Investigating the Trends of Transport Category Maintenance Operations and its Effect on Aircraft Safety and Security

by

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A Research Project

Submitted to the Worldwide Campus

In Partial Fulfillment of the Requirements

of Course AMNT 490, The Aviation Maintenance Capstone Course,

for the Bachelor of Science in Aviation Maintenance Degree

Embry-Riddle Aeronautical University

May 2016

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Abstract

Transport category heavy airframe maintenance was traditionally performed by the airline or in the case of smaller operations, was outsourced to domestic maintenance repair organizations. A series of events beginning with the Airline Deregulation Act of 1978, the revision of federal aviation regulations to allow the certification of foreign repair stations, terrorist attacks, and airline bankruptcies has resulted in a large portion of that work being outsourced and offshored. The airlines have realized significant savings from this practice and have also divested a majority of their maintenance infrastructure in the process. Certain safety items including human factors issues affect the quality of maintenance; there have been isolated incidents in the U.S. that have been directly attributable to outsourced or offshored maintenance that have resulted aircraft accidents. The practice of offshoring airframe heavy maintenance reduces the supply of qualified maintenance personnel for domestic operations as those skilled are transferred to other industries when displaced workers seek new employment. The Federal Aviation Administration (FAA) has also surrendered its enforcement ability to local authorities through bi-lateral agreements. This trend can be reversed through either economic incentives, taxes or other legislative remedies to bring the work back within the continental U.S. and under the oversight of the FAA and to increase safety and the supply of qualified maintenance personnel.

Investigating the Trends of Transport Category Maintenance Operations and its Effect on Aircraft Safety and Security

The airlines have traditionally accomplished their own heavy maintenance in-house. It was viewed as an investment in the equipment to get the longest usable life out of the aircraft, and ensured there was direct control over the processes and the quality of the work. The smaller operators, such as on demand charters, could not justify the infrastructure for a maintenance program and their heavy aircraft maintenance was usually contracted out to domestic operations. These domestic maintenance repair organizations (MROs) were still subject to surprise inspection by the Federal Aviation Administration (FAA), this guaranteed a certain level of oversight by the operator. This would change beginning with the implementation of the Airline Deregulation Act of 1978.

Deregulation of the United States airlines created certain market conditions that eliminated the guarantee of an operating profit. Fares and routes were no longer dictated by the Civil Aviation Board, airlines were left to the mercy of the free market which caused them to reexamine their business models and attempt to reduce their operating costs as much as possible. Many of the airlines were forced into bankruptcy , merged with their competitors, or ceased operations entirely. Those that did survive had to reduce their fixed costs to remain competitive; items that were previously seen as an asset to the operation were now viewed as a liability. The airlines attempted to separate the business of air travel as much as possible from the expense of aircraft maintenance. This separation could only be accomplished certain ways in the heavily unionized aviation sector and the primary tool was using layoffs, followed by the bankruptcy courts when the bargaining agent refused to capitulate to the company’s demands. The aircraft

still required maintenance, but it was being shifted to domestic MROs to reduce costs. This caused an expansion of the domestic MRO companies until the FAA revised FAR §145.71 to allow the certification of foreign repair stations in 1988.

Foreign repair stations have a cost advantage over domestic operations through the use of uncertificated mechanics, lax labor laws, and a lack of effective oversight by the FAA. This resulted in the airlines shifting a significant portion of their heavy aircraft maintenance to these operations. This trend has reduced costs for the aircraft operator, but it has introduced a higher risk into the safety equation. This increased risk exposes the aircraft, its passengers, and the crew to a dangerous situation that could result in a catastrophe. The following project will investigate the cascade events that allowed transport category operators in the United States to shed their maintenance operations and shift the work overseas. The safety issues associated with the offshoring of the work and what measures the operators have taken, if any, to correct the deficiencies. Bilateral safety agreements will be analyzed, including the use of local authorities to perform the inspections on behalf of the FAA. Publicly available information will be analyzed to trace the amounts spent on maintenance and to correlate it with the change in regulations demonstrating there has been a concerted effort by the airlines to divest their maintenance infrastructure in favor of overseas operations.

The supply of mechanics will be analyzed to determine if there is a correlation between the skills drain that has become prevalent in aviation and its relationship to the practice of offshoring of aircraft heavy maintenance. This will be accomplished with U.S. Bureau of Labor and Statistics and Depart of Transportation data related to the number of aircraft mechanics working in the field and the projected growth of the job classification in the industry.

The Airline Deregulation Act of 1978

The Airline Deregulation Act of 1978 was a defining moment in the history of air travel in the United States. Before it was enacted the airlines were highly regulated as to what routes they could fly, how much to charge for a ticket, and the frequency of the flights (Smith & Braden, 2008). This changed after deregulation, profits were no longer guaranteed and the airlines now had to compete on the price of the ticket. This brought the market forces to bear on what was once a highly regulated industry, which has resulted in over 150 bankruptcies or cessation of operations for the airlines (Morris, 2013). Competition is the hallmark of the American economic system, so it was only natural that it was extended to the air transportation sector, but the law of unintended consequences took over. With profits no longer guaranteed, the airlines began a boom-bust cycle that continues to this day, this has caused them to examine their business model and to cut costs as much as possible to allow them to continue to operate.

