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Airport Safety Management Systems: Leadership Manual on Building a Culture of Safety

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AIRPORT SAFETY MANAGEMENT SYSTEMS: LEADERSHIP MANUAL ON BUILDING A CULTURE OF SAFETY

by

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INTRODUCTION

In 2007, Brandon Afoa was a ramp agent at Seattle-Tacoma International Airport (SEA-TAC) Airport in Seattle. Afoa was involved in a catastrophic collision when the brakes and steering of his aircraft tow truck failed and collided with a broken luggage lift that crushed him (Afoa v. Port of Seattle, 2015). The flight-line worker sustained severe injuries to his spine and was partially paralyzed and lost use of his legs and his right arm. Afoa's injuries require him to have medical professional care on a daily rotation.

In 2011, Afoa filed a lawsuit against the Port of Seattle in King County Superior Court, alleging that the Port failed to maintain safe premises and violated common law and statutory duties to maintain a safe workplace (Afoa v. Port of Seattle, 2015). The Port of Seattle legal defense argued that because Afoa was an employee of a private company contracted to the airlines and not the airport authority, that in this case that they were not the liable party for the Afoa's injuries. (Afoa v. Port of Seattle, 2015).

On March 31, 2015, a King County jury returned a verdict of $40 million dollars. The judge cited that the airport has a duty to provide a safe working environment for all workers including contractors and third-party entities operating at the airport (Afoa v. Port of Seattle, 2015). Shortly after the accident, SEA-TAC became one of the first FAA pilot airports to research and implement a SMS plan (ACRP, 2007) The SEA-TAC bodily injury case highlights some key reasons on why a safety management system (SMS) is necessary in modern business environments like an airport.

Most airports are like SEA-TAC in the respect that they have government employees as well as private third-party vendor employees working within close proximity. As the evidence in this case clearly demonstrates, there were a multitude of hazards that were not identified on the

airfield. Both the heavy machine tow was defective and should have not been operational and the broken baggage rack was also a hazard. A strong safety culture may have prevented this accident from occurring and may have prevented Afoa from sustaining such debilitating injuries. SEA-TAC Airport no doubt would have been spared the negative media attention, financial and legal resources, and time spent on this accident if there was a strong safety culture at that time.

One of the growing trends in aviation is the development, implementation and maintenance of safety management systems (SMS). The conceptual framework of SMS research in the commercial aviation industry has become more prevalent in the past decade, has after they proved successful in use by the military and other high-risk industries. Safety Management Systems has been implemented in several other industries such as manufacturing (Cooper and Phillips, 2004), nuclear energy sites (Aerosafe Risk Management, 2010), railroad transport (DOT, 2007), and chemical processing plants (Hoffman and Stetzer, 1996).

The main purpose of SMS is to eliminate aircraft accidents or serious incidents (ICAO, pg. 2-1, 2013). While elimination of all incidents is the ultimate goal, it is not possible for an airport to be completely free of hazards and risk (Reason, 1997). Insuring that safety risks are constantly mitigated is challenging task in the transportation industry. However, SMS is a continuous streamlined process that can greatly improve the safety performance of an organization (Reason, 1990).

Occupational risks occur from both airport personnel as well as the equipment that personnel operate in daily operations. The main concept of SMS is to minimize risks to acceptable levels. The purpose of this paper is to (1) briefly synthesize modern literature on safety culture, (2) review common leadership theories and demonstrate its application for safety coordinators, (3) To make recommendations and give practical strategies on building strong

safety cultures in airports. One of the gaps in safety and human factors research is how do airport administrators build and maintain a culture of safety with limited resources or limited experience with SMS implementation? Developing and maintaining a culture of safety is key to having all members of an organization take ownership and to actively engage daily tasks with safety as a core value. This manual addresses the key elements of SMS and draws upon leadership and management strategies for airport managers to build and improve a safety culture within an airport organization.

One of the key factors of SMS culture requires that there is a communal involvement and a visible commitment from airport management to promote safety in the daily activities throughout an airport. Due to the dynamic concepts involving SMS, all airport personnel must value safety regardless of experience, title, or seniority. Since airports are a public utility, there is a duty of care by all aviation administrators to be knowledgeable and adept at managing their airports as safely and efficiently as possible.

One of the gaps in safety research is the significance of the leadership role in building a quality culture of safety. Building a culture of safety is important in facilitating a successful safety management system. Culture plays a significant role in all of the components of SMS especially in the safety risk management and safety assurance phases of the SMS process (Stolzer et al., 2011). This manual is designed to provide the Accountable Executive and other airport stakeholders in charge of safety operations with a reference guide to aid in successfully implementing, building, and sustaining a robust safety culture and environment.

CHAPTER 1

DEFINING SAFETY MANAGEMENT SYSTEMS

Safety Management Systems (SMS) are formalized, proactive and collective approaches toward managing safety risks (IACO, 2013). SMS includes systematic procedures, practices, and policies for the management of safety (IACO, 2013). SMS has been used by a variety of different public and private sector industries such as chemical manufacturers, petroleum, nuclear facilities, railroad, and medical institutions (ACRP, Report 1, Pp. 12-17, 2007).

In the context of aviation, safety is actively mitigating against property damage or bodily injury within an airport by designing metrics and benchmarks through continual data collection and evaluation. The goal of safety management systems is to reduce or maintain risks to an acceptable level within an airport (IACO, 2013).

While elimination of all incidents is the ultimate goal, it is not possible for an airport to be completely free of hazards and risks. Human error will always be present in any environment, especially in an airport environment with planes, motor vehicles and people all moving at a consistently rapid tempo (Reason, 1997).

The SMS process includes four components; Safety Policy, Safety Risk Management, Safety Assurance, and Safety Promotion. It is important to remember that the four components are relational and flow together as a process (ACRP, 2010).

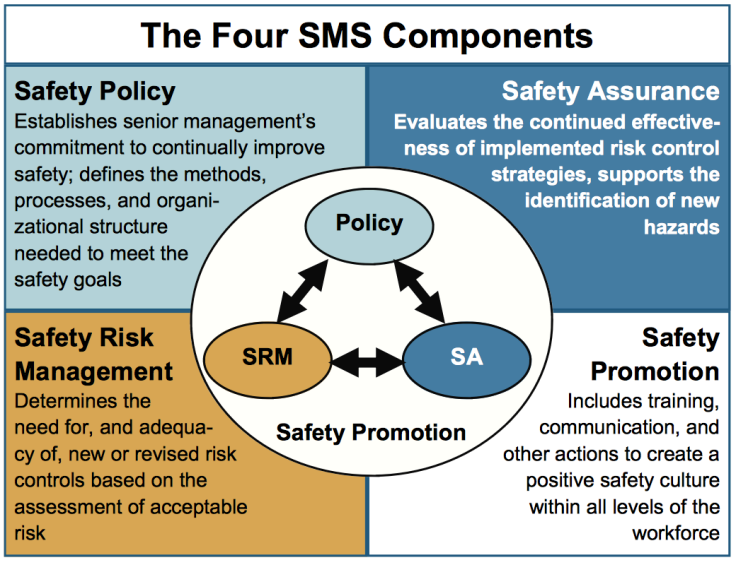

Figure 1.

