# Safety Management Systems: The Perspective of Tennessee Airports

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**Abstract**

*Safety Management Systems (SMS), which is the proactive, formalized approach to managing risk and enhancing safety, is not yet mandatory within the aviation industry in the United States. Two pilot SMS studies were conducted at a handful of airports nationwide by the Federal Aviation Administration (FAA), which examined the feasibility of implementing SMS at airports. Although SMS is not yet mandatory in this country, many in the industry think it will become mandatory in the near future. This research investigates via a brief, online questionnaire with two additional follow-ups, data analysis, and aggregate reporting of data, the degree to which Tennessee airports support SMS adoption. The majority of Tennessee airports responding to the survey are not too familiar with SMS; currently have a proactive safety plan in place other than SMS; support a mandatory SMS for Part 139 airports; may consider implementing an SMS if it remains voluntary; would expect some resistance from airport employees, tenants, and users if implementing an SMS; and would anticipate needing additional funding to properly develop and implement an SMS.*

## INTRODUCTION

*"Needless deaths through accidents are a betrayal of our society."*

*~Worick (1975, p. 7)*

Every accident result from "faulty habits and attitude" (p. 25), and everyone should know what his or her attitude is and how it can be tailored (Worick, 1975). Most people think engineering is the literal job; however, it can simply be described as way of coming up with how to create a proper system–or in our case systems safety (Rodgers, 1971). "Safety touches many areas of a man's life. There are ethical, moral, religious, aesthetic, legal, and many other considerations that involve safety," (Worick, 1975, p.1).

According to Rodgers (1971), everyone thinks that they understand the meaning of safety. However, it is not until they are asked to write a definition that they cannot do so. There are many ways one can define safety depending on the context (Rodgers, p. 3). For example, Rodgers (1971) defines safety as the "surety that the environment that personnel or items are subjected to is free from inadvertent or unexpected events which may result in injury to personnel or damage to the items exposed" (p. 2). However, Mroz (1978), defines safety as "the prevention of accidents and mitigation of personal injury or property which may result from accidents" (p.7). According to Rodgers (1971), "piloting a private airplane is considered relativity *safe*, to a trained pilot; but, to someone who has never taken flying lessons, it would be a very dangerous and almost certain fatal venture," (p.1).

## LITERATURE REVIEW

### *Safety Background*

Mroz (1978) claims that the system safety analysis originates from the aerospace industry (p. 19), and according to Roland and Moriarty, the earliest form of a safety concept came in 1947 from a paper that was presented to the Institute of Aeronautical Sciences entitled "Engineering for Safety." The paper states, "Safety must be designed and built into airplanes just as are performance, stability, and structural integrity. A safety group must be just as important a part of a manufacturer's organization as a stress, aerodynamics, or a weights group," (1983, p. 11).

Unlike other industries that have been around for some time, having safety as a profession is still new (Worick, 1975, p. 254). Many safety professionals who now are in the safety/accident prevention career initially planned to become certified in prevention. Years ago anyone could perform the job of accident prevention; however, today it is a more strict profession requiring that people are certified in specialty fields (Worick, 1975, p. 254). Accidents occur daily in this world. Some are fatal–such as an airplane accident–and some are non-fatal–such as a broken leg. Many accidents could have been prevented by simply implementing a Safety Management System. The leading cause of death in the United States among individuals from 1 through 38 are from preventable accidents. Preventable,

accidental deaths are the fourth leading cause of death in all age groups (Mroz, 1978, p. 1). When presented with this statistical data, it becomes clear that a safety program needs to be proactive rather than reactive; this is the primary goal of Safety Management Systems. Florio, Alles, and Stafford (1979) define safety education as the education of people to prevent accidents (p. 25). They also state that, due to using safety programs in profession, "between 1912 and 1976[,] accident fatality rates dropped by 71 percent," (Florio et al., 1979, p. 429). Their findings positively support the impact that a safety program has in the workplace, home, and community.

Rodgers (1971) states, "Safety programs have been established in the past on an after-the-fact philosophy" (p.2), meaning that previously, something major must occur for an employer to take notice that safety measures must be implemented. For example, many aviation professionals have stated that most of the minimum standards set at airports are usually the result of something that occurred at the airport. This trend is a tragedy; every person should be educated in safety, and Rodgers (1971) explains that the mass production of goods post WWII caused the entire industry "to think in terms of systems" (p. 9). As a result, workers began to see a systematic way of carrying out tasks in order to be able to mass produce those items after the war without many problems.

Pybus (1996) gives many examples of some accidents, the warning signs, and the outcomes. One such accident includes an oil rig accident in the North Sea on July 6, 1988 that resulted from leaking gas and an ignition source. The rig was engulfed by flames killing 167 people. During the investigation phase, many issues were uncovered. These issues included a lack of a proper hazard assessment, no proper permits, no written documents, and improper record-keeping of dates and times. Furthermore, employees did not receive the proper training; therefore, their safety auditing was not performed correctly, and management ignored previous incidents that occurred on the same oil rig (Pybus, pp. 7-11). Another well-publicized accident occurred on January 28th, 1986:

> On 28th January 1986 at 11:38 eastern standard time, the Space Shuttle *Challenger* was launched from the Kennedy Space Center. Seventy-three seconds later its flight ended in an explosive burn of hydrogen and oxygen propellants. All seven crew members died. The immediate cause of the disaster was the failure of a rubber O-ring one of the two solid fuel booster rockets, leading to a leak of fuel, which ignited. The flame deflected on to the surface of the external liquid hydrogen/liquid oxygen Shuttle propellant tank, causing failure of the tank structure and escaping liquid fuels ignited explosively, and the Shuttle assembly was destroyed. With this space-age technology, how was it that a simple o-ring failed with such disastrous consequences? The Presidential Commission of enquiry unearthed significant underlying causes (p. 11).

