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"Managing Change: A Human Factors study investigating the impact of strategic decisions on personnel and processes in U.S. Airline Operations"

"An Invitation to a Safer Air Transportation System"

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ABSTRACT

In May 2008 the FAA completed an assessment regarding inspections at major airlines. The assessment concluded with findings that the FAA failed to perform more than 100 recommended safety reviews at major air carriers in recent years. According to an article published in the Wall Street Journal, the importance of this examination became clear earlier in 2008 because of revelations that FAA managers allowed Dallas, Texas based Airline Southwest Airlines to fly airplanes that hadn't undergone mandatory structural safety inspections. The article also stated that The FAA hadn't reviewed Southwest's system for complying with agency safety directives since 1999. The researcher will provide a qualitative approach and collect opinion data to support the previous stated questions. The researcher also intends to research possible examples of more efficient ways for the FAA and the Airline industry to manage and communicate issues that could possibly lead to deviations in federal regulations, and that could subsequently lead to an incident or accident.

Since the Air Transportation Oversight System (ATOS) program is designed to support the airline regarding possible issues within their perspective departments, the interface with the FAA ATOS program needs to be reviewed to determine if the ATOS program should be voluntary or mandatory. Essential voluntary programs such as the Internal Evaluation Program (IEP), Aviation Safety Action Program (ASAP), Maintenance Safety Action Program (MSAP) and Dispatch Safety Action Program (DSAP) require oversight by the FAA. There is a need to determine the effects of ATOS becoming mandatory or voluntary and the effects of the FAA ATOS system interface has on the voluntary airline safety programs. The researcher intends to answer the following two questions explicitly to support this ongoing issue with the FAA and the airline industry; since the ATOS system was designed for the FAA to provide active oversight to the airlines from a system safety perspective and for the airlines to communicate their oversight to the FAA:

- Should ATOS become voluntary or a regulation for Air Carriers; Should the IEP continue to be voluntary?
- Should there be more active oversight within the FAA regarding its interface with the Air Carrier?

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ACRONYMS

AC- Advisory Circular

ALPA- Airline Pilots Association

AOPA- Airline Operating and Pilots Association

ASAP- Aviation Safety Action Program

ATOS- Air Transportation Oversight System

CASS- Continuous Analysis and Surveillance System

CAMP- Continuous Airworthiness Maintenance Program

CFR- Code of Federal Regulations

CMHO- Certificate Management Holding Office

DCT- Data Collection Tool

DOD- Department of Defense

DSAP- Dispatch Safety Action Program

EPI- Elemental Performance Inspection

FAA- Federal Aviation Administration

FAR- Federal Aviation Regulation

FOQUA- Flight Operations Quality Assurance

GMM- General Maintenance Manual

HMI- Human Machine Interface

IEP- Internal Evaluation Program

ACRONYMS

IASA- International Aviation Safety Association

ISASI- International Society of Air Safety Investigators

LMSC- Line Management Safety Culture

LOC- Letter of Concern

LOC- Letter of Compliance

LOI- Letter of Investigation

MSAP- Maintenance Safety Action Program

NIP- National Inspection Program

NTSB- National Transportation Safety Board

OSHA- Occupational Safety Health Administration

SMSC- Senior Management Safety Culture

SAI- Safety Attribute Inspection

SMS- Safety Management System

SOPs -Standard Operating Procedures

TSM- Total Safety Management

U.S - United States

INTRODUCTION

According to a recent study conducted by the U.S. National Transportation Safety Board (NTSB), the U.S. and Canada have a fatal aircraft accident rate of 0.12 per million flight hours and a rate of 0.19 per million departures. Other geographical areas such as Central and South America have a fatal aircraft accident rate per million flight hours of 0.56 and 0.84 per million departures. Africa and the Middle East have a fatal aircraft accident rate per million flight hours of 1.54 and 3.62 per million departures, respectively. According to a Commercial Aviation Safety database, a total of 1,402 accidents occurred world-wide between the years of 1959-2004. From 1959-2004, there were 1,104 aircraft commercial (non-fatal) jet accidents and from 1995-2004, there were 285 recorded aircraft commercial (non-fatal) jet accidents. Also, from 1959-2004, there were 604 recorded aircraft commercial (fatal) jet accidents. Recently, the statistics conveyed that between the years of 1995-2004, there were only 135 aircraft commercial fatal jet accidents. According to the database, the most prevalent accident in U.S. commercial 14 CFR Part 121 (Operating Requirements for Domestic, Flag, and Supplemental Operations) operations was attributed to flight crew human error. The least prevalent accident was attributed to mechanical error. Finally, between the years of 1985-2004, the United States and Canada had less than two accidents per one million departures. Other countries had a rate of more than four accidents per one million departures (NTSB 2003). Most of those accidents were considered maintenance related accidents and incidents and some were attributable to the flight crews' inability to follow Standard Operating Procedures (SOP). Human Factors related incidents and accidents continue to drive research and development for better practices in aviation. Although human error can never be eliminated, a reduction in the consistency of errors can help improve the overall world average of related incidents/accidents in flight crew and aviation maintenance operations. While rare, aviation accidents can have catastrophic consequences, with a large loss of life.

