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FORUM

SUSPECTED UNAPPROVED PARTS IN THE AVIATION INDUSTRY: CONSIDERATION OF SYSTEM SAFETY AND CONTROL

Steven J. Sletten

It is well known and highly touted that there is a historically high level of safety in U.S. air transportation. The American traveling public has come to expect this level of safety in the skies. Key elements in maintaining this high level of air safety are specific federal regulations, along with Federal Aviation Administration (FAA) surveillance, inspection, and enforcement activities. The U.S. Code of Federal Regulations include a framework of rules governing the design, manufacture, and use of aviation products and parts. The rules are in place to assist the aviation industry in maintaining its excellent safety record, and serve as a means to prevent unwanted or suspected deficient parts from being used on aircraft.

In the early 1990s the FAA increased efforts to educate the public and its own inspectors regarding the potential safety threat posed by aeronautical parts that do not meet applicable design, manufacture, and maintenance requirements. In 1993, the FAA established the Suspected Unapproved Parts (SUP) Program to coordinate FAA efforts to minimize safety risks posed by the entry of "unapproved" parts into the U.S. aviation inventory and their installation on aircraft (Dept. of Transportation, 1995).

Even though the SUP Program was put in place, there was still concern within Congress, the Department of Transportation Office of the Inspector General (OIG), the public, and the FAA itself that the FAA's plan to regulation and monitoring aviation parts and enforcing the regulations was not comprehensive enough. The underlying concern was whether all parts installed on aircraft during preventive maintenance, routine maintenance, and alteration met all the necessary FAA requirements (Dept. of Transportation, 1995). If they did not, then safety may be compromised, and the degree in which the public's safety is potentially in peril is still up for debate.

The aircraft parts sales market is a \$45 billion a year industry, with growth occurring on a seemingly annual basis (Paige, 1999). Obviously, with so much money at stake, all types of people and companies attempt to get in the aircraft parts business as distributors and brokers. Some of these individuals are highly qualified, others are not. This is an area that the FAA has had difficulty in regulating, and where a breakdown in system safety processes often occurs. Greed is a strong force, and unscrupulous people are willing to sell aircraft parts that are knowingly not airworthy. These are unapproved aircraft

parts that can be a critical component to aviation safety.

Often, the reason why these parts are unapproved or "bogus" is because they are old parts that have been altered to look like new. Suspected unapproved parts (SUPs), now a euphemism for what was typically called "bogus parts", includes everything from totally counterfeit parts, to outdated parts passed off as new, to otherwise airworthy parts that somehow have been separated from their certification paper trail or are not manufactured according to FAA specifications (Paige, 1999). Any aircraft part that does not have the proper identification paperwork accompanying it is considered a suspected unapproved part, and should not be installed in an aircraft until proper testing is conducted.

Even parts that do have accompanying paperwork are suspect because inconsistencies in the information provided on the certificates leads to questioning the part's authenticity. The SUPs problem that the aviation industry currently faces is really brought on by the very nature of the industry itself. The control mechanisms that supposedly were there to prevent parts from getting back into the repair system were not heavily enforced by the FAA (Purdue University, 1995). Also, the air carriers' ability to sell parts back to brokers, or to scrap yards poses yet another problem, because these discarded parts are then re-sold back into the system (Dept. of Transportation, 1994).

Differing views exist concerning how significant the SUP threat may be to the aviation industry. One area that all will agree upon is that SUPs do exist, and have infiltrated into the aviation industry at manufacturing and maintenance facilities all across the country. The aviation industry as a whole has to come to grips with this issue. Although mechanisms have been put into place to prevent

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unapproved parts from being used, there is still more that can be done. This paper will examine some of the issues regarding suspected unapproved parts (SUPs) in the aviation industry, and explore how system safety may be compromised, regardless of how the regulations currently in place are implemented.

Discussion

One of the interesting difficulties with the concept of suspected unapproved parts in the aviation industry deals with the differing views and approaches of two Department of Transportation government offices. Principally, this difference of viewpoints revolves around the FAA and the Office of the Inspector General (OIG). The FAA has stated a position that unapproved parts do not pose a significant safety threat to the air transportation system. They cite the fact that the National Transportation Safety Board (NTSB) has indicated that not one commercial airliner accident in the United States has occurred due to unapproved parts (Purdue University, 1995). This is not to say that incidents have not occurred due to unapproved parts, but there is a distinction between aircraft "incidents" versus "accidents" in the lexicon of the aviation regulatory community. This distinction provides a justification by the FAA not to establish a high regulatory emphasis or funding on the suspected unapproved parts issue, at least to the level that the OIG would like to see (Purdue University, 1995).