After a thorough investigation of the Space Shuttle Challenger accident, there proved to be four main causes of the accident. The first cause was due to improper design of the

O-ring. It was too sensitive for the environmental conditions in which it would be utilized. At the time of the launch, the temperature was thirty-nine degrees. According to NASA policy, the temperature was not supposed to be lower than fifty-two degrees. Interestingly, the design of the *Challenger's* rocket booster was rated fourth out of all its other competitors (Pybus, 1996, p. 12).

The second cause of the accident stemmed from the fact that no person who conducted a hazard assessment objected to its questionable yet faulty design. Furthermore, employees tended to ignore the problems. As time elapsed through the investigation phase, NASA and the seal manufacturer decided to stick by their initial design choice rather than go back and redesign it in order to avoid more inherent costs on the project. There were also gaps in communications–which is the third cause of the accident–between the people who were conducting the launch and senior management.

The fourth cause was due to the high-profile level of the project, the demands of meetings deadlines, and "stretched" resources while "fundamental principles [were] overridden," (Pybus, 1996, p. 13). Throughout the entire process, there was evidence against the launching of the space shuttle, but the determination to launch was even greater at the cost of seven lives (Pybus, 1996, p. 13). Nevertheless, another tragic event occurred due to cost cutting and an improper Safety Management System (Pybus, 1996, p. 12). Those seven people lost their lives in an event that was supposed to mark the highlight of their lives, but because no one objected to the defective design in the O-ring, they died as the world was watching. Pybus (1996) said, "It was the replacement of a safety-driven culture by a performance-driven culture" (p. 13).

## SAFETY MANAGEMENT SYSTEMS

> *"Let's [f]ace it, safety costs money, doesn't it? It brings extra bureaucracy and slows things down, doesn't it? All that red tape; all those constraints on getting with the real job. Safety. Not a good fit with the modern business image of risk taking, cost cutting and entrepreneurial spirit, is it?"*
>
> *~Pybus (1996, p. 1)*

"In November of 2005, International Civil Aviation Organization (ICAO) amended Annex 14, Volume 1 (Aerodrome Design and Operations) to require member states to have certified international airports establish an SMS," (FAA, 2007). To introduce this new system, the FAA created Advisory Circulars to inform aviation personnel of the information, sponsoring guidance and pilot studies. The Federal Aviation Administration released an Advisory Circular on February 28, 2007 entitled "Introduction to Safety management Systems (SMS) for Airport Operator" (FAA, 2007) However, before the final rule implementation in 2010, they wanted to obtain the opinion of the public and make sure they did not have repetition between 14 CFR Part 139–which is the Certification of Airports–and the new program (SMS). In addition, they planned to implement,

training, oversight from the FAA and many other factors (FAA, 2010). "The application of systematic, proactive, and well defined safety program (as is inherent in a SMS) allows an organization producing a product or service to strike a realistic and efficient balance safety and production."

## SMS OVERVIEW

### *SMS Pilot Studies*

Two projects have been funded to help further guide the implementation of SMS. The FAA used these pilot studies to determine the costs and time involved with SMS implementation, as well as to develop models for future airports SMS projects (Federal Aviation Administration, n.d). Funding for this project came from AIP planning grant funds; however, airports must meet certain eligibility requirements. The first pilot study results showed that the initial set up for an SMS is covered under AIP grants while the second pilot study uncovered dissimilar valuable findings (Federal Aviation Administration, n.d). All the airports were in need of a Safety Management System, all had a safety program in place but not SMS, and 14 CFR Part 139 did not fully cover what SMS did; additional studies needed to be completed, perhaps using smaller airports.

The Transportation Research Board's Airport Cooperative Research Program (ACRP) funded ACRP Volume 1: Safety Management Systems Overview. It is said that aviation safety had been reactive rather than proactive, and usually human factors are the cause of most accidents. "There will always be hazards and risks in the airport environment. Proactive management is needed to identify and control these safety issues before they lead to mishaps" (Transportation Research Board, 2007, p. X). The report says that "SMS provides a systemic, explicit, and comprehensive process for managing risks," and the "FAA projections anticipate 1.4 million additional domestic takeoffs and landings each year from 2007 until 2020" (Transportation Research Board, 2007, p. 1).

Safety Management Systems have four key principles that include management commitment to safety, proactive identification of hazards, actions taken to manage risks, and evaluation of safety actions. SMS should be something that all employees receive from top management to bottom airfield crew with everyone having a proactive approach (Transportation Research Board, 2007, p. 2).

SMS should not be burdensome to the average employee and is not intended to formulate extra steps in day-to-day activities. It is something that should come as second nature without the employees realizing it. Airport management may be wondering how airports and their employees will benefit from having an SMS. First, SMS will allow the analysis of airport accidents and injuries and provide solutions as they are approaching. Appendix 1, courtesy of *Prather Airport Solutions*, presents the gap analysis and SMS manual and implementation plan. Next, the cost will be significantly lower if one can recognize the early signs of incidents and accidents and have good company morale with strong communication from top management to each department down to each individual person (Transportation Research Board, 2007, p. 3). Other benefits include a track record of good

safety, learning from mistakes, and overall improving practice (Transportation Research Board, 2007, p. 4).

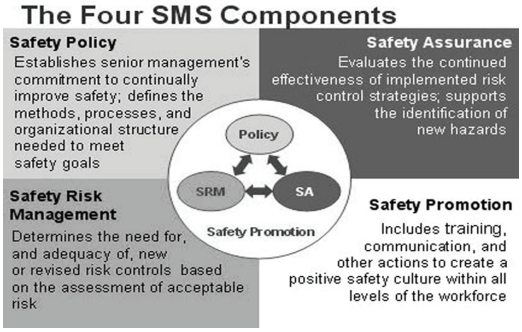


*Figure: 1 SMS Components (Federal Aviation Administration, 2009).*

### *Safety Policy*

There are four distinct pillars or components that make up Safety Management Systems, as shown in Figure: 1. They include: Safety Policy, Safety Risk Management, Safety Assurance, and Safety Promotion (Transportation Research Board, 2009, p. 9). The first pillar is the Safety Policy, and it consists of the policy statement, organizational structure, and the procedures (Transportation Research Board, 2007, p. 6). The FAA states that an effective SMS defines the organization's overall approach to managing safety (FAA, 2007). The policy explains an organization's vision and its commitment to safety (FAA, 2007).