This cascade event had far-reaching consequences beyond the lowering of fares and fostering of competition. Initially there was an expansion among the airlines in an effort to gain market share, total employment for the industry increased from 408,000 in 1978, to 455,000 in 1981 (Goodman, 2000). This may be seen as a good trend but most of the growth in these jobs occurred not in the maintenance department but in the passenger service sectors such as baggage handlers, flight attendants, and gate agents to meet the increase in passengers due to lower airfares (Goodman, 2000). The Bureau of Transportation statistics reports that as of February 2016, total airline employment including full and part-time jobs is approximately 617,000 jobs in the United States (2016). There has been considerable growth in the airlines because of the Act, but it has also created much turmoil in the industry resulting in the bankruptcy or consolidation of many airlines into just a handful of major operations creating an oligopoly.

Bankruptcies and Consolidations

Before deregulation, an airline bankruptcy was a rare event, as of 2011 there have been 189 airline bankruptcies which include both chapter 7 liquidation and chapter 11 reorganization (Bemis, 2011). Several major mergers have also taken place resulting in just 4 major airlines in the United States. These bankruptcies and consolidations have resulted in the reduction of domestic heavy aircraft maintenance operations in favor of less expensive offshore operations. United Airlines entered bankruptcy in 2002; the following year they shuttered their Indianapolis and Oakland maintenance bases while also negotiating the ability to outsource all of their heavy aircraft maintenance (Chandler, 2003). United's wide body heavy aircraft maintenance went to China two years later, by 2007 almost 75% of all aircraft heavy maintenance was contracted out to offshore organizations (Rentz, 2011).

American Airlines has also taken a similar path but they were the last legacy carrier to file for bankruptcy (Davies, 2011). When American began the process of reducing its workforce, the hardest hit were the mechanics with targeted job eliminations of 4,600, the closure of its Fort Worth, Texas maintenance facility, and a reduced headcount at its main maintenance facility in Tulsa, Oklahoma (Gavett, 2012). The Fort Worth maintenance base had two separate operations at the location. The company performed wide body heavy maintenance and had a joint venture with Rolls Royce Aero Engines to perform engine overhaul for American and other airlines. The announcement by American that they would be moving their wide body maintenance to China occurred within a year of filing for bankruptcy (Gordon, 2012). Rolls Royce would later end the joint venture with American and shut down their facility in 2016 resulting in additional job reductions at the carrier (Ahles, 2015). This was due to decreasing demand for the engine types that were serviced at that facility.

Bankruptcy filings are the main tool used by the airlines to shed their in-house heavy aircraft maintenance operations. Delta, Northwest, United, and U.S. Airways all used the bankruptcy process to shed their in-house heavy maintenance operations and infrastructure in favor of offshore operations (Tang & Elias, 2012). This trend represents a paradigm shift in the industry, it shows that their in-house maintenance programs that were once treated as an asset to the operation are now considered a liability that affects the bottom line of the company. The divestment of the maintenance programs did not happen immediately after deregulation or the revision of 14 Code of Federal Regulation §145.71, but did occur due to prevailing economic conditions when then bankruptcies were filed, once those cost savings were realized there was little chance of reversing course.

Labor Strife

The airlines in the United States are one of the most heavily unionized sectors of the transportation industry; it was placed under the jurisdiction of the Railway Labor Act in 1936. The Act is designed to prevent disruptions to the transportation system and to set forth rules for the negotiation of labor contracts. This makes it difficult for the bargaining agent to seek self-help during contentious negotiations. The last strike at a major airline in the U.S. was the American Airlines flight attendants strike in November 1993 that lasted four days, there has not been a significant labor disruption in the industry since then (Reed, 2013). Labor disruptions in the airline maintenance sector are an even rarer occurrence because of the Railway Labor Act and the process to get released from negotiations. The last significant mechanic strike at an airline was at Northwest where the mechanic and related employees represented by the Airline Mechanics Fraternal Association (A.M.F.A.) struck over proposed pay cuts to prevent bankruptcy of the airline (Maynard & Peters, 2005). The following month Northwest filed for

bankruptcy, and emerged almost 2 years later (Freed, 2007). The airlines may claim that uncertainty during labor negotiations and strikes are the reason for the offshoring of heavy aircraft maintenance, the evidence proves the contrary, that the labor strife is a result of the airlines demanding concessions from the workforce and the decision to send the work overseas had most likely already been made.

