SAFETY MANAGEMENT SYSTEM MANUAL
Public Passenger Transportation Systems

American Public Transportation Association
March, 2016

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RECORD OF REVISIONS

Revision #	Revised By	Date	Issue / Revision Description
0	Initial document	3/15/2016	Original Draft Document
		3/22/2016	Final

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ABBREVIATIONS

APTA	American Public Transportation Association
CEO	Chief Executive Officer
CFR	Code of Federal Regulations
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FLSSC	Fire Life Safety and Security Committee
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
GM	General Manager
JHA	Job Hazard Analysis
LRV	Light Rail Vehicle
MAP-21	Moving Ahead for Progress in the 21st Century
NTO	National Transit Institute
NTSB	National Transportation Safety Board
PI	Policy Instruction
PTSD	Post-Traumatic Stress Disorder
SMS	Safety Management System
SOP	Standard Operating Procedure
SSCP	Safety and Security Certification Plan
SSCVR	Safety and Security Certification Verification Report
SSP	System Safety Plan
SSRC	Safety and Security Review Committee
TCRP	Transit Cooperative Research Program
TRACS	Transit Advisory Committee for Safety
TRB	Transportation Research Board
TSO	Transportation Safety Institute
WI	Work Instruction

BACKGROUND AND INTRODUCTION

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This manual reflects current thought on the best practices to employ in public transportation safety and security and the evolution from the long standing System Safety Program process, defined in the System Safety Program Plan (SSPP). This process was initially developed by NASA and the Department of Defense. The impetus for the development of a systems level approach came in the early 1970s with the expansion of subways to support the growth of major cities across North America. In the 1980s, the Urban Mass Transit Administration partnered with APTA to create a national program for the development of System Safety Programs to ensure that all the new transit systems could be designed and built using the best safety practices. Over the ensuing years this program expanded to Commuter Rail and Bus transportation.

As new transit systems began to age and wear, major accidents surfaced from a lack of maintenance and increase in pressure to operate at higher capacities that could not be supported by the intended design, among many other variables involving financing, political influence, and organizational structure that did not see value of safety as a critical component of the business plan. These accidents led Congress to create legislation known as MAP-21 in 2012, which gives the Federal Transit Administration (FTA) regulatory authority and the right to establish a new direction in addressing these management safety failures, known as Safety Management Systems (SMS). While SMS still has a major role in the design, construction and certification of new systems, it adds considerable focus to the organization and management of safety throughout the system lifecycle. Congress also created the Rail Safety Improvement act of 2008 directing a new safety approach for the Federal Railroad Administration; and in 49 CFR 270 published in September, 2012, the Federal Railroad Administration (FRA) requires commuter and intercity passenger railroads to develop and implement a System Safety Program (SSP) incorporating focus on the management of safety programs and development of a positive safety culture.

The provisions of MAP 21 relating to safety include:

- Public transportation safety certification training program for federal and state personnel
- Transit agency safety plans for all federal transit recipients
    - Strategies for identifying risks and minimizing exposure to hazards
    - Adequately trained safety officer to report directly to the general manager or equivalent
    - Performance targets based on the safety performance criteria above
    - Board of Directors approves safety plan

- State safety oversight program (for states with rail systems not regulated by Federal Railroad Administration (FRA)) approved by the FTA
- FTA authority to inspect and audit all public transportation systems; make reports and issue directives with respect to the safety of public transportation systems; issue subpoenas and depositions; require the production of documents; prescribe recordkeeping and reporting requirements; investigate public transportation accidents; enter and inspect equipment, rolling stock, operations and relevant records; issue regulations to carry out section 5329
- FTA enforcement authority.

49 CFR 270 requires that the railroad's System Safety Program be a structured risk reduction program with proactive management processes and procedures to identify and mitigate or eliminate hazards and the resulting risks on the railroad's system including a holistic view of organizational structure and positive safety culture.

Implementation of Safety Management Systems (SMS) has proven to be an effective method for dealing with the factors affecting organizational context.

The purpose of this *APTA Safety Management System Guide for Public Passenger Transportation Systems* (SMS Guide) is as follows:

- Provide a set of organizational values, management principles and safety philosophies that address the specialized needs of the public passenger transportation industry to move people safely
- Assist public passenger transportation agencies to achieve the desired safety objectives by providing them choices for optimizing their resources at the systems level for positive outcomes
- Use a safety risk based approach
- Implement a rigorous performance measurement system for ongoing assessment of the effectiveness of managing safety risks
- Establish and maintain a positive safety culture that involves all participants in the public transportation agency from the Board of Directors to all staff
- Promote sustainability of safety through continuous improvement.

