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Abstract

Due to the requirement to maintain and improve the safety record of commercial air transportation in the United States (U.S.) despite increasing traffic, several proactive safety programs have been introduced in recent years. Among these proactive safety programs is a form of Flight Data Monitoring (FDM) known in the U.S. as Flight Operational Quality Assurance (FOQA). FOQA is a program utilizing quantifiable, objective data collected from the air carrier aircraft's data recording system. The data is then analyzed to identify trends and other indicators of potential safety problems. With few exceptions, FOQA data analysis has been rudimentary, often limited to relatively simple statistical methods. The purpose of this study was to introduce a method in which current FOQA methodology can be enhanced with the more sophisticated quality and statistical concepts found in Six

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Sigma – a structured, data-driven approach built upon to eliminating defects through the reduction of variation in processes. A general introduction to both FOQA and Six Sigma is provided, along with a hypothetical exemplar case study using Six Sigma methodology on a FOQA problem, i.e., tail strikes during takeoff.

The U.S. air transportation system is considered one of the safest forms of transportation in the world (NASA, 2004). Airline safety departments have developed and implemented numerous proactive safety initiatives over the past several years such as the Advanced Qualification Program (AQP), Flight Data Monitoring (FDM), Aviation Safety Action Program (ASAP), Internal Evaluation Program (IEP), and the Voluntary Disclosure Reporting Program (VDRP), with the primary intent to improve safety. However, additional gains may be possible by implementing a widely utilized and highly regarded quality program known as Six Sigma. This research provides an overview of one of the most significant proactive safety, airline-oriented flight data monitoring programs - Flight Operations Quality Assurance (FOQA), and Six Sigma. With that background established, an exemplar case study of the application of Six Sigma principles to a FOQA problem is then presented.

Airline Safety

Throughout most of the aviation industry's history, the primary method of research concerning the mitigation of risk has been reactive, that being post-event analyses of incidents and accidents. Many significant advances in safety have resulted from this methodology: decreases in serious wake turbulence encounters due to greater in-trail spacing, improved cargo compartment smoke detection systems, transponder-based intruder conflict alerting systems, improved windshear detection systems at airports, to name but a few. The list of advances is long indeed, and proves the worth of rigorous post-accident investigation (NTSB, 2004). However, by the 1990s, investigators and regulators alike were coming to the realization that there was a limit to the effectiveness of post-hoc fixes to safety problems, and that limit was based upon relatively simple math.

Figure 1 depicts the accident rates per 100,000 flight hours for U.S. scheduled air carriers operating under 14 CFR 121 from 1985 through 2004 (NTSB, 2005). Although the accident rate is somewhat uneven year to year, the linear fit line (indicated at a value of approximately .22 accidents per 100,000 flight hours) suggests that the rate has stabilized despite an increase in the number of flights. Nevertheless, Weener (1990) hypothesized that if the current rate remained the same, a significant rise in the number of hull losses would occur, thus emphasizing the necessity for proactive safety methodologies such as FOQA.