Revision of FAR §145.71

In 1988, the Federal Aviation Administration issued a significant revision to the Federal Aviation Regulations (FAR). This revision allowed the certification of foreign repair stations to perform work on U.S. registered aircraft (U.S. Government Publishing Office, 1998). This was a significant step in the globalization of the U.S. aviation industry. Airlines were no longer restricted to domestic Maintenance Repair Organizations (MROs) and could seek even greater cost savings with overseas operations. The effect was negligible at first, only a small number of aircraft were initially sent offshore for heavy maintenance and they were approaching the end of their useful life. The terrorist attacks on September 11, 2001 dynamically changed the way airlines do business. By 2005, all of the legacy carriers had declared bankruptcy or merged with the exception of American Airlines, which did not enter bankruptcy until 2011 and then subsequently merged with U.S. Airways (Airlines for America, n.d.).

FAR §145.71 allowed foreign MROs to compete directly with domestic operations as they could now be certificated by the FAA to work on U.S. registered aircraft. The shift from domestic operations to foreign organizations began to accelerate, as the airlines had to reduce operating costs as much as possible. This resulted in an expansion of foreign MROs mainly in China, Mexico, and Central America. These countries offered a significant savings over domestic operations because of the lower labor costs in those areas.

The Rise of Foreign Maintenance Repair Organizations

The business of aviation maintenance has turned into a globally interconnected industry. No longer do aircraft have heavy maintenance performed in their primary area of operation, instead airlines prefer to use offshore operations that have a reduced cost. Since 2002, worldwide spending on MROs was estimated to be 20 to 30 billion dollars and is projected to grow to 65 billion by 2020 (McFadden & Worrells, 2012). Most of this projected growth will occur in China, India and Asia for the wide body aircraft while the majority of narrow body aircraft from North America will go to Mexico and Central America (McFadden & Worrells, 2012). This may seem like the natural progression of a global industry, in reality it is a technology and skills transfer from more affluent and technologically advanced countries to the lesser ones to lower costs.

China is currently the center of investment for MROs; they are experiencing annual growth rates of 8.1%, almost twice as much than their nearest competitors in the Asia- Pacific region (Asian Aviation, 2013). Mexico is one of the largest centers for the offshoring of work in the Western Hemisphere. MROs in Mexico are primarily concerned with servicing narrow body aircraft, Delta Tech Ops has joined forces with Groupo Aeromexico to invest in an operation in Queretaro, Mexico (Couret, 2014). The Chinese MROs are reaching saturation and they no longer give a cost advantage as their wages began to climb at the rate of 10% per year, in addition domestic airline operations have increased creating competition for the available hangar space (Perret, 2015). This has caused an expansion of the MROs in Central America, Aeroman and Coopesa in El Salvador are investing in new wide body hangers to capture some of the market that traditionally went to Asia (Shay, 2015). While the Chinese MRO market begins to tighten up, Hong Kong Aircraft Engineering Company (HAECO) has bought TIMCO Aviation

Services (TIMCO) in the U.S. to expand operations into North America (Shay, 2013). It is unknown if this represents a resurgence in the domestic MRO market as TIMCO is primarily concerned with narrow body airframe maintenance while HAECO concentrates on wide body aircraft. MRO growth in the North American market is expected to be relatively flat from $19.9 to $20.6 billion (B) through the year 2023 while markets in Africa will almost double from $5.5B to $9.2B; Asia will see significant growth from $13.9B to $24.3B, and Europe will expand from $16.9B to $21.8B (Team SAI, 2013). The relatively small growth in the U.S. MRO market is most likely due to the rapid fleet modernization that is taking place among the legacy carriers as newer aircraft have lower maintenance costs than the previous generation of passenger aircraft. This growth in new aircraft are being offset by lower fuel costs that are allowing the older, less fuel-efficient aircraft to remain flying thus slowing down investment in new technologies and replacement aircraft by the smaller carriers in the U.S. (Wall, 2015). These smaller carriers are traditionally heavy users of MROs.

Divestiture of Maintenance Infrastructure

Once an airline begins to experience financial difficulty it attempts to lower its fixed costs as much as possible, the maintenance infrastructure is typically the first casualty. Hangers are fixed assets that can be expensive to staff and maintain, and when the heavy aircraft maintenance is offshored, they are no longer needed. This pattern is predictable and has been repeated at the various airlines that have had financial difficulty or entered bankruptcy. Continental Airlines started the process when they began to experience financial problems in the 1990’s and closed both their Denver and Los Angeles facilities in an effort to cut costs (The New York Times, 1994). Shortly after the 9/11 terrorist attacks airlines began to shrink their operations to deal with the economic conditions. Northwest Airlines was one of the first to begin

this divestiture of its maintenance assets in an attempt to reduce costs by closing its Atlanta facility (Catlin, 2002). One year later United closed its Indianapolis facility which not only performed airframe maintenance but also engine overhauls (O'malley, 2010). Delta began to close its maintenance facilities in 2004 and ultimately entered into bankruptcy along with Northwest before their merger (Foust, 2009). Since American was the last legacy carrier to enter bankruptcy, they did not begin to shed their maintenance infrastructure until shortly before entering bankruptcy and began with closing the Kansas City maintenance base they acquired with the purchase of TWA (Maxon, 2010). The closing of the Alliance airport maintenance hangars in Fort Worth followed three years later; the engine overhaul facility ceased operation three years after the hangars shut down (Ahles, 2015). The rate of savings by the outsourcing of maintenance can be determined by looking at an airline's respective Securities and Exchange Commission 10K filings. For example American Airlines reduced their costs by 7.9% in 2015 by increasing their outsourcing and reducing the maintenance infrastructure when compared to 2014 levels (2016). After the legacy carriers shut down their maintenance operations, most of the work is outsourced to either domestic or offshore MROs and since the airlines have also shed those maintenance facilities, it is unlikely that the work will ever return.