The term "Safety Management System" has many definitions in the literature as does "Safety Culture".

A good model for the definition of SMS for public passenger transportation can be found in a Transportation Research Board (TRB) presentation made by Dr. Ahmed (TRB585, January 25, 2011): "An organized set of programs, principles, processes and procedures for the allocation of resources to achieve the condition where safety risks are managed to acceptable levels".

According to Dr. Ahmed, safety, management and system are defined as follows:

- ***Safety***- condition to which risks of harm arising out of agency's decisions and operations are managed to acceptable levels
- ***Management***- the allocation of resources to achieve specific goals (leading/directing, planning, organizing, improving, performance measurement)
- ***System*** - organized set of programs, processes and procedures used to deliver services.

Safety culture is the product of individual and group values, attitudes, perceptions, competencies and patterns of behavior that can determine the commitment to, style and proficiency of the public transportation agency.

Purpose of APTA SMS Manual

This APTA SMS Manual provides public passenger transportation agencies methods for defining a Safety Management System within their agency. It is not meant to detail SMS implementation but rather to define the contents of the SMS, along with general implementation strategies.

The appendices to this SMS Manual provide implementation guidance for the development of SMS plans for rail transit, bus and commuter rail systems: Appendix A (rail transit); Appendix B (bus); Appendix C (commuter and intercity rail). These documents serve as the detailed implementation for SMS through the development of an SMS Manual (for rail and bus transit also known as the Public Transit Agency Safety Plan under MAP-21 requirements) and a System Safety Plan for commuter rail and intercity railroads. Hereafter, in this SMS Manual, these plans will be called Safety Plan. Appendix D contains the APTA Glossary of Transportation Safety Terms.

This SMS Manual applies to the public passenger transportation modes shown below:

- Rail
    - Light rail
    - Heavy rail
    - Streetcar
    - Commuter rail
    - High speed rail
    - Monorail
- Automated Guideways, Ropeways, Cable Cars and People Movers
- Bus

    - Fixed route

- Demand response
- Commuter bus
- Bus rapid transit.

The intent of this SMS Manual is to assist public passenger transportation agencies in achieving their desired safety objectives by providing them choices on how to achieve that outcome. This methodology is known as a performance based approach. The goal for public passenger transportation agencies should not be to only meet the minimum regulatory requirements. Safety Management Systems should embody safety as a core value, where safety management is critical to the overall business performance of the agency. Following a developmental SMS approach provides the tools and methods necessary to achieve a more proactive and predictive approach to safety risk management, addressing safety risks at their source.

COMPONENTS OF A SAFETY MANAGEMENT SYSTEM (SMS)

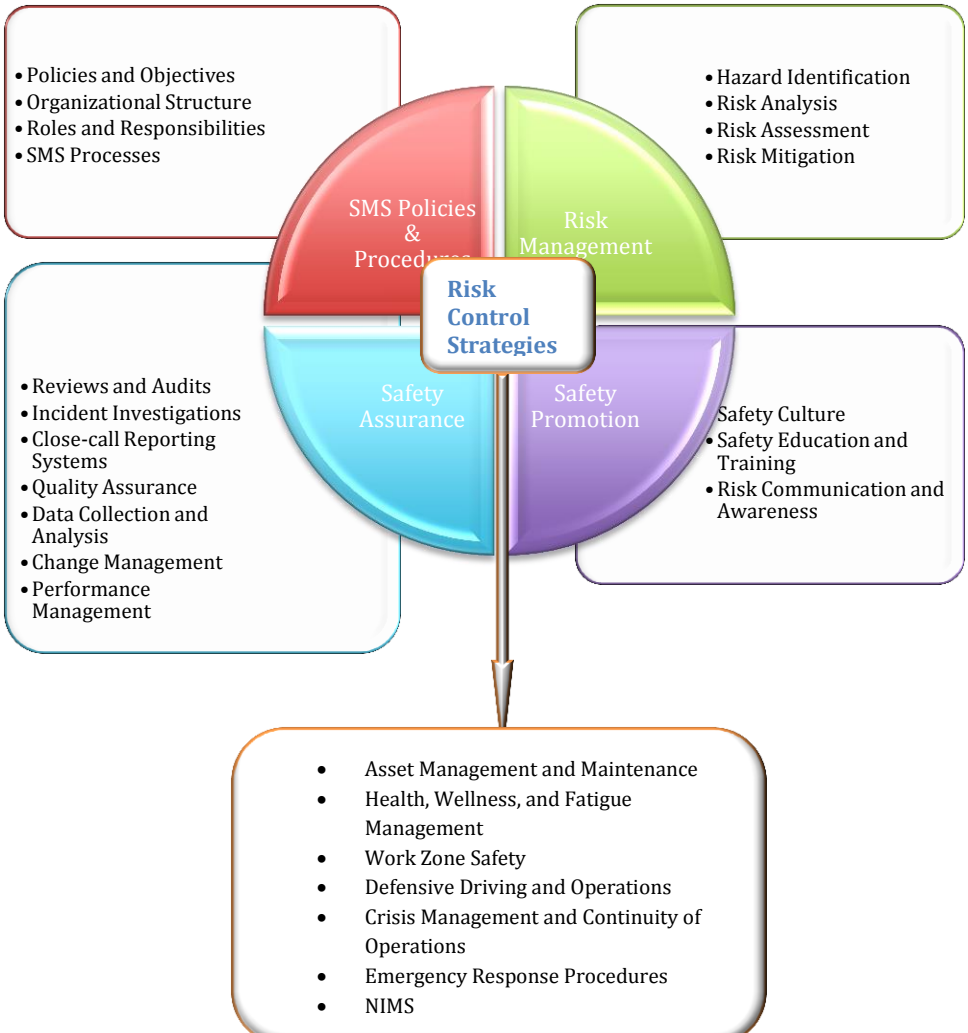
A Safety Management System defines the safety culture (framework) of the organization and includes senior leadership commitment, front-line engagement, management accountability and continual safety process improvements derived from data-driven safety risk assessment.