On the other hand, the Office of the Inspector General (OIG) believes that unapproved parts, and even suspected unapproved parts, do pose a significant safety issue to the U.S. air transportation system (Purdue University, 1995). Not until relatively recently have aircraft parts been examined in such detail to determine how they serve as a "weak link" in the aviation safety chain. The OIG approach is that SUPs should be deserving of the same regulatory scrutiny as other air transportation safety issues such as weapons screening or crew resource management training. Because there is a contrast in opinion between these two government agencies, with the FAA seeming to believe that the OIG's office is on some sort of crusade, the two government bodies have not always cooperated in the most productive way. Management has not been jointly communicating with each other, influencing a system program implementation. The lack of any FAA regulatory "bite" has also allowed for aviation parts brokers and distributors to essentially have a free reign of the market place with out fear of retribution.

The civil and criminal penalties are also relatively light considering the number of deaths that could occur if a catastrophic parts failure took place in an airborne jetliner. In fairness to the FAA, there are regulations in place regarding specifications required by the machine shops that

manufacture aircraft parts, and the FAA certificate for these manufacturing operations allows standards to be recognized and set. Within the aviation industry, it is very important that parts have the proper FAA certifying paperwork accompanying them. It is this industry's "good house keeping seal" standard that is sought to determine if a part is airworthy. This allows all people buying and utilizing a particular part to have some assurance that the part is authentic and has met certain engineering criteria regarding part integrity and quality. However, like other certification programs, there are ways to circumvent the system and make products, and their associated paperwork, appear to be authentic to the untrained eye.

Herein lies a problem for the aviation industry when parts are bought and sold that carry certifying paperwork that has been forged or counterfeited. If an aircraft part does not have paperwork accompanying it, it is suspect, and therefore would be considered unapproved. From a systems safety perspective, there are mechanisms in place to control suspected unapproved parts from entering the system, but there are also gaps in the system that exist. Until these procedural voids are rectified, there is more of a likelihood that suspected unapproved parts will continue to enter the aviation industry, and be installed on aircraft.

In this information age and use of computer chip technology, there are new ways for parts to be ordered, and inventoried, such as on a computer data base. Companies such as Boeing sell a multitude of aircraft parts on their web page daily (AW&ST, 2000). Boeing has even granted exclusive distribution rights to another company for its surplus commercial aircraft parts supply. This will primarily be for Boeing's out-of-production transports, and will involve a global sales force and responsibility for next day shipping and warranty processes (AW&ST, 1999). Airlines place 4,000 orders daily over the Internet for spare parts, cutting the average pre-Internet delivery times of about a week to one day ("Control of the Supply Chain is Shifting, 1999). This example of business-to-business cybertrade brings about its own set of security control issues to contend with, that will unfortunately still allow for SUPs to exist. For example, a small parts manufacture can now get on-line and offer customized aircraft parts products at lower prices than some of the larger, more established parts enterprises. If the intentions of such a small parts firm were devious, then SUPs could enter the system. The members of the aviation industry, especially the airlines, have become more savvy, however, in the realization that if a part is priced at a very low cost, then there is a high probability that its authenticity is in question (Purdue University, 1995). Also, with formal procedures now in place for reporting suspected unapproved parts, the

less-than-honest parts broker is often singled out in the industry so they will not be used. Additionally, as the number of vendors is being reduced through consolidation, the mom-and-pop businesses have a harder time competing. The airlines are more reluctant to trust their business to a mom-and-pop operation. In the past few years, several major carriers have reduced their supplier base from as many as 50 vendors down to a core group of 5 to 10 (Nelms, 1998). This, however, is not a guarantee that bogus or unapproved parts will not trade hands.