Lack of Oversight by FAA

Domestic MROs are subject to surprise inspections by the FAA; this is not the case with foreign operations. They are required to be inspected annually and certificates are initially issued for one year and after a satisfactorily passing a review period it is extended to every two years (Federal Aviation Administration, 2015). The problem is that there can be no spot inspections due to the necessary cross border cooperation between the local authorities and the FAA, inspections are therefore never by surprise and the MRO has advanced notice to address any

issues that may be a problem beforehand. There are over 700 certificated foreign repair stations that must be inspected by the FAA and the average number of inspections done by a single inspector annually is approximately 15 (Federal Aviation Administration, 2015). Even with the advent of bi-lateral safety agreements, there is still cause for concern because of the reduction in the number of inspectors for foreign repair stations (Office of the Inspector General, 2015). In 2005, there were 23 FAA safety inspectors and two field offices in Europe, as of 2015 there are none (Office of the Inspector General, 2015). Similar to the airlines, the FAA has shifted its burden of responsibility over to a foreign entity.

These bi-lateral safety agreements are also for Singapore and Canada, and are known as Maintenance Implementation Procedures, they allow the inspection of FAA approved repair stations by local authorities. The problems with oversight of the European Aviation Safety Authority (EASA) inspecting on behalf of the FAA are alarming since they have a mature and robust inspection program. These problems are magnified in Asia as they are experiencing growth in their MRO industry at twice the rate of other areas (Perret, 2015). This lack of oversight is directly caused by the FAA's shortage of inspection personnel and a switch to risk based model for inspection procedures (Scovel, 2009). The risk based model is faulted as it relies on the carriers own internal audit data in addition to previous inspection records (Scovel, 2009).

The inspection problems will increase in severity as airlines continue to search out the lowest cost provider of maintenance services. Once the available hangar space for MRO operations in Asia and the European Union (EU) becomes congested and the workforce becomes more affluent, costs will rise. Narrow body aircraft in the western hemisphere will most likely remain in the Americas, but the operational range of wide body aircraft will allow the carriers to seek out maintenance operations in developing countries that will make it difficult for the FAA

to inspect the facility or to ensure the safety of the aircraft. The globalization of aircraft maintenance has reduced costs for many operators, but it is only a temporary solution until the next financial cycle that will start the offshoring problem over again causing the FAA to adapt its oversight to deal with the conditions.

Agreements with Foreign Authorities

To address the problems associated with the inspection of foreign repair stations the FAA has enacted bi-lateral Maintenance Implementation Procedures (MIPs). They allow the local aviation regulatory agency to inspect the repair station on behalf of the FAA. This requires special training as the inspection process may vastly differ between the inspecting agency and that of the FAA (Office of the Inspector General, 2015). The FAA has several MIPs but the most notable ones that affect the American transport category airlines are with the Singapore, Canadian, and EU aviation authorities. Singapore is of the greatest concern as it is the most recent agreement so the inspectors will not have a mature program for dealing with FAA related issues (Federal Aviation Adminstration, 2016). The effectiveness of these agreements are in doubt as the U.S. Department of Transportation's Inspector General has expressed concern over the inspection procedures and the identification of deficiencies by the local authorities (2015).

The initial bi-lateral aviation agreements began approximately 20 years ago with France, Germany, and Ireland and then expanded to the EU and other nations (Office of the Inspector General, 2015). It may have appeared as a solution to solve the problem of the manpower shortage within the FAA but using local authorities to perform the inspection also introduces bias into the process. There is a vested interest in keeping the operation going for the benefit of the local economy, even though there may be an element of surprise introduced into the inspection process there is some doubt as to the integrity of the system. The only way to correct this

deficiency is to reintroduce FAA inspectors into the equation to oversee the inspection of foreign MRO's. This will guarantee the integrity of the system and compliance by the repair stations.

Human Factors Issues at Foreign MROs

Human factors issues at foreign repair stations are of great concern, particularly in areas that have lax labor laws. In addition, many of the specific tasks that are required to maintain the aircraft are not performed in any other industry. The maintenance manuals are printed in English, this can cause procedural and translation errors resulting in the maintenance performed incorrectly. The issue with maintenance errors is that they may not materialize immediately and will not cause problems until long after the repair has been completed.