The Four Pillars of Safety Management Systems

The SMS is comprised of the following four major components:

- Safety Management Policy
- Safety Risk Management
- Safety Assurance
- Safety Promotion.

Safety management policy, safety risk management, safety assurance and safety promotion (referred to as the four pillars) are the foundation for the Safety Management System Plan. This is depicted graphically below (from TRACS WG 12-02-9-37-13) and also defined in the *FTA SMS Framework,* August 2015.



SPECIFIC PRINCIPLES AND CRITERIA FOR DEVELOPING A SMS

The Role of Safety Management Policy Within the SMS

The Safety Management Policy Statement is of primary importance. It should declare the intention of the agency to safeguard the safety of employees, customers and contractors/suppliers. The policy sets out the safety culture expected in the organization by establishing the commitment of senior management to incorporate and continue to improve safety in all of the agency's activities and provide meaningful opportunities for employees to be engaged in the safety effort. The policy should reflect the mission, vision and values of safety within the organization. The policy should also state the authority under which it is issued and establish a method of accountability within the organization for those tasked with responsibility to implement the plan.

The policy should be signed by the agency chief executive and/or the Board of Directors and should include the following:

- Safety is a core value and a vital business component of a public passenger transportation agency
- Commitment to continuous improvement
- Statement about providing resources for managing safety
- Comply with applicable federal, state and local safety regulations
- Be documented, implemented and maintained
- Be communicated to all employees with the intent that employees are made aware of their safety obligations
- Commitment to an employee safety reporting system
- Encouragement for employee reporting of safety concerns, including conditions under which exemptions from disciplinary actions are applicable
- Definition of unacceptable operational behaviors
- Commitment to a risk based approach to managing safety
- Be reviewed periodically to ensure that it remains relevant and appropriate to the organization.

The subcomponents of Pillar 1 Safety Management Policy are:

1. Safety Management Policy Statement
2. Safety Accountabilities and Responsibilities
3. Integration with Public Safety and Emergency Management
4. SMS Documentation and Records

The Role of Safety Risk Management in the SMS

Safety Risk Management is a system of hazard identification and evaluation, management to control hazards to an acceptable level of risk, and evaluation of the results. Hazards are defined as a condition, act, process or operation that has the potential to cause harm or danger or damage.