THE ACTIVE INGREDIENTS TO A SAFER AIR TRANSPORATION SYSTEM

Commercial aviation is one of the safest forms of transportation (Breiling Associates, 2001, p. 6-7). The public demands a high standard of safety and expects continued improvement. Commercial Aviation is an important element of the U.S. air transportation system and the U.S. economy. The Federal Aviation Administration (FAA) regulation and certification program establishes aviation safety standards, monitors safety performance, conducts aviation safety education and research, issues and maintains aviation certificates and licenses, and issues rules. The various methods of exchanging technical expertise, the willingness of NTSB investigators to serve, and the continuous exchange of information to improve aviation safety around the world are just a couple ways that can improve communication within Aviation Safety. The NTSB also reviews data from past incidents, accidents and current events and as an agency, investigators try to figure out what preventive measures should be taken to reduce the risk of a potential hazard. Many other government agencies such as the Airline Pilot's Association (ALPA), International Society of Air Safety Investigators (ISASI), and the Aircraft Owners and Pilots Association (AOPA) all try to enhance safety awareness in ramp operations and in-flight operations. Recommendations from incidents and accidents investigated by the

NTSB are evaluated and forwarded to the FAA for consideration regarding better safety enhancements for U.S airlines. As air travel increases and new aircraft are developed, there is a demand for continuous surveillance of the airline industry's maintenance and flight operations programs to ensure quality in processes and improvements in aviation safety.

ACCIDENT AND INCIDENT THEORY

An "accident" as defined by the Random House Dictionary of the English language (2nd ed.) is "any event that happens unexpectedly without a deliberate plan or causes; by chance, fortune, or luck" (Vergas, 1993, p. 17). According to research conducted on "Accident Causation", most accidents rarely occur by chance at all, and their causes can be tracked (Vergas, 1993, p.17). Accidents are usually the result of an accumulation of factors whose results are seen in their consequences. These factors are numerous and range from the measured reliability on both an individual perspective and an organizational perspective, of completing a task successfully to reliability's converse and the incidence of error present during task completion (Chamberlin, 1996). An incident is an occurrence, other than an accident, associated with the operation of an aircraft that affects or could affect the safety of operations.

HUMAN+ FACTORS = HUMAN FACTORS

"Is this combination really needed"?

Human Factors is a term that can be described as the Human Interface with a System(s) or an environment. The most commonly used term that is utilized interchangeably with Human Factors is Human Machine Interface or (HMI). Human factors discovers and applies information about human behavior, abilities, limitations, and other characteristics to the design of tools, machines, systems, tasks, jobs, and environments for productive, safe, comfortable, and effective human use (Chapanis, 1985). When manufacturers design an aircraft, the goal is to ensure that the design has met the specifications from the customer and the perspective government entity. Systems Engineering teams within manufacturing companies coordinate with several specialists such as: Human Factors Engineers to determine the impact a design on safety and product integrity. However, within the operational arena; such as 14 CFR Part 121 air carrier operations in the airline industry, the Human Factors discipline is viewed quite differently. The airline industry's aspect of Human Factors is not derived from an engineering design perspective; in fact it is really derived from an operational human performance factors perspective. What does this mean? This means that the airline focuses on everyday operational issues such as incidents and accidents that occur every day within maintenance operations, and within flight operations that are related to human error. The factors that influence the behavior of human beings in the airline industry are always being researched and investigated by scientists and other safety specialists within the industry. Since the airline industry has thousands of departures everyday, keeping track of these incidents, accidents, and the validity of those occurrences becomes crucial. Airline safety specialists sometimes investigate or research the underlying factors that influenced the judgment of a crew member, ramp agent, customer service agent or even an A&P mechanic. The FAA relies

on its inspectors and its' relationship with the airlines' to help identify existing and potential threats to safety. From a Human Factors perspective, it is sometimes a rigorous task for safety professional(s) within the airline industry to pinpoint Human Factors related failure(s) within the operations environment vs. Human Factors related failures at the management organizational level. The difficult task of identifying the "Human Factor" is because some organizations don't develop good safety program plans or standards for the airline company to track human factors related issues and the mitigation of those issues. For example, if an A&P mechanic is completing a C-Check (The "C" check is the most thorough type of maintenance work performed by an airline. The airframe and the entire aircraft are put through an extensive series of checks, inspections and overhaul work in the hangar), and the mechanic utilizes a task card that is no longer valid to complete a task on the aircraft; meaning that the task card does not contain the approved method to complete the task, there could be some potential risks associated with utilizing invalid task cards to complete work on the aircraft. What is the categorization of this event? Is this event considered a Human Factors error at the operational/maintenance environment perspective? Or could this event be considered a Human Factors error at the management organizational level? These are just some of the reasons why it is very important to understand human failure perspectives. In this scenario, the reasons for an invalid task card could be because line management did not update the task card. There could have been an update or temporary revision with the task card that was not communicated to the mechanic. Management could have not created a process for the particular task within their General Maintenance Manual (GMM). Or put another way, the mechanic could have created his or her own heuristics regarding the completion of the task which resulted in non-approved or incorrect task card information to complete the job. These types of actions create a risk to the airline company, creating a liability within the company. There are several other possible scenarios that could make this scenario even more complicated to understand the "Human Factor". There is a constant need to research and investigate the human behavior to reduce human performance based incidents and accidents within the airline industry.