One of the most prevalent human factors issue at foreign repair stations is the language barrier (Ma, Dury, & Marin, 2010). The highest misunderstood translation errors occur in Asia with an error rate approaching 60% (Ma et al., 2010). The highest rate for misunderstanding an doucment that is in English occurs in the EU with an error rate that exceeds 75% (Ma et al., 2010). Language problems may be the most visible human factor but when combined with others it increases the chance for errors exponentially. The lack of technical training has also become a problem in the MRO industry. The rapid expansion of the sector has caused a shortage in the foreign markets of qualified mechanics. The labor rates may be lower but in some countries political connections and graft allow certain connected families to obtain jobs in companies that they are not qualified for (Tang & Elias, 2012). Aviation is one of the few industries where the workforce must not only be technically skilled, they must also have an education level that is higher than the average worker due to the nature of the tasks that need to be completed.
What may appear to be bargin for an airline may actually cost them more because of the rework that is required ensure the airworthiness of the aircraft once it retruns to domestic operations. As

aircraft become more advanced, human factors issues become more important to the safety of the aircraft.

The Transportation Security Agency and Aircraft Maintenance

The Transportations Security Agency (TSA) plays an important role in securing aircraft maintenance facilities. The TSA has just recently issued rules concerning the security of foreign MROs almost 10 years after they were directed by Congress to do so (Lynch, 2014). These new rules force the repair stations that are located on an airport to adopt certain security measures in order to maintain their certification (Lynch, 2014). These items include background checks, drug and alcohol testing, and security risk assessments (Civil Aviation Security, 2016). This rule making was five years overdue as the FAA was forced to stop issuing repair station certificates to foreign MROs until the TSA implemented the new rules (Lynch, 2014). This ban had the effect of limiting the use of offshore heavy maintenance as they were already approaching saturation, this caused several companies to use current FAA approved facilities in the U.S. thus increasing their costs (Broderick, 2013).

The effectiveness of the rules are still in doubt as they were partially influenced by the Aeronautical Repair Station Association (ARSA) as their vice president of legislative affairs, Daniel B. Fisher, was appointed to the Aviation Security Advisory Committee (ARSA, 2015). It may be common practice to get input from industry representatives concerning new legislation, it is unwise to give the MRO industry's trade association a seat on the very committee that is responsible for crafting the rules they will have to operate by. A more effective method would be to use the party system much like the National Transportation Safety Bureau (NTSB) uses during an investigation. This will at least limit the industry's influence on rule making and prevent insiders from gaining influential positions on the very regulatory bodies that will be overseeing

certain facets of their operations. It may be beneficial to make other agencies concerned with aviation safety independent such as the NTSB is.