The subcomponents of Safety Risk Management are:

1. Hazard Identification and Analysis
2. Safety Risk Evaluation.

The Safety Risk Management process, as shown in Figure 1, is a core element within the agency's Safety Management System. Steps within the process include:

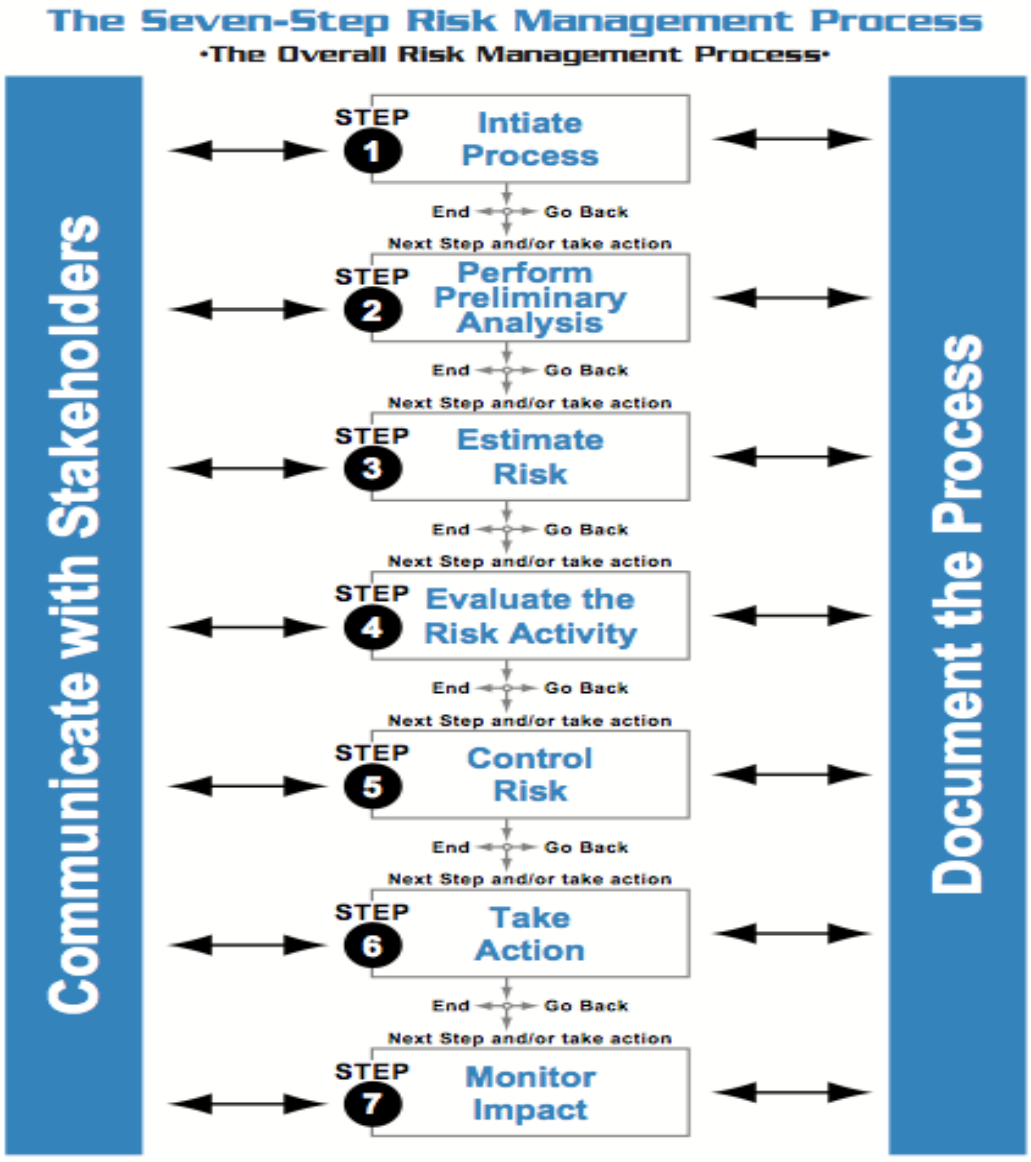
- Hazard Identification- identification of as many credible hazards that may result in harm or damage to the operating system under study
- Safety Risk Estimation- probability/likelihood and consequences of various risk scenarios
- Safety Risk Evaluation- ranking of the safety risk in terms of acceptability
- Safety Risk Control- options for mitigating the safety risk are considered, including financial feasibility
- Safety Risk Mitigation- plan for placing safety risk control measures into action, including documentation of the process
- Safety Risk Monitoring- evaluation of the effectiveness of the safety risk decision and control measures over time.

There are many different approaches to safety risk management planning. The agency should allow a broad range of methods for identifying and assessing hazards including:

- Formal analysis
- Informal analysis
- Programmatic solutions.

It is important to note that safety does not mean the elimination of all safety risks. For example, a rail system that has at-grade highway-rail or pedestrian grade crossings cannot ever eliminate the safety risk at those crossings. However, using the Safety Risk Management process, the hazards to persons or equipment can be minimized to an acceptable level by use of various types of engineering controls and signage.

