USE OF SMS RISK-BASED METHODOLOGY TO IDENTIFY AND MITIGATE AIRFIELD HAZARDS

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ABSTRACT

From 2009-2012, the Ohio State University (OSU) Department of Aviation/Center for Aviation Studies and The Ohio State University Airport partnered with the FAA on its Airport Safety Management System pilot implementation study program. As part of this study, OSU researchers performed literature review, conducted focus groups, established paper-based and digital-based hazard reporting and analysis models, and presented recommendations towards improving the safety of the OSU airfield. Such safety recommendations included the reduction of risk in certain pavement areas on the ramp and taxiway areas of the airfield, and other risk related to wildlife hazard and runway incursion mitigation.

This paper and presentation will summarize the background, methodology, and findings of this study, and provide insight as to how risk-based performance modeling may be applied to other areas of the airfield, including pavement management.

INTRODUCTION

This paper reports on a project performed by The Ohio State University Department of Aviation on the topic of applying risk-based hazard identification and mitigation methodology to airfield operations and infrastructure at The Ohio State University Airport (KOSU) as part Phase II of the Federal Aviation Administration's (FAA) Airport Safety Management Systems (SMS) Pilot Study.

While Phase I of the FAA SMS Airport Pilot Study focused primarily on larger commercial service airports, the primary purpose of the Phase II study was to assess the feasibility of implementing SMS at smaller commercial service and general aviation airports, where commercial air service tends to be less frequent, but the variety of airfield users, complexity of airfield layouts, and availability of staffing and financial resources to implement SMS may be of equal, if not greater, challenge than their larger airport counterparts.

The study reported on in this paper focused on the implementation of Safety Risk Management (SRM) through the use of Safety Risk Assessments (SRAs) to assess the risk of three operational components of the airport: runway incursion hotspots, wildlife hazards, and ramp area operations. The study also assessed the feasibility of the use of various hazard reporting mechanisms, ranging from paper hazard report submissions to Internet based hazard reporting and risk analysis software.

BACKGROUND: SMS RISK BASED AIRPORT HAZARD MANAGEMENT

Since its inception, the primary mission of the FAA in the United States has been to ensure the safety of those traveling within the nation's aviation system. As such, the FAA has always been concerned with the policies and practices associated with safe airport operations, particularly at those airports which serve commercial air carriers. Specifically, at these airports, the FAA requires compliance with Federal Aviation Regulations 14CFR Part 139 – Certification of Airports, under which, airports are required to develop and operate under an approved Airport Certification Manual (ACM). The ACM describes the practices to be performed by the airport that ensure a sufficient level of safety for aircraft operations. These practices range from maintaining sufficiently sized and hazard free areas around runways and taxiways to maintaining

proper administrative records. ACMs and their associated documents may be thought of as key elements of an airport's operating policies.

While the safety policies described under FAR Part 139 have been in existence for many years, more formal SMS programs, which attempt to address a deeper safety-oriented philosophy, are only recently being studied by the FAA in the airport environment. While a new topic to airport operators in the United States, SMS programs do have a history internationally. ICAO Annex 6 – International Commercial Air Transport - Aeroplanes, Annex 11 – Air Traffic Services, and Annex 14 – Aerodromes, all make mention to safety management practices. Furthermore, ICAO has a published Safety Management Manual which provides a comprehensive guide to developing SMS at its member state airports [1]. As part of this study, the FAA provided the analysis team with this document for review, as well as an example of an SMS developed based on this document, the SMS for the Bangalore International Airport, Bangalore, India [2].

In the United States, the philosophy of SMS has existed outside of airports for some time, even within the FAA. Specifically, the FAA's Air Traffic Services Organization (ATO) included SMS within the FAA 2006-2010 strategic plan [3]. In an effort to increase participation in safety management, the FAA office of Airports began an Airport Safety program in 2007 to develop SMS specifically for airports. As part of this effort, the FAA has sponsored SMS research through the FAA's Airport's Cooperative Research Program (ACRP). The initial efforts of this research produced an ACRP synthesis report describing SMS for the airport environment [4] and guidebooks to help airports develop SMS programs [5]. The FAA has also published an Advisory Circular introducing SMS to airport operators [6]. More recently, the ACRP released a synthesis report on lessons learned from the SMS Airport Pilot Studies conducted at The Ohio State University and other airports throughout the country [7] and updated its Advisory Circular for Airport SMS [8]. The Department of Transportation had initially published a Notice of Proposed Rulemaking (NPRM) on SMS for Airports in 2010 [9]. The NPRM is now being revised by the FAA and is expected to be re-released as a Supplemental NPRM in 2014 [10].

Each of the above documents contribute to describing the promotion of a safety culture at airports that go above and beyond the familiar procedural safety requirements described in FAR Part 139 ACMs at airports. As described in the FAA's SMS advisory circular, critical elements of an effective safety culture requires more than just organizational structure and operational rules and procedures. SMS consists of a proactive philosophy designed to anticipate and address risks to safety and effectively manage safety risks.

The Foundational Components of SMS

SMS is said to include several key principles: management commitment to safety, proactive identification of hazards, actions taken to manage risks, and evaluation of safety actions. To address these principles, the FAA has adopted ICAO guidance in describing four key components of SMS.

These four components are: Safety Policy, Safety Risk Management (SRM), Safety Assurance, and Safety Promotion. These components, described below, form the basis of this

study's GAP analysis.

Safety Policy:

It is thought that the even the most well intentioned and developed SMS programs will only be effective through strong leadership. To meet this challenge, SMS programs should include a clearly written policy statement, authored by senior management and communicated to and by all airport staff, tenants, and users. In addition, an effective SMS safety policy will be sufficiently coordinated with outside agencies, including local law enforcement and emergency services. Critical elements of an effective SMS Safety Policy include a clear description of the airport's organizational structure, including a chain of command and effective communication strategies, as well as a complete and comprehensive written set of safety procedures by which the organization identifies and manages safety risks. SMS safety policies are considered "living documents". They may be continuously reviewed and modified as conditions around the airport change.