A goal aspired to in the aviation industry is to attempt to place a seal or stamp of approval on every aircraft part (Purdue University, 1995). Many aircraft parts are too small to physically have a traditional stamp or seal placed on them. Often this stamp or seal would be placed on the box and/or paperwork that accompanies a part. Opportunities exist for parts to be switched. With the new use of computer chip technology, there is an effort underway to place an electronic chip on each part so that the part can be scanned and pertinent data retrieved (Nelms, 1998). This would help eliminate forgery of paperwork, which has existed for many years in the industry. One of the ways in which a mechanic or engineer distinguishes between a bogus part and the real thing is to look for a trademark. If someone does not bother to place a trademark on his or her product, it raises suspicion that they may not be proud of their work. In the past, manufacturers had an excuse for not putting trademarks on really small parts. It used to be very difficult, but today there is equipment capable of making engravings so small you need a microscope to see them ("Dealing with Bogus Plastic Parts...", 1998). These electronic chip and trademark concepts are areas that FAA could consider implementing, but of course cost is an important consideration that could slow down any implementation of such a new identifying system process.

While there is not a "silver bullet" to close the door on the counterfeit spare parts issue, or resolve the problem of airworthy, but unapproved parts, a major step in that direction is the FAA's release of Advisory Circular 21-229B that outlines procedures for detecting and reporting suspected unapproved parts (Nelms, 1998). This advisory circular is a step in the right direction, but to some, it does not go far enough in stopping parts distribution fraud. This document is only guidance, not regulation, so it is a voluntary, not mandatory, notification process to the FAA. Not all cases will be properly reported, and tighter controls will not be kept. To date, the reported cases of SUPs is relatively low, yet this is misleading, because one case may have 100,000 parts involved with it. The FAA has established regulation requiring that specific certification

procedures for product and parts manufactures be required. These certificates include the production certificate (PC), parts manufacturing approval (PMA), technical standard order (TSO), and production approval holders (PAH). Supporting parts documentation will indicate that by the use of such certificates, a part is traceable to an FAA-approved source (Dept. of Transportation, 1998).

The issue of parts traceability will be one of the new challenges the industry will face. The FAA is cracking down on the traceability issue. Thoroughly traceable parts lead to quality material, but as noted earlier will also result in high cost, and high-tech equipment. This could put a lot of smaller firms out of business and the cost of such efforts could be borne by the traveling public. After 2000 there will be major fleet changes, with newer equipment coming on-line and supply of spares for aircraft in use drying up. Older equipment will not be in demand and carriers are dumping, rather than selling, older equipment and their spare parts ("Spare Parts in High Demand", 1998).

The military is facing its own dilemma of the lack of spare parts. No one is making the parts anymore for the aging military fleet. As a stopgap measure, the military scavenges its own heaps of retired aircraft and cannibalizes their own equipment (Freeberg, 1999). Some of the parts off of military equipment make it onto commercial aircraft. Many of these parts have civilian and commercial aircraft applications as well, and as military hardware ages to historically high levels, these parts are in demand by parts brokers and distributors (Freeberg, 1999).

Analysis

In looking at the system of spare parts in the aviation industry, one cannot help but notice the economic, supply and demand, nature of this industry niche. One also notices how easy it has been for suspected unapproved parts (SUPs) to be bought and sold, due to a lack of regulatory oversight and severe penalties involved. Since the mid-1990s, there has been a good deal of effort taken to try and reduce SUPs from the marketplace. It appears that the battle is being one, but as the cliché goes, the war is not over. All of this effort, however, would not have come to the forefront without the vocal and legal efforts from people in positions of authority to speak out about such aviation safety concerns. The issue as to the significance of safety exists because the threat of SUPs still remains. The FAA states that safety is not significantly compromised, yet official guidelines regarding safety parameters and standards have not been presented by the FAA (Purdue University, 1995). This is a level of risk assessment that will have to be weighed. The process by which the results of risk analysis are used to make decisions is an important part of the system safety process. Perhaps, as part of the solution, a

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risk assessment matrix could be developed based on the types of aircraft parts used. This matrix would then suggest criteria levels, and if they became unacceptable, then specific SUPs would be held to higher risk standards than others (Dept. of Defense, 1997). The level of operational criticality of each of the thousands of aircraft part in airplanes do not pose the same threat to safety. A piece of equipment may malfunction during flight, but then be properly repaired at the conclusion of the flight, without incident, or alarm. Categorization of parts may be based on severity, since not all SUPs hazards are of equal magnitude to personal safety (Dept. of Defense, 1997). If the FAA and the aviation industry can not stop suspected unapproved parts from entering the system completely, then at least there could be very tight controls and demands place on a certain type and percentage of parts used in aircraft (e.g. fan blade parts, brake systems). The focus here would be on a determined type and percentage of parts, not all of them. This is a point of consideration that the government and lawmakers could deliberate further, and eventually could be a catalyst to help promote total SUPs elimination.