The first element of the Safety Policy pillar is the policy statement, which should include a statement of the company's dedication to implementing the process, to properly monitoring safety performance, to addressing the issue of employees having fear for reporting certain issues as well as appropriate behavior toward safety, to establishing and evaluating goals, and to dedicating the resources needed (Transportation Research Board, 2007, p. 6). The policy explains an organization's vision and its commitment to safety (p. 7).

The organizational structure represents the second element of the Safety Policy. The precise organizational structure will depend upon the size of the airport. Larger airports may have a more defined structure full of many different parts for each department–such as accounting, human resources, or leasing office–while smaller, general aviation airports may only have an SMS Director/Manager who supervises the implementation and ensures the successful implementation.

The third and final element of the Safety Policy involves the procedures. This document spells out the proper procedures that need to occur and benefit the overall safety of the airport. In any case, when the procedures are changed, such changes must be properly communicated to all those who will encounter them (Transportation Research Board, 2009, p. 6).

***Safety Risk Management***

Safety Risk Management (SRM) is the second pillar. Although it is impossible to eliminate all risks, SRM techniques will enable risks to be reduced through the consistency of its three elements–hazard identification, risk assessment, and risk mitigation and tracking. (Transportation Research Board, 2007, p. 8). Safety Risk Management is defined in the Advisory Circular 150/5200-37 as:

a formal process within the SMS composed of describing the system, identifying the hazards, assessing the risk, analyzing the risk, and controlling the risk. The SRM process is embedded in the operational system [and] is not a separate/distinct process (FAA, 2007).

The first element and first step is hazard identification (Transportation Research Board, 2007, p. 8). A hazard is defined by the FAA as:

"any existing or potential condition that can lead to injury, illness, or death to people; damage to or loss of a system, equipment, or property; or damage to the environment. A hazard is a condition that is a prerequisite to an accident or incident" (FAA, 2007).

One must first take a hard look at what hazards the airport faces and what must be implemented in order to identify what may happen (Transportation Research Board, 2007, p. 8). Once the hazard has been identified, a risk assessment must be conducted, which is the second element under Safety Risk Management. The risk assessment addresses the seriousness of the consequences and the likelihood of it happening again.

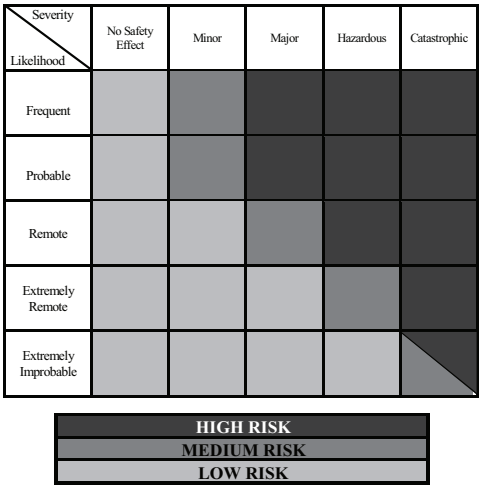


*Figure: 2 Risk Management Matrix (Federal Aviation Administration, 2007)*

The Risk Management Matrix, as shown in Figure: 2, is often used to measure incident severity (Transportation Research Board, 2007, p. 9). The last element is risk mitigation and tracking. When the hazard is mitigated, it should be fully examined to determine what was the specific cause of the hazard. This can be done through a system that allows one to

"counteract any risks to safe operation." Once a system is in place for mitigating risk, it must then be under constant monitoring to make certain that the risk mitigations currently in place continue to operate as needed (Transportation Research Board, 2007, p. 10).

***Safety Assurance***

Safety Assurance is the third pillar of Safety Management Systems and also functions as a morale booster (Transportation Research Board, 2007, p. 10). Safety Assurance is the "process [of] management functions that systematically provide[s] confidence that organizational products/services meet or exceed safety requirements" (FAA, 2007). Safety Assurance consists of three elements–internal audits, external audits, and corrective action. First, internal audits should be both formal and informal–done by each department–and should be conducted regularly while taking into consideration the effects that program will have both immediately and in the future. The second element is external audits, which are conducted in the same manner as internal audits but with one exception–they must be carried out by an independent agency. Corrective action is the third element, carrying consequences to those who are not following proper safety procedures set forth and ensuring that hazards are resolved (Transportation Research Board, 2007, p. 10).

***Safety Promotion***

Safety Promotion represents the fourth pillar (Transportation Research Board, 2009, p.10), functioning as "a combination of safety culture, training, and data sharing activities that supports the implementation and operation of an SMS in an organization (FAA, 2007). Safety Promotion consists of culture, training and communication. SMS should not only be the priority of management but also all employees. The culture should be positive and should be integrated into all everyday activities (Transportation Research Board, 2009, p. 10). Training is the second element of Safety Promotion; it is crucial to provide proper training on policies and procedures to all airport employees. Proper training enables the airport to demonstrate the responsibility that each member of the team brings (Transportation Research Board, 2007, p. 7).

The final element is communication, which is the key in any successful situation. Written communication should not be the only form of communication; employees must also see that top management is doing all they can to fulfill these new obligations and set the example. The communication process allows for growth in seeing what went wrong, how issues can be fixed, and what lesson each member of the team can take away to ensure that the lessons learned will not reoccur (Transportation Research Board, 2007, p. 8).

Research has proven that SMS is needed with the aviation industry. On July 5, 2000, an Air France Concorde flying from Paris to JFK crashed after takeoff from Charles de Gaulle International Airport. A Continental DC-10 departing before the Air France Concorde lost a 16-inch strip of metal, which caused the Concorde to run over it, puncturing a tire and rupturing a fuel tank, killing 113 people. So far, we know that previous incidents could have been prevented had the proper internal audit (which falls under the SMS pillar Safety

Assurance) been completed (Transportation Research Board, 2007, p. 17). Outside the United States, there have been several airports that have successfully implemented Safety Management Systems by using three different approaches of implementation.