If a single component is omitted or neglected this may result in the overall SMS plan not properly mitigating risk. SMS does not develop in an immediate fashion. SMS is a process that requires commitment from the leadership, active participation from organizational members, and time (Stolzer et al., 2011). Airport management must be unilaterally on-board or the SMS process will not work. Commitment should be clearly articulated in the safety policy and in the safety information disseminated for safety promotion (FAA, 2015). The process of data collection expanded beyond reviewing only accidents or incidents and attempting to mitigate risks proactively. These principles are demonstrated in the SMS model and they reinforce the emphasis that continuous data collection and analysis to identify hazards and risks are necessary to having a functional SMS plan.

SMS stresses the importance of communication and creating an environment that positively fosters safe behavior rather than creating an environment of fear. Once SMS is gradually implemented into an organization, safety becomes a fundamental value of the organization and will significantly improve the performance of the airport (IACO, 2013).

Implementing SMS and leading a strong safety culture is a challenging task. At first, the idea of implementing SMS may be received with skepticism or negatively by airport employees. Airports that have management, employees, and staff that have worked there for a long duration of time may demonstrate a resistance to something that is new and unknown. This is what makes the initial phases of the SMS implementation so critical to the long-term safety performance. Airport leadership must actively engage employees and promote safety, while at the same time understanding the concerns of the employees. Admiral Thad Allen, Former Commandant of the Coast Guard once said "Change is hard, but not as hard as recovering from a missed opportunity or loss of confidence that comes when leaders fail to act." (Coast Guard, 2007)

CHAPTER 2

BRIEF HISTORY OF AVIATION SAFETY

The evolution of aviation safety has three distinct eras starting in the early 1900's. The first era is called the *technical era* and refers to aviation safety from the early days of aviation to the late 1950's (IACO, 2013). As aviation quickly became part of the United States transportation infrastructure and significant as a social utility, safety was viewed in terms of mechanical or technological factors (IACO, 2013).

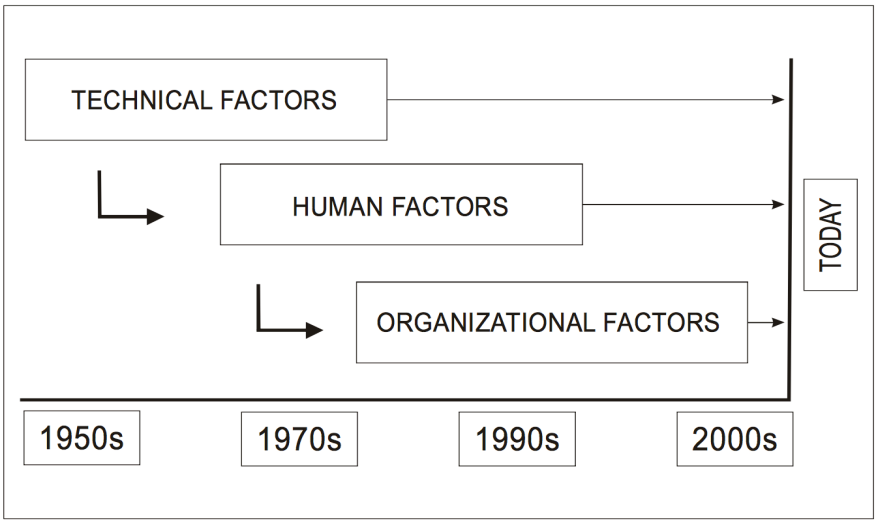

Figure 2. Evolution of Aviation Safety

Accident investigations often concluded that aircraft mechanical failure was the root cause of the accident and mitigation strategies focused on engineering and improving the design and maintenance of aircraft (Reason, 1990). World War II was the catalyst for many of the modern technological improvements that overall impacted and improved safety within aviation.

Aerospace technology research and development significantly improved by the 1950's and there was a decline of aircraft incidents through new transportation legislation passed by Congress during the 1950's and 1960's. The U.S. Air Force began developing 'safety systems'

as a strategy to preserve resources and to maximize combat capability (Air Force Safety Handbook, 2000). During the 1950's the Air Force cited 10 aircraft incidents per 100,000 flight hours (Air Force Safety Systems Handbook, 2000). After the U.S. Air Force implemented safety systems, safety performance improved significantly to less than 2 aircraft incidents per 100,000 in the 1980's (Air Force Safety Systems Handbook, 2000).

The U.S. Air Force invested time and money into a branch-wide comprehensive safety plan because it was method to decrease the massive costs associated with aircraft incidents as well as loss of combat ready resources (Air Force Safety Systems Handbook, 2000). Essentially, it is too expensive not to have a plan of safety. This should be the main goal of any organization to preserve resources and protect valuable personnel from damages.

The Air Force safety systems program has saved billions in taxpayer money since the implementation of the branch-wide safety systems. This early example of SMS implementation by the U.S. Air Force presents a good example regarding why the implementation of a safety system is important to preserving fiscal resources and can aid in lower costs associated to paying out claims for damages caused by incidents in general aviation.

The second era, the *human factors era* is the investigative perspective that aircraft and airport incidents may be caused due to variables beyond technological failures. The regulatory framework being developed through legislation proved to have a positive impact on aviation safety. As aviation grew to be a more viable mode of long-distance transportation and it became a significant part of the larger transportation industry.

Although aircraft incidents decreased by the 1970's, aviation investigations determined that human error was commonly cited as one of the causes of aviation accidents. However, the scope of the Human Factors Era, was limited to the accident and the individual. This perspective

erroneously separates the investigation of the individual and larger organizational framework. The idea that airports are complex social structures and the behaviors of individuals are related to the organization was overlooked until the early 1990's (Zohar, 2010).

The *organizational era* is the modern perspective of aviation safety staring from the early 1990's to present day. The organizational era began to view aviation accidents as a multi-faceted issue that is more complex. Investigations began to take into account variables other than just the technological factors, human error, but also the organizational structure in which the accident happened.

CHAPTER 3

SAFETY CULTURE

While the terms safety culture and safety climate are used interchangeably, their meanings differ slightly. Safety culture references patterns of behavior (safe or unsafe), core beliefs and behaviors. Safety climate refers to the current perceptions employees have of safety in the airport. To achieve the best possible outcomes of improving the culture of safety from the SMS plan, safety values must be clearly articulated through the general core values within an organization.

Safety culture defines what the values, beliefs, and behavior individual exhibit in daily activities (Reason, 1997). Culture is one of the most important foundations to safety management systems that is commonly overlooked in the technical application of SMS. Culture is important when discussing SMS because the root cause of accidents was historically tied deficiency in an organization of safety culture (Reason, 1997).