If it remains easy for a scrap dealer to sell aircraft parts off the lot with no fear of retribution, then the SUP, or bogus, parts problem is going to persist. There is always a customer wanting to make a deal, especially if it is an airline in an economically depressed situation. Not until the FAA and other law enforcement agencies work effectively together to catch people conducting this type of selling activity will it curb the fraudulent brokers and distributors from making an "easy buck". System safety programs encounter communication breakdowns, and the friction that exists in this circumstance between the FAA and OIG is perpetuating a chronic communications gap that must be closed. Sadly, lack of communication and loss of information are age-old concerns for most organizations, even if they are not separate ones, trying to work together (Stephenson, 1991). Safety is a line responsibility that requires everyone to "be on the same page", and work effectively together throughout the entire structure. This is not happening with the FAA and the OIG in the manner that it should be. Too much time and effort seems to be wasted on internal bickering, issue formalities, and turf battles. We as citizens of the United States do not need government organizations of this stature "spinning their wheels", and delaying effective efforts to resolve a problem, regardless of how significant or insignificant one may believe it is. The key here is that a problem does exist, and safety is influenced by it. The FAA is an agency with the utmost concern for aviation safety priorities. This agency needs to provide the staff support necessary to ensure that the line organization is able to do its job well (Stephenson,

1991). Interagency cooperation, beyond the Office of Inspector General (OIG) is an must for reduction in SUPs in the aviation system. Initial and ongoing training for all individuals involved in stopping SUPs use is an important aspect of good safety practice beginning as far upstream as possible. This can also help reduce the amount of money spent on areas such as the SUP enforcement and control issue (Stephenson, 1991). Safety is achieved by doing things right the first time. The OIG would contend that the FAA has not taken this approach. One could assess that the system safety effort to repair the SUPs condition as it currently exists is more difficult because it is not a first time operation. The parts distribution process is one that has developed over time, and system safety controls could not ideally be laid out at the infancy of the SUPs distribution process. The system safety effort should begin when the project begins and continue through the life cycle (Stephenson, 1991).

It is true that a major airline accident has not occurred in the United States due to SUPs being used. However, there have been other events such as a 1989 Norwegian charter flight that crashed and killed 55 people after a tail section fastened with unapproved parts tore loose. And, a near catastrophe occurred in June 1995, in Atlanta, when the engine of a ValuJet DC-9 exploded on takeoff, hurling shrapnel through the fuselage, causing a cabin fire, and injuring passengers. Investigators found the failure occurred in a replacement part overhauled at a non-FAA approved repair station in Turkey (Paige, 1999). The SUP issue is certainly global in nature, and has come close to directing its influence on American soil.

Incidents, and not accidents, (there is a distinction in FAA terminology) have occurred in the United States, but perhaps it is only a matter of time before a SUP is a cause of a major accident. Perhaps it already has been, but with millions of parts strewn all over the ground, the cause of some horrific crashes will never be known. As noted earlier, not every part of an aircraft is a critical one, and not all unapproved parts pose the same threat to safety. However, if people knew that less than standard (i.e., FAA-approved) parts were involved in the construction of the aircraft that they were on, then they might have second thoughts regarding operational safety. Having an imitation may work well for a fake Rolex watch one buys from a local street vendor, but few passengers may be willing to accept the same analogy with the parts operating the engines, or critical flight controls, of a commercial airliner they are flying in.

The area of SUP and spare parts in general is huge in the aviation industry. One gets the sense though that the entire concept of aircraft maintenance and spare parts is

undergoing major changes from the way it had been for many years. The aircraft maintenance industry is going through a evolution of sorts, and the FAA, OIG, and Congress are pushing concepts that are changing the way people think about maintenance, and the kind of commitments that are made to their capital and business operations. They are in essence providing additional safety and warning devices that will deter the use of unapproved parts for being installed on aircraft (Stephenson, 1991). With the advancement of technology and better ways of record keeping, improved controls are being considered and applied to the aviation parts industry. A safety precedence sequence is taking form that offers such controls and warning devices to improve the design of the parts inventory system (Stephenson, 1991). The establishment of the Suspected Unapproved Parts Program has gone along way to help develop a safety precedence, and get a sequence in place. The aviation industry as a whole should analyze itself even more closely regarding the SUP issue, by conducting a operating and support hazard analysis. The importance of this process is that it helps integrate the people and procedures into the system, so that weak or deficient areas can be address (Stephenson, 1991). Government agencies and people working together requires more improvement in the battle against SUPs. A complete project evaluation tree may be used to perform such an analysis on the current aviation industry SUP reduction system (Stephenson, 1991). A detailed review of the procedures, personnel, and tools to accomplish this safety task is the kind of rude awakening the FAA and the aviation industry needs to determine gaps, or weak links, in the SUPs distribution system.