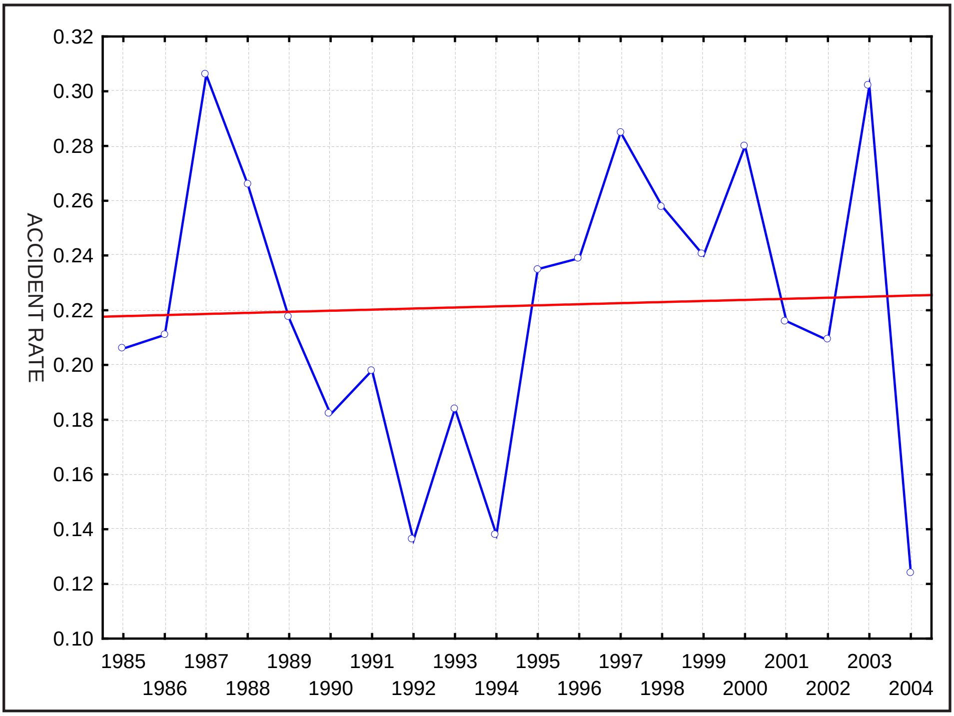

Figure 1. Accident Rates Per 100,000 Flight Hours, 1985 through 2004, for U.S. Air Carriers Operating Under 14 CFR 121, Scheduled Service (Airlines).

Flight Operations Quality Assurance

FOQA, a term coined by the Flight Safety Foundation (FSF) in the early 1990s, is a form of FDM where flight related parameters are collected and analyzed for the purposes of monitoring and improving flight operations with a potential byproduct being the enhancement of flight safety. FOQA methodology has involved:

1. Selecting parameters to monitor and defining events.
2. Capturing, retrieving, and analyzing recorded flight data to determine if the pilot, the aircraft's systems, or the aircraft itself deviated from typical operating norms.
3. Identifying trends or singular anomalies.
4. Taking remedial steps to correct problems.
5. Continuously monitoring the effectiveness of actions taken.

The advantage of data monitoring has been evident due its prevalence in various industries other than aviation. For example, automotive engineers utilize telemetry to monitor multiple aspects of a car's design and performance. Formula One teams feed off telemetry information to determine whether changes made to a car's setup, results in higher performance. Hospitals utilize this technology to monitor patients' health with information logged for the detection of unwanted trends. Complex modern systems such as high-tech manufacturing plants, subway networks, nuclear power plants, and power grids have utilized data monitoring to understand the processes that occur throughout the system.

FOQA is unique among other proactive airline safety initiatives in that it has been the sole utilizer of objective, quantitative data. Depending upon the capabilities of the aircraft involved, FOQA collects parameters from hundreds of sensors located throughout the structure that feed analog and digital input to recording equipment onboard. On a typical Boeing 757 manufactured 15 years ago, for example, 200 to 300 parameters can be recorded and stored each second. Sophisticated airplanes produced today are capable of capturing over 2,000 parameters per second (Phillips, 2002). Pilot control inputs, control surface positions, engine performance parameters, avionics information, and numerous other parameters have been recorded throughout the duration of the flight. FOQA analysts then routinely probe the data to monitor and detect trends in the operation of the aircraft, to determine if exceedances (i.e., an event that exceeds predetermined thresholds) have occurred, and to assess the efficiency of operations. By detecting trends and patterns, it is possible to correct potential problems before they occur.