The foundation of safety culture must start from the top of the organizational scale. Senior airport management is paramount in actively participating and communicating the core safety values (Manuele, 2013). Dr. Robert Helmreich and Ashleigh Merritt (2001) research determined that the ‘culture of a profession’ is stemmed from a sense of community and social bonds of a common identity. Most importantly, the norms and values of the organization are demonstrated daily by the senior members of the organization and then indoctrinated down to the new recruits (Helmriech and Merritt, 2001).

While there is no unanimous definition of safety or culture in the aviation community, there are some common elements identified (see Figure). The IACO Safety Management Manual defines safety as;

"Safety is the state in which the risk of harm to persons or of property damage is reduced to, and maintained at or below, an acceptable level through a continuing process of hazard identification and risk management" (IACO, 2013)

Safety management scholar Fred Manuele provides a good definition to understand culture. Manuele defines culture as;

"An organization's culture consists of its values, beliefs, legends, rituals, mission, goals, performance measures, and a sense of responsibility to its employees, customers, and community" (Manuele, 2013)

Human factors scholar James Reason provides five detailed components of a safety culture. In the first component, Reason posits that every safety management system is reliant on the active participation of the members of the organization to report hazards or incidents. Everyday airport employees may be subject to a variety of different hazards and in order for SMS to be successful, all employees must feel comfortable reporting hazards, accidents or incidents that may have occurred without fear of blame or disciplinary action (Reason, 1997, pg. 195).

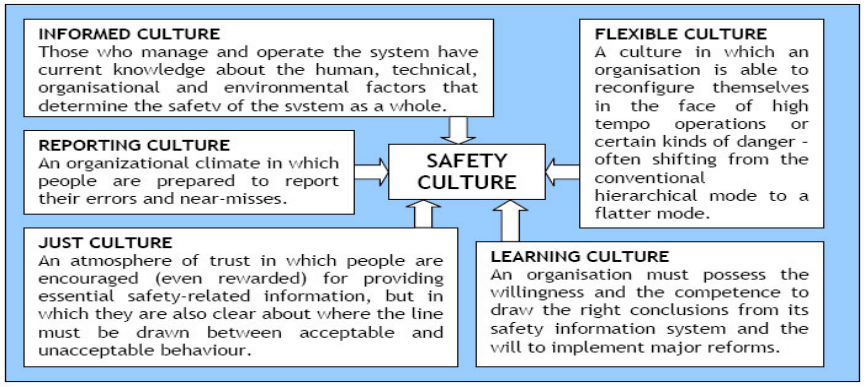

Figure 3. Safety Culture Model – James Reason (1997)

Airport management must design reporting procedures that insure the confidentiality of the employee or patron submitting a report will be maintained. Secondly, it is also important that the information being provided about an incident will be evaluated and acted upon. Since SMS is data-driven, having a confidential hazard reporting system is imperative to the success of SMS.

The actions of management are important take after a hazard report has been submitted. Employees that do not see any action from management after submitting an incident or hazard report, may conclude over time that there is no purpose or reason to report incidents and general participation will decline. Additionally, if employees feel that they may be punished for 'telling' on themselves or co-workers about an incident will not participate in hazard reporting.

A safety management system is most efficient when there is data and information about incidents happening throughout the SMS processes. Since hazards and risks are constantly changing, having employees submit an incident report is invaluable to the continuous process of SMS and to mitigate against new hazards in a timely manner.

The second component of SMS culture that is closely tied to the reporting culture component is *informed culture*. An informed culture means that the safety coordinator is collecting and reviewing safety incidents or hazard reports. Most importantly, the SMS coordinator has the responsibility to keep the entire organization informed on safety issues on a consistent basis (Reason, 1997, pg. 195).

For an example, if there were numerous reports submitted to the SMS coordinator about specific hazard and that information is not communicated throughout the organization - the probability that a preventable incident may occur increases. However, if information about that hazard is clearly communicated throughout the organization, then all employees can benefit from that safety announcement of that hazard and can modify their behavior to prevent an incident

from happening. Safety coordinators that can demonstrate a commitment to keeping their organization constantly informed about safety issues will generate more individual participation in the SMS process.

As previously mentioned in reporting culture, the safety coordinator must develop an environment of trust so that employees are encouraged and comfortable in providing information about safety issues. One strategy that can help with creating an atmosphere of a just culture is the standard that reporting unsafe actions will not result in disciplinary action if the error was unintentional (Reason, 1997, pg. 195). One management strategy that creates confidence and trust is designing a reward system that provides positive reinforcement for those that do report safety issues through the proper channels.

Airport management must use reasonable judgment when assessing safety errors or unsafe acts. Employees who act recklessly or assume unnecessary risks should face disciplinary consequences if the facts of the incident clearly determine error was not unintentional (Reason, 1997, pg. 195). Airport managers may find unique challenges in assessing appropriate disciplinary actions when they implementing a new SMS program.

One strategy that can help safety coordinators develop a just culture is to have an incremental disciplinary process that may start with a verbal warning and clearly communicating to the employee on why their actions were erroneous and provide constructive feedback to avoid problems in the future.

An incremental disciplinary process starting with a verbal warning is optimal to building an environment of trust and insuring that other employees will not be fearful of a written disciplinary action that may have adverse effects on their performance reviews. Airports that are implementing a SMS program in their organization for the first time or making significant

changes to their old SMS plan, that it may take time for the culture of safety to mature. Airport management that can establish confidence and trust from the start of the SMS implementation will see more participation from their employees.

According to James Reason (1997), a *flexible culture* involves an organization 'shifting' from a standard hierarchical mode to a flatter professional mode. For an example, during a crisis, the organization will rely upon the task experts to adapt to the circumstances and find solutions to the crises. This requires that the organization trust, respect, and train members so in the event of a crisis or major change in the daily operations everyone can still perform within their roles. One way that airports can achieve a flexible culture is by investing in emergency training and conducting hands-on simulations that replicate crisis situations. This subcomponent of safety culture ties directly to the safety promotion phase of SMS and will pay dividends in the event of a crisis.

A learning culture means that an airport is able to identify and learn from their mistakes. If the SMS process is being constantly assessed and monitored through the use of data and information, this should be disseminated to employees through regular safety promotion (Reason, 1997). Dr. James Reason concludes that administrators must be competent to make the right decision using safety information provided through SMS. Most importantly is that there must be a willingness to implement organizational reforms based upon risks or issues presented (Reason, 1997, pg. 196).

The main focus of SMS should not be solely the financial costs involved with implementing a plan. Business decisions always are tied to how much capital is available and the effects that the decision has on revenue. Transforming an organization's safety culture also means that the Accountable Executive and SMS coordinator must show evidence that

investment in safety is worthwhile from a business and financial decision-making perspective (Stolzer et al., 2011).