Effects on the Domestic Supply of Mechanics

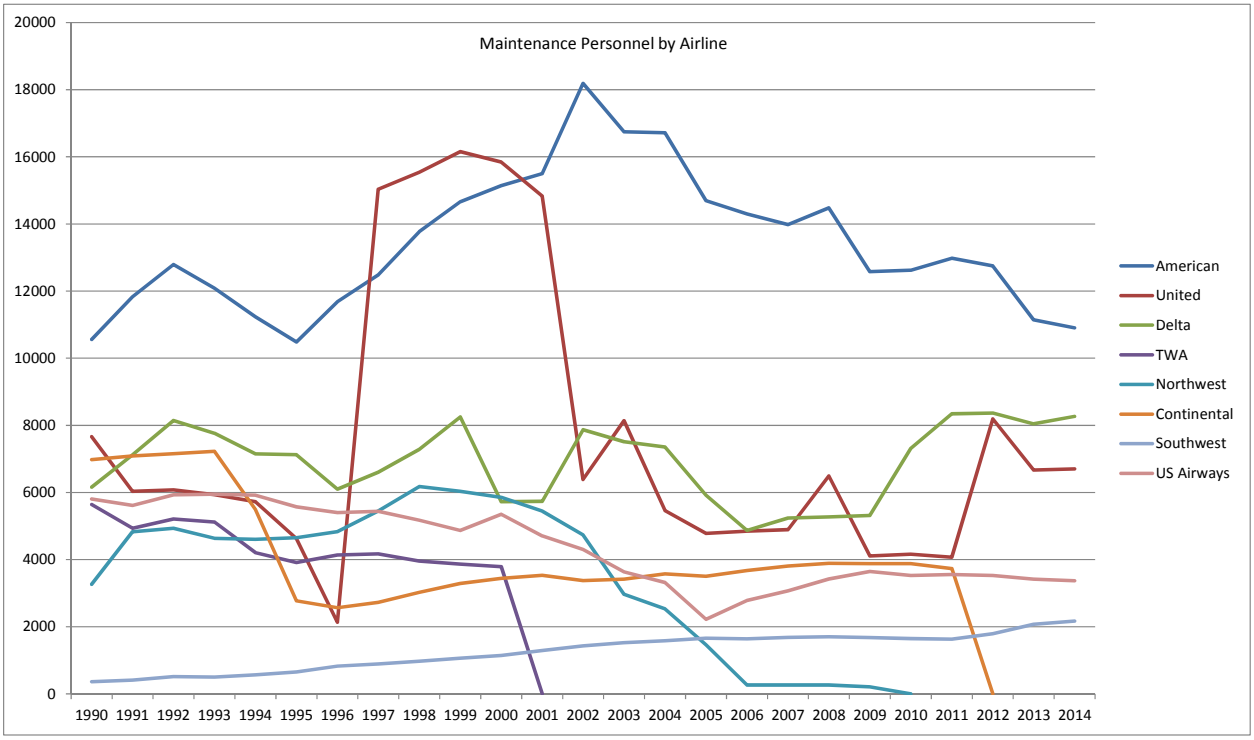

Figure 1: Data retrieved from U.S. Bureau of Transportation Statistics.

With the exception of two airlines, Southwest and Delta, the number of aircraft maintenance personnel has been in a steady decline. This is due to a combination of fleet modernization and headcount reductions through bankruptcies. Southwest has primarily used domestically provided outsourced heavy aircraft maintenance so the growth of their maintenance personnel is related to line operations (Bachman, 2008). Delta airlines are the second anomaly on the chart as they are also increasing their maintenance personnel headcount. This is primarily due to the expansion of the maintenance services division known as Delta TechOps that is based in Atlanta (Harty & Sloan, 2014). Delta's operation has turned into a profitable division for the airline while ensuring there are suffecient personnel to maintaint their fleet. This downward trend

in transport category maintenance personnel causes those that have been laid off to seek employment in other industries that covet the skills of an airicraft mechanic (Napert, 2012). This industry shift causes a reduction in the amount of available mechanics but wages have not risen to account for the percieved shortage which further discourages those from entering the field or returning from a layoff (Napert, 2012). The volatility of the airline industry has caused many individuals to forego a career in aircraft maintenance because of a lack of stability (Kinane, 2012). This presents a problem for the industry, in 2006 there were approximately 138,000 aircraft maintenance personnel, eight years later that number has remained largely unchanged with only a 1% expected growth in the field (U.S. Bureau of Labor Statistics, 2015). This lack of growth coincides with the prediction made by Team SAI consultants that projected a relatively flat growth in domestic MRO operations (2013).

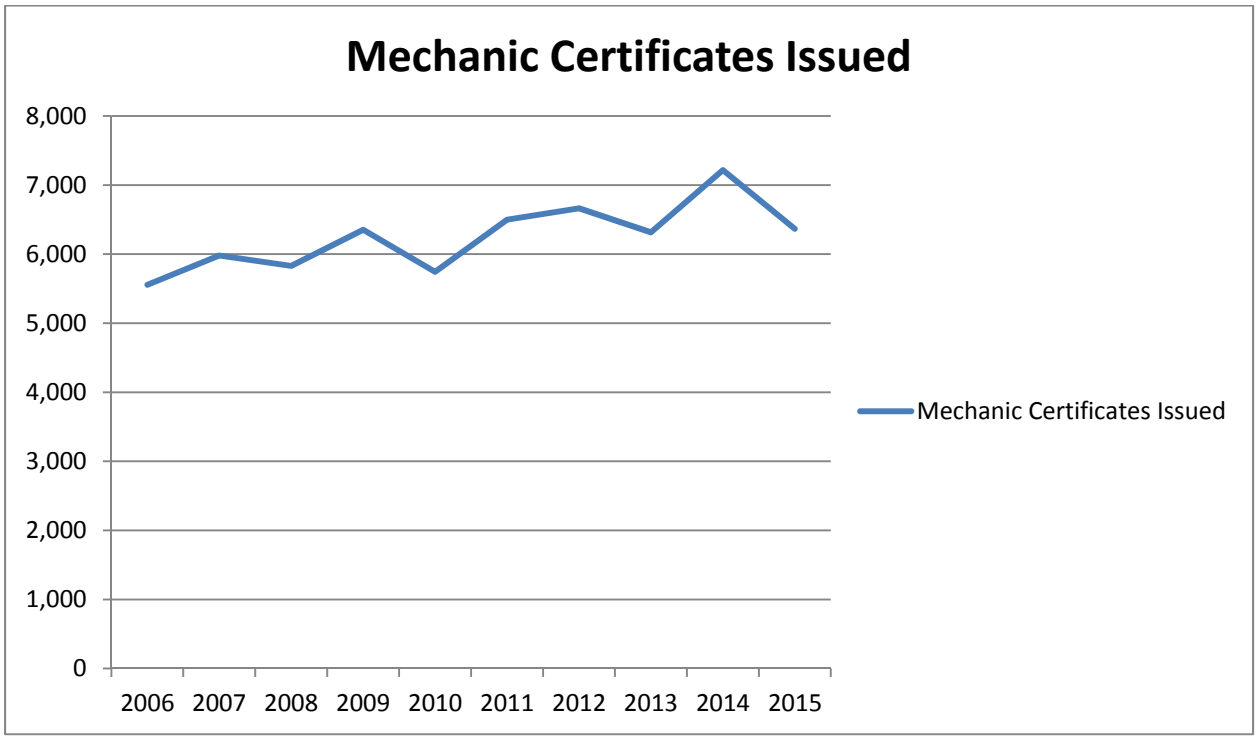

Figure 2: Data obtained from Federal Aviation Administration.