## SMS IMPLEMENTATION

There are three approaches to implementing SMS. These approaches are the Evolutionary Style, the Phased Methodology Approach, and Fast Track Adoption. The first approach, the Evolutionary Style, takes several years to complete and gradually creates the safety culture. The next, the Phased Methodology Approach, gives the airport milestones to implement and gives organizations a more structured way that is faster to implement. The last approach to implementing SMS is the Fast track Adoption, which is a rapid implementation that does not allow for adjustment; this method can be hard on employees and cause a negative safety culture with much resistance (Transportation Research Board, 2007, p. 23). Appendix 2 gives details on each step to implementing an SMS entails.

### *Airports outside the United States*

In 2007, interviews were conducted with the Civil Aviation Authority (CAA), which discussed the process that certain airports had to go through in order to implement a successful SMS. In January 2007 at Calgary International Airport, Mr. Paul Van den Eynden, who is the Director of Safety Management Systems, was interviewed, stating that since SMS has been implemented, culture and awareness at the airport both have risen, including a "drop of more than 70 percent in incidents, accidents and near misses between 2001 (134) and 2006 (34 as of the end of November 2006)" (CAASD, n.d, p.4). Some lessons that Calgary International Airport has learned during the process include implementation in stages as opposed to all at once, and "the true value of safety is demonstrated by its absence."

In January 2007, Graeme Gamble at Cardiff International Airport was interviewed regarding its SMS–which was developed over a number of years using the Evolutionary Approach since implementing SMS, Cardiff International Airport has seen some changes, including a decrease in runway incursions, regular auditing, proper documentation, and a monthly meeting where minutes are documented and a meeting agenda are provided; however, Cardiff International Airports says "there is still more work to do" (CAASD, n.d, pp. 7-8).

Furthermore, William Fullerton shed some light on the implantation of SMS at Jorge Chavez International Airport (JCIA) in the December/January 2008 issue. In 2001, JCLA's management was taken over by LAP officials. They worked to instill "safety as a core value" and make it just as important as maintaining sales. The objectives that LAP set forth has proven to be successful, because their SMS has moved from a reactive to proactive approach with statistical information showing that incident rates have lowered from higher than 0.42 per 1,000 operations index in 2005 to meeting their goal of 0.38 in 2007. They are very proud of themselves and owe their success to the commitment to SMS and safety (Fullerton, 2008, p. 43). Part of their success is due to having an Airport

Safety Committee (ASC), which "holds bimonthly meetings, reviews safety statistic, hosts joint training sessions, conducts joint inspections, and makes explicit recommendations for coordinated practices in ramp operations that enhance the safety of all operators." On top of that, the ASC regularly holds a round table to discuss the goals and plan of action for the following year. The ASC's subcommittee also works with other airport committees, such as the Wildlife Hazard committee and Facilitation committee (Fullerton, 2008).

Jorge Chavez International Airport (JCIA) wanted to create a phenomenal safety culture that everyone would embrace and work hard to achieve but also recognized that it would not happen overnight; it would take some time to establish this. Airport authorities did so by first developing their human resources department, examining job descriptions, and providing proper training to ensure that their employees understand what hazards to look for and know the extent of their reporting duties consist of. Furthermore, they rewarded their employees. After taking care of human resources, JCIA turned to operations. They recognized the need for an appropriate reporting system that was active and easily accessible, thus developing a database that housed all of the proper information (Fullerton, 2008, p. 44). Part of the safety culture is establishing, maintaining, and following through with the proper sanctions as a result of a violation. JCIA used "the ICAO risk management framework" for their risk management (Fullerton, 2008, p. 45). As a part of JCIA's Safety Assurance, they have strict enforcement of the whole SMS process from the requirements to the failures. In addition to the traditional enforcement, they follow through with ICAO's standards, which are to have an internal and external audit performed annually (Fullerton, 2008, p. 46).

***Airports within the United States***

Airports in the United States are currently working on proactive SMS plans. One is San Antonio International Airport. At the American Association of Airport Executive Annual Conference in May 2010, John Chase (SMS Manager for San Antonio) spoke of their interpretation of SMS, their plan, and how it worked. First, San Antonio International Airport currently has a SMS program Manual. John Chase used the FAA's definition to define terms, uses voting and non-voting members on his board, and is very open to receiving feedback from everyone, including the public. Furthermore, San Antonio puts more focus on the airport's SMS but also wants to see a proactive SMS in other aspects of the airport, such as ATC and airline. They hope to implement SMS into Air Traffic Control in four to five years and believe that it will affect the airport. Moreover, San Antonio believes that a "one size fits all" take on SMS does not work. They strongly believe that SMS is sizeable (Chase, personal communication, May 16, 2010).

After implementing their version of SMS, there still are many unanswered questions. For example, will the FAA have regulated safety-reporting software, or will it be up to the individual states or airports themselves? Where does the accountability really lie? What makes the issue "that bad" before it makes it to Washington? How is the fining going to work, and who is regulating it–the authority, airport or the FAA? Regardless of the many

unanswered questions, one thing is certain–San Antonio has a solid, proactive SMS in place. They currently plant safety issues and hold walks to see if their staff can actively seek out the safety issues or hazards. Staff members who find the most safety issues or a certain number receive awards and prizes such as Chili's gift cards. Nonetheless, San Antonio is building a safety culture around willing staff dedication and participation, and that is exactly the kind of SMS that should be in place (Chase, personal communication, May 16, 2010).