Safety is part of business and there is a cost to doing business. Unfortunately, safety is often viewed as a necessary evil that needs to be there, but at the same time safety takes away funds from other projects at the airport (Stolzer et al., 2011). Safety administrators should be aware that a strong safety culture will help mitigate against hazards and prevent accidents, however this sometimes is hard to prove. Typically, an airport with zero accidents cannot directly correlate the safety culture to the accident rate, but if there is an accident, the subsequent investigation can prove that there was a poor safety culture that caused the accident (Stolzer et al., 2011).

The Seattle-Tacoma International Airport accident is a clear example of the possible consequences stemming from a poor safety culture. It is viable to account for the total amount of losses attributed to the medical and worker compensation claims, attorney and legal fees, and the final jury verdict that weighed in at $40 million from the accident. From a business perspective, the purpose of maximizing revenue and minimizing losses includes those losses paid out for property damage, bodily injury claims, worker compensation cases, lawsuits, or governmental fines. However, some airport administrators fail to understand the importance of loss minimization as it applies directly to financial planning and maximizing revenue (Stolzer et al., 2011).

Siehn (2008) provides a variety of examples of cos that an airport many incur due an accident. First, direct costs are expenses similar to those aforementioned losses such as payments worker compensation claims, site clean-p, damages to property or other facilities. Secondly, there are indirect costs associated with an accident as well. Indirect costs could be

the loss of revenue from a client or customer due to suspended service, loss of revenue from sales, poor public relations, human capital investment (rehiring or retraining due an accident).

Although these lists are not exhaustive these examples of loses can begin to draw a picture of how expensive accidents are and how they can hurt the financial performance of an airport. One way to estimate on how much accidents or incidents are costing an airport is to reviewing accident and incident reports. The next step is to acquire audit reports from the airport's insurance provider regarding the total cost of each accident claim or incident.

It may become apparent that even a few small claims ranging from a few dollars can add up over time and this is adversary to preserving the bottom-line. Using proactive risk mitigation strategies can help airports achieve maximum financial performance through preventing losses that can cost the airport significant money over time.

CHAPTER 4

MODERN THEORIES OF ACCIDENT CAUSATION

Accident causation often focuses on the active failures at the operational level that was a breach of the safety mechanisms. Active failures are the action or lack of action such as human error that has an immediate consequence. One way to think about active failures is actions by an employee or tenant of an airport that is unsafe and may cause a destructive outcome (IACO, 2013).

The Swiss-Cheese Model is a conceptual model designed by Dr. James Reason that provides a clear understanding of the interaction between organizational and managerial factors that lead to airport accidents or incidents (Reason, 1997, pp. 9-20). Reason (1997), describes that within an airport that there are numerous defenses to protect against human error or decisions that are made in the hierarchical chain.

Even though these defenses typically prevent accidents from occurring, any breaches in the protective defenses can lead to a catastrophic accident. Dr. Reason contends that single-point failures are rarely the cause of accidents. Rather that breaches in safety defenses are the often the consequence of decision-making at the highest levels of the organization (Reason, 1990).

Reason (1997) suggests that accidents occur due to a combination of active and latent conditions. Latent conditions are variables that are present in the aviation environment, are not perceived as harmful and are present for some time before an accident. The Chernobyl RBMK nuclear reactor disaster in 1986 is a prime example of how a combination of active and latent conditions can lead to a catastrophic event.

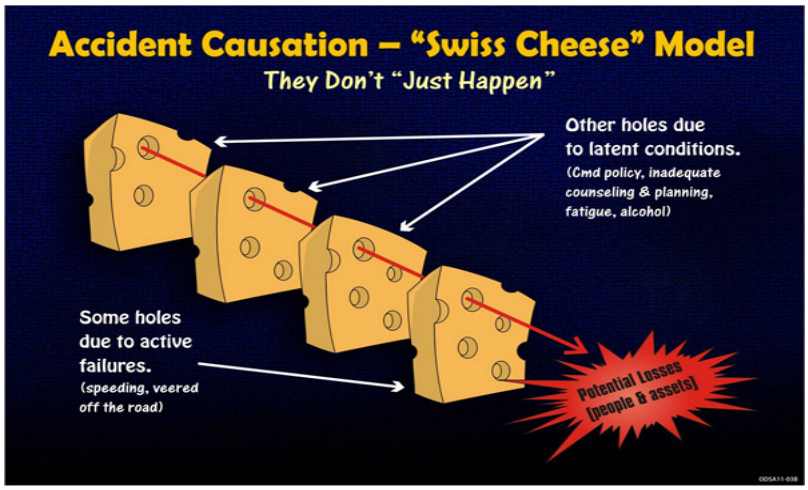

Figure 4. "Swiss Cheese Model"

In the case of Chernobyl, a combination of events that lead to the disaster such as the deliberate modification of emergency protection equipment mixed with violations in operating procedures. The subsequent investigations of the Chernobyl catastrophe demonstrated that lack of safety culture is a common latent condition that is often not recognized until it is too late. The Swiss-Cheese model helps emphasize that it is important to identify and mitigate these latent conditions through out the entire airport system as part of the SMS process.

Another perspective of how organizations and members deviate from a procedures and rules over time. The term practical drift is derived from research that Colonel Scott A. Snook conducted to determine the root cause of a deadly friendly-fire incident involving the two U.S Air Force F-15's fighter jets and two U.S. Army UH-60 Blackhawk helicopters, an incident where twenty-six servicemen lost their lives.

According to Snook (2000), practical drift is a phenomenon that occurs in when members of an organization slowly begin to stop following rules and procedures over a period of time. The diagram demonstrates in the beginning of a system design such as SMS, the baseline performance and the operational performance are functional and in-sync (Snook, 2000).