Using advanced flight data analysis software such as the SAGEM Analysis Ground Station (AGS), FOQA analysts have been able to examine individual flights or aggregated data from numerous flights tracked over time so that statistical trending, through robust reporting and animation modules, can be performed. An aggregate study might examine, for example, the number of unstabilized approaches at a particular airport per month over the last 12 months. This type of analysis provides potentially valuable information, especially in terms of whether the airline's performance is improving, holding constant, or deteriorating. This look at aggregate exceedances over time provides airline managers with a new perspective on potential problems that would not otherwise be apparent. Based on the trend analysis, airline managers can take corrective action to reduce or eliminate detected exceedances by focusing on the root causes and making or recommending changes.

In spite of the availability of both internal and external sources of information coupled with increasingly sophisticated computational technology, many airline managers could gain from additional knowledge and training in the use of quality and statistical tools necessary to reap the maximum advantage from these potent sources of information. In a survey conducted by the GAIN working group, it was revealed that most safety personnel have not received much, if any, formal training directed at the effective use of analytical tools (Global Aviation Information Network, 2001). The report revealed that some sophisticated tools are being used, for example, one airline reported using a tool called Procedural Event Analysis Tool, another reported employing Reason's model and root cause analysis, and several airlines perform flight data analysis and trending using internal databases (Global Aviation Information Network, 2001). What may be most noteworthy regarding the list of tools used is the absence of well-established quality tools and processes such as control charts, Pareto charts, scatter diagrams, cause and effect diagrams, and many other quality management tools (Stolzer & Halford, 2004). FOQA's effectiveness has been determined by the ability of the user to properly determine aspects of a flight operation to be monitored, maximizing the flight data analysis software's potential, formulating analysis results that are meaningful to upper management and other stakeholders (such as pilots), and finally, implementing proper frameworks to remedy and monitor any potentially dangerous trends. The purpose of this work is to assert that FOQA's effectiveness and, thus, airline safety may be enhanced by the application of Six Sigma methods. Six Sigma is a disciplined, data-driven approach to eliminating defects via the reduction of variance. To understand these methods more thoroughly, a rudimentary discussion of distribution, variation, and Six Sigma as a management system is presented.

Six Sigma

In the early and mid-1980s, Motorola engineers developed the concept of Six Sigma – including the standard itself, the methodology and the cultural change associated with it – to provide greater resolution in measuring and decreasing defects. Six Sigma is credited with helping Motorola save billions of dollars by optimizing many processes throughout the company related to manufacturing and other sectors (Motorola, 2004). Inspired by Motorola's success, hundreds of companies around the world have adopted Six Sigma as a way of doing business.

The fundamental objective of the Six Sigma methodology is the implementation of a data-driven strategy that focuses on variation reduction and process improvement through the application of Six Sigma improvement projects. By determining the degree of variation present in an existing process, one has been able to determine its capability by referring to the standard normal distribution, where measures of dispersion can be correlated with probabilities of failure, and parts per million (ppm) defectives.

Distribution

In a standard normal distribution (also known as the "bell curve" or Gaussian distribution), the area under the curve has represented the percentage and thus the probabilities of values contained within and beyond each standard deviation. In fundamental statistics one learns that for a distribution of Mean (μ) = 0 and σ = 1, approximately 68% of values are contained within $\pm1\sigma$ around the mean, ~96% of the cases within $\pm2\sigma$ around the mean, and ~99.7% of the cases within $\pm3\sigma$ around the mean. Therefore, a process capability established at 2σ would result in an acceptable rate of ~96% and a probable "defect" (out of specifications) rate of ~4%; out of every 100 outputs, probability theory states that approximately four will be defective.

Variation

According to Park (2003), the two forms of variation, common cause and special cause, are the primary foes of quality control. Common cause variation is known as naturally occurring variation, where the sources of variation form a stable and repeatable distribution over time. Such a process is ‘in control’. Special causes of variation, on the other hand, refers to those instances where an external element causes the overall process distribution to shift erratically causing it to be ‘out of control’. For example, if a basketball player with a historical shot percentage of .800 were to attempt 100 in any given day, the conversion rate will naturally and expectedly vary with an ~80% success rate. However, during this process if a special cause is introduced, such as another player attempting to block the shot, this will likely significantly reduce the shooter’s ability to convert the free throws. The identification of variation – being able to differentiate between common and special causes – and reduction or elimination of special cause variation are critical elements in ensuring that a process remains standardized and under control.