Another proactive SMS currently in place is at Seattle-Tacoma International Airport (SEA-TAC). Safety has always been a focal point for SEA-TAC, so when the airport discovered Safety Management Systems and the possibility of participating in a pilot study conducted by the FAA, they wanted to take part in it. Having successfully taken part in the Phase I Pilot study, they were optimistic about their participation in the Phase II Follow-on Study. During Phase II they welcomed the help of their consultant, Landry Consulting, to aid them in the process with making 70 percent of all the work being completed on site in order to guarantee proper testing from findings in Phase I, learning to tweak and incorporate it to the environment. Upon completion of Phase II, SEA-TAC and its consultants were surprised to learn that what they predicted from the gap analysis conducted was completely opposite of their findings (Coates, 2010, p. 38). However, this discrepancy led them to learn a great deal, such as the fact that the SMS should be integrated throughout the airport–from administration to the ground–that people should become involved early, and that "one size does not fit all."

Nevertheless, they did discover that having an SMS "if implemented correctly, can leverage, build upon, and enhance the safety of the entire airfield" (Coates, 2010, p. 39). Furthermore, SEA-TAC has an automated system implemented for the regulation of Part139 and also has safety programs addressing communications routes (Landry, Landry Consultants, 2009). With two pilot studies behind them, what is next for SEA-TAC? SEA-TAC has decided fully to implement SMS because they "strongly believe in the strength and effectiveness of SMS." The airport also has a greater safety culture environment with an increasing number of staff showing interest by attending meetings. The staff has integrated SMS terms more often and is looking forward to having a full SMS (Coates, 2010).

### *Benefits of SMS*

As an airport manager, one may ask what SMS will *do* for the airport. SMS allows the anticipation of accidents and provides a way to manage risk situations, thus allowing the airport fully to analyze the occurrence of accidents and learn ways to adapt. The TRB states, "the SMS approach reduces losses, improves productivity, and is generally good for business" (Transportation Research Board, 2009, p. 7).

## STATEMENT OF THE PROBLEM

"Safety is not a vague concept. It is who we are and what we do" (CAASD, n.d.), yet after two SMS pilot studies carried out by the FAA, many questions still remain: What lessons were really learned from the pilot studies? What was the underlying purpose?

What are the perspective of the airports regarding SMS? Regardless of many unanswered questions, SMS clearly has it benefits. Additionally, in an effort to determine the degree of support for SMS among Tennessee airports, a research project was carried out during the summer of 2010. Tennessee airport managers were chosen to complete the brief online survey. The researcher's close proximity was the deciding factor for choosing which airports to survey. Research questions to be analyzed in this study include:

To what extent are airports familiar with SMS?

What type of SMS is currently in place at the airport?

If SMS remains voluntary, would airports still consider implementing SMS?

Would airports need additional funding to properly develop and implement SMS?

## METHODOLOGY

According to Tennessee Department of Transportation–Aeronautics Division (TDOT Aeronautics) in the state of Tennessee, there are currently 75 public-use airports; however, some of those airports did not have an email address. Therefore, a paper survey was sent out on June 14, 2010 to twelve airports, and the electronic survey sent June 17, 2010 to fifty-eight airports coincided with airports receiving the online survey. This was done on two different dates, allowing the paper survey time to be received by the airports. On June 24, 2010, the first follow-up email was sent to the forty-nine non-respondent airports. On July 1, 2010 the second follow-up was performed via telephone. A total of forty-seven airports were called to request their participation. After conversations with some of the airport mangers, eight of them requested the survey be resent, which was done. On July 14, 2010 the survey was closed, and there were no additional paper surveys received. The results of the survey include a total of 68 emails, including 27 responses and 41 non-responsive managers. When the initial electronic responses were sent out, 7 of the surveys bounced, and 0 opted out of the survey. Of the 12 mailed surveys, 4 paper surveys were mailed back, leaving 8 surveys not mailed back. The final response rate was 38.6%.

## FINDINGS/DISCUSSION

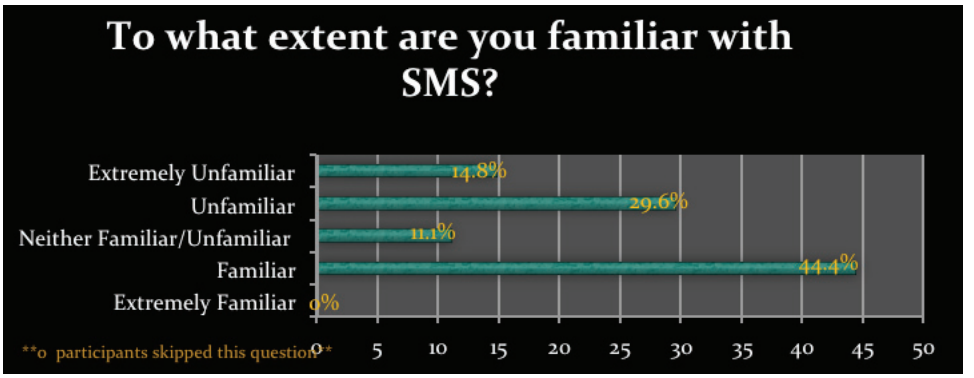


*Figure: 3 Familiar to SMS*

On July 14th, 2010, the survey was complete with the following findings. To begin the survey, referring to Figure 3, airport managers where asked how familiar where they with SMS. 44.4% of surveyed airport managers said that they were familiar with SMS, with a surprising 44.4% stating that they were either unfamiliar or extremely unfamiliar. 11.1% said that they were neither familiar nor unfamiliar with SMS, while zero participants skipped this question.