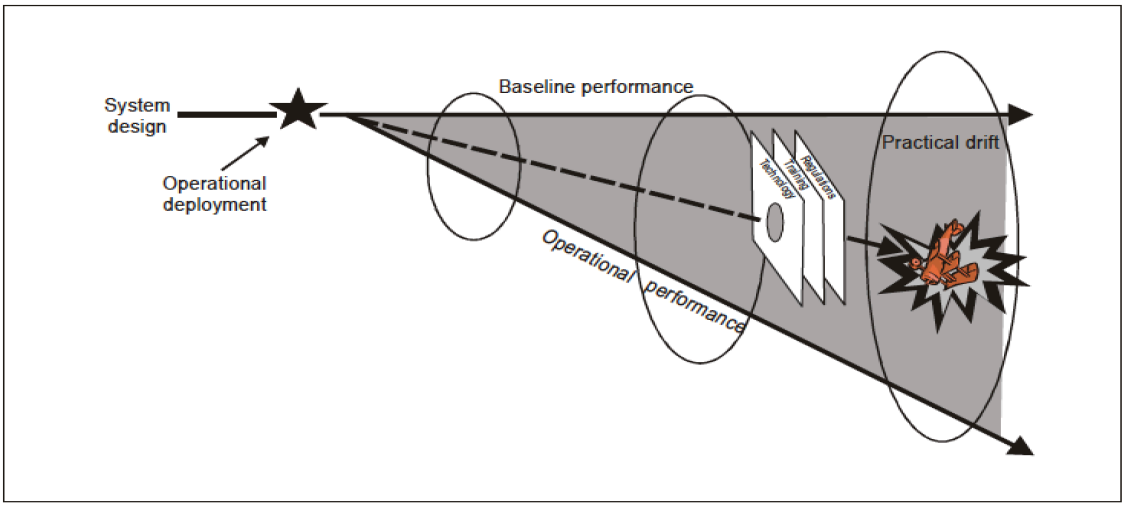

Figure 5. Practical Drift Model

Gradually, the operational performance (actual behavior by members of the organization) deviates from the baseline performance (standard of behavior by the members of the organization) and due to failures in the system such as technology, training and regulations an aircraft accident is more likely to happen. When rule abiding decreases over time and is not corrected by leadership, this is called practical drift. In the analysis of the friendly-fire incident, Col. Snook (2000) identifies that there were three major parties involved in this fatal accident.

The UH-60 Blackhawk unit had been flying operations together for approximately three years (Snook, 2000). The Air Force F-15 Eagle team had been experienced flying together for approximately the same time (Snook, 2000). Additionally, there was a Boeing E-3 Sentry Airborne Warning and Control System Aircraft (AWAC) that was responsible for controlling the airspace and experienced supervising live-fire missions with joint-operations aircraft in that region (Snook, 2000).

Col. Snook determined in his investigation of the friendly-fire there were joint-operations being conducted in the Iraq with multiple branches of the military, however each branch was

operating within it's own individual sphere of influence without regards for procedures (Snook, 2000). Essentially, there were rules and procedures that were over a period of time were replaced by unofficial rules and procedures that resulted in each of the respective branches acting autonomous (Snook, 2000).

The habitual rule violation in both branches resulted in the Air Force F-15 crew failing to properly indentify the Army Blackhawk crew as a bona-fide target and the AWAC aircraft crew not indentifying the errors of the F-15 pilots and intervening as the liaison between the Army and the Air Force (Snook, 2000). After multiple investigations by the Department of Defense, Congressional Committees and independent U.S. government agencies over a two-year period, no single cause of the accident could be identified (Snook, 2000).

According to a report by the U.S. Air Force Air Combat Command, there were over 130 various mistakes involved in the friendly-fire incident – all stemming from practical drift in each organization (Snook, 2000). Practical drift often occurs without intention and is a naturally occurring process due to compliancy or adoption of non-official procedures by its members to increase efficiency in daily tasks (Snook, 2000). Administrators should be aware of practical drift and its effects on an organization's safety. The SMS process can help identify incidents or trends in behavior that may lead to an accident occurring from natural practical drift. The promotion process of SMS is important in keeping everyone in the organization mindful of safety culture through continuous and purposeful learning opportunities.

CHAPTER 5

6 BEST PRACTICES FOR IMPLEMENTING SMS

The goal of airport management should be to design a structured safety management system implementation plan that will provide guidance and updated information on events and things that are happening during the implementation phases. All of this information should be disseminated to all members of the organization on as need basis and readily available either in paper or online format. Keeping all members of the airport informed about changes that are occurring is a key strategy to acquire and maintain support for SMS. The SMS implementation chart highlights some of the basic activities occur during each phases of implementation.

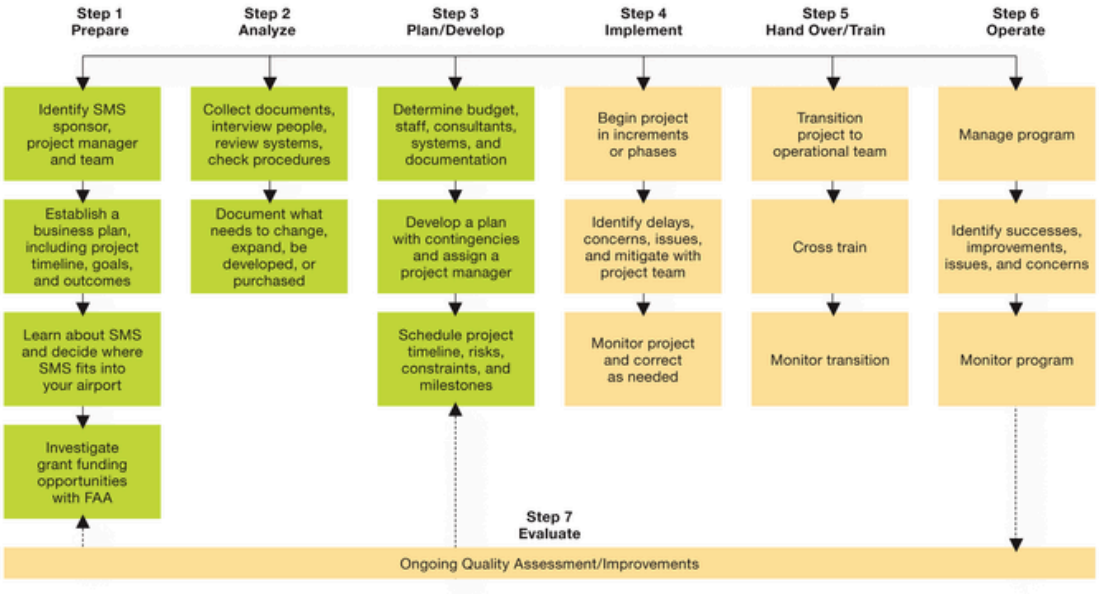

Figure 6. SMS Implementation Chart

Using a flow chart like the one above is practical and easy to use as a visual planning tool for an airport. Depending on the complexity of the organization and the safety management system, additional tasks can be added or omitted as needed. It is important to plan enough

adequate time to complete complex projects and to always consider problems or delays that may occur.

Being flexible during the implementation process will help alleviate some of the growing pains of getting acquainted with a new SMS. It is important to remember that there will be issues and challenges that will arise, but this is just the process of starting a new way. Seizing upon those opportunities to learn from the mistakes and to be constantly vigilant of issues in the horizon will build the safety intelligence of the workforce and will grow a healthy safety culture.

This chapter is designed it is to provide some strategies to help administrators when they are designing, planning and implementing SMS at their airports. This chapter has collected, analyzed and synthesized some of the lessons learned and strategies to aid with challenges evaluated in the SMS pilot studies. These suggested practices are derived from research conducted by the Federal Aviation Administration (FAA), the Transportation Research Board (TRB), and the Airport Cooperative Research Program (ACRP), The International Civil Aviation Organization (ICAO) and literature from aviation experts around the world.