Prior to the mid-1980s, Motorola was operating at 4σ, but desired a higher standard to account for variations in the process over time (Harry, n.d.). Motorola engineers determined that once a long-term process is no longer centered at the specified target (design specification) due to a variation of ±1.5σ, the rate of defects increases and the capability to produce results within specifications is hampered. This results in a process at 2.5σ (4σ – 1.5σ = 2.5σ) resulting in each output having greater variability from one another. In order to account for variation, a process spread of 6σ was suggested to preserve the process under specifications even if a shift of 1.5σ were to occur (6σ – 1.5σ = 4.5σ). By establishing a standard of 6σ from the outset, the process is still highly standardized even if it shifts, thus leaving the process at 4.5σ (Swinney, n.d.). The exact reason why a shift of 1.5σ was assumed and how such a value was arrived upon has been a topic of contention. Some have argued that in a properly monitored process, such a shift would have been detected immediately and controlled. The accuracy of the 3.4 ppm figure (see Table 1) assuming a 1.5σ shift has also been under scrutiny (Voelkel, 2004). Nevertheless, Motorola’s assessment of 1.5σ stood and has been considered the baseline ‘standard’ approximation with Six Sigma charts reporting values with this shift in mind. The bottom line is that Motorola acknowledged the existence of some form of variation, whether it is .5σ or 1.5σ, regardless of how controlled a process might be. Table 1 illustrates the percentage of acceptable values and its defective rates with and without shift according to sigma levels.

Table 1
Six Sigma Process With Shift and Without Shift (Adapted from Park, 2003).

Sigma Process Level	**With Shift of 1.5σ**		**Without Shift**	
	Acceptance Rate (%)	Defective Rate (ppm)	Acceptance Rate (%)	Defective Rate (ppm)
1σ	30.23280	697,672	68.26894	317,311
2σ	69.12300	308,770	95.44998	45,500
3σ	93.31890	66,811	99.73002	2,700
4σ	99.37900	6,210	99.99366	63.4
5σ	99.97674	233	99.99994	0.57
6σ	99.99966	3.4	99.9999998	0.002

As an example of a process shift, if an item has an original specification of 50mm, with a tolerance of +/- 2mm, and if the process goal is 3σ, the item is free to vary +/- 0.6mm (52mm - 48mm / 6σ = 0.6mm) up to a limit of 51.8mm or 48.2mm before it approaches and exceeds the threshold of being considered 'defective'. Further, if the process drifts by say, 1σ, it will degrade to a 2σ level (52mm - 48mm / 4σ = 1mm) resulting in a less standardized overall process distribution with an increased number of defectives (Figure 2).

In order to proactively avoid the negative consequences of a process shift, one would attempt to establish a process of 6σ (52mm - 48mm / 12σ = 0.3mm), resulting in a leptokurtic (low variation) distribution (Figure 3). Thus, even if the process were to drift slightly, the overall process is still highly standardized, increasing the probability that the number of defectives remain minimal. To reiterate, the purpose of Six Sigma is to attain a high process quality via standardization through the minimization of variation. Further, the most successful approach has been where one shifts away from reactively fixing something once a defective is identified, to proactively identifying and controlling causes of variation, which in turn results in a lower rate of defectives. By achieving such a standard, productivity and customer satisfaction is increased and so is profitability in some cases (Velocci, 1998).