THE MANAGEMENT PERSPECTIVE

"The Common Denominator"

When we think of the definition of Management, we think of planning, organizing, leading by example, directing and controlling an organization; in an effort for the purpose of accomplishing a common goal. Within an airline business, upper level management is the key to get valued decisions made. When decisions are made, all employees at the management level and line-operations employees should be aware of the decisions and know their compliance statement with the policies and procedures. However, just because management develops a perceived positive infrastructure to convey the aspects of safety doesn't necessarily mean that all employees will understand and abide by the policies and procedures set forth by upper level management. If the polices and procedures are not communicated well within an organizational structure then the entire organization is susceptible to the miscommunication of safety-related protocols. Safety culture is operationally defined within this narrative as the meticulous practice developed by the airline company to address safety related initiatives to improve an airlines' safety business infrastructure. Safety related initiatives are developed by

management to increase the vigilance of safety protocol within an airlines' operational environment. Safety is not a marketing agreement. Safety cannot be purchased nor can airlines' afford not to implement a safety business strategy. Safety must be developed by the entire organization supported by upper-level management leadership. In the airline industry, airlines' are in constant communication regarding safety related issues. Airlines' discuss safety related issues at forums and symposiums to increase the awareness of safety related issues at airlines' across the world. These safety-partnership related meetings encourage the constant oversight of safety at the leadership level and the line management level of the airline. There are two types of management cultures, they are: Senior Management Safety Culture (SMSC) and Line Management Safety Culture (LMSC). SMSC is normally developed at the leadership/corporate level at an airline company. Individuals' that are selected as leaders within the company lead positions such as: Vice President of Safety, Vice President of Maintenance Engineering, and other Director level positions. Decisions that SMSC develop are transferred to LMSC and Line Management level employees implement the strategies within their working group. The previous stated strategies represent a perfect world scenario. However, a perfect world does not exist. There are many instances where SMSC is not accepted by LMSC. Line management sometimes argues that Senior Management develops policies and procedures without consultation with line management employees. This disconnect in communication creates a stranglehold on the relationship between senior and line management; this disconnect could be detrimental to the airline company if the two organizations do not communicate effectively. For example: If Senior Management creates a new policy for mechanics and line management to work mandatory overtime to speed up the C-Check process and other maintenance related processes without consulting Line Management in an effort to save money and time; this decision could effect the overall efficiency, and adequacy of maintenance planning and inspection. Since maintenance planning is developed to ensure that all planning and coordination of scheduled maintenance activity and aircraft routing is accomplished within the time limitations set forth by a Continuous Airworthiness Maintenance Program (CAMP) by the airline company and that all aircraft checks are planned according to service bulletins and other aircraft planning related material received by the manufacturer; it is essential that Senior Management communicates very well with Line Management to minimize confusion regarding the timeframe for planning checks. If senior management develops a new timeframe for a "check" that eludes the recommended service bulletin check, the aircraft could potentially be considered not safe to fly. Below is an example of how the communication between SMSC and LMSC should interface to ensure quality and product integrity.

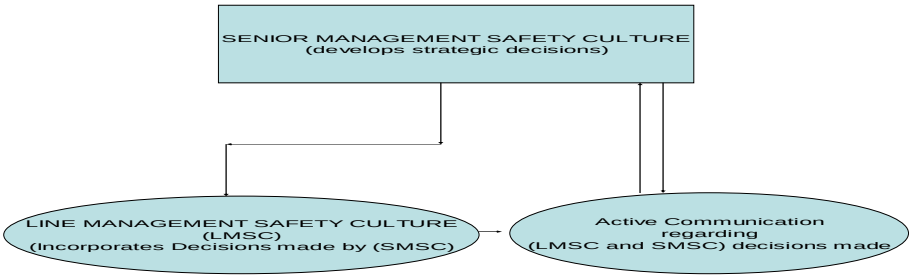

Figure 1
SMSC vs. LMSC Interfaces

THE VITAL AIRLINE INTERNAL EVALUATION PROGRAM (IEP)
"Strategic Methods of Empowerment"

Airline Internal Evaluation Programs (IEPs) provide oversight supporting the overall safety and efficiency of Maintenance, Flight Operations, and Customer Service programs. Compliance with external regulatory requirements, the identification of non-conformance to internal company policies and procedures, are some of the ways that the IEP can help identify opportunities to improve organizational policies, procedures, and processes. Under the provisions of 120-59A Advisory Circular (AC) (Internal Evaluation Programs), it is imperative to understand that, although IEPs are not considered regulatory, the FAA encourages the participation. However, there are other agencies such as the Department of Defense (DOD) that could consider participation in the IEP program at an airline a requirement. It is up to the airline to determine the applicability and demonstrate a continued awareness and compliance with applicable safety regulations. Most airlines have an auditing/evaluation technique within the company which enables them to monitor the overall system performance, efficiency, and risk potential to the business within their program. In the early 80's the FAA instituted an inspection program for the airline industry. This inspection program was the National Inspection Program (NIP) which later became the National Aviation Safety Inspection Program (NASIP). This program provided support to Air Carriers. The inspectors were not necessarily affiliated with the airline, but provided a rigorous inspection to the airline and repair stations (IASA, 2005). On May 11, 1996 ValuJet Flight 592, a DC-9-32 crashed killing all 110 crew and passengers. According to the NTSB, the probable cause of the accident was a fire within the class D compartment which was initiated by one or more oxygen generators carried improperly (NTSB, 1998). "Contributing to the accident was the failure of the FAA to adequately monitor ValuJet's heavy maintenance programs and responsibilities, including ValuJet's oversight of its contractors, and SabreTech's repair station certificate; the failure of the FAA to adequately respond to prior chemical oxygen generator fires with programs to address the potential hazards; and ValuJet's failure to ensure that both ValuJet and contract maintenance facility employees were aware of the carrier's 'no-carry' hazardous materials policy and had received appropriate hazardous materials training."(NTSB, 1998) After the investigation of the crash, System Safety was adopted by the FAA. A couple years later ATOS was developed by the FAA to enhance the overall system safety aspect of Air Carrier Programs that require oversight by the FAA. The ATOS program is utilized for U.S. Air Carriers with oversight from the FAA and its approach is considered systematic. For example, American, Continental, Delta, and Northwest airlines have already implemented the ATOS system within their airline structure; and some have been even been considered "ATOS Carriers". The term "ATOS Carriers" is generally reserved for airline companies who have implemented the ATOS program and the FAA has approved their methods of implementation within the airline.