Top Management Support

One of the most important factors in implementing and planning is to have visible support from airport top management support. No matter how well developed the SMS plan may be if there is not support from top management – the system will not function. The airport manager and safety manager must understand that the responsibility of safety policy starts at the top. Demonstrating the value for SMS from the top management will help the indoctrination and safety training of employees.

Employees that recognize the value and benefits of SMS are more likely to buy-in and actively participate in activities such as hazard reporting and safety training. One strategy that

airport administrators can use is developing a department or assigning a safety manager that reports directly to the airport manager. Here the relationship between the safety manager and the accountable executive is strengthened and will improve communication regarding safety issues. Safety policies and decisions can then be made by the Accountable Executive with the guidance of the safety manager and then disseminated down to the rest of the organization.

Conduct an Airport Safety Culture Survey

Every plan has to start somewhere, but in order to properly identify each airport's safety needs. Examining the airport the airport through the lens of safety management can help assess deficiencies or strengths in safety culture. Airport management can save a lot of time, money and resources by conducting a safety culture assessment of the airport during the initial planning stages of SMS. The culture survey should be viewed as tool in implementation of SMS and not as an audit report for the organization. An airport safety culture survey can also be part of the gap-analysis during the initial planning stages. The ACRP Synthesis 37 described one of the lessons learned by airport managers is that a gap-analysis helped with formulating a more accurate timeline for implementation and helped with the transition process (ACRP, 2012)

Common trends of safety issues should be used as benchmarks and objectives to achieve and track using metrics. It is important that the safety culture survey is not designed as a method to discipline employees. Safety culture assessments can be conducted internally by the airport or externally by a credible third-party. Airport administrators will have to make the decision on how in-depth the survey will be based upon the amount of information needed for the SMS plan (ACRP, 2012).

Performing a safety culture assessment of the airport will provide invaluable information to senior airport management about the status of safety culture. Performing annual cultural

assessments will provide data to track progress or deficiencies from the start of the implementation phases (IACO, 2013). Without proper information or data to determine safety culture there is no validation that the culture of safety is improving over time. It is important to remember that SMS is data-driven and the more reliable data available, the more informed airport management will be at making decisions about safety (Zohar, 2010).

Establish a Flexible SMS Implementation Schedule

Airport managers should be deliberate when designing the timeline for implementation. Timelines should be realistic and based upon the factors and resources readily available. At times during the implementation, schedules and deadlines should be re-evaluated to insure the final quality. Demonstrating strong management commitment will increase the probability of success and limit future problems when gaining support SMS (Stolzer et al, 2007).

Implementation timelines give both employees and supervisors a positive first perception of SMS and will increase their motivation to participate if they feel they are part of the planning from the beginning. Having a clear implementation timeline also provides personnel with adequate time to get acquainted with any new changes in rules or procedures that may come from the new SMS processes. In some cases, airport improvement projects can disrupt daily operations and this may require additional planning and coordination. The chart below is an example of a SMS implementation timeline for an airport.

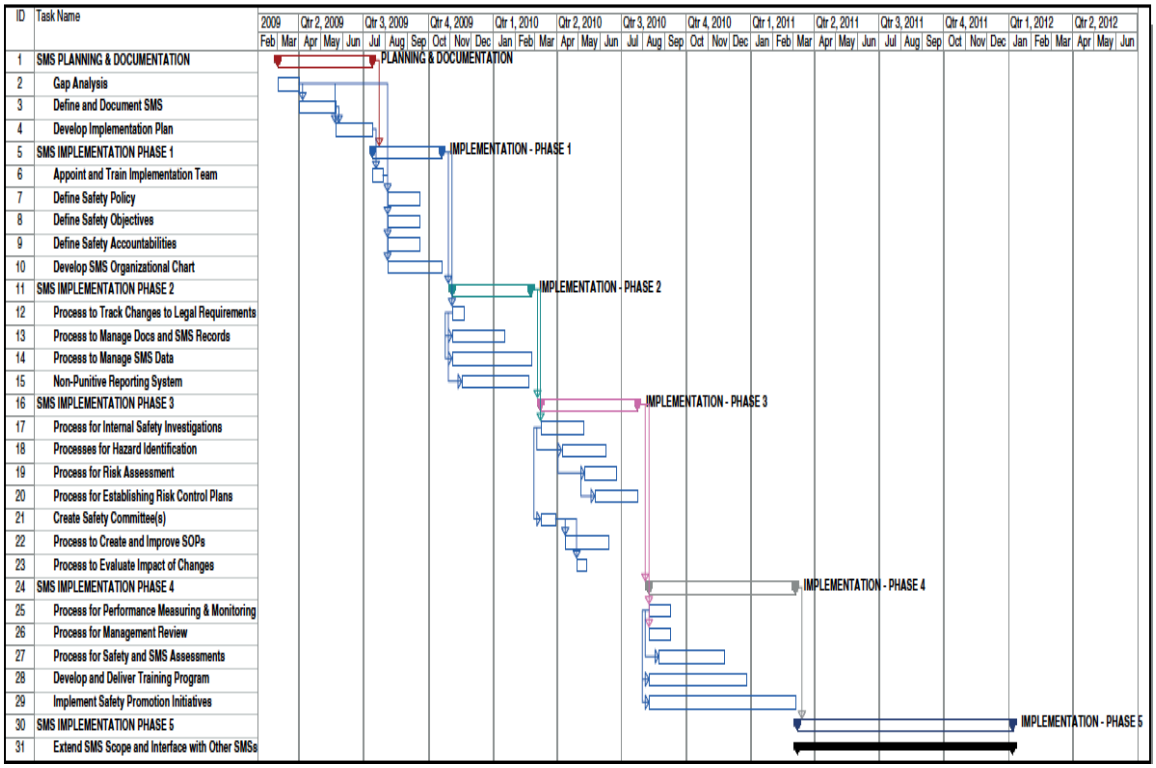

Figure 7. SMS Implementation Project Schedule (Sample)

In this example, the SMS implementation process is broken down into five distinct phases identifying the key elements of SMS per the guidance of the FAA Advisory Circulars and IACO. SMS implementation planning charts should be designed so that they can be easily amended, if needed during any phase of the implementation (ACRP, 2012). The main goal of the accountable executive and the safety coordinator is keep the implementation on schedule as best as possible, however certain phases of implementation may take longer or less time than others depending on the airport (IACO, 2013).

SMS Manual Development: Take Due Diligence

The airport SMS Manual should serve as the premier source for guidance on safety. Since specific information detailing the SMS framework and how the components of SMS integrate throughout the organization time should be invested in developing a quality SMS manual (Ayers, 2009). The SMS manual should serve as the primary reference on airport safety and should be

designed to encompass all elements referencing safety (ACRP, 2012). Larger airports have more complex and layered organizational structures and may have many stakeholders. Having all of the appropriate stakeholders engaged in the SMS manual development will help ensure that the document is complete and properly reflects the organization (Ayers, 2009). The commitment to safety will clearly be articulated though the sections of the SMS manual and should serve as a resource for promotion and training employees about SMS (Ayers, 2009). SMS manuals should be customized specific for each airport and using a generic SMS plan from another airport (ACRP, 2012).