Conclusion

We all take risks in our lives, and for the most part, we all try to reduce them when given the chance. As noted in the beginning of this paper, air travel in the United States is very safe. It has existed this way with the use of suspected unapproved parts (SUPs), so why should there be a concern that air travel will suddenly become a lot more dangerous now that we know SUPs are being installed? Some of this revolves around the issue of common sense, and some of it about looking analytically at a system process and noting that the system process has a potential for critical, or even catastrophic, failure due to SUPs. The words critical and catastrophic are extreme descriptions for hazard severity, so it is worth taking notice, and that is what the aviation industry has done. Risk assessment description of both severity and probability categories are taken into account in the approach to system safety (Stephenson, 1991). Safety is a productive concept and introducing parts that do not fit industry established

specifications is non-productive. This has the makings of a classic case of an upstream effort to eliminate the SUPs from the manufacturing system and use people, technology, and techniques to help accomplish this.

We rely on our government to uphold safety standards, and in some eyes, they have failed at this. Perhaps government can use the resources of the private sector to help accomplish safety goals and set parts manufacturing standards. In recent times, other parts of the federal government have emulated private sector approaches to reduce cost and increase efficiency. Multinational organizations such as the International AntiCounterfeiting Organization (IACC) both initiates actions and supports government actions that will ultimately result in increased enforcement, lead to the prosecution of intellectual property infringes, and create a strong deterrent to counterfeiters and pirates (IACC, 2000). These organizations can provide assistance to the FAA and law enforcement agencies.

Federal investigators do a lot to curb fraudulent parts activities, but as the views of the OIG have expressed, not enough is being done. Business and industry have a vested interest in making sure that the services they provide are done correctly and safely. The aviation industry is no exception. With the FAA being more reactive than proactive, a good hard analytical review of SUPs in the manufacturing system must be done. In many respects this is happening, but one may consider if it is fast enough to prevent a SUP from causing an air disaster. For such an important issue as aviation safety, it does seem unusual that elements such as counterfeit or unapproved parts could be so pervasive, for so long, in the system. Then again, it is an awesomely large system, so getting a handle on it poses a herculean challenge. This emphasizes the point that the FAA may not be able to do this with its own resources.

Making FAA advisory circulars such as No. 21-29B mandatory, increasing civil and criminal penalties for counterfeiting, and developing an electronic scanning and data base for all in the aviation industry to use to know who has been involved with unapproved parts is all fine and good, but it does not go to the heart of the problem. The smartest of crooks will learn how to circumvent a system, and the areas just listed are not enough to deter individuals trying to make easy money dishonestly. It is up to the aviation industry to invest in the resources and control concepts, be it man or machine, to stop the excessive use of SUPs. However, like many things that are not right, throwing money at something is only a partial remedy. There are too many incorrect issues for our government to throw money at.

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We as a society have to rate the risks involved with suspected unapproved parts (SUPs) use, and determine how much chance we want to take in air travel. If one portion of our government regulatory authority claims that SUPs do not pose any significant risk, then is this enough to satisfy the majority of our population? After all, the FAA is the expert in the aviation field. Much of this falls back on supply and demand economics, and the need for tight regulatory control to curb the use of SUPs. The key is to think creatively, and "out of the box" to find better ways to enforce such a problem as SUPs, and that helps to reduce the chance of harm in terms of severity and probability.

From the work being done to date in aviation, it appears that this is in fact taking place, and we can only collectively

hope that aircraft accidents due to SUPs, or any other cause, will not occur. Nevertheless, relying on chance and playing the odds is not a foundation for a system safety approach. Control measures must be brought into place to significantly diminish the threat of SUPs installation on aircraft. The FAA, and other organizations, can take further steps to plan, manage, and conduct a reliable system safety program so that SUPs are not as prevalent in the complex parts supply system. The hazards regarding SUPs have been identified, and the fundamental goal is to reduce the risks for the traveling public. □

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