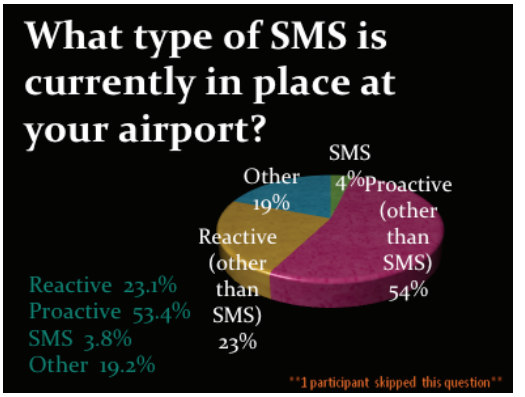


*Figure: 4 Current SMS*

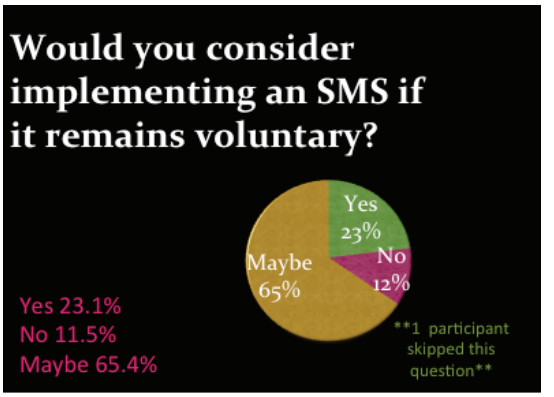


*Figure: 5 Voluntary SMS*

As Figure 4 illustrates, when asked which safety plan was currently in place at the airport, 53.8% of managers said there was a Proactive plan other than SMS, 23.1% said their plan was Reactive other than SMS, and 3.8% said that SMS was the safety plan. 19.2% had another form of SMS in place, and one airport manager skipped this question. As Figure 5 demonstrates, if SMS remained voluntary, 23.1% said that they would consider

implementing SMS, leaving 11.5% saying *no* and 65.4% saying *maybe*. One participant skipped this question.

| How Supportive Would You Be for a Mandatory SMS for: | | | |
|---|---|---|---|
| ** 1 participant skipped this question** | High Resistance | Some Resistance | No Resistance |
| **Airport Employees** | 0% (0) | 52% (13) | 48 (12) |
| **Tenants** | 30.8% (8) | 57.7% (15) | 11.5% (3) |
| **Users** | 19.2% (5) | 69.2% (18) | 11.5% (3) |

*Figure: 6 Support Mandatory SMS*

As shown in Figure 6, the overall consensus was that managers where neither supportive nor unsupportive for SMS between the classes of certificated airports.

| If SMS were implemented at your airport. What degree of resistance would you expect from: | | | |
|---|---|---|---|
| ** 1 participant skipped this question** | High Resistance | **Some Resistance** | No Resistance |
| **Airport Employees** | 0% (0) | **52% (13)** | 48 (12) |
| **Tenants** | 30.8% (8) | **57.7% (15)** | 11.5% (3) |
| **Users** | 19.2% (5) | **69.2% (18)** | 11.5% (3) |

*Figure: 7 Resistances with SMS*

The results shown in Figure 7 would not hold any high resistance from the Airport employees if SMS were implemented; however, 52% said there would be some resistance, and 48% said no resistance. While the majority of tenants would show some resistance at 57.7%, 69.2% of users would show some resistance. One airport manager skipped this question.


*Figure 8: In need of Funding*

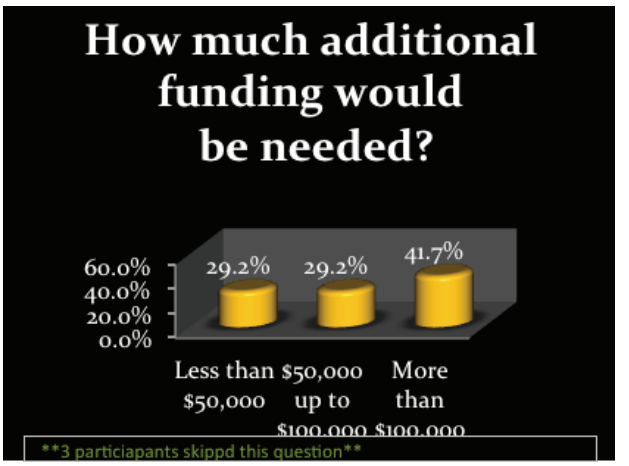


*Figure: 9 Funding Needed*

With development and implementation of new programs, the cost must be considered, as shown in Figure 8. When asked if airports would need additional funding properly to develop and implement and SMS, 96.2% of airport managers said that they would need additional funding, and 3.8% said they would not need any additional funding. Referring to Figure 9, of the airport managers who answered *yes* to needing additional funding properly to develop and implement SMS, 29.2% said they would need less than $50,000, 29.2% needed $50,000 to up to $100,000 and 41.7% needed more than $100,000; three airports managers skipped this question.

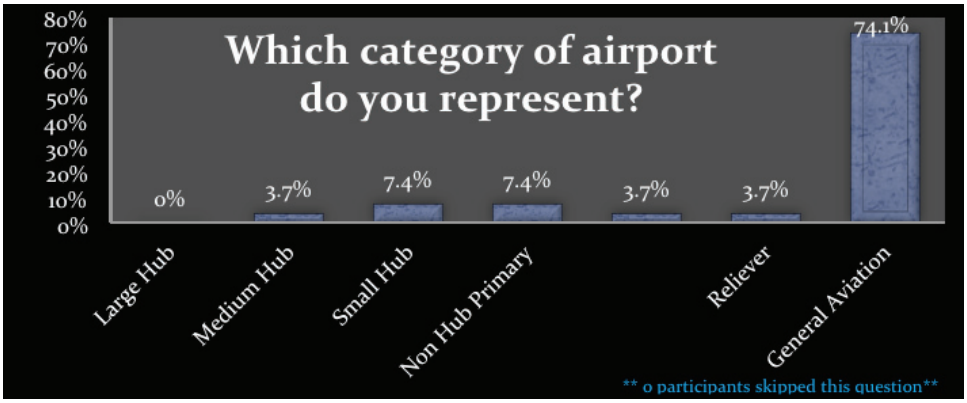


*Figure: 10 Demographics-category of airport*

In order better to understand the size airport size of survey respondents, as represented in Figure 10, a question asked which category of airport they represented. 74.1% were *general aviation*, 22.2% were neither a *medium/small hub* nor a *non-hub primary/non-primary commercial*. 3.7% were *reliever's airports*.