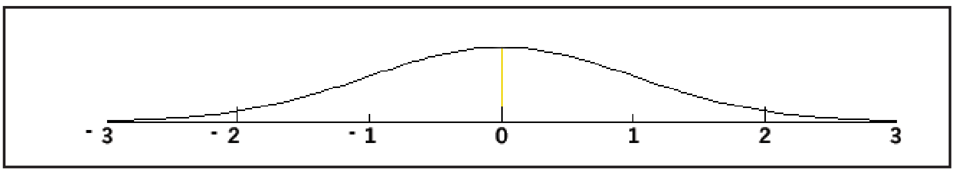

Figure 2. High variability distribution with several scores away from the target specification.

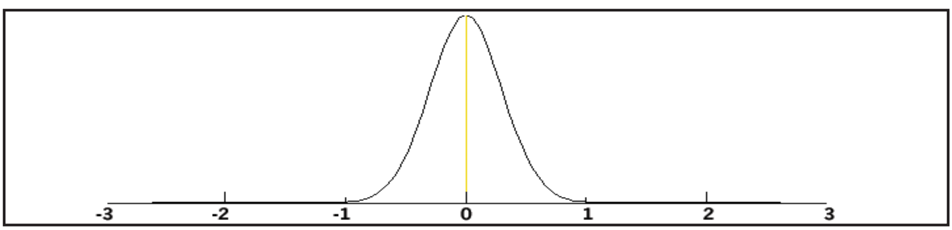

Figure 3. Low variability distribution, scores are closer to specification.

Six Sigma Management System

Motorola management considered Six Sigma a paradigm shift in the way the company operated at all levels. By involving management in the new quality thought process, a top down approach becomes possible, where all employees are trained and educated in the concept of quality and the need for the identification of causes of variation and controlling those causes (Motorola, 2004). By having all levels involved, emphasis is placed on teamwork – where multiple teams throughout the company via their respective team leaders have a singular goal of satisfying the requirements of all respective stakeholders who are recipients of whatever process output. These processes include anything from payroll to document processing, shipping, and even marketing. The result was that Six Sigma has evolved from an operationally focused metric into a management system.

Although process standardization is the goal, Six Sigma is distinctive in that it provides a structure in which to attain reduction in variation through the process improvement methods. DMAIC (Define, Measure, Analyze, Improve, and Control) is the typical tool used for making such improvements.

DMAIC

DMAIC has been defined as a 'rigorous, structured, and disciplined' approach to process improvement (Rath & Strong, 2003). The tools contained within DMAIC are simple but effective, and have been available in one form or another in several previous quality methodologies such as Total Quality Management.

According to Park (2003), Six Sigma is simply an evolution of Total Quality Management (TQM), which in turn was built upon Total Quality Control (TQC), Statistical Quality Control (SQC), and Quality Control (QC). Whereas TQM and earlier quality methodologies provided a multitude of statistical tools aimed at achieving and maintaining a high level of quality, Six Sigma has provided a structured framework in which these tools may be more effectively used. Figure 4 lists some of the most commonly utilized tools in each phase.