As the U.S. aviation safety regulator, the FAA and the various inspectors are responsible for ensuring compliance with the Federal Aviation Regulations (FARs). It is the airlines' responsibility to operate their aircraft in a safe manner. The FAA is responsible for examining an airline's operations and maintenance when the airline seeks a certificate to operate and for conducting ongoing inspections to ensure continued

compliance with safety regulations. There are several types of inspectors that are assigned to a particular region of the U.S. for an airline. Under the provisions of Title 14 CFR Part 121 (Air Carrier Domestic and Flag Operations) operations, the FAA issues inspectors to each airline to act as active oversight to the airline. The FAA usually provides the airline with several safety inspectors, including a Principal Maintenance Inspector and a Principal Operations Inspector; there are several other Principal Inspectors that are assigned to an air-carrier, however for this paper the researcher will discuss the previous stated positions within the FAA. According to a study performed by the International Aviation Safety Association (IASA), the FAA issues and enforces the regulations and provides a qualified team of inspectors to each airline to provide oversight (IASA, 2005). The FAA and the airline industry rely on regulations and the oversight of those regulations to ensure quality and efficiency of safety within the industry. The FAA has to ensure that after an airline has applied to become a certificate holder that they conform within the regulations and operate with the highest degree of safety. If the airline does not conform within the Code of Federal Regulations (CFR), the possibility exists of the Certificate Management Holding Office (CMHO) fining or revoking the air-carriers' certificate. However, before the air-carrier is eligible for the revocation process of their certificate, several attempts to counsel the airline are made to ensure the adequacy of the fine or revocation.

The FAA's inspector(s) issue a Letter of Concern (LOC) to the Air Carrier when there are issues from the FAA's stand point of non-compliance issues within federal regulations. The FAA establishes a date that the air-carrier must provide a response to the (LOC) and a corrective action program to maintain compliance. If non-compliance continues, the FAA provides the Air Carrier with a Letter of Investigation (LOI) in which the FAA will now seek an audit of the airline's processes and procedures. Again, the FAA establishes a date that the air-carrier must show to the inspector, a corrective action program to maintain compliance. After several attempts to ensure that the airline is conforming within the regulatory standards and a re-evaluation shows the airline continues to be negligent in correcting the issue, the FAA then issues a fine. To prevent these types of actions from occurring, the airline keeps a letter of compliance (LOC) to ensure that all applicable regulations are being followed and there is reasonable explanation to the FAA of how the airline will follow the regulations applicable to the airlines' departments. The airline industry is fixated on maintaining compliance with the FAA regulations and limiting the occurrence of incidents and accidents within the business. However, regulations alone are not the only means of ensuring a safe airline. Airlines across the U.S. have implemented FAA Advisory Circulars (ACs) coupled with their standard practices everyday to ensure that the airline is managing the policies, procedures, and standards. Advisory Circulars are methods of communication developed to provide guidelines on a particular subject matter, such as how to comply with a regulation.

Operationally defined within this narrative, Advisory Circulars are advisory based-methods that when implemented and followed provide better situational awareness to aviation safety related factors in the airline industry. Within the airlines' IEP, another method of showing compliance with standards is an airlines' auditing/evaluation technique. Some methods of evaluating internal processes are the: Aviation Safety Action Program (ASAP program), Dispatch Safety Action Program (DSAP), Maintenance

Safety Action Program (MSAP) and the Flight Operations Quality Assurance (FOQA) just to name a few. These programs are an essential part of an airlines' IEP. Why? If these programs are implemented within an airline IEP, the management of safety related issues are more organized and the ability to convey issues within the airline to the FAA and other agencies becomes streamline. For example, the ASAP provides methods of collection, storage, mining, and the analyses of safety related data. The ASAP program and other voluntary safety programs are a unique partnership with the FAA, union officials, and the perspective airline. The goal of the ASAP is to widen the communication of safety related issues while identifying actual or potential risks throughout their operations. The analyses of the information collected can be a good way of conveying to the administrator and its partners the measurement of aviation safety related issues. Other voluntary safety action programs follow the same blueprint of the ASAP strategy.

THE "GET OUT OF NON-COMPLIANCE CARD"?

The Voluntary Disclosure Reporting Program is a program that allows the airline to submit safety and security data related to possible violations regarding regulatory compliance. Per AC00-58A, the program is a voluntary program that encourages the airline to report non-compliance issues. Airlines across the U.S. have implemented this program to ensure that they have the opportunity to identify possible non-compliance situations, monitor their effectiveness and provide feedback to the FAA for a comprehensive fix for the non-compliance situation. It is very important that the airline that chooses to implement the program understands that this program is not a program that should be used and abused. The program is not designed for airlines to purposely commit violations and then reveal those violations to the FAA through the program. The airline company must understand that this program is NOT a get out of complying with regulations incentive. In contrast, the program is designed for airlines' that may have committed an error(s) and need to disclose the issue to protect the airline company from possible regulatory fines or certificate revocation. The airline must also understand regulations are the minimum safety standards an airline must follow. This program interfaces with the IEP. It should be the responsibility of the IEP to understand the issues within the airline departments' and report those issues to the individual in charge of the perspective department (s). The IEP then determines the best method of reporting the information to the FAA. This program supports maintenance, flight operations and other safety/security related programs within an airline. Since these programs are an essential component to the operation of an airline, understanding the implementation process of the Voluntary Disclosure Program and the development of the program to assist the airline company with understanding the need to follow safety standards is paramount. Two examples of non-compliance scenarios are provided on pages 13-16 to convey the aspects of why airlines' report non-compliance issues through the Voluntary Disclosure Program. Case #1 is a maintenance related incident that interfaces with operations. Case #2 is an Operational related incident.