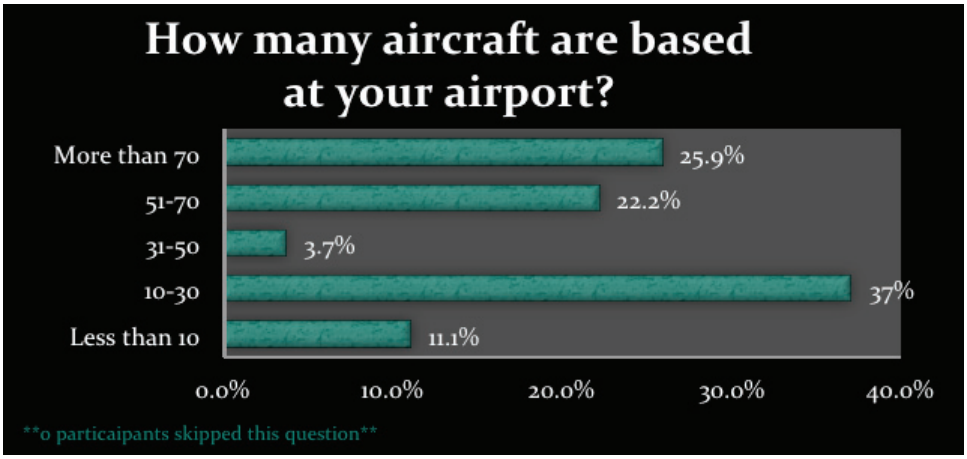


*Figure: 11 Demographics- based aircraft*

Of the 27 airports that completed the questionnaire, as shown in Figure 11, 11.1% stated they have less than 10 aircrafts based at their airport, 37% had between 10 and 30 aircrafts, about 25.9% had between 31 and 70, and 25.9% had more than 70 aircraft based at their airport.

The last question on the survey was an open-ended question allowing airport managers share any feedback. Four airport managers responded to this question. The following are their thoughts:

1. "Already has an ER plan, other plans for certain situations. SMS not necessary for GA airports. 139 does need a unique standard across the board–diff in all areas of the country. FAA is not happy until everyone else is not happy!"— General Aviation Airport–extremely unfamiliar with SMS

2. "SMS is a very good idea, but the operating cost of implementing the plan, annual maintenance/record keeping and liability is a concern".— Small Hub Airport–neither familiar or unfamiliar with SMS

3. "I feel that SMS is extremely important to airports, regardless of the category. I think it should be mandatory at all airports with some exceptions made for airports in different categories."— General Aviation Airport–familiar with SMS

4. "We have developed guidelines for a safe and efficient airport that my employees must read and initial upon initial training and periodically thereafter. I would be reluctant to support mandatory implementation without more specific knowledge on the requirement. Government mandates always cost more money and are normally policed by personnel with general knowledge of a program but little practical experience. Most of us don't like to be told how to do our jobs by folks who don't know, or have never done our jobs. I cannot be here at all times, and cannot personally ensure a safe operation at this airport except by establishing local procedures for my assistant managers and line personnel. Whatever system is mandated, or not, each airport must establish and execute their own safety program."— General Aviation Airport–unfamiliar with SMS

The majority of Tennessee airports responding to the survey are not too familiar with SMS, currently using a proactive safety plan other than SMS; supporting a mandatory SMS for Part 139 airports; may consider implementing an SMS if it remains voluntary; would expect some resistance from airport employees, tenants, and users if implementing an SMS; and would anticipate needing additional funding to properly develop and implement an SMS.

## CONCLUSION

"Although aviation is among the safest modes of transportation in the world today, accidents still happen" (Stolzer et al., 2008). As air transportation demands rise, so does the need for a formalized safety plan. System safety has eventually evolved from an unregulated system to a regulated system approach. Safety has moved from technical issues that needed to be fixed to human performance issues and presently the proactive approach SMS. SMS has a bright future full of jobs, community building within airports, and prevention of accidents that could have occurred if SMS had not been adopted. According an article in *Airport Magazine*, "compliance with regulations doesn't mean it's an effective SMS; SMS is about people, processes, and relations" (Coates, 2010, p. 39). Research in other industries, as well as other countries, have proven SMS to be successful. Clearly, SMS and the safety benefits it provides is not only beneficial for Tennessee airports but for airports nationwide and the entire aviation industry; "if compliance guaranteed safety, then we would only need one rule: Don't crash. Obviously, it takes a lot more than that" (FAA, 2008).

## APPENDIX 1

*Courtesy of Prather Airport Solutions, Murfreesboro, TN*

***Work Management Summary***

Clearly, developing a Safety Management System is a complex process. The RFQ for this project lists nine main requirements and three deliverables that the selected consultant would be responsible for completing. However, as stated in the RFQ, these requirements are not all-inclusive. Therefore, in determining what tasks will be completed by our firm for this project, and relying upon our expertise in developing Safety Management Systems, we have referred to the Statement of Work for the 2nd FAA SMS Airport Pilot Study. As a result, if selected for this project, our firm will complete a detailed Gap Analysis, as well as an SMS Manual & Implementation Plan, containing no less than 21 distinct components.

*1. Gap Analysis*

1.1 Review of current airport safety management practices, including safety plans and practices of tenants and operators at the airport

1.2 Review of current safety-specific airport documents, including Airport Certification Manual, Memorandums of Understanding/Memorandums of Agreements, Safety During Construction Plans, Surface Movement Guidance and Control System Plans, Airport Emergency Plans, and any quality management and/or risk management program

1.3 To be conducted utilizing the unique Gap Analysis Form (Appendix E) developed by Prather Airport Solutions, Inc. utilizing guidance from TP 14343E and the 2nd FAA SMS Airport Pilot Study Statement of Work

*2. SMS Manual & Implementation Plan*

2.1 Written safety policy statement and description of how it is communicated to airport employees

2.2 Identification and description of the airport safety goals

2.3 A plan for employee SMS indoctrination and training, including an outline of proposed curriculum and resources required

2.4 Documented process to identify training requirements for systems safety

2.5 Plan to validate training effectiveness and the process to gain training feedback, including usable metrics

2.6 Defined process to communicate safety policies and objectives throughout the organization, including examples of how information will be communicated and processes for follow-up