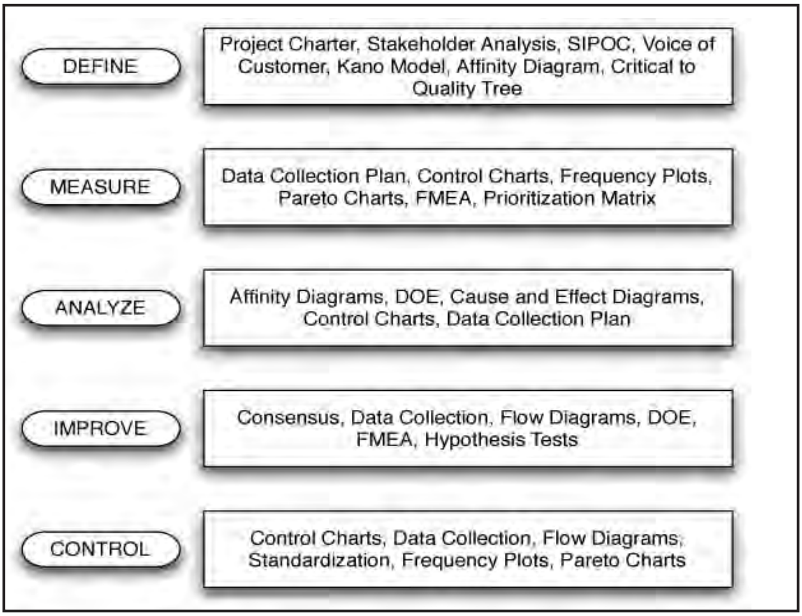

Figure 4. Typical quality tools employed throughout the DMAIC process (Adapted from Rath & Strong, 2003).

The following is a general overview of the major objectives in each step of the framework provided by Six Sigma:

Define. This phase involves a systems engineering approach, where the purpose and scope are defined together with background and historical information. Study goals are defined and so are limitations as to how far the study is to go and what it can bring to the overall operation. A stakeholder analysis is also performed, where each of those involved (in an airline setting this may include managers, analysts, pilots, maintenance) defines what such a study is expected to accomplish for them.

Measure. The priority in this step is placed on the improvement effort. Historical information and other data relevant to the subject at hand are gathered. Using this information, the source of the problem is identified for further analyses. The current process sigma is also determined at this point.

Analyze. Based on the current process performance and knowledge of the source of the problem as determined in the previous phase, the focus then shifts towards identifying root causes. Root causes can range from poor communication between departments, lack of resources allocated to the wrong places, and even the wrong data being collected. Techniques such as Design of Experiments (DOE) could potentially identify variables that were initially unforeseen. Data mining is yet another breakthrough technique in the quest to identify causal factors and trends among a multitude of data.

Improve. In this step, candidate solutions are introduced and implemented. The purpose is to verify that the proposed improvements solve the issue at hand. Some issues might be resolved completely without further intervention; however, others require even deeper understanding. In some cases, a lot of data is present and experiments can be done to determine the complexity of the issue.

Control. Suggested solutions in the previous step are prepped for implementation. The focus of this step is standardization, which will ultimately result in a decrease in variation and, thus, a higher sigma process level.

The application of the DMAIC framework has been successful across many industries, regardless of the processes involved. And though they do not use these specific terms themselves, the FOQA Rule (14 CFR, Part 13) and the associated guidance provided to FAA Inspectors responsible for oversight of FOQA programs (HBAT 00-11) both indicate a requirement that mature FOQA programs possess the attributes of continuous improvement (that DMAIC inherently supports). It is in the Measure and Analyze steps of DMAIC that Six Sigma techniques offer the greatest power.

The parameters recorded during flight allow for a FOQA air carrier to monitor adherence to standard flight protocols. Each parameter can be monitored for variance based on set tolerance thresholds as determined by the air carrier upon appropriate validation. For example, a target value of 165 knots could be established for a certain phase of flight, with a maximum allowable variation of ±10 knots. Any exceedance (which in Six Sigma terms can be considered a 'defect') of these limits is flagged as an 'event', which is differentiated by severity levels. Therefore, a recorded parameter of 172 knots might be considered a level 1 severity event, while an exceedance of 180 knots could be considered a severity 3.

When excessive numbers of severity 1 and 2 events are detected by the FDM software, airline managers might elect to re-evaluate the tolerances since they might be too strict. However, when a severity 3 is detected, it usually points to a potentially dangerous violation of standard procedures; thus, they usually warrant close examination. If an airline continues to detect excessive numbers of severity 3 or other events after adjusting severity thresholds, the potential for an incident or accident may be indicated.