Safety Promotion:

Promotion of SMS within an organization is an important component of SMS, with the specific intention of ensuring that every member of the organization accepts, adopts, and assumes a culture of safety. To achieve this, SMS promotion should include effective training methods to effectively project the philosophy, policies, and importance of SMS. Promotion should also provide clear and non-punitive channels of two-way communication throughout the organization, and provide for the establishment of trust in the SMS process by every member of the organization. As opposed to the elements of "safety policy", formal "safety promotion" activities have not traditionally been explicitly described in the standard operating procedures (SOPs) or ACMs at U.S. airports. This is not to say that such activities do not exist, although it is hypothesized that any such activities that are adopted are typically done so on an "informal" or "unwritten" basis.

Safety Risk Management:

Several sources within the SMS literature assess the level of safety risk as a function of two risks factors: the likelihood of an event with adverse safety impacts, and the potential severity to safety of the event should it occur. As illustrated in Figure 1, a risk assessment matrix illustrates that any given combination of event likelihood and severity may result in a certain level of risk. Based on a given level of risk, certain risk mitigation measures may be implemented. As may be implied by Figure 1, higher levels of risk are naturally higher priorities for mitigation, while other lower levels of risk may require less prevention, or may very well be considered "acceptable" levels of risk. Should risks be considered for mitigation, a range of proactive mitigation strategies may be considered. Such considerations may be evaluated based on timeliness, costs, organizational capabilities, and overall effectiveness. Once risk mitigation strategies are implemented, safety risk assessment calls for proper monitoring and tracking of such risks should be performed in order to assess the effectiveness of the strategies.

Safety Risk Management is often performed in part through the exercise of conducting Safety Risk Assessments (SRAs). SRAs investigate certain specific elements of the airport in

order to determine the presence of any potential hazards to safety, and assess the level of risk these hazards may impose. As will be described later in this report, three SRAs were conducted at OSU as part of its SMS implementation effort.

Safety Assurance:

To "close the loop" on SMS, certain actions are required to assure that the policies and directives intended to enhance safety are effective. These actions include internal and external auditing, and if necessary, the taking of corrective action to remedy any exposed deficiencies.

The four components of SMS described above are intended to enhance system safety by providing the tools for implementing a culture of safety, implementing policies and procedures that are feasible and effective in identifying, assessing, and ultimately reducing safety risks, and methods for assessing existing and modifying policies as safety risks change. An SMS is a basis for a continuous progressive approach to safety.

ACRP Report 1 describes four steps towards establishing an airport SMS. They are: Establishing a safety policy and assigning safety responsibility, performing a gap analysis, developing a strategy for SMS implementation, and developing individual elements of the SMS. The remainder of this report describes the gap analysis performed by KOSU towards its establishment of an airport SMS.

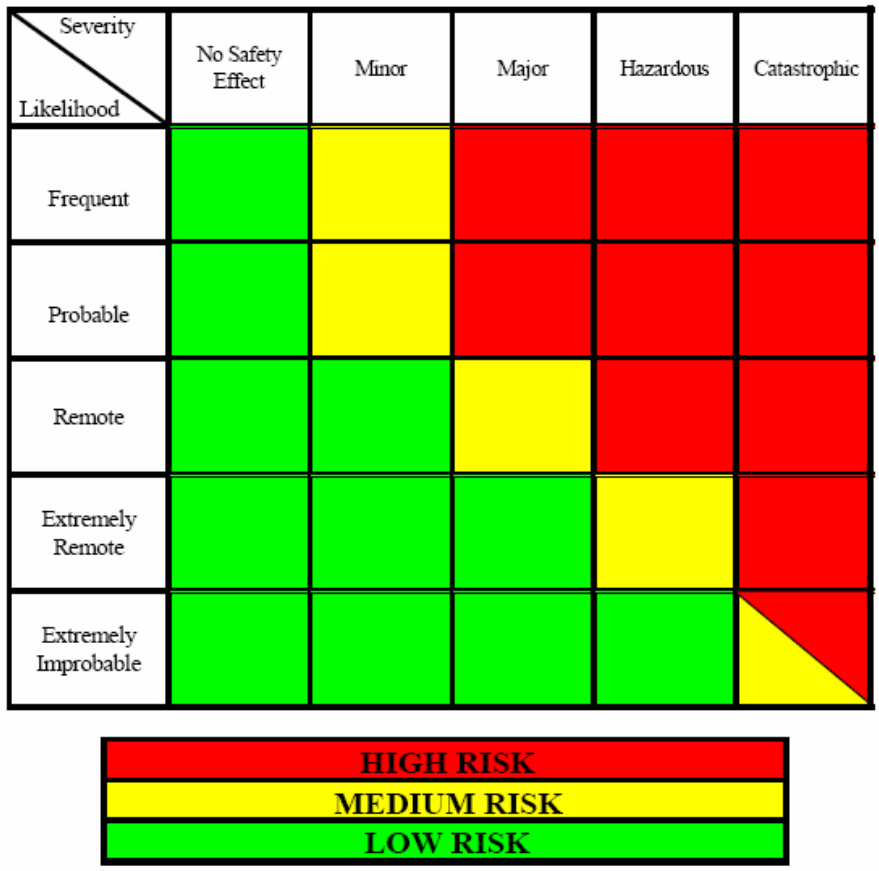

Figure 1: FAA SMS risk assessment matrix.

The Ohio State University Airport, Don Scott Field (KOSU)

The Ohio State University Airport is one of the leading general aviation facilities in the nation, providing educational opportunities to the university's students and aircraft services to many of central Ohio pilots and business. The airport is owned and operated by The Ohio State University, a state of Ohio Land Grant University. The OSU Airport (KOSU) serves as a general aviation reliever for Port Columbus International Airport. KOSU is a certified under FAR Part 139 as a Class IV airport, certified to accommodate unscheduled air carrier operations on aircraft with greater than 9 seats, including those aircraft with 31 or more passenger seats. This certification assures the aviation community that the facility will meet specific standards in terms of operations and maintenance.

