Antioch University Repository and Archive and that AURA is an open access archive.

   http://aura.antioch.edu/

I am not sure who the copyright owner is. Could you please help point me in the right direction. Thank you.

Reference:


Best
Regards,

Nate Woods

Leadership and Change Program, PhD Candidate
Antioch University
M +251 935 987 013 | M +1 513 240 8741

Figure as adapted in Chapter 5: