

SAFETY MANAGEMENT STANDARDS &

A Comparison

A. Michael Shekari

SAFETY MANAGEMENT SYSTEMS (SMS) are indisputably useful to organizations that implement them correctly in their operations. The benefits that SMS bring to organizations include reduced incident and fatality frequencies, and reduced severity of injuries, illnesses and property damage from unfavorable events. Over time, governmental, industrial and international bodies have published varying standards and guidelines for the development and implementation of SMS. These bodies include International Organization for Standardization (ISO), ANSI, International Labor Organization (ILO) and U.S. Federal Aviation Administration (FAA). The author's objective was to conduct a comparative analysis of SMS standards and accompanying guidance provided by ANSI, ISO, ILO and FAA sources, and to demonstrate the need for global harmonization of safety management standards.

Defining Safety Management Systems

Depending on the context of an organization and its safety program, the system used to manage safety may be known by various names: occupational safety and health management system (OSHMS), occupational health and safety management system (OHSMS) or SMS. These terms are often used interchangeably in many workplaces. For uniformity, all systems used to manage safety are referred to as SMS in this article. However, there is no globally agreed-upon definition of "safety management system." Following are a few examples currently in use:

KEY TAKEAWAYS

- This article describes in detail safety management system standards from International Standards Organization, American National Standards Institute, International Labor Organization, and Federal Aviation Administration.
- It highlights areas where the safety management system standards differ and identifies best practices.
- Finally, the article discusses the need for a globally harmonized safety management system standard.

- "continuous improvement process that reduces hazards and prevents incidents" (NSC, n.d.)

- "systematic approach to managing safety by organizational goals, policy, structure, planning, accountability and safe standard operating procedures" (Safeopedia, 2017)

- "formal, top-down, organization-wide approach to managing safety risk and ensuring the effectiveness of safety risk controls that includes systematic procedures, practices and policies for the management of safety risks" (FAA, 2016)

- "set of interrelated or interacting elements of an organization to establish policies and objectives and processes to achieve those objectives in occupational health and safety" (ISO, 2018)

- "set of interdependent elements that establish or support processes of the occupational health and safety (OHS) policy and objectives as well as mechanisms to achieve those objectives and continually improve OHS" (ANSI/ASSP, 2019)

The FAA and Safeopedia definitions of SMS are the most robust from the descriptions found throughout the literature review, but neither can serve as the best definition because FAA mentions a top-down approach in its definition but does not mention accountability. Meanwhile, the Safeopedia definition mentions accountability but not a top-down approach. Across all of the definitions, there is agreement that SMS is systematic and consists of multiple components. Perhaps the best definition for SMS, using the FAA definition as a base, would be "the formal, top-down, organization-wide approach to managing safety risk and ensuring the effectiveness of safety risk controls that includes systematic procedures, practices, policies and accountability for the management of safety risk."

SMS Standards Descriptions ISO 45001 Standard

Introduced in March 2018, the first edition of ISO 45001 is a comprehensive document for SMS to accomplish OSH goals with a holistic approach extending beyond the immediate workplace using the plan-do-check-act concept, also known as the Deming cycle. It is apparent at the beginning of the document that safety programs should emphasize overall wellness. The document explicitly mentions mental health as an element that should be protected by the program. Another noteworthy feature of ISO 45001 is that the stakeholders in the safety program should extend beyond employers and employees and into the local community potentially impacted by the activities of an organization.

Structurally, the document has three major sections: Scoping and References (Clauses 1 to 3), Program Requirements (Clauses 4 to 10), and Supplemental Information (Annex A). Clauses 1 to 3 establish the scope of how the standard should be used and defines 37 terms in the document to specify a common language used in safety programs compliant with the document's requirements. Meanwhile, Clauses 4 to 10 define actual program requirements under the following categories:

- "**Context of the organization**" lays the foundation of how the rest of the SMS will be developed. Developing the organization's context involves evaluating internal and external issues



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Performance Analysis

relevant to OSH, such as the needs and expectations of workers and other interested parties. The organization will then use the issues to determine the scope of the SMS.

•**Leadership and worker participation**” defines the responsibilities organizational leaders hold for ensuring that the SMS is supported by the organization’s policies, is adequately resourced, encourages worker participation, protects workers from reprisals and is integrated into the organization’s daily business practices. The clause also directs organizations to establish mechanisms for worker consultation on various OSH topics within the workplace. The section recognizes the reality that nonsupervisory workers often have the most intimate knowledge of workplace hazards.

•**Planning**” starts by looking at an organization’s context, requirements of interested parties, scope of the SMS, and risks and opportunities within the OSH environment. The goals of planning are to ensure that the SMS will achieve its intended outcomes, prevent or reduce negative impacts, and achieve continuous improvement. The planning process encompasses many activities, including the identification of risks and opportunities triggered by change, identification of hazards both under and outside the control of the organization, determination of legal and other requirements, and establishment of OSH objectives.

•**Support**” discusses the elements required to guarantee that the SMS will be able to function as intended. The required support elements are resources dedicated to SMS establishment and maintenance, worker competence, worker awareness, internal and external communication, and SMS documentation.

•**Operation**” revolves around the use of SMS in the workplace environment to meet OSH objectives. A complete SMS, meeting the requirements of the operation clause, will have a means of establishing processes and controlling their implementation, and will use the following hierarchy of controls:

1. elimination of the hazard
2. substitution for lesser hazard
3. engineering controls and work reorganization
4. administrative controls, including training
5. adequate PPE

A successful SMS, meeting the operation clause requirements, will also address change management, procurement and outsourcing.

•**Performance evaluation**” is the means an organization’s leadership will use to identify opportunities for improvement of the SMS. According to ISO 45001 requirements, proper per-

formance evaluation will determine what should be measured, methods for monitoring and measurement, when measurements and monitoring should take place, criteria from which the performance measurements will be judged, and level of compliance with regulations or other standards. During performance evaluation, organizations also shall develop and execute internal audit programs and conduct management reviews to ensure the continuing suitability, adequacy and effectiveness of the SMS.

•**Improvement**” incorporates the opportunities identified during performance evaluation and deficiencies identified from incidents and nonconformities with the organization’s policies or legal requirements to improve the organization’s SMS. It includes enhancing performance, promoting a culture supporting the SMS, promoting worker participation, communicating relevant results of improvement efforts and documenting evidence of continuous improvement.

While ISO 45001 does an excellent job of specifying requirements for a quality SMS in the OSH environment, it fails to provide much guidance on how the requirements may be achieved using acceptable practices, making the document less useful to organizational leaders who may wish to use an SMS but lack dedicated personnel with a professional safety background. This may also be a symptom of ISO’s business model.

ANSI/ASSP Z10 Standard

The latest revision of the ANSI/ASSP Z10 standard, released in August 2019, was done to provide general, high-level alignment with ISO 45001 and utilizes approaches similar to those in the ILO-OSH 2001 guidelines. This allows organizations to comply with both the ISO and ANSI standards. The general structure and content of ISO 45001 and ANSI Z10 are similar, but there are areas where Z10 is more comprehensive and slightly different than certain sections of ISO 45001. However, one of the most important statements Z10 makes is that, whenever practical, the organization’s SMS should be integrated into already existing business practices.

One unique approach of ANSI Z10 is the standard-based methodology. Like ISO 45001, Z10 uses the Deming cycle but it looks at the process in a more nonlinear fashion. The nonlinear approach is illustrated in Z10 through the use of feedback loops showing relationships between SMS components that may not be in normal plan-do-check-act sequence, such as doing plan actions several times and checking results before acting to make changes. Using a nonlinear approach when applying the

Deming cycle allows the organization to see a more dynamic relationship among components in the SMS, particularly the continuous improvement cycle.

The hazard control hierarchy in Z10 also has an additional step, warnings, placed between engineering and administrative controls. Z10 also mentions this process is required to prioritize OSH issues within the SMS, based on factors such as fatality, severe injury/illness potential, standards, regulations, feasibility, and potential positive or negative business consequences. Also helpful is that Z10 discusses considerations made when selecting which hazard control method(s) is used to resolve an OSH issue:

- nature and extent of the risks being controlled
- degree of risk reduction desired
- applicable regulations
- industry best practices
- effectiveness, reliability and durability of control being considered
- human factors
- available technology
- cost-effectiveness
- internal organization standards
- strategies to eliminate or mitigate potential health exposures, including those not originating from work activities

Another aspect of the Z10 standard not found in other standards is that it requires organizations to adopt recognition of and reasonable accommodation for medical conditions that may affect a worker's ability to perform duties safely and effectively, regardless of the work-relatedness of the medical condition.

The full value of Z10 is revealed in the explanatory texts of Annex A. This section allows users of Z10 who are developing an SMS in their organizations to receive supplemental information to make compliance with the standard's requirements less complicated. The supplemental information ranges from examples of potential issues affecting an organization's context to details on different incident investigation tools. Annex B, a bibliography with citations for source texts used in the standard's development, provides users of the standard additional resources to expand knowledge on specific SMS/OSH topics.

ILO-OSH 2001 Guidelines

Compared to other sources of SMS standards, ILO is unique due to its status as an agency of the UN. The organization's affiliation with the UN is also demonstrated in the ILO-OSH 2001 guidelines foreword section, where it is mentioned that poverty cannot justify disregard for worker safety and health. The foreword also brings up the concept of "decent work," in "conditions of freedom, equity, security and human dignity." This concept is not mentioned in other SMS standards because it was developed in a context where the existence of these conditions is assumed, whereas the UN's experience recognizes that conditions of freedom, equity, security and human dignity are not omnipresent in all nation-states.

ILO-OSH 2001 is also different from other SMS standards because it is designed to be used on two different levels, national and organizational. On a national level, the document is meant to help nation-states develop frameworks for OSH management systems supported by laws and regulations. On the organizational level, it encourages the integration of OSH management systems into already existing policy and management constructs.

The general structure of ILO-OSH 2001 includes sections for policy, organizing, planning and implementation, evaluation, and action for improvement. This format is like those of the

ANSI/ASSP Z10 and ISO 45001 documents; however, ILO-OSH 2001 has several unique differences. ILO-OSH 2001 states that when crafting the organization's OSH policy within the SMS, employees and their representatives should be consulted. The document also states that the organization's safety policy should be made available to interested outside parties, as appropriate. It is recommended that the employer or most senior accountable person in the organization bring the policy into effect with their signature. The ILO guidelines state that OSH objectives should be "realistic and achievable," a detail left out of the other SMS standards documents examined. This places the ILO-OSH 2001 more in line with the specific, measurable, attainable, realistic, and time-bound (SMART) objective methodology used in other traditional management frameworks. The other standards speak to the specificity of objectives, their measurability and time-bound review requirements, but miss attainability and feasibility critical to organizational success with OSH objectives.

The ILO document also does a better job than other standards in the emergency-preparedness area. ILO-OSH 2001 encourages organizations to reach out specifically to relevant external authorities and emergency services during planning and emergency response arrangements. This is more specific than "interested parties" or "external parties" used in the ISO 45001 and ANSI/ASSP Z10 documents, because it reduces the chances of local emergency services coordination being overlooked.

ILO-OSH 2001 does not have a copious number of embedded notes nor a supplemental information annex to assist in better understanding or complying with guidelines; however, as an organization, ILO has a multitude of "code of practice" documents covering a wide range of topics from the prevention of major industrial incidents to ambient factors in the workplace.

FAA: 14 CFR Part 5

FAA requires that all scheduled Part 121 air carriers have an SMS under 14 CFR Part 5 regulations (Safety Management Systems, 2015). The regulations state that an air carrier's SMS shall consist of four core elements:

1. Safety policy. The FAA SMS requirements are precise when it comes to safety policy. Within this section, airlines are required to state safety objectives and show commitment to fulfilling them. This section must also make a clear statement about providing necessary resources for the implementation of the SMS. Safety reporting requirements by employees on hazards, definitions of unacceptable behavior and a process for disciplinary action against those who violate safe practices must also be included. FAA safety policy requirements state that there must be a written emergency response plan.

The most striking aspect of FAA's safety policy is the legal requirements placed on the accountable executive. The accountable executive must sign the organization's safety policy, make sure it is documented and communicated throughout the organization, and review it regularly to ensure that it stays relevant and appropriate for the organization's operation. The requirements further specify how safety responsibility and authority should be delegated. While the points throughout 14 CFR Part 5 are recommended in the other SMS standards, they are unique in this standard because they hold the weight of enforceable government regulation.

2. Safety risk management (SRM). SRM is "a process within the SMS composed of describing the system, identifying the hazards, and analyzing, assessing and controlling risk" (Safety Management Systems, 2015). Under 14 CFR Part 5, the SRM

process is required whenever a new system is implemented, a current system is changed, operating procedures are developed, or when identifying hazards or ineffective risk controls. The system description requirement under SRM is robust; the organization must, at minimum, analyze the system by identifying the function and purpose of the system, its operating environment, an outline of the system's processes and procedures, and resources necessary for the operation of the system.

3. Safety assurance. The regulation defines the hazard identification, risk assessment and risk control elements of the SRM process in less detail than the other standards. The airlines must possess the process elements, but the details are at the organization's discretion. Safety assurance is defined as "processes within the SMS that function systematically to ensure the performance and effectiveness of safety risk controls, and that the organization meets or exceeds its safety objectives through the collection, analysis, and assessment of information" (Safety Management Systems, 2015). FAA requires the safety assurance portion of an SMS to include safety performance monitoring and measurement, safety performance assessment, and continuous improvement elements. The necessary tools for accomplishing safety performance and monitoring include:

- monitoring of operational processes
- monitoring of the operational environment to detect changes
- auditing of operational processes and systems
- evaluations of the SMS and operational processes and systems
- investigations of incidents
- investigations of reports about potential regulatory or other safety noncompliance
- a confidential employee reporting and solution proposal system

Using information compiled through safety performance and monitoring, the organization can conduct accurate safety performance assessments to help determine compliance with safety risk controls, and SMS and risk control effectiveness, and to identify any new hazards that may have arisen from changes in the organization's operational environment. Based on the results of the safety performance assessment, organizations can then formulate plans for continuous improvement of their safety program.

4. Safety promotion. Safety promotion is "a combination of training and communication of safety information to support the implementation and operation of an SMS in an organization" (Safety Management Systems, 2015). This section of the SMS primarily functions by ensuring that everyone in the organization knows how to perform their roles relative to the SMS, and communicates why safety policies, procedures and controls are in place.

The regulation only applies to direct aviation operations of an airline, which generally revolves around elements such as flight operations, dispatch and aircraft maintenance; however, the general concepts discussed in 14 CFR Part 5 can also apply in an OSH context.

To assist airlines in compliance with the regulation, FAA published Advisory Circular (AC) 120-92B, "Safety Management Systems for Aviation Service Providers," a how-to manual with acceptable SMS practices on meeting the requirements of the regulation. The document gives FAA's SMS standard a unique advantage over other available standards because it provides enough practical advice and explanation to allow those not already versed in SMS to function with minimal additional safety-specific training or education.

Some of the most important concepts introduced by AC 120-92B are safety culture, open reporting and just culture. Safety culture is a phenomenon that develops over time from

leadership and organizational learning, rather than being instantaneously created or implemented. It is best described as a deeply ingrained and automatic psychological and behavioral aspect of safety performance. Safety cultures are the product of an organization's values and consistent safety-focused actions. Open reporting is part of a management framework for a safety culture that encourages the disclosure of errors without fear of reprisals. The open reporting of errors also enables organizations to cultivate a just culture. Just cultures address systematic issues in an organization and are intolerant of recklessness or willful violation of procedures. For example, if an employee unintentionally violates a rule, it can be reported and no punishment will follow; however, discipline will be implemented when rules are intentionally broken or policies violated.

From a practical standpoint, AC 120-92B also provides useful tools revolving around hazard identification, mitigation and risk assessment. These tools include SRM worksheets located in the document's second appendix. The worksheets include a description of SRM triggering conditions, and system analysis, a hazard listing with potential consequences and pre/post control risk analysis that uses a severity times likelihood formula. All of the worksheets require the signature of an accountable person, as part of the delegated responsibility and accountability listed in 14 CFR Part 5.

The FAA safety management methodology recognizes the interdependence of an SMS and an organization's safety culture. This recognition by FAA shows that the SMS will mature in phases of implementation. FAA lists four main phases during SMS implementation:

1. Planning and organization. The management team commits to providing the resources necessary for full SMS implementation. Management develops an understanding of the organizational structure and a gap analysis between the SMS requirement and the organizational structure. The organization will then develop an implementation plan to address identified gaps. The plan should be approved by top management.

2. Basic safety management. The organization implements SRM and safety assurance processes and applies them to existing systems. At this phase, the organization can identify hazards and address unacceptable risks.

3. Functional SMS. The organization manages risks in future operations, proactively using SRM and safety assurance for new designs and planned changes.

4. Continuous improvement. The organization constantly monitors the SMS and operational processes. Improvements to the SMS will be made using observed risks and opportunities during the monitoring processes.

The phases of implementation also allow organizations with preexisting safety programs to assess where they may currently be in the process of creating an SMS within their organization. This is important because the intent of 14 CFR Part 5 and the accompanying AC 120-92B is to incorporate SMS components into already existing management structures, rather than force organizations to restart safety management efforts.

Comparative Analysis of SMS Standards Method

This study compared the SMS standards by identifying 38 overarching topics discussed in each document, compiled in Table 1 (p. 36). If the topic is covered to any degree in the document, an "X" appears in a corresponding box in the table to indicate that it is addressed. Once the table was generated, the study identified topic areas not possessed by all of the examined

TABLE 1
SMS STANDARDS COVERED TOPICS

This table compiles a list of 38 topics mentioned in at least one of the SMS standards and supplemental information examined. Of the topics listed, 24 were contained across all of the documents; ISO 45001 (30/38); ANSI/ASSP Z10 (32/38); ILO-OSH 2001 (29/38); 14 CFR Part 5 with AC 120-92B (29/38).

SMS topic	SMS standard document			
	ISO 45001	ANSI/ASSP Z10	ILO-OSH 2001	14 CFR Part 5
Audit program	X	X	X	X
Awareness	X	X	X	X
Change management	X	X	X	X
Continuous improvement	X	X	X	X
Contractors	X	X	X	--
Corrective actions	X	X	X	X
Design review	--	X	--	X
Disability accommodation	--	X	--	--
Documentation	X	X	X	X
Emergency preparedness	X	X	X	X
External communication	X	X	X	--
Feedback/organizational learning	X	X	X	X
Hazard controls	X	X	X	X
Hazard identification	X	X	X	X
Human rights	--	--	X	--
Incident investigation	X	X	X	X
Information security	X	X	X	--
Internal communication	X	X	X	X
Just culture	--	--	--	X
Management commitment	X	X	X	X
Management review	X	X	X	X
Mental health	X	--	--	--
Monitoring performance	X	X	X	X
Occupational health	--	X	--	--
Open reporting of errors	--	--	--	X
Organizational context	X	X	X	X
Organizational responsibilities	X	X	X	X
Phased implementation	--	--	--	X
Priorities	X	X	X	X
Procurement	X	X	X	--
Protection from reprisals	X	X	--	--
Resources	X	X	X	X
Risk assessment	X	X	X	X
Safety culture	--	--	--	X
Safety management as a system	X	X	X	X
Safety objectives	X	X	X	X
Safety policy	X	X	X	X
Worker participation	X	X	X	X

SMS standards. The discussion section addresses the details of these topics. When reading the individual standards, readers may not see the exact nomenclature used to describe each topic within a document because the organizations creating them may use different terms with similar definitions.

It is impossible to definitively declare a single SMS standard and its accompanying supplemental texts as “the best.” Each standard has unique merits encouraging consideration during implementation of an SMS; however, this article attempts to rank the standards based on the topical thoroughness and accompanying supplemental information provided in Table 2. Topical thoroughness was assessed by determining the percentage of the 38 overarching topics covered in each SMS standard. Usefulness of supplemental information was determined by qualitative means based on information availability, thoroughness and ease of use.

Discussion

Comparative analysis of the various SMS standards revealed that the standards have more commonalities than differences. Of the 38 topics identified in the examined SMS standards, 24 are addressed in all. The following list discusses 14 topics included in at least one of the examined SMS standards but not included in all of them.

1. Contractors. It is common practice for companies to use contracted workers. As of May 2017, 6.9% of the U.S. workforce consisted of independent contractors (BLS, 2018). This percentage does not include the number of workers who are employed by agencies providing services to other businesses at their work sites. All of the OSH-specific SMS standards mention contrac-

TABLE 2
SMS STANDARDS RANK-CHOICE

This table is a rank-choice chart of the SMS standards examined based on topical thoroughness and the usefulness of supplemental information provided with the standards. ANSI/ASSP Z10 is the most thorough standard in terms of topics addressed in an SMS. ISO 45001 is a close second in terms of numbers of topics covered, but it does not cover many of the topics in as much detail as Z10. ILO-OSH 2001 and 14 CFR Part 5 with the accompanying AC 120-92B cover the same number of topics, but in the OSH context, the ILO-OSH 2001 document has more detail on what the SMS should do by providing more topic-specific material. The 14 CFR Part 5 standard and AC 120-92B offer more of a methodology to implementing and maintaining the SMS. The 14 CFR Part 5 standard ranked the highest in terms of the usefulness of its supplemental information because AC 120-92B provides specific tools on how to apply an SMS methodology. ANSI/ASSP Z10 also has excellent tools for users in its Annex A. ILO-OSH 2001 also provides many guidelines on specific topics related to the SMS, but they are separated into many documents, reducing the ease of use significantly.

SMS topic	SMS standard document			
	ISO 45001	ANSI/ASSP Z10	ILO-OSH 2001	14 CFR Part 5
Topical thoroughness	2	1	3	4
Supplemental information	4	2	3	1

tors, but the FAA standard (14 CFR Part 5 with AC 120-92B) does not. Considerations must be given to how the organization’s operations affect contractor safety and health. The organization should also ensure that contractors are conducting at least the same level of safety management as the organization.

2. Design review. Of the examined standards, design review is only mentioned in the FAA and ANSI/ASSP standards. This critical process examines new operations, procedures and technologies from the beginning of a conceptual design for potential hazards. It also continuously reviews the design for hazards as changes are made throughout the life cycle of the item being examined.

3. Disability accommodation. Accommodation of disabilities is only mentioned in ANSI/ASSP Z10. Meanwhile, nearly 5.8 million persons with disabilities are employed in the U.S. alone (BLS, 2019). On a global scale, there are approximately one billion persons with disabilities; about 80% are of working age (ILO, n.d.). With such staggering numbers, organizations should accommodate workers with disabilities in their safety management system programs.

4. External communication. This is another element not communicated in the FAA SMS standard; however, communicating in advance with relevant external parties can be of great benefit, especially in the area of emergency planning. In the U.S., a regulatory requirement may exist for organizations to communicate with local emergency responders, as is the case with the Emergency Planning and Community Right-to-Know Act (EPCRA) of 1986 for organizations dealing with chemical emergencies.

5. Human rights. ILO mentions human rights in the ILO-OSH 2001 document. If the rights of workers as humans are not reaffirmed in the workplace, safe and healthful conditions may be less likely to exist in an organization.

6. Information security. The SMS used by organizations will likely contain vast amounts of proprietary information and personally identifiable information. Keeping this information secure is essential to the success of the SMS. Due to its importance, it is discussed in the ISO 45001, ANSI/ASSP Z10 and ILO-OSH 2001. Information security is not discussed in the FAA SMS methodology; however, the target audience of 14 CFR Part 5, commercial airlines, is required to keep certain types of security information protected under the Transportation Security Administration regulations in 49 CFR Part 1520. The key tenets of information security are availability (ensuring that the information is accessible to authorized users), integrity (ensuring that the data is correct) and confidentiality (ensuring that unauthorized users are unable to access the information; Grama, 2014).

7. Just culture. Just cultures address systematic issues in an organization but are intolerant of recklessness or willful violation of procedures (FAA, 2015). Of the SMS standards and supplemental information examined, FAA's AC 120-92B is the only document that addresses just culture. This concept is critical because if an organization terminates individuals who make minor, unintentional errors, safety performance may never improve. Learning experiences due to errors are lost as a result of the terminations. However, there is an understanding that if an individual engages in intentionally reckless or grossly negligent behavior, the person will be terminated immediately.

8. Mental health. ISO 45001 is the only SMS standard to mention "mental health." Even then, the document fails to elaborate on how the SMS will be used to help ensure the mental health of workers. According to U.S. Department of Health and Human Services (2019), mental health "includes our emotional, psychological and social well-being. It affects how we think, feel and act. It also helps determine how we handle stress, relate to others and make choices." Given its profound impact on abilities affecting safety performance in the workplace, mental health should be a core consideration in an SMS.

9. Occupational health. Ironically, of the SMS standards examined, only ANSI/ASSP Z10 gives specific provisions of managing occupational health within the SMS. The Z10 requirements focus on identification of chemical, biological, physical and ergonomic stressors that can negatively impact worker health; prevention, detection and treatment of work-related illness and injury; and recognition and accommodation of work-related and non-work-related medical conditions that could impact safety.

10. Open reporting of errors. This is a component of just culture described in FAA's AC 120-92B. Being able to report errors without fear of negative consequences allows organizations to identify safety hazards experienced by individuals more quickly.

11. Phased implementation. Phased implementation is another concept unique to the FAA SMS methodology. It is unrealistic to expect that an SMS will be implemented and fully function immediately. To help determine where the SMS is on its progression in maturity, the aforementioned four phases of implementation can be used.

12. Procurement. Resource allocation can be critical to the function of an SMS. This concept is discussed to varying degrees in ANSI/ASSP Z10, ISO 45001 and ILO-OSH 2001, but is best described in Z10. The standard requires that organizations evaluate potential hazards associated with supply, equipment, raw material and service purchases. It also requires a securing of supplies, equipment, raw materials and services to help control risks.

13. Protection from reprisals. While this concept may be promised by law governing industries where workers report a safety hazard, it should also be built into the policies that serve as the foundation of an SMS. If workers are punished for reporting unsafe conditions to management, a lack of reporting will result. Nonreporting of hazards can cause significant harm in the form of incidents. This is discussed in ISO 45001 and ANSI/ASSP Z10, but not in the ILO or FAA documents.

14. Safety culture. Safety culture is a phenomenon that develops over time from leadership and organizational learning, rather than by being instantaneously created or implemented. It can be best described as a deeply ingrained and automatic psychological and behavioral aspect of safety performance (FAA, 2015).

Regardless of the industrial context of the SMS, incorporating all 14 of the topics discussed will greatly increase the quality of an

SMS already utilizing all 24 of the shared properties. This also opens a significant opportunity for future work on safety management systems: global harmonization of SMS across all industries and regions.

Conclusion

Each industry has unique technical hazards and mitigation strategies; however, general safety management can be shared in a way that all safety professionals and organizational management teams can use standard methodologies, processes and terminology.

Of the SMS standards examined, no single standard necessarily stands out as better than the others. Each standard has elements that should be considered as "best practice" within the safety management landscape. A large number of similarities were discovered between the standards, but the study demonstrates a need for global harmonization of safety management across all industries and regions to advance the safety management profession. By promoting common terminology and standards, workers, managers and organizations can more easily move forward in providing safe and healthful working environments. **PSJ**

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A. Michael Shekari is a graduate student researcher and NIOSH Sunshine Education and Research Center trainee pursuing an M.S. in Occupational Safety Management at Embry-Riddle Aeronautical University. He holds a B.S. in Homeland Security and an A.S. in Aviation Maintenance Science from Embry-Riddle. As an early career professional, many of Shekari's safety experiences come from volunteer service in the Civil Air Patrol, where he performs mission safety officer duties for homeland security support and disaster relief missions. His research interests include aerospace and occupational safety management systems, emergency worker safety, disaster response risk management and workplace violence. Shekari is a student member of ASSP's Space Coast Chapter and the Embry-Riddle Aeronautical University Student Section, part of the Central Florida Chapter, and a member of the Society's Transportation Practice Specialty.