The airfield at KOSU is comprised four active runways and an associated taxiway system, illustrated in Figure 2. Primary runway 9R-27L is a 5000' x 100' precision instrument runway, with ILS CAT I system on RWY 9R. RWY 9R-27L is able to accommodate most business jet aircraft, with weights up to 60,000 lbs., and handles the majority of transient operations at the airport. Parallel runway 9L-27R is 2994' x 100' and accommodates primarily local flight training traffic through closed traffic pattern operations. Crosswind runways 14-32 (3437' x 100') and 5-23 (3555' x 100') intersect each other at the midfield of the airport. These runways also intersect runways 9R-27L and 9L-27R in a number of locations.

The majority of aircraft activity originates from the fixed base operator, flight education department, hangars and tie-down areas on the ramps on the south portion of the airfield. Access to the runways is by way of a series of taxiways, designed to minimize the amount of runway crossings.

KOSU is home for 230 aircraft, including single and multiple engine, piston and turbine engine aircraft and rotor aircraft. AT the time of this study, the OSU airport accommodated an estimated 100,000 operations per year, including corporate activity, student training, and pleasure flying. By operations, the OSU airport ranks in the top five airports in Ohio.

Primary users of the facility include local businesses and residents, as well as transient users. The airport is also the home to the OSU department of Aerospace Engineering and Aviation Gas Turbine Laboratory, several facilities operated by the OSU College of Agriculture, the Ohio Department of Transportation Office of Aviation, fourteen corporate flight departments and four flying clubs.

Overall, the airport is operated by a small administrative staff of approximately 10 managers and 25 full time staff. In addition there are a number of part-time and student employees at the airport performing in various departments of airport administration. The lines of succession illustrated in Figure 3 are identified in the airport's ACM, dated 2007 (In 2011, the airport underwent a minor organizational restructuring).

The airport provides training in accordance with the requirements set forth in FAR Part 139 in the areas of Aircraft Rescue and Firefighting, handling and storage of hazardous substances and materials, self-inspection programs, pedestrian and ground vehicle movements, wildlife hazard management, and airport condition reporting.

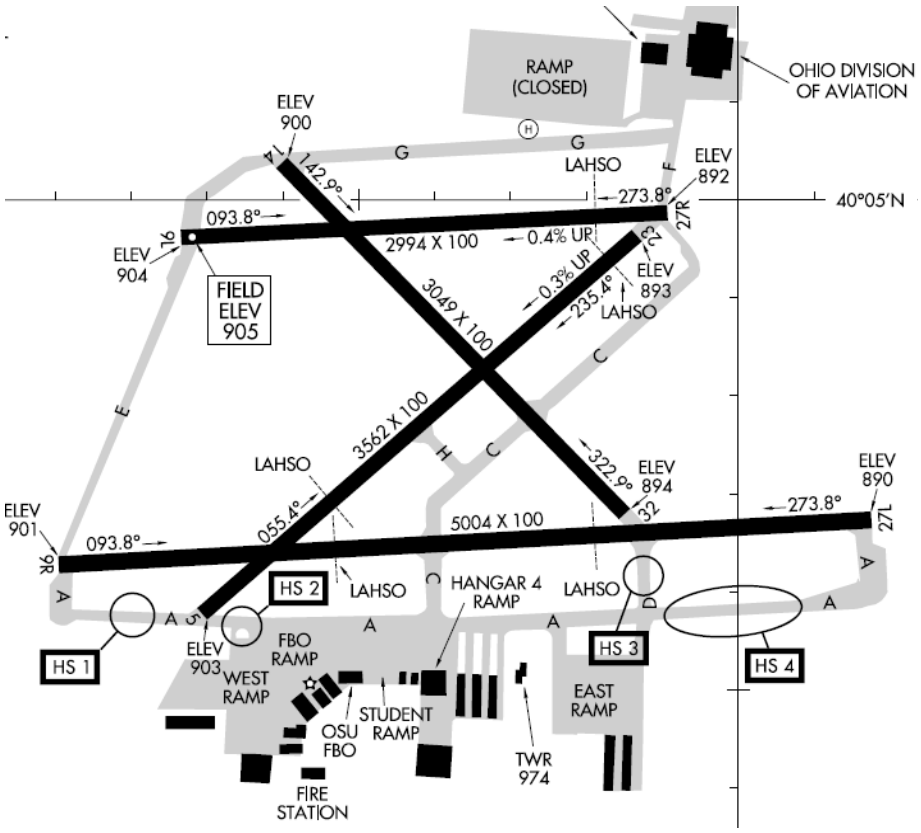

Figure 2: KOSU Airfield Diagram.

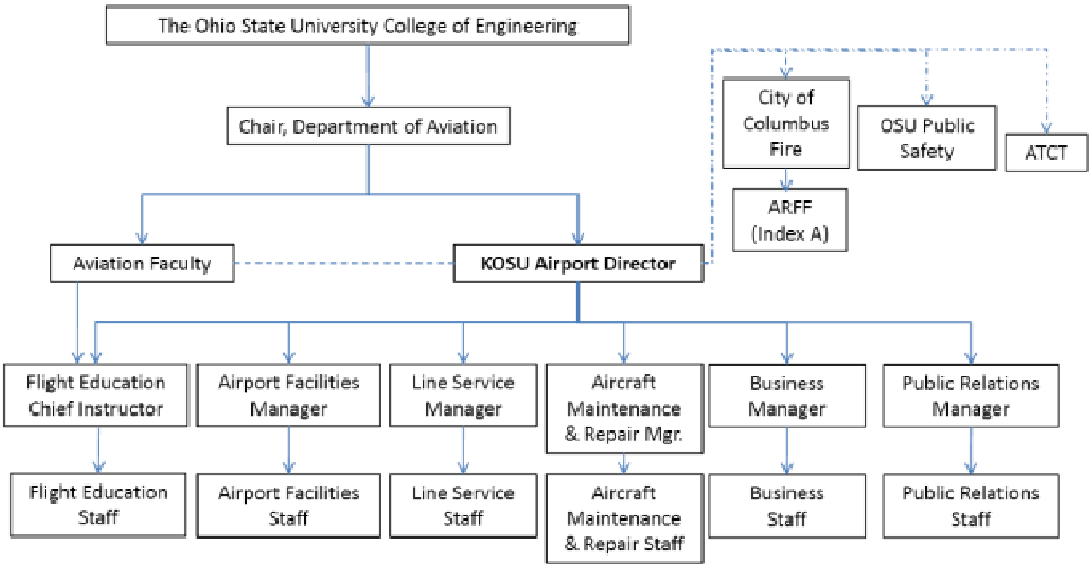

Figure 3: Administrative Organizational Chart

Safety Risk Assessments

As part of the airport's SMS implementation study, three Safety Risk Assessments were conducted. The first SRA focused on potential airfield incursion hot spots. The second SRA assessed hazards associated with wildlife activity within the vicinity of the airport. The third SRA assessed hazards in the non-movement area of the airport, with a focus on terminal area ramp operations. These three areas were selected because of their relevance to the daily operations of KOSU, as well as alignment with current FAA safety initiatives. Each SRA consisted of initial research activity, which included literature reviews, reviews of past occurrences, and interviews with members of the airport's safety committee and other users of the airport to determine hazards in each area. In addition, hazard reports were collected from airport users over a period of time, and all data was analyzed using the FAA's predictive risk matrix tool to assess a level of risk to hazards found within each area of study.

Each of the SRAs conducted for this study followed were conducted using the following actions:

1. Describe the System.

2. Identify the hazards.

3. Determine the risk.

4. Assess and analyze the risk.

5. Treat (mitigate, monitor, track) the risk.

This 5-part process consisted of conducting interviews with airport users to hear their thoughts on where hazards may exist, based on their experiences. These users included local pilots, flight instructors, airport employees, and the airport safety committee assembled for this project. The process also consisted of referencing historical data, such as incursion reports and wildlife strike databases.

In addition, a public hazard reporting process was established. KOSU designed a custom hazard reporting form that was placed around the airport in various locations. The forms were coupled with a bright red binder and submission envelope. In addition, an internet-based form was created for users who desired to submit reports digitally.

Airfield Incursion Risk Assessment

Activity on the movement area can be characterized by authorized aircraft and ground vehicle operations on runways and taxiways. Aircraft use this area for takeoff, landing, and taxi operations. Maintenance personnel use this area for maintenance of the runway facilities. Stakeholders involved in the movement area include pilots, air traffic controllers, airfield maintenance personnel, landscape personnel, and line service personnel. Equipment involved

includes aircraft, maintenance trucks, snow removal equipment, ARFF equipment, landscaping equipment and aircraft tow tractors. Operations in the movement area include aircraft taxiing, aircraft take-off and landing operations, grass mowing, aircraft towing, and maintenance operations. All operations in the movement area require radio coordination between the user and air traffic control during control tower hours of operation, as well as obedience to movement area signage and pavement markings. The goal of this risk assessment was to identify hazards and hotspots associated with the airfield through data collection and research, and analyze the severity and frequency of risk scenarios associated with those hazards.

Hazard "hot spot" locations associated with the potential for airfield incursions were identified. These locations are displayed graphically in Figure 4. Specifically, the hazards assessed were:

- Area "A1", an Absence of a marked "run-up" area for Runway 5 at Taxiway A
- Area A2: Multiple runway thresholds at the taxiway C intersection with runways 27R and 23
- Area A3: A close proximity of the Runway 32 threshold to the intersection of Taxiway D, Runway 27L and Runway 32
- Area A4: A portion of Taxiway A located within the Runway 32 approach zone.

For each of the above identified hazards, SRA's were performed to assess the level of risk these hazards impose.

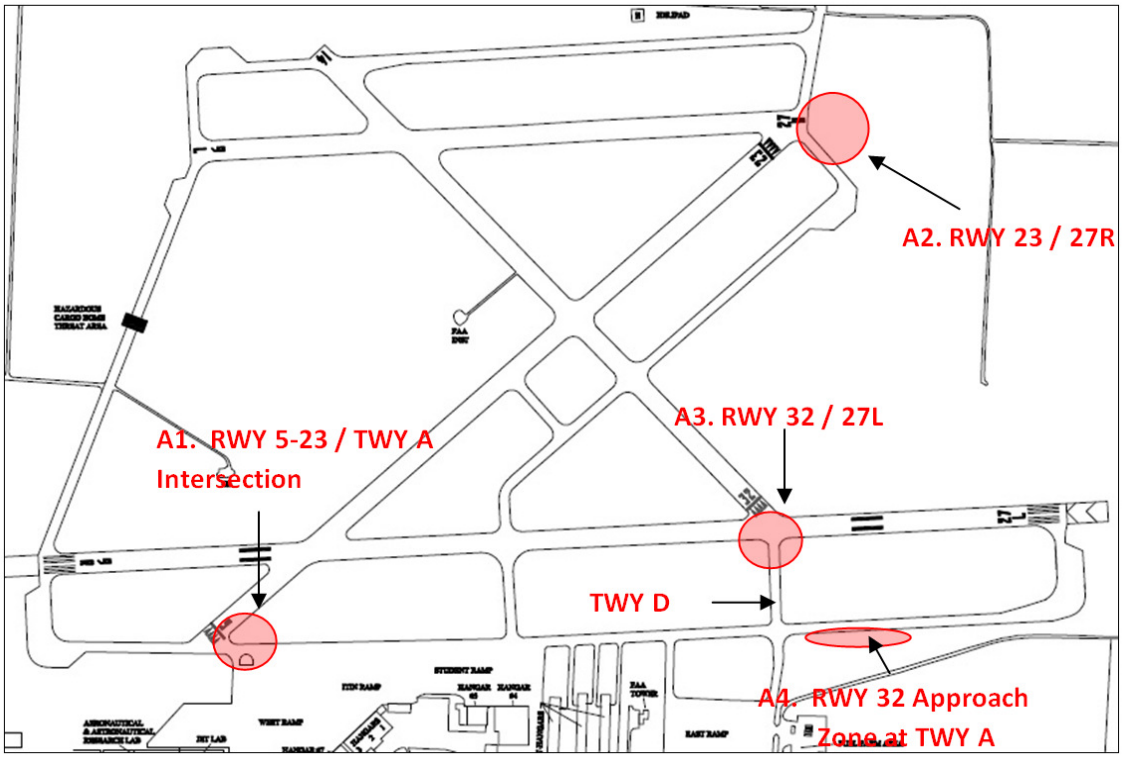

Figure 4: Airfield Incursion risk analysis.