FOQA's proactive nature means that it functions by concentrating on level 1 and 2 events, proactively implementing remedial action and standardizing the operations in order to avoid level 3 events from occurring. In the U.S., commercial air transportation is already highly standardized and level 3 events are rare, but they do occur. Examples of level 3 events are tail strikes during takeoff, and overshooting or undershooting runways during final approach due to energy mismanagement. The rarity of these events makes it problematic to utilize rate-based methods that depend on events that have already occurred in order to estimate the chances of any future occurrences.

To illustrate, for an air carrier operating thousands of flights per month, FOQA trend data will be increasingly abundant with commonly occurring events such as speed or pitch violations. As data is collected and analyzed, the distribution will eventually become normalized, allowing for proper predictive statistics. However, for extremely rare events such as tail strikes, the distribution will not likely be normal, but rather highly skewed due to the extended amount of time without any occurrence. There will not be enough data to support proper predictive statistics.

Tail Strikes

Tail strikes are serious events with historically low rates of occurrence. Some tail strikes are so severe that they are declared accidents due to the extensive damage to the aircraft. These can prove costly in many ways, such as in maintenance costs and damage to an air carrier's reputation.

As a hypothetical example of how Six Sigma techniques could aid a FOQA study, a newly formed air carrier is interested in the topic of tail strikes during takeoff and what Six Sigma techniques can offer. Assuming the carrier has been operating at a rate of 500 flights per month, the flight safety department would like to determine the probability of a tail strike occurring during takeoff based on a year's worth of data gathered via the FOQA program. The aircraft manufacturer established that a tail strike could occur if the takeoff angle reaches a certain critical angle with the main undercarriage oleo fully compressed. The air carrier established as a standard procedure a rate of rotation after takeoff of 2 to 3 degrees per second to a pitch attitude of 15 degrees.

Historically, tail strikes during takeoff have involved several different variables. Some of the most commonly attributed causal factors are:

1. Improperly trimmed stabilizer
2. Improper rotation speed
3. Improper flight director use
4. Excessive rate of rotation

No tail strikes have yet occurred, and the air carrier would like to minimize as much as possible the chances of one happening. Utilizing Six Sigma's DMAIC methodology, the air carrier would like to determine what its current process level is and what the probabilities are of a tail strike during takeoff given its current process capability. This study is presented below according to the DMAIC structure.

Define. During the define phase, the underlying motivation was to idetify methods in avoiding any embarrassing and costly events from occurring. Tail strikes during takeoff are the FOQA topic selected and the decision was made to focus on one aircraft. The objective is to determine the current process level and the potential for future tail strikes.

Measure. The aircraft is fully FOQA equipped. Based on relevant parameter data, it was determined that the mean for the parameter 'Max Takeoff Pitch' of all flights up to this point was 15.5 degrees and the standard deviation was 1.67, thus establishing the process sigma at 3.89 with an exceedance rate of .005% - equivalent to a potential of one tail strike every 19,951 flights with ~39 months between each occurrence.

Analyze. The calculations indicate that the air carrier is due to experience a tail strike in about two more years of operation if no change is made. Therefore, several different scenarios are considered. For example, if the mean (average max takeoff pitch) of 15.5 degrees is maintained, but the standard deviation is decreased to 1.5, the exceedance rate would improve to .0007% (equivalent to a process sigma of ~4.33). Thus, approximately one tail strike every 134,127 flights is expected, equivalent to ~268 months before the event is due to occur.

Another scenario would be if the mean were decreased to 14.5 and the standard deviation maintained at 1.67. This would result in a process sigma of 4.49, where the exceedance rate of .0004% would be equal to approximately one tail strike every 280,817 flights, equivalent to ~561 months before one is due to occur. Hence, it is clear that even slight improvements in standardization significantly decrease the probability of a tail strike occurrence. Additionally, if the standard deviation remained the same, but the mean of the scores improved, significant reductions in the probability of a tail strike occurrence is also possible.