At smaller airports, fewer employees may mean that each employee or manager is taking on several different roles. Each of those roles and responsibilities are each important to the development and implementation of the SMS manual (ACRP, 2015). Both internal and external stakeholders should be provided with an opportunity to have early access and input in the SMS manual development. Smaller airports are commonly faced with smaller budgets and limited resources for projects. However, SMS is customizable and scalable to any size airport or organization and can be completed by airport administrators with minimal time to spare (ACRP, 2015).

The most recent guidance on SMS manual content is provided in both the advisory circular (AC) 120-92B Safety Management Systems for Service Providers under Title 14 of the Code of Federal Regulations (14 CFR) mandates that part 121 air carriers that are now required to implement Safety Management Systems (SMS) based on 14 CFR part 5 (FAA, 2015). Although there is no specific rule by the FAA mandating that airports have an SMS plan, AC 120-92B can serve as the most recent document providing guidance on SMS implementation.

The new AC 120-92B is compliant with SMS Standards of the International Civil

Aviation Organization (ICAO), as published in ICAO Annex 19 for operations covered under Annex 6 Part I (FAA, 2015). These resources should be referenced for guidance when drafting or revising a SMS manual.

Every Component of SMS is Critical

When evaluating safety management systems, it is natural to gravitate towards the Safety Risk Management (SRM) component of SMS. Although, SRM is at the heart of SMS, it is important to remember that each component of SMS interacts and influences with one another in a continuous process (ACRP, 2015). A quality safety management system places emphasis on all of the components of the SMS process equally. Being flexible and adaptive to the changes in the internal and external environment of the airport will insure that the SMS evolves and is a living document.

For an example, a safety policy outlined in the SMS manual will serve as the precedence for how SMS is to be implemented and followed by all airport employees. However, having safety policies are worthless if employees are not aware of them or do not understand them. Thus, the promotion component of SMS is the method is which employees are trained about safety policies. Having regular safety training opportunities will help foster awareness about SMS and will help promote SMS throughout the airport.

Important operational and analysis components of SMS are found in the safety risk management and safety assurance processes of SMS. Understanding how SRM and SA are relational can help strengthen the validity of the analysis on safety hazards and risk mitigation. Being able to track the progress of SMS will help provide data that will help provide justification for further investment or expansion of SMS.

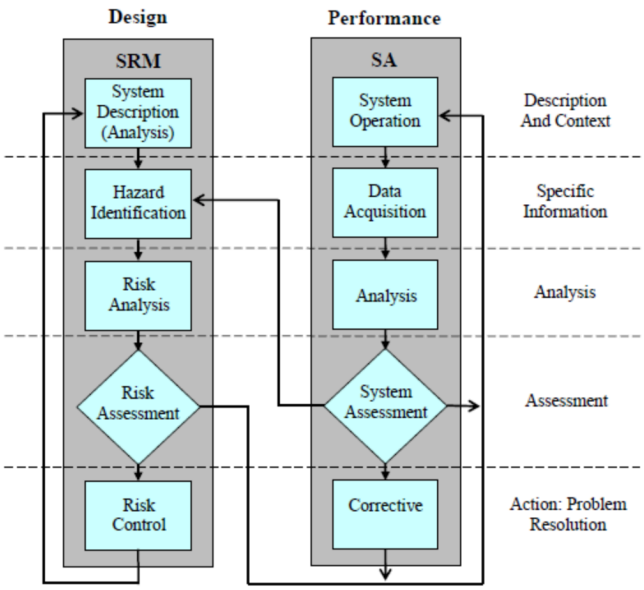

Figure 8. SRM and SRA Analysis Flow Chart

During the safety assurance phase, it is recommended that airports develop and implement a method for monitoring safety performance (ACRP, 2012). Airport management should annually evaluate the continued effectiveness of implemented risk mitigation strategies under SRM and determine areas of weakness (ACRP, 2012). Accountable executives should systematically provide confidence that the airport is meeting or exceeding its safety objectives through continuous improvement (IACO, 2013). Safety assurance verifies the effectiveness of the mitigations established under SRM and thus both processes are interdependent (ACRP, 2012).

Safety Risk Management – 5 Step Process

For many airport administrators safety risk management may be a new concept and can be confusing if not formally exposed to the process. This section is designed to provide the accountable executive, safety coordinator or safety committee with a simple breakdown of the SRM process and how to conduct a basic safety risk assessment.

The first step in the SRM process is to (1) *Describe the System.* The system can be anything ranging from the employees, departments, or specific work duties that are interacting in the same environment that may be the catalyst for hazards. For an example, a new construction project in a terminal may be the system being examined for hazards and risks. The system can be described as anything within the sphere of influence of the airport or the scope of daily operations.

Having an interactive roundtable with various stakeholders that can provide data and information in a quick and holistic manner can help strengthen the analysis conducting during the SRM and SA processes. Although, two airport departments may work in the same part of the airport system, each department administrator may hold varying perspectives of that same system.

The next step and one of the most crucial activities of the SRM process is *(2) Hazard Identification.* Airport administrators should be aware that this is the most complicated and time-consuming part of the SRM component. Stakeholders must analyze the system they are evaluating for any hazards that could potentially lead to an accident.

One common mistake that occurs during the hazard identification process is the common tendency for airport stakeholders to confuse hazards with their consequence or outcome rather than the hazard itself. For an example, an airport may have a problem with proper runway marking and one stakeholder proposes that the hazard is an aircraft collision on the runway. In actuality, the hazard is the poor runway markings and one potential consequence is an aircraft collision on the runway. Identifying the consequence and severity of the outcome in the next step of SRM. One method for identifying hazards is to draw broad categories on a dry-erase board and then reach consensus on each hazard using a majority vote. In some cases, multiple hazards

may require the same mitigation strategy. Another common mistake during this process is to automatically attempt to provide a mitigation control while at the same time identifying the hazard. Compartmentalize each part of the SRM process and have the accountable executive facilitate the meeting with some time parameters so that the process does not become drawn-out or stagnated.

The third step in the SRM process is to *(3) Analyze the Risks*. During this step stakeholders need to determine the potential outcome of the hazards, the severity of the outcome and the likelihood an incident would occur (ACRP, 2015). It is important to remember that hazards and risks are two different concepts. A hazard can present a risk to the airport, whereas risk is the likelihood or probability that an accident will occur with an outcome (IACO, 2013). As recommended in the second step of SRM, drawing categories of hazards will help cluster similar hazards along with the severity, likelihood and outcome analyses in this process. Again, compromise will be paramount during this evolution.