Area "A1", the intersection of runway 5-23 and Taxiway A, was found to be a potential incursion spot. Alpha intersects with the threshold of runway 5, and interviews have determined that when runway 5 is in use, pilots tend to get confused at this intersection as to where to conduct their engine run-up. This intersection is marked by painted mandatory hold-short bars, runway signs, and wig-wag lights. However, if an aircraft utilizes runway 5 for departure, and wishes to conduct a run-up, there is no designated or marked run-up area for runway 5. This area is prone to aircraft diverting from Taxiway A, particularly for the purposes of performing run-ups in advance of using runway 5 for departure. Often, these diversions result in aircraft performing engine run ups in close proximity to the ramp area, which results in prop wash in the vicinity. In other cases, aircraft may taxi onto the runway 5 to perform their run ups, which would result in incursions on runway 5 and runway 9R-27L. The potential for an aircraft accident as a result of this incursion is low due to the location of the infraction, particularly in relation to RWY 9R-27L, however, safety margins are compromised. This risk assessment has evaluated that this hazard has a "probable" likelihood of occurrence and a "minor" level of severity should such an incursion occur which is estimated to be a **medium risk** according to the risk matrix illustrated in Figure 1.

Area "A2", the intersection of runways 27R, runway 23, and Taxiway "C" is considered a hazard spot on the airfield. At this location, taxiway "C" meets the thresholds of two runways. To enter either runway for departure from the taxiway, a left turn must be executed, a slight left turn for 27R, or a sharp left turn for 23. The multiple intersecting runways have proven to be confusing for pilots unfamiliar with KOSU, potentially leading to aircraft entering the wrong runway for departure. The risk associated with this hazard is an aircraft mistakenly entering an incorrect, active runway for departure, causing a runway incursion. This risk assessment has evaluated that this hazard has a "probable" likelihood of occurrence and a "minor" level of severity should such an incursion occur which is estimated to be a medium risk according to the risk matrix illustrated in Figure 1.

Area "A3", the threshold of runway 32 at the intersection of runway 27L-9R and Taxiway D has been identified as an incursion hotspot for various reasons. When runway 32 is in use, aircraft wishing to depart on 32 must hold short of the runway at Taxiway D short of 27L for departure. Once take-off clearance is obtained, aircraft must taxi across 27L and turn to the left to enter 32. SRM research has indicated that this spot has been troublesome for some pilots, with aircraft occasionally turning the wrong way, or mistaking 27L for a run-up area. Until 2009, the runway 32 threshold was located adjacent to Delta, which also intersected runway 27L. A 2009 runway rehab project relocated this threshold, placing it in its current location, north of 27L, eliminating the intersection of 32 and 27L. The risk associated with this hazard is a possible scenario where because a pilot cannot see the runway 32 threshold from taxiway Delta, he/she may accidently enter runway 27L, or the pilot hesitates and stops on runway 27L trying to find runway 32. The likelihood of such an occurrence is considered "remote" and the potential severity resulting from such an event is evaluated as "minor". As a result, this was evaluated to be a low-risk hazard.

Area A4, The runway 32 approach zone is located on taxiway Alpha, and has been identified as a potential incursion spot for this analysis. The zone is marked by mandatory hold-short bars and signs, and the air traffic control (ATC) tower will often assign hold-short instructions to aircraft or vehicles for this zone if an aircraft is on final approach to runway 32. A recent change to ATC hold-short instruction phraseology has resulted in pilots getting confused at this zone. For example, interviews with the control tower manager and flight education personnel have revealed that aircraft, when instructed to "taxi across

the 32 approach zone," commonly approach the zone and become confused as to whether they are clear to cross it. This risk associated with this hazard includes the scenario where an aircraft taxiing on taxiway A mistakes approach zone hold-short markings as RWY 27L hold-short markings, which would be the intended runway in this area. Aircraft stops in approach zone, instead of outside approach zone. The likelihood of this occurrence is estimated to be "remote" and the severity of any incident resulting from this occurrence would be "minor". As a result, this was evaluated to be a **low-risk** hazard.

In summary this SRA provided priorities to mitigate the risk of airfield incursions should be placed with a clearer identification of a runway 5 run-up area and implementing some sort of enhancements to reducing confusion at the multiple threshold area of runways 23 and 27R at taxiway D. These two areas reveal a medium level of risk, so active monitoring prior to any enhancements was deemed to be prudent.

Wildlife Hazards Risk Assessment

The second of the three safety risk management assessments focused hazards associated with wildlife in the vicinity of the airfield, with particular attention paid to migrating wild foul. The land footprint of KOSU is approximately 1,200 acres. Within this area, there is the airfield complex itself, which consists of paved runways and taxiways, separated by grass-covered safety areas. Surrounding the airfield on the west side are Ohio State University agricultural facilities, with fields for animal grazing. The north and east sides of the airfield are mainly grassland habitats, with scattered deciduous tree cover. The south side of the airfield is developed, with the terminal and ramp area, hangars, parking lots and maintenance facilities. Within this developed area, there are various species of ornamental trees and shrubbery placed near buildings and along access roadways.