Naturally, one should not adopt a false sense of security by depending solely on these predictive rates, as the nature of probability theory dictates that the events can occur more or less frequently than expected. However, since probability is based on what is likely to occur, a prudent airline will try to get the odds on its side. Finally, this approach is only one of several factors that have a bearing in determining the likelihood of a tail strike. There have also been efforts by aircraft manufacturers such as Boeing's implementation of the 'tail strike protection application' within the flight control system software of the B777-200LR and 300ER variants (Louthain, 2005). This demonstrates the current interest in every sector within the aviation industry in flight safety.

Improve. Given the analyses of possible scenarios, stakeholders are presented with various solutions. These may include forming an informational campaign for the pilots demonstrating that even slight improvements in standardization and adherence to flight procedures can significantly decrease the likelihood of a serious event occurring. Another choice would be modifying current standard flight procedures to reduce the pitch attitude from 15 degrees to 14 degrees and, thus, significantly reducing the chances of a tail strike occurring (even if the standard deviation remained constant).

It is worth noting that given the complexity of flight operations, the possibility of creating unintended consequences is an important factor to keep in mind when exploring improvement strategies. For example, the reduction of initial rotation pitch attitude described above might result in compromised obstacle clearance or noise abatement. As with any intervention strategy, a full consideration of the consequences is necessary before proceeding with the plan. Once having defined the potential effects of the intervention, wise use of FOQA can give valuable information on all of those effects, as the DMAIC process proceeds from Improvement to Control.

Control. Whichever solution is chosen, relevant data can be continuously monitored to verify the effectiveness of the changes undertaken utilizing tools such as process control charts. This hypothetical case study is only one of several possible studies an air carrier could perform with an existing FOQA program by adopting Six Sigma techniques. Advanced methods such as data mining and design of experiments (DOE) could also provide a deeper insight into tail strikes. For example, what is the relationship between energy and tail strikes? Also, are there any other monitored aircraft parameters that might have potential influence in a tail strike occurrence? Future possibilities also include data mining the Aviation Safety Action Program (ASAP) database and correlating the information with FOQA databases.

Discussion

Flight Operations Quality Assurance has been one of the most highly regarded and potentially effective airline safety initiatives to emerge in the past 20 years. It is a program based on quantifiable, objective data collected from the air carrier aircraft's data recording system. On some modern aircraft, over 2000 parameters each second are recorded. The FOQA system uses expert software to analyze the data from individual flights of interest, or aggregated data from multiple flights in order to examine trends that may affect safety. Unfortunately, with very few exceptions, the analysis of FOQA data has been limited to relatively simple statistical methods. It has been surmised that the application of more sophisticated quality and statistical methods may increase the effectiveness of the program and the air carrier's return on investment (Stolzer & Halford, 2004).

Six Sigma is a structured, data-driven approach to eliminating defects. The primary objective of the Six Sigma methodology is the implementation of a data-based strategy that focuses on variation reduction and process improvement through the application of Six Sigma improvement projects. DMAIC – Define, Measure, Analyze, Improve, and Control – is the method used to engage in process improvement. It was asserted that Six Sigma methods might be effectively used in FOQA programs, especially for addressing very infrequently occurring events.

An exemplar case study was presented using Six Sigma's DMAIC methodology on a safety problem, i.e., tail strikes during takeoff. The process sigma was calculated to be 3.89 with an exceedance rate of .005%, which equates to a potential for one tail strike every 19,951 flights with ~39 months between each occurrence. The effect on the process sigma of varying the mean and standard deviation was explored. Stakeholders were presented with various solutions to decrease the probability of a tail strike from occurring.

A disciplined quality approach to improving safety is needed in the airline industry. Airlines would benefit by increasingly embracing and employing quality principles in designing, implementing, and managing safety programs, including FOQA. Six Sigma is one quality-based program that may be used to increase the effectiveness of FOQA, particularly for process improvement initiatives. Whether an airline employs Six Sigma or various other methods in its safety improvement efforts, quality in airline safety must be the goal.

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