CASE #1

"Airline XYZ is a 14 CFR Part 121 Air Carrier, and has flown several takeoffs and landings in their fleet of ABC aircraft. Airline XYZ has not performed any audits regarding log book entries within the last year. XYZ airlines is required by the FAA to perform continuous audits per XYZ airlines' Continuous Analysis and Surveillance System (CASS) which is regulated by the FAA's 14 CFR 121.373. Airline XYZ notices the non-compliance situation when ABC aircraft is in the process of being released from the hangar during a routine maintenance inspection check. The A&P mechanic notices the logbook has not been signed by anyone within the last year (neither maintenance nor crew-members) closes the logbook without signing that he has completed his work either. When the mechanic locates his inspector, the inspector says "Are we all buttoned up?" The mechanic replies that he has signed the logbook and the aircraft is airworthy and ready to continue service on the line. The inspector states that "I trust you, we have to get this aircraft out as soon as possible because we are losing money and I don't want to hear it from my supervisor; so I am trusting that you have done an excellent job on that aircraft". Next, the inspector says to mechanic, "Don't forget about our Trust Culture" out here in the hangar, I want us to be able to trust each others' work has been performed; and you know I don't really care to much about the company corporate safety culture, that is why I have created the trust culture." The inspector says, "Contact the operations center and let them know that the aircraft is ready for line service." The mechanic who previously noticed the non-compliance situation regarding no log book sign offs does not report it to the operations center, dispatchers or maintenance control who is in charge of flight 0000 for Airline XYZ. Now that the aircraft is at the gate, and the ramp agents are in the process of conducting ground operations, the pilots review the weather information, flight manifest, and review the logbook entries. After the captain reviews the logbook entries, the captain states to the first officer, "We cannot fly this aircraft". The first officer replies why? The captain states that there are no signatures verifying that today's work has been inspected and that we can fly in an airworthy condition per 14 CFR 121.709 (Airworthiness release or aircraft log entry). The crewmembers contact their systems operations control center and the flight was cancelled. The Director of Safety, and MSAP Manager was contacted the next morning by Maintenance control indicating a possible need for a Voluntary Disclosure.

Case #1 is just one of many issues that occur daily within an airlines' maintenance and operations programs. When reviewing this case, it is undoubtedly known that each individual (s) involved had a significant part in this safety related issue. First, the airlines' maintenance program should have identified a year ago that there were issues associated with logbook entries. Per AC-120-79, the airline should have implemented a CASS program that would have detected this latent failure before it became an active failure. AC-120-79 states that an airline could utilize the CASS AC as a method of compliance for 14 CFR 121.373 requirements, or the airline could simply follow another method that is acceptable by the FAA. However, simply implementing the program and not following program objectives doesn't constitute compliance. The fact that the airline did not demonstrate active oversight within the CASS program shows a latent failure within the organizational infrastructure. Next, during the maintenance check the A&P

mechanic is required to show evidence per 14 CFR 121.373 that the work has been completed. In this case, the airline shows that work is completed by the use of a signature. When the mechanic was in the process of signing the logbook, he/she should have noticed that there were other logbook entries that did not contain signatures. This is an example of poor situational awareness, lack of maintenance oversight, and deviations to safety compliance factors. This case also featured issues with safety culture and heuristics. The inspector plays a vital role in the quality assurance of an inspection sign-off and the inspector should be the final sign off when a maintenance task has been completed. Furthermore, per regulations and the policy at the airline, the inspector should have reviewed the task that the mechanic claimed to have completed and the inspector should have completed a visual inspection to ensure the job had been performed per the task card instructions. Following the procedures of the airlines maintenance program could have eliminated possibilities of non-compliance in this scenario. The fact that the inspector said, "I trust you" indicates a poor safety culture.

It is extremely important that inspectors or mechanics do not develop complacency. Why? Complacency could lead to heuristic risk(s). Operationally defined within this narrative, a heuristic risk is a combination of probability and severity leading to undesired complacency-related safety error(s). The probability of an event occurring because of the use of heuristics becomes higher when individuals take shortcuts to achieve a desired result. The severity factor complicates the issue by introducing severity or a hazardous related event. In this case, the airline does not have a record of the work being completed; hence there is no indication that the aircraft is airworthy to fly in accordance to FAA regulations and this could lead to a possible hazardous situation. Last, the captain and first officer did a good job of noticing the non-compliance situation and reporting to dispatch that the aircraft could not be flown in an airworthy condition. The maintenance organization, operations organization and the IEP program need to determine how to initiate the Voluntary Disclosure to the FAA per AC00-58A (Voluntary Disclosure Reporting Program).

Although shortcuts taken by personnel have several different variations of magnitude that sometimes don't affect safety of flight; certain shortcuts in safety could trigger deviations leading to failures causing an undesired event. On January 13, 2003, Air Midwest flight 5481, operated by U.S. Airways Express crashed shortly after takeoff from runway 18R at Charlotte Douglas International Airport. Two flight crewmembers and nineteen passengers were killed. The NTSB and the FAA concluded that lack of oversight of the work being performed at Air Midwest's maintenance facility in Huntington, West Virginia was a contributor to the crash. Also NTSB investigators found that the accident airplane entered a maintenance check with an elevator control system that was rigged to achieve full elevator travel in the downward direction. However, the airplanes elevator control system was incorrectly rigged during maintenance, and the incorrect rigging restricted the airplane's downward elevator travel to about one half of the travel specified by the manufacturer. One of the mechanics examined and incorrectly adjusted the elevator control system (NTSB 2003).

When personnel utilize heuristics to complete a job function to achieve a desired result, it could lead to the "Normalization of Deviation". For example, the risk is considered to be normalized if a group of mechanics are used to a safety culture where its deemed ok to not sign off records and to use a "trust safety culture" with a lack of oversight; the deviation becomes apparent when a set of instructions required by the airlines policies an procedures are eluded leading to a deviation. Individuals' who commit these deviations could become complacent and careless when completing a job function. Oversight is an essential component in airline operations thus creating a more controlled environment for ensuring safety management. Even though change usually starts from the top of the organization, the downstream of safety protocol affects all employees.

CASE #2

Airline XYZ is a 14 CFR Part 121 certificated Air Carrier, and has flown several takeoffs and landings in their fleet of ABC aircraft. Ground Handling Services is in the process of loading customer bags from a belt loader in to the aircraft for a flight that departs from Gate ABC in 20 minutes. According to the flight manifest, there are 145 passengers on the aircraft meaning the aircraft is considered a full flight per specifications. The operations supervisor notices that the weather at XYZ airport is becoming inclement and there could be a need to de-ice the aircraft. The operations supervisor contacts the dispatch operations at XYZ airlines and ensures that the weather is indicative of deicing. After the operations supervisor contacts dispatch, the operations supervisor notices a contracted deicing agent approaching the aircraft. The de-icing agent indicated through a radio call that he needed to review the procedures for deicing the aircraft because he hadn't deiced this airlines' aircraft before nor did the deicing agent have training from the airline to perform the duties of a contracted deicer for the airline. The deicing agent communicated with the operations supervisor to retrieve XYZ airlines Deicing manual. However, when the operations supervisor attempted to locate the manual, it could not be found. The operations supervisor communicated with the deicing agent and said "The manual could not be retrieved, complete the job based on your knowledge with previous aircraft that you have worked on at other airlines." The deicing agent attempted to complete the job but positioned the deicing machine incorrectly and subsequently loss control of the deicing unit and damaged the aircraft. After the incident occurred the operations supervisor attempted to locate the deicing manual a second time. The manual was found by the operations supervisor in the break room on top of a refrigerator unit without any recent incorporated revisions to the manual. The operations supervisor notified safety hotline, ASAP manager, the dispatch operations unit, and the safety department indicating a possible need for a voluntary disclosure.

In Case #2, there are several issues that would need to be investigated by the IEP program before possible voluntary disclosure is developed. According to the FAA regulations, No person may dispatch, release or takeoff an aircraft any time

conditions are such, that frost, ice, or snow may reasonably be expected

to adhere to the aircraft, unless the dispatch, release, or takeoff comply with 14 CFR 121.629(c), in addition, no person may takeoff an aircraft when frost, ice, or snow is Adhering to the wings, control surfaces, propellers, engine inlets, or other critical surfaces of the aircraft in accordance with 14 CFR 121.629 (b). Also, according to 14 CFR 121.137 (b), each person to whom a manual or appropriate parts of it are furnished under paragraph (a) of this section shall keep it up-to date with the changes and additions furnished to that person and shall have the manual or appropriate parts of it accessible when performing assigned duties. Why did the de-icing agent complete the task of deicing the aircraft when he was not trained on the airlines' specific deicing procedures for contracted deicer? Also, why was the manual not available for the deicer when completing the job of deicing the aircraft, and more importantly why did the operations supervisor indicate that it was ok to utilize the deicers experience on previous aircraft he had worked on to complete the deicing task for the airline? First, the airline or airport should have training files on record for all employees that require an interface with the airline. It is the airlines' responsibility to ensure that active oversight with their vendors is achieved. This type of oversight should reside at the operations supervisor level with the airline, and the IEP ground safety manager should have a master copy of the contracted agency employees providing the deicing services; this record is needed to ensure that the employee has met the requirements to perform deicing. Some requirements that are required for deicers are that they meet the minimum training requirements and evidence that the deicing agent has successfully passed the practical tests for deicing an aircraft. Second, the operations supervisor indicated that the manual was not available for the deicer to review. Per FAA regulations, the manual should be available for the deicer to review and should be updated. The airline should have ensured that the manual was available but more importantly, the operations supervisor should have never replied to the deicer "Utilize your previous experience". In this case, the procedures for deicing an aircraft were different based on the design of the gate apron area where the aircraft was preparing to depart; this is why it is essential for the airline to provide oversight with contracted vendors, follow company policies, procedures, and follow FAA regulations. This example conveys a poor safety culture. The safety culture could have been compromised because of latent failures throughout the entire organizational structure that subsequently led to the active failures within the operational environment. These failures could have been avoided if the failures had been identified in the beginning.

THE ATOS DETERMINATION

"A Systematic Approach to Regulatory Oversight & the Needed Interface"

It is very clear and evident that based on the previous case studies, there is a need for an IEP program to facilitate an active interface within the entire organization. But is the IEP program the only program needed that will suffice the airline industries protection against incidents and accidents? The answer is No. Since the inception and development of the FAA ATOS initiative, part 121 airlines' have become more efficient with understanding the regulations and the need to communicate compliance with these regulations through the constant development of robust policies and procedures.
It is very important to understand the theory behind the term System Safety before understanding the approach the FAA has utilized for air carriers. A system is a group of

interrelated processes in a specific environment to perform a specific task. Safety is the optimization of risk. System Safety is developed when these two principles interface. In the airline industry, risk is an explanation for probability and severity; these factors are analyzed to reduce potential hazards within a system. According to James Reason, professor of Psychology at the University of Manchester, risks leading to a possible hazard can be identified as latent or active failures within an airlines' organization (Reason, 1990). Reason's Swiss Cheese Model classification of unsafe actions is a widely accepted framework for aviation safety and training. The defining characteristic of Reason's taxonomy involves the intentionality of the act or behavior leading to the mishap (Wells, 1997). In many studies conducted by James Reason, he predicted that unsafe acts could be categorized as either intentional or unintentional. Unintentional acts are due to memory failures in both long term and short term memory and attention to detail. A key to long-term memory, which distinguishes it from most other theories of memory, is that experts develop, through practice and study, retrieval structures for the task domain (Fernand, 2000). Most information that cannot be retrieved is because of a lack of redundancy, which can ultimately lead to errors. In addition to the intentionality of error actions, error may have differential effects, especially in a systemic analysis of mishaps and disasters. Reason distinguishes between two types of errors: 1) active errors, which effects are felt immediately in a system, and 2) latent errors, which effects may lie dormant until triggered later, usually by other mitigating factors (Chamberlin, 1996). The presence of defenses or safeguards in a system can usually prevent the effects of latent errors from being felt by closing the "window of opportunity" during which an active failure may be committed, according to (Chamberlin, 1996). In the airline industry, active failures are more than likely the fault of "front-line" employees such as ramp agents, pilots, air-traffic controllers and anyone that may have a direct effect on the total operation of any particular system. Active failures result in failed defenses. Latent failures, on the other hand, are associated with those individuals such as upper management who are separated by time and space from the consequences of the system. Latent failures appear dormant or undetected within a system or multiple systems; these errors could have originated in the beginning training record. The ATOS program indicates a systematic perspective in managing system safety related issues at the management level and operations level at an airline.

The FAA ATOS system has identified six safety attributes that the U.S. airline industry utilizes to convey compliance with regulatory standards. The six safety attributes are: Responsibility, Authority, Interfaces, Controls, Procedures, and Process Measurements. The authority attribute is the individual (s) that are responsible for the entire process, Responsibility is the organization or person responsible for the overall quality of the process, Procedures are the documented method of accomplishing a process, Controls are method to ensure procedures are followed, Process Measures are utilized to analyze the process, and Interfaces are used to indentify and manage the interactions among processes (ATOS, 2005). These safety attributes are incorporated within an airlines' safety management program in an effort to assist safety professionals. The utilization of Data Collection Tools (DCTs) provides the airline with a structure that supports the airlines' system; the airline specific system assists the airline in determining which safety attributes apply to the airline system. FAA inspectors utilize these tools to evaluate an airline company's compliance with regulatory standards. For example, the

System break down structure could include Flight Operations, the subsystem represents airline policies and procedures, and the element represents the airline carry-on-baggage program. This systematic breakdown allows the inspector and the airline company to understand the process of systematically evaluating their operations. Furthermore, the FAA has identified Safety Attribute Inspections (SAIs) and Elemental Performance Inspections (EPIs) to assist the airline in surveillance of their processes and procedures. SAIs are used to evaluate a manual system, the purpose is to determine that the air carrier has the processes documented and includes the six safety attributes. EPIs are used to determine if an air carrier is following the procedures and regulatory standards. Below is an example (Case #3) of how the ATOS system works and how the system can be very different than a conventional audit technique within an IEP program.

CASE #3

An evaluation of standards and compliance for the XYZ Airlines Carry on Bag Program was conducted at the XYZ Airport recently. Results of the evaluation were supported by 14 CFR 121.589 federal regulations regarding Carry-on Baggage. The findings and concerns were as follows: There were 25 occurrences of passengers' carry-on baggage not fitting in to the overhead compartment. There were five additional occurrences of bags forcibly loaded in the overhead bins. There were five occurrences of aircraft being pushed back prior to all overhead bins being secured. There were 20 occurrences of passengers needing assistance lifting bags to be placed in overhead bins, five passengers were elderly. Furthermore, there were bag sizers available at the ticket counter and departure gates. The ticket and gate agents appeared to be monitoring carry on bags for quantity, size and weight.

According to 14 CFR Part 121.589, carry-on baggage must fit in to the overhead compartment. Essentially, the goal is to decrease the amount of baggage that cannot fit in the overhead compartment by tagging the baggage oversized before it even gets to the aircraft for the departure. If the bag is not tagged oversized, then the risk of the baggage stowed in an incorrect place on the aircraft can lead to improper weight and balance calculations and load considerations. Also, the delay in baggage not fitting in to the overhead compartment can lead to a substantial delay in departure. This delay can then lead to irate customers and a decrease in customer service standards upheld by XYZ airlines. Last, if baggage cannot fit in to the overhead compartment and the baggage is left in the galley, passengers could have the potential to trip over baggage components which can lead to customer service injuries. This can lead to possible OSHA recordable and reportable injuries in the future per the OSHA 1910 regulation.