With a large, open land area containing many acres of grassland and deciduous trees, OSU is a prime spot for airborne and ground-based wildlife. Some of the more prominent species that tend to inhabit OSU are Canadian geese, European starlings, red-tailed hawks, mourning doves, coyotes, and deer. In an effort to be proactive, OSU has contracted with the U.S. Department of Agriculture Wildlife Services to actively manage the presence of wildlife at the airport. A full-time wildlife biologist is staffed at OSU to implement and manage strategies for the control and reduction of wildlife hazards to aircraft operations. His expertise in the area of wildlife management at airports has been invaluable to this risk assessment.

Hazards that were assessed in this analysis were those that the management at OSU has some control of, with respect to the presence of wildlife on the field, particularly wildlife that may have in flight strikes with aircraft. As such, "the presence of birds" was not considered to be a hazard in and of itself. Rather, the presence of a condition on the airfield, which may encourage the presence of bird, was the type of hazards that were sought out and assessed.

The following hazards that were found to be associated with wildlife hazard issues were:

- Grass height in the in the Aircraft Operations Area (AOA)
- Vulture attractants in fields near the AOA
- Ornamental Trees near the AOA

For each of the above identified hazards, SRA's were performed to assess the level of risk these hazards impose.

One of the most significant factors in the presence of wildlife at KOSU is the maintenance of the grass height. If the grass in the safety areas and panels is not maintained within a height range of 7-11 inches, the grass becomes conducive to wildlife nesting. Since the airport has a relatively large acreage of grass area and a relatively small staff for landscaping and other airfield facilities maintenance, the grass often exceeds the desired height. During this assessment, there was also greater than normal levels of precipitation, which further prevented mowing operations from maintaining a proper grass height. This has led to bird nesting activity within taller grassy areas, particularly by European Starlings. These birds are often out of the line of sight to the ATC control tower and aren't reported until they are disturbed by the sound of a nearby aircraft and fly out of the grass. Furthermore, they often go unseen by aircraft at night, until the occasion that a startled bird(s) cause a strike. This analysis in fact revealed that a number of starling bird strikes occur yet go unreported, because they occur at night when the air traffic control tower is closed. Only through careful runway inspection by the USDA on site has evidence of such strikes been revealed. The risk of this hazard creating a bird strike was estimated to be "probable" and the severity of any incident caused by such an event is most likely "minor," as evidenced by the aircraft that have not required any repair upon occurring a strike in this manner. This assessment evaluated this hazard as a **medium risk**.

The second identified hazard revealed the hazards created upon the mowing of the grass, as well as harvesting of grass-like vegetation. As a result of grass mowing operations, the subsequent shorter grass and churning of the vegetation by the mower tends to allow insects and mice to surface, becoming attractants to turkey vultures. The areas where this phenomenon is most prominent are the alfalfa fields located on the airport property.. These fields are located east, west and south of the runway complex, and are part of the Ohio State Agriculture Facilities operations. The alfalfa is harvested roughly three times per year and processed into bales of hay. These operations have resulted in turkey vultures airborne-foraging for food in fields on airport property, bringing them into close proximity with active taxiways and runways. Bird strikes from turkey vultures are indeed rare at the airport, but this risk assessment hypothesizes that such events could become more frequent ("probable"). However, the severity of such an event occurring would be relatively minor. This assessment is summarized in Table 8 and estimated to be a **medium risk**.

The third hazard investigated the risk of the presence of ornamental trees located near the air operations area (AOA). European starlings and American robins have been found to been attracted to soft mast producing trees such as ornamental crab trees, especially during the winter months. These trees are located near the AOA, and pose a hazard to aircraft due to their attractiveness to birds. These ornamental trees are found both near the north side of the AOA, where local traffic pattern operations are often conducted, and the south side of the AOA, near the primary runway 9R-27L, where larger itinerant activity occurs. During the winter months, non-migratory birds adjust their feeding patterns, and feed on the soft mass produced by the ornamental trees near the control tower and large community hangars on the south side of the field. The trees bring the birds closer to the aircraft operations area, which increases the likelihood of a bird strike. According to the research associated with this assessment, no bird strikes have been confirmed to occur from the birds feeding in these trees. However, the assessment has revealed that a non-trivial number of bird strikes that have occurred in this area have gone unreported, so

it is hypothesized that this area may be a root cause of such occurrences. As such, the determined likelihood of this risk is "remote", and the severity of this risk has been categorized as "minor." This assessment is summarized in Table 9 and estimated to be a **low risk**.

From this SRA, it was determined that priorities to mitigate the risk of a wildlife strike should be placed with a more active airfield lawn management program, so that grass heights that minimize bird nesting are maintained, and vulture attractants from lawn shavings and other remnants from recently mowed grass are mitigated. These two areas reveal a **medium risk**, so active monitoring prior to any enhancements is prudent.

Ramp Area Operations Risk Assessment

KOSU contains a large ramp to accommodate the wide range and volumes of transient and based aircraft. Visiting aircraft that arrive at KOSU are instructed by air traffic control to taxi to the transient ramp, where they are met and escorted to a parking spot by a line service technician. Passengers, pilots and associates of that aircraft exit the ramp area via the Fixed Base Operator (FBO) building, colloquially known at OSU as the "terminal." Users and stakeholders of the ramp area include pilots, passengers, line service personnel, aircraft maintenance personnel, and privately operated passenger transportation drivers. Vehicles within operating within the ramp area include aircraft, aircraft tow tractors, aircraft fuel trucks, airfield maintenance vehicles, and rental cars and other private vehicles. The goal of this risk assessment was to identify potential hazards associated with the normal day-to-day operations occurring on the ramp, and how they may affect users and employees of the ramp area.

Research for the ramp area risk assessment was performed through interviews with frequent users of the ramp, including line service technicians, customer service employees, and pilots. In addition, hazard reports were collected at the terminal customer service desk, submitted by both employees and visitors to the airports. The research indicates that a few hazards exist within the operation of the ramp. The hazards identified were:

- Untrained Drivers on the ramp
- Blind spots near hangar corners
- Pedestrian traffic near entrance to FBO from ramp.