The current attrition rate for aircraft maintenance personnel is estimated to be from seven to ten percent annually (Kinane, 2012). This presents a problem as the number of certificate issuances does not keep up with that rate. From 2006 to 2014 the number of mechanics certificates that have been issued by the FAA was on an upward trend but began to decline again in 2015 (Federal Aviation Administration, 2016). The upward trend may be related to the cessation of foreign repair station certificates and a slight resurgence in the domestic MRO market as some of the larger maintenance bases abandoned by the airlines have been taken over by third party maintenance providers (O'malley, 2010). This may be only a temporary condition as the expansion of hangar space by Aeroman and other entities in Mexico and Central America will begin to capture more of the North American heavy narrow body airframe maintenance (Shay, 2015).

In the last five years domestic airlines have also embarked upon a fleet modernizaion program to replace their ageing aircraft with more fuel efficient ones. These newer aircraft do not require as much maintenance as their predacessors and airframe manufacturers are offering packages for the operator that include maintenance management services such as airframe overhaul (Airbus, n.d.). This of course reduces the operators need for maintenance infrastructure and personnel as a heavy maintenance base is no longer required for the operation of the airline. This shift to outsourced maintenance has not fully reached the line operations yet but if the trend continues it can be expected to occour. This will drive down wages as contractors will not pay as much as the airlines or offer the same benefits, thus making the jobs less desireable. Lower wages do not attract highly skilled people and they will seek out other opportunities in industries that offer more stability without the associated liability of being an aircrft mechanic. As the domestic airlines continue with the divestment of the maintenance infrastructure, the availability

of the aircraft mechanic jobs will continue to decline in transport category as more work is shifted to offshore operations. As the job field shrinks, it will make it less desireable for new entrants into the field thus decreasing the supply of available mechanics in the industry and causing a skills drain in the domestic market.

Accident Rates of Domestic Airlines

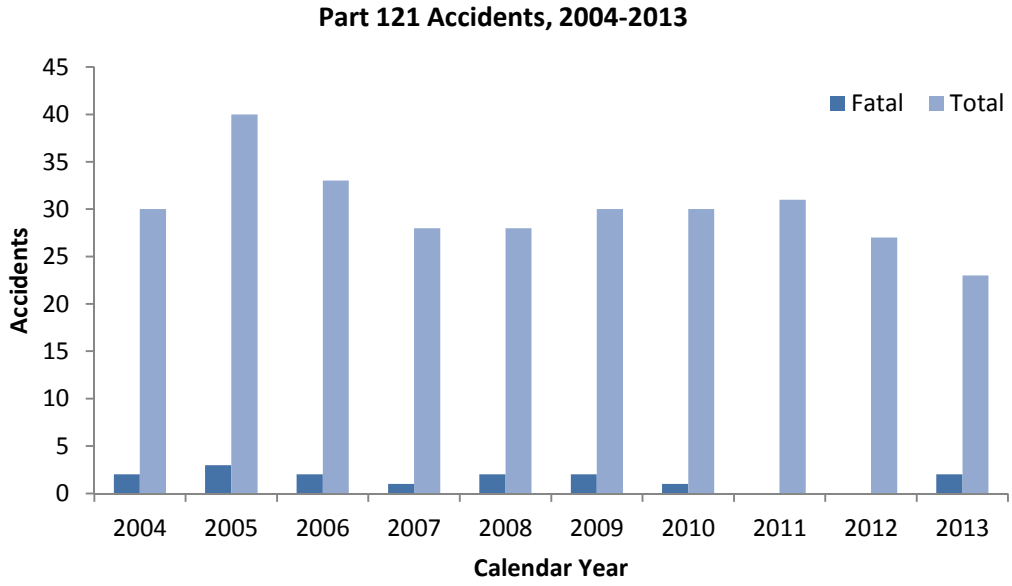

Figure 3: Data obtained from the National Transportation Safety Board

There have been some high profile aviation accidents related to both domestically outsourced and offshored maintenance while the main theme among them seems to be a lack of oversight by the operator and the FAA. Between 1995 and 2009, there were six separate incidents in the U.S. that have been directly attributed to outsourced or offshored aircraft maintenance that were investigated by the NTSB (Quinlan, Hampson, & Gregson, 2013). Interestingly, according to NTSB data, there is a downward trend in aircraft accidents, but this chart is limited to scheduled U.S. airlines. Unfortunately, the phenomenon of contracting out aircraft heavy maintenance is not unique to the American domestic airlines. Australia has also

offshored a large portion of its heavy aircraft maintenance industry and has discovered many problems associated with this practice (Hampson, Fraser, Quinlan, Junor, & Gregson 2015). The main problems that occur are most likely related to the ratio of certificated mechanics to non-certificated, this can be as high as 1:22 in the Phillipines down to 1:8 in Hong Kong (Hampson, et al., 2015). It would appear that the main cause of problems with the outsourcing and offshoring of aircraft heavy maintenance is a lack of oversight by the regulatory authorities and the carrier. The anomaly is that as the outsourcing of heavy airframe maintenance increased, the accident rate for U.S. airlines decreased. This data from the NTSB does not include findings by the airlines own maintenance personnel once the aircraft is returned for service.