In this scenario, there are several possible issues to investigate. In a conventional IEP program, safety auditors would audit the issue regarding the carry-on-baggage program. However, with the development of the ATOS System Safety perspective, the focus is an evaluation of the overall program from a systematic management perspective; this perspective is quite different than the IEP perspective. First, the airline would need to determine if the regulations regarding carry-on baggage were breached through an examination of their Letter of Compliance (LOC) Secondly, utilizing the DCTs developed by the FAA ATOS program, the airline would need to locate and examine the Flight Operations section and the subcomponent parts of flight operations to include the carry-on baggage program. After the examination is complete the airline would need to

discuss how the six safety attributes apply within this scenario. The airline would need to determine who in the airline company has the responsibility for the airline policy regarding carry-on baggage. In some cases, the director of in-flight may retain the responsibility for the development of polices and procedures; but the overall authority may be flight operations. Utilizing interfaces, the airline could determine who interfaces with the program. For example, are customer service agents and ramp agents the only team-members that use the carry-on baggage program? There should be a process map created and implemented by the program that conveys the interfaces for the carry-on baggage program. Next, the airline would need to determine relevant control methods to deter non-compliance with regulations. This determination is needed to understand any areas within the program that are susceptible to possible deviations within the regulation. Is there a need develop better control methods, or are the current control methods enough to meet the minimum safety requirements set forth by the FAA? In order to answer this question, Process Measures need to be examined so that the airline has a process to measure the results of compliance or non-compliance with airline policy and regulatory standards. This is a helpful technique for evaluating the case #3 carry-on baggage scenario since there was data collected during the evaluation and the data can be utilized to convey compliance and non-compliance issues within the program. An essential component of measuring the process is data mining; verification of the regulations, tracking, trending and statistical analyses are all subcomponents that assist the airline with illustrating the overall efficiency and quality of the current process. These components also assist the airline with refining current procedures to increase compliance with airline policy and regulatory standards and the development of new policies and procedures. These methods give the FAA and any other government entity the ability to examine the process and provide feedback to the certificate holder regarding best practices. Most Part 121 airlines have adopted this feedback mechanism most commonly known as the Safety Management System (SMS). This system interfaces with the IEP and ATOS programs. The SMS must have accountability to ensure the effectiveness and integrity of the operational management and control of the system; this is needed to ensure accuracy of the data collected and measured.

It is very clear that the U.S. Air Transportation system is the safest in the world. The basis of this fact can be found throughout statistics developed by the FAA, NTSB, and industry professionals to elude any conjectures that the U.S. Air Transportation isn't the safest. There is significant and ample evidence that suggests U.S. government officials; airline professionals and manufacturers will continue to improve the U.S. Air Transportation system in the current years ahead. Airlines across the U.S. have contributed to the constant decrease in incidents and accidents by reporting non-compliance issues through already established voluntary programs. The need to keep these established voluntary programs such as the: ASAP, MSAP, IEP and DSAP programs is an essential component to ensure the adequacy of regulations set forth by the FAA and other government entities, quality assurance regarding airline operational performance, constant quality feedback to government officials and the constant preservation of life. These programs need to continue their existence within the airline industry and should not be terminated.

There is a need for the ATOS infrastructure and the constant implementation within the airline industry, and the ATOS initiative should become mandatory and should

become a regulation. It should become mandatory so that all airlines' have the opportunity for a more systematic approach to safety. Since the development of ATOS, scheduled 14 CFR part 121 domestic air carrier operations accident rates have plummeted considerably between the years of 2002-2008. One obvious reason is because airlines are communicating with each other regarding safety issues. Another reason is because airlines are communicating with the government through the voluntary safety programs incentives. The ATOS inspection system should become a regulation because it would assist the airlines' with identifying various aviation safety related issues that parallel the existing structure of FARs within Title 14 Aeronautics and Space Part 121. ATOS would increase communication within the airline and the administrator since ATOS is a method that inspector utilize regarding the evaluation of an air carriers' airline system. However, the legacy IEP is still needed. The IEP is needed to ensure Total Safety Management (TSM) within an airline. TSM includes the active pursuit of determining risks, the constant management of the current risks to the airline company and the effects of the associated hazards. The airline IEP should implement the ATOS initiative, so that the airline has a more formal systematic approach to identifying regulatory non-compliance, non-compliance with company policies and procedures, and factors leading to incidents and accidents within the airline. Since the ATOS breakdown structure shows the current airline systems and its' interfaces with federal regulations, the airline should be able to constantly identify issues utilizing the ATOS system and then actively manage these issues throughout the voluntary IEP.

The cases examined within this research paper are only a very small percentage of events that constantly occur in U.S. airline operations. However, even with a more systematic approach, there needs to be constant monitoring regarding the effectiveness of the administrator, or the FAA. Since the FAA provides the airline industry with a more robust process for monitoring issues and the FAA is utilizing the same process for inspecting an airline, their needs to be a government entity developed for constant oversight of the FAA inspectors that take part in the FAA ATOS initiative at the inspector level to ensure that the FAA inspectors understand the ATOS process and are evaluating per the ATOS incentive for the airlines. As previously stated, according to a Wall Street Journal article, the FAA was accused of failing to perform more than 100 recommended safety reviews at major air carriers in recent years. According to the article, importance of this examination became clear earlier in 2008 because of revelations that FAA managers allowed Dallas, Texas based Airline Southwest Airlines to fly airplanes that hadn't undergone mandatory structural safety inspections. It would seem pertinent that there needs to be constant communication with the airline and the FAA regarding issues that could cause the airlines' certificate to be revoked or the possibility of loss of life. We must continue to monitor our current progress and to strive for an A+ air transportation system, and the possibility exists with an active interface with the federal government and airline safety professionals.

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