The first ramp area hazard identified for assessment was the presence of vehicle drivers on the ramp who have not had formal airfield driver training. The KOSU ramp services general aviation users. Unlike a commercial service airport, where FAA regulations require that persons accessing the ramp be either trained or escorted by a trained individual, OSU security requirements are not as stringent. As such, OSU does not have a Security Identification Display Area (SIDA), which limits access strictly to badged and trained persons. As a result, drivers of limousine services, rental cars, and sometimes personal vehicles are allowed to drive to aircraft on the ramp to pick up or drop off passengers.

Interviews and hazard reports by line staff have revealed that the untrained nature of these drivers has resulted in inconsistent driver patterns among the population of vehicles. Specifically, the routes taken from the ramp entry gate to an aircraft are non-standard (there are no defined traffic lanes striped on the ramp), vehicle speeds highly vary, and attention and

awareness of vehicles and associated pedestrians to aircraft or other ground vehicles is highly suspect. While no physical injuries have ever occurred due to this environment, an increasing number of vehicles associated with any forecast increases in aircraft activity may lead to an injury.

What does seem to occur relatively frequently, however, is an incident where an aircraft or ground vehicle may have to slightly deviate from a normal operation, by some sort of minor evasive action, such as a quick shut down of engines, a hard brake, or unexpected turn, to avoid an unexpected oncoming vehicle. While this may typically have a relatively low severity impact, the risk of up to a "minor" severity does exist in this situation.

Two risk scenarios were analyzed for this situation.

Passengers exiting or approaching a vehicle with unfamiliar driver crosses the path of an aircraft departing its parking spot: While this occurrence was deemed to occur on a remote frequency (perhaps once in more than 10 years), the severity of such an occurrence would be major, consisting of minor to moderate injuries and moderate to significant property damage. This scenario presented the environment as a medium risk hazard.

Passenger vehicle with unfamiliar driver crosses the path of an aircraft departing its parking spot. The aircraft must quickly stop to avoid the vehicle: This occurrence was deemed to occur on a more frequent basis (considered a "probable" occurrence), with the severity of such occurrences being quite minor, with slight impacts to the airport's reputation for safety being impacted more than anything else. As such, this scenario also presented the ramp environment as a medium risk hazard.

The second ramp area hazard concerned the presence of blind spots around certain hangar corners near the ramp. At the corner of one of the large community hangars (Hangar 4) and one of the large corporate exclusive use hangars (Hangar 7) on the OSU ramp, there is fairly heavy vehicle traffic, such as fuel trucks, aircraft tow tractors, and airport maintenance vehicles. Vehicle turning around these corners is part of the travel route from the main ramp area to the satellite portions of the airport, including T-hangars and airport maintenance. The route is heavily traveled by these vehicles, and according to a submitted hazard report, could be potential spots for a vehicle collision. These blind spots are illustrated in Figures 5 and 6.

With respect to Hangar 7, aircraft support vehicles traveling in opposite directions around corner are at risk of being unable to see each other, and must quickly react to avoid collision. While the airport has never had such an incident occur, the risk of occurrence may be increasing with the activity associated with the corporate hangar to the south of the blind spot. This relatively new hangar (approximately 10 years old) is home to active flight operations of a large corporation. As activity continues to increase in this area, the risk of an incident in this area may increase accordingly.

The corner of Hangar 4, presents less visibility for turning vehicles than at Hangar 7, which increases the potential of two vehicles traveling from opposite sides colliding. This area, however receives less traffic than at Hangar 7, and vehicles tend to travel more slowly.

Given the physical geometries of these blind spots, the risk of aircraft being involved in an incident is relatively low. As such the risk associated with these hazards were considered to be of **low risk**.

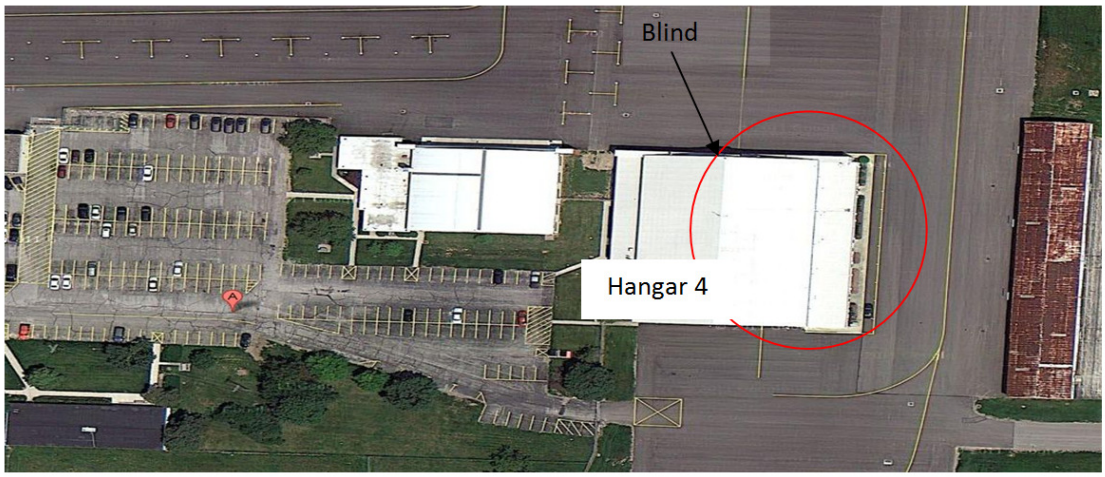

Figure 5: Blind spot at corner of Hangar 4.