Australian maintenance personnel have been some of the most vocal opponents concerning the outsourcing of maintenance. Although a crash has not been directly attributed to outsourced maintenance in that country for transport category aircraft, there have been reports of mechanics finding broken drill bits in the fuselage frames, glued on rivet heads, and other maintenance discrepancies once the aircraft comes back from overhaul at a foreign MRO (Hampson, et al., 2015). As long as the airlines continue to realize a significant costs savings by outsourcing their maintenance programs with a decrease in accident rates, this practice will continue.

Recommendations

It is unlikely that FAR §145.71 will be revised again to eliminate the certification of foreign MROs. Furthermore, there is not much that can be done to force the large airlines to reinvest capital into maintenance facilities and infrastructure but there are certain economic and legislative options available to bring that work back to domestic MROs. This will increase demand for domestic operations while at the same time offering opportunities for expanded

employment options for certificated mechanics. There are two types of economic incentives that will most likely be effective in bringing the work back to within the continental U.S. they can be in the form of tax credits or punitive measures such as tariffs. Congress could offer tax credits to the operation equal to the amount spent to have the aircraft heavy maintenance performed at a domestic MRO. This has the benefit of lowering the airlines overall taxes while also stimulating the local economy where the MRO is located. If tax credits do not entice aircraft operators to bring the work back to the U.S., they could institute tariffs on the aircraft equal to 150% of the value of the work done at a foreign MRO before it can return to service.

If taxes and tariffs are not successful, other legislative measures can be taken. For example, a majority of U.S. airlines participate in the Civil Reserve Air Fleet (U.S. Air Force, 2016). While participating in this program they are given preferential treatment as to the carriage of passenger and cargo for the Department of Defense (U.S. Air Force, 2016). Congress could amend the program to require that as a matter of national security that any aircraft that has been on the roster in the past 12 months or is currently participating in the Civil Reserve Fleet have their heavy overhaul maintenance performed within the continental U.S. This should shift a majority of the wide body overhaul back to the domestic MROs. To bring back a majority of the narrow body work would involve the U.S. post office and its contracts with the legacy airlines concerning the shipment of mail and cargo. The three remaining legacy airlines, American, Delta, and United have contracts with the U.S. Postal Service to haul a significant portion of mail across the country (Dastin, 2016). The Postal Service could stipulate in their contracts that any aircraft involved with the carriage of mail or cargo under contract must have the heavy maintenance performed within the continental U.S., these would be the same conditions for aircraft participating in the Civil Reserve Fleet. This would force the operators to make the

decision to bring the work back to within the borders of the U.S. if they wish to earn revenue from contracts with the government. These recommendations would expand the domestic MRO market while also increasing employment in the sector for aircraft maintenance personnel. The increased need for aircraft mechanics would most likely stop the skills drain to other industries or offshore operations while increasing employment opportunities in the domestic market. If none of the previous suggestions are successful then the FAA must increase their inspector headcount and reopen offices in the regions where a majority of the heavy airframe maintenance operations are concentrated such as China, Singapore, Mexico, Central America, and Europe. This would allow oversight and enforcement of FAA regulations by agency personnel without relying on local authorities under the MIP agreements.

Conclusion

With the push by the major airlines to modernize their fleets, the new aircraft will not need heavy airframe maintenance for at least three years. China is expanding their domestic fleet that will eventually occupy most of the MRO hangar space in that area. This will leave few choices for wide body aircraft operators, either return the work to domestic operations or seek out even more cost effective MROs in either India or Africa. The larger airlines have realized the costs savings from divestment of infrastructure and the offshoring of heavy aircraft maintenance, it is unlikely that they will rebuild that capability unless it becomes cost prohibitive to outsource.

The security of the aircraft while undergoing maintenance cannot be guaranteed. Although certain security measures may have been in put in place by the TSA at foreign MROs, with the current political climate and the expansion of terrorism, the effectiveness of these policies must be put in doubt. The majority of transport category operators will most likely not bring the work back unless there is some form of government enticement, intervention, or overt

action by a another entity that causes a major air disaster as a result of access while the aircraft is being serviced overseas. Aircraft maintenance has turned into a global operation, but to ensure the quality of the work, the supply of maintenance personnel, the security, and the safety of the aircraft, it would be beneficial to return a majority of heavy airframe maintenance to the U.S. for domestic airlines.

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