The fourth step of SRM is to *(4) Assess the Risks.* In this step, airport stakeholders need to conduct analysis of the likelihood and severity of the risk compared to what the acceptable level of risk. Below is an example of the standard FAA '5x5' risk matrix. Various risk matrices or instruments can be designed or modified at an administrators' discretion. The definitions of risk levels are detailed in the FAA Order 5200.11 (FAA, 2010).

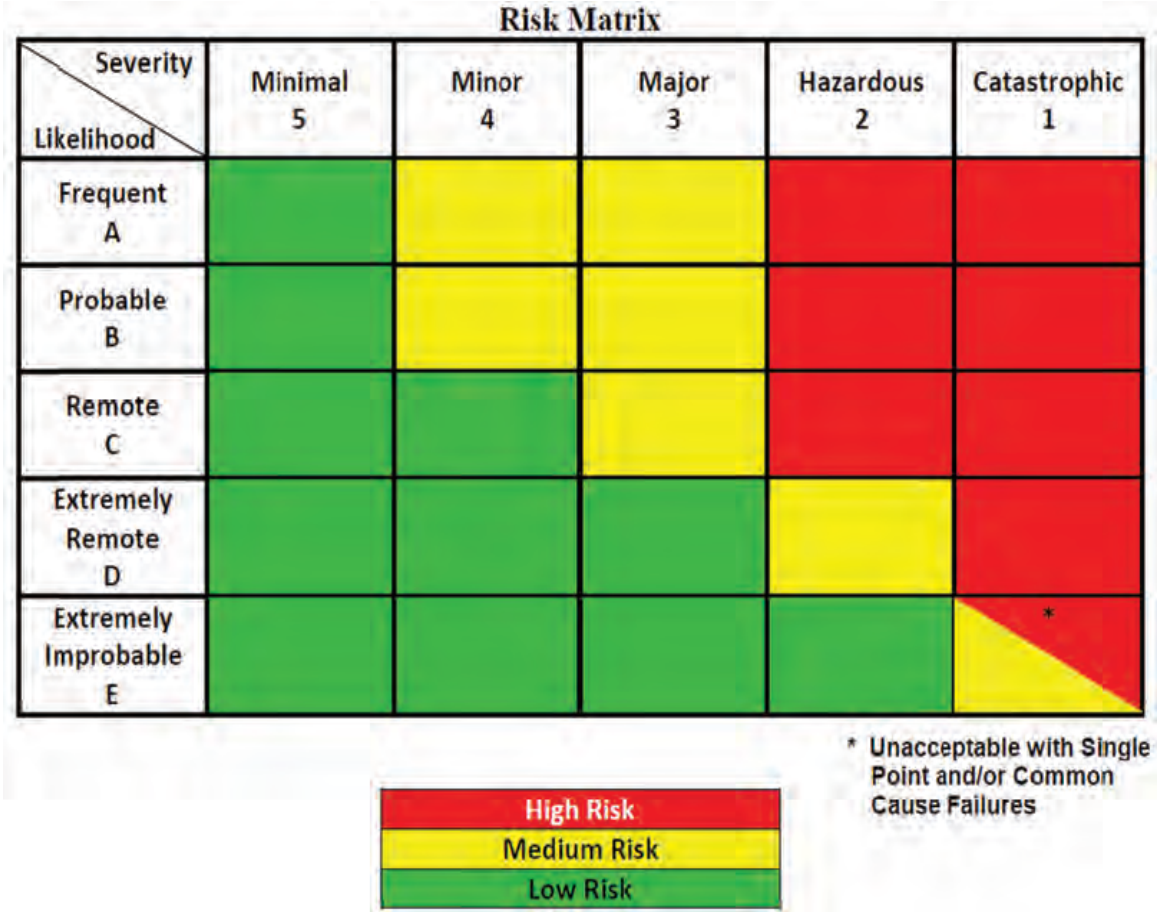

Figure 9.

There are three categories of risk detailed in Order 5200.11 – Low Risk, Medium Risk and High Risk. High Risk is considered unacceptable if a hazard is ranging from major to catastrophic in severity or that the likelihood of an accident is frequent or probable. Therefore, airport stakeholders need to devise methods to mitigate the hazard and to bring down the level of risk. If the level of risk cannot be decreased to an acceptable level using mitigation strategies - the project or activity should be suspended or terminated until the risk can be deemed acceptable.

Medium Risk is a threshold that is considered acceptable by the FAA standards. It can be considered the minimum requirements of acceptable risk, however the project or activity can continue as long as risk level is not increased. Proper methods for tracking hazards and risks

should be proven using reliable data. The final level of risk is Low Risk, this level is acceptable and these types of hazards do not require significant tracking or monitoring. All hazards and risks should be documented however there should be no issues in daily operations.

After all hazards have been properly identified along with their respective risk factors the final step of SRM is mitigation. In this phase, the Accountable Executive along with the safety coordinator will typically have the final authority on what mitigation strategies or resources are used to decrease the risk of an airport. These actions range from accepting the risk if the risk is determined to be minimal or there are no further options for decreasing the risk to avoiding or suspending an activity or operation based upon hazardous conditions. Airport decision-makers must use their best judgment using the best information available while brainstorming and deploying mitigation strategies.

Further details regarding safety risk management and performing safety risk assessments can be referenced in the new ACRP Report 131 and the FAA Airport Circular 120-92B released this year. The 2013 IACO Safety Management Manual provides a comprehensive overview of airport safety management systems and provides supplemental documents to help airport and safety managers implement SMS. Based upon the new FAA regulation that mandates Aviation Service Providers implement some form of a safety management system, Part 139 airports may be subject to similar regulation in the near future.

CONCLUSION

SMS has become a practical and valuable resource for airports and other high-risk industries to implement as part of their business strategic plan. Proper risk management tactics can help an airport preserve and maximize resources and minimize the amount of financial losses over time due a decrease in accidents. Accidents due to negligence can be costly directly and indirectly. The reputation of the airport and its' employees can be severely damaged by an accident and this can hurt the airport as well as third-party businesses.

Airport administrators must demonstrate a strong commitment to safety through their actions and how they implement safety policy. A strong organizational safety culture is synonymous with members demonstrating their commitment safety by actions in the workplace. Airports that can establish an environment that supports confidential hazard reporting should evaluate their organizations total safety performance improve over time. An airport's SMS manual should serve as the document for all policies and information pertaining to airport safety.

A SMS plan can be scalable to any size airport. A SMS plan does not have to be costly and is a plan that is developed and implemented over time. Justification for investing money should be based upon doing the right thing to make the airport as safety for everyone as possible.

In January 2015, the FAA passed federal rules requiring commercial airlines to have a safety management system as part of their operating requirements. As an effort to increase safety in the aerospace industry airports may be subject to similar rules as commercial airlines are by the FAA in the near future. Airports that are progressive in designing their safety management systems prior to FAA rulemaking may be at an advantage in building a stronger safety culture.

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