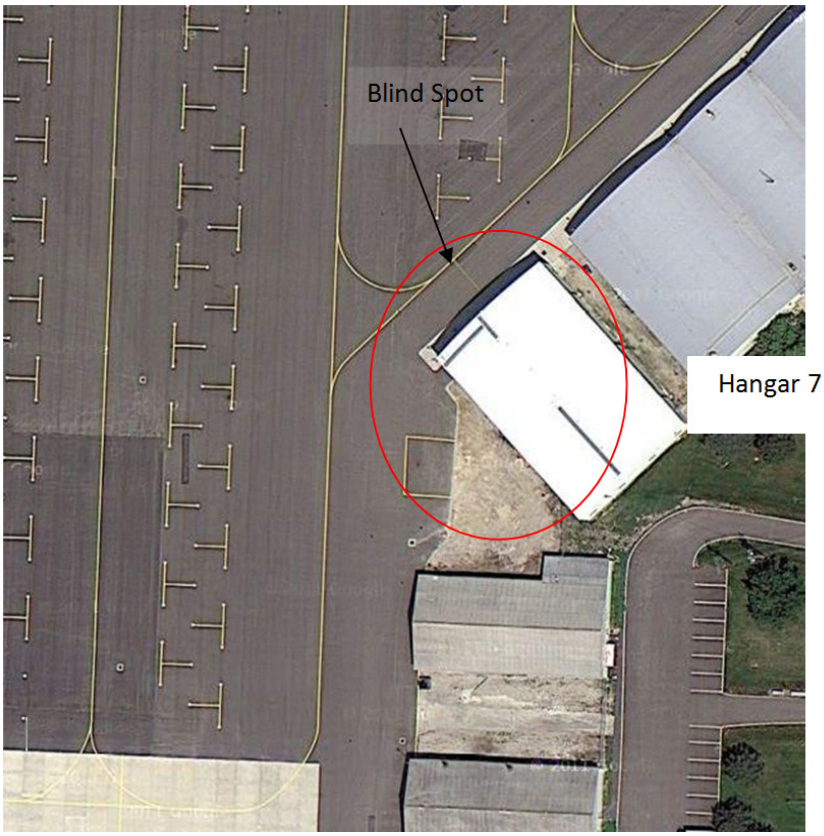

Figure 6: Blind Spot at corner of Hangar 7.

The third hazard assessed was the area immediately outside the entrance to the FBO. The entrance to the passenger terminal or FBO from the ramp area is located at a slight physical bend in the building complex, as illustrated in Figure 7. A vestibule extends from the terminal out to the ramp area, where passengers and flight crews walk out to their aircraft. The vestibule extends into a corridor which aircraft tow tractors, fuel trucks, and airport maintenance vehicles heavily utilize. The area surrounding the vestibule is less visible from either side due to the curve in building frontage.

Figure 7: FBO Entrance from Ramp.

The worst case safety scenario in this area is passenger or flight crew member walks in path of oncoming ramp support vehicle and moderate injuries are sustained. This situation has never happened on the airport, and such a situation occurring in the future is estimated to be extremely remote. Yet with increased activity, the risk increases. Thus, this hazard was estimated to be a **medium risk.**

From this risk assessment, it was recommended that priorities to mitigate the risk of injury on the ramp should initially focus on improving safety of personal vehicle movements in the vicinity of aircraft on the transient ramp, as well as pedestrian movements immediately outside the ramp entrance to the FBO, in the vicinity of service vehicle movements. These two areas reveal a medium level of risk, so active monitoring prior to any enhancements is prudent.

SUMMARY OF FINDINGS AND CONCLUSIONS

This multiyear multiphase study provided valuable insight into the preparation and implementation of the FAA's proposed SMS requirements for 14CFR Part 139 Class IV airports. The Ohio State University Airport is typical of such airports in that the airport does not serve regularly scheduled commercial service operations, is catered more towards private and corporate aviation activities, and operates with relatively small staffs and budgets. KOSU in particular operates nearly the entirety of airport operations with in-house staff, and as such operates with a certain degree of community and what may be perceived as informality. This study focused on the development and initial implementation of the Safety Policy and Safety Risk Management (SRM) portions of a draft SMS for the airport.

Safety Rick Assessments (SRAs) were performed for three areas of the airport and risks associated with hazards initially identified around these areas were estimated. As a result, the airport was able to prioritize management of these risks. From this analysis, it was found that:

- Certain airfield locations presented a medium safety risk for runway incursions. As such, active monitoring of operations within these vicinities were prioritized, and efforts to publicize operating with extra care within these areas were made.
- Wildlife hazard mitigation was prioritized towards a focus on lawn management, with an effort to maintain an optimal grass length to mitigate the resting of birds in the airfield.
- Ramp area operations safety should focus on reducing the risks associated with the current movement of aircraft, ground vehicles, and pedestrians near the vicinity of the terminal entrance.

This analysis has helped the airport in identifying, prioritizing, and mitigating safety risks using its initial SMS program. The analysis proved to be a rewarding process, although the process itself demanded more resources than was budgeted. The use of in-house staff to lead the SMS study did prove useful with getting buy-in from airport staff and tenants. The establishment and participation of an SMS committee proved fruitful, and it seemed that simply routine meetings of the committee have proven highly beneficial in sharing issues and potential solutions with regard to airport safety, and certainly aided in the promotion of the SMS process throughout the airport. What was more challenging was to achieve any level of participation associated with hazard reporting. Very few hazard reports were filed, both through manual and web-based entry methods. This suggests that achieving a true buy-in of the SMS process, moreover an adoption of the SMS culture is a much more challenging effort. It is suspected that such a culture shift would be nearly generational in nature, requiring at least three to five years of significant promotional and policy initiatives to gain traction.

The Ohio State University Airport will be using this initial risk assessment study towards further development of its airport safety management system. As such, the airport will be monitoring the hazards analyzed within this study, develop methods for mitigating these hazards, implementing mitigation strategies on a prioritized basis, and performing assurance audits to analyze the future effects of mitigation on safety risk.

It is hoped that this study helps to contribute to the gaining body of knowledge that will assist both the FAA in developing guidance for SMS implementation at airports, as well as for the hundreds of airports operating under 14CFR Part 139 to successfully participate in SMS, and ultimately further enhance the safety of the airports' users and employees.

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