2.7 Plan and description for employee non-punitive reporting systems, both existing and new

2.8 Organizational chart identifying the names and safety responsibilities of all key personnel, including top management, safety manager, department heads/ managers, and established safety committees and chairpersons
2.9 Description of the safety risk management (SRM) process, including application of "The Five Phases of SRM," as discussed in FAA AC 150/5200-37
2.10 Guidance on the use of SRM and trend analysis
2.11 Defined process for documenting the results of SRM to include a description of how documents will be stored
2.12 Description of how top management will follow-up on SRM to ensure safety mitigation strategies are appropriate
2.13 Description of the airport quality management and/or risk management program (if currently existing) and its integration into the airport SMS
2.14 Description of a plan to integrate apron safety management into the airport SMS, including a description of current apron safety management practices and an explanation of how current apron safety management practices meet the intent of SMS
2.15 Detailed method to document self-auditing processes and their findings, to include use of airport self-inspection process to address system safety
2.16 Detailed method to document self-inspection reviews, analysis, and findings
2.17 Description or plan to integrate the tailored SMS program into the overall operation of the airport
2.18 Documented plan for training and education, safety communication, competency, and continuous improvement processes
2.19 Procedures to promote safety awareness and participation in non-punitive reporting systems
2.20 Process to document and review lessons learned from within the organization
2.21 Schedule for implementation and anticipated associated costs

## APPENDIX 2

*Courtesy of Prather Airport Solutions, Murfreesboro, TN*

***Preliminary Work Plan***

Based on our experience, to effectively produce a Safety Management System that is usable by the Airport and supported by all levels of staff and tenants, certain tasks must take place. In essence, implementing an effective Safety Management System involves much more than simply writing a Safety Manual. It requires a concerted effort by the consultant and Airport Management to bring about real change in the organization. Without this effort, any attempts to implement an SMS will be met with resistance and will enjoy little success (if not complete defeat).

True, there is wide variation in methods and approaches to developing and implementing an SMS. ICAO, Transport Canada, and FAA offer guidance on this, although there appears to be no "one best way." Prather Airport Solutions, Inc., based on past experience and in studying the extensive guidance on this issue, has developed the following Work Plan:

Step 1: Meet with Airport staff to agree upon a Work Plan and Schedule
Step 2: Conduct Safety Culture Survey of a sample of Airport employees and management
Step 3: Develop Senior Management Commitment to Safety
Step 4: Determine Safety Manager and members of the SMS Committee
Step 5: Conduct Gap Analysis
Step 6: Revise Work Plan based on gaps identified
Step 7: Develop the SMS Manual
Step 8: Develop the Implementation Plan
Step 9: Offer follow-on services to client in the form of Training, SRM, and On-line Non-Punitive Reporting System

***Step 1: Work Plan and Schedule***

This step involves the consultant meeting with the client to agree upon the scope of the project, develop a Work Plan to meet the client's needs, and develop a schedule which is mutually beneficial.

***Step 2: Safety Culture Survey***

To determine the current safety culture of the organization, a sample of organization employees and management will be asked to complete a Safety Culture Survey (adopted from Transport Canada). These results will be analyzed and shared with management.

***Step 3: Senior Management Commitment to Safety***

Prather Airport Solutions, Inc. will develop a draft Senior Management Commitment to Safety and in consultation with senior management, the written commitment will be revised and signed by Senior Management. This will then be distributed to organization employees so that, early in the process, they will understand the importance of safety and support the move toward a fully functioning SMS.

*Step 4: Safety Manager and Members of the SMS Committee*

The importance of this step cannot be overstated. It is very important for one individual to have responsibility for managing the Safety Management System and be involved in this process from the beginning. Additionally, by appointing members of the SMS Committee at this early stage, input can be sought for the development of the SMS Manual and Implementation Plan, thereby engendering support.

*Step 5: Gap Analysis*

Due to our knowledge of SMS criteria and the requirements for an effective SMS Program, Prather Airport Solutions, Inc. has designed a unique Gap Analysis Form. This Gap Analysis Form guides the firm in conducting a Gap Analysis for the client, considering both FAA requirements and Transport Canada guidance.

This Gap Analysis involves comparing the 21 components of the SMS Manual and Implementation Plan to existing systems at the airport. Each gap analysis question is designed for a "yes" or "no" response. "Yes" responses indicate that the airport already meets the criteria for that particular SMS component. A "No" answer indicates that a gap exists between the stated criteria and the airport's policies, procedures, or processes. If the response is "Yes", the next column of the gap analysis form can be used to indicate where (in company documentation) the requirement is addressed. If the response is "No", the same column can be used to indicate how and/or where the policy, procedure, or process will be further developed o bring the airport into compliance with the requirement.

*Step 6: Revise Work Plan*

Clearly, once the gaps are identified, the firm and the client will have a much better understanding of areas where additional work is needed. As a result, it is prudent to meet again and revise the Work Plan from this step forward.

*Step 7: SMS Manual*

At this step, the information gathered thus far, as well as knowledge of the components of the SMS Manual, are utilized to develop the SMS Manual. The firm has developed an SMS Framework (Appendix F) to guide this effort. At this stage, all of the resources of the firm are committed to producing this deliverable to the client.

***Step 8: Implementation Plan***

This final phase involves the development of an Implementation Plan for the client. As previously stated, the SMS Manual is only one aspect of a fully functioning Safety Management System. After the Manual is produced, the respective components must be implemented over time. It is important for the client to note that this is not accomplished overnight. To assist with this, phases of implementation have been developed. Appendix G contains these Phases of Implementation

***Step 9: Offer Follow-on Services***

Lastly, once the project is completed, Prather Airport Solutions, Inc. always offers additional services to the client to allow the easy realization of a fully functioning SMS. For instance, our firm can host an on-line, confidential reporting system for the non-punitive reporting of safety concerns, as well as training programs, awareness materials, and independent safety audits.

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