Figure 2
Safety Risk Management Process



The Role of Safety Assurance in the SMS

Safety assurance determines how well the SMS is meeting agency requirements and expectations. It consists of a series of processes and activities that monitor the agency internal processes as well as its operating environment to detect changes or deviations that can affect safety risk mitigations or cause additional safety risks.

Safety assurance includes auditing, analysis, document reviews and evaluations to make sure that agency safety performance criteria are met and that safety risk controls are effective

The subcomponents of Safety Assurance are:

1. Safety Performance Monitoring and Measurement
2. Measurement of Change
3. Continuous Improvement.

Safety Assurance includes the following activities:

- Developing performance targets/measures
- Conducting safety assessments.

Performance Targets/Measures

One key portion of safety assurance is the establishment of realistic, risk-based performance targets.

Performance targets are of two types: leading and lagging. Leading indicators are input based measures with a relationship to an end product or goal. They measure and track performance before a problem occurs. Examples of leading indicators are workplace inspections, audits, safety training, near misses and running red signals. Lagging indicators are outcome-based measures that are directly related to an end product or goal. They measure performance against prior goals. An example of a lagging indicator is the number of preventable accidents per 100,000 miles.

The agency can use the following methodology to develop performance targets (measures).

1. Conduct a readiness assessment
2. Agree on outcomes and activities to monitor
3. Select key metrics
4. Identify data needs
5. Pilot test and collect baseline data on metrics

6. Set targets
7. Monitor performance and evaluate results
8. Report findings.

Performance metrics include a number, rate and ratio or percentage. The number can be total number of collisions, total number of fatal accidents, average time to implement findings of safety inspections, etc. The rate can be expressed as fatalities per 100 million passenger miles traveled, crashes per 100 million vehicle miles, number of red light violations per month, etc. The ratio or percentage includes the ratio of fatal to nonfatal collisions, preventable accidents to non preventable accidents, percent of collisions occurring at grade crossings, etc.

Performance targets can be grouped into four categories:

1. Casualties
2. Operations
3. Systems and Equipment
4. Organizational Culture and Human Performance.

Casualty targets include customer/employee/public fatalities and injuries. High consequence incidents can be mainline derailments, mainline collisions, grade crossing collisions, fires, and evacuations due to safety reasons.

Operations targets include the following:

- Rule violations measured by
    - Near misses/close calls
    - Proficiency testing
- Fitness for duty evaluations measured by
    - Random drug and alcohol testing
    - Number of excursions of agency hours of service
    - Fatigue guidelines
    - Supervisor observations

Systems and Equipment targets include the following:

- Rolling stock measured by
    - Mean distance between failures
    - Vehicle inspection results
    - Compliance with vehicle maintenance and inspection schedules
- Infrastructure/Facilities measured by
    - Asset conditions of various facilities such as signal systems, elevators and escalators, tunnels and bridges, emergency exits

Organizational Culture and Human Performance targets are measured by continual learning, training and competency assessment. Safety controls are reviewed and analyzed. Front line employees are involved and management is responsive. The effectiveness of communications processes is evaluated.

Safety Assessment

Safety assessments include safety studies, safety surveys, internal investigations, peer reviews and safety audits.

- Safety studies are analyses that are conducted to gain an understanding of broad safety issues
- Safety surveys use questionnaires, interviews and checklists to provide qualitative information
- Internal investigations are conducted for certain incidents such as when serious accidents occur or theft has been discovered on the property
- Peer reviews are conducted by highly experienced personnel who conduct on-site interviews of agency staff and review documents to provide observations and recommendations
- Safety audits evaluate agency conformance to agency established plans and procedures, oftentimes associated with regulatory compliance. Safety audits, which include internal and external audits, can also be performance based.

The Role of Safety Promotion in the SMS

Safety promotion, as the term is used in the SMS, does not refer to awards, incentives or slogans. Safety promotion has the wider meaning of how the safety concepts, philosophy and culture of the organization are integrated into the way business is conducted in a visible, purposeful and proactive manner. Implementation of safety goals and objectives through programmatic controls with identified performance targets can be shown to promote a positive safety culture.

The subcomponents of Safety Promotion are:

1. Safety Communication
2. Competencies and Training.

There are several important concepts included in safety promotion that drive the level of effectiveness:

1. Safety training
2. Safety communication
3. Safety vigilance.

Effective, proactive identification and management of safety risks depends on communicating organization wide commitment, beginning with training from senior leadership to the front line worker to identify safety risks, then be alert to take action against those risks, and then to circle back through multiple communication channels to initiate review and update of the plan and controls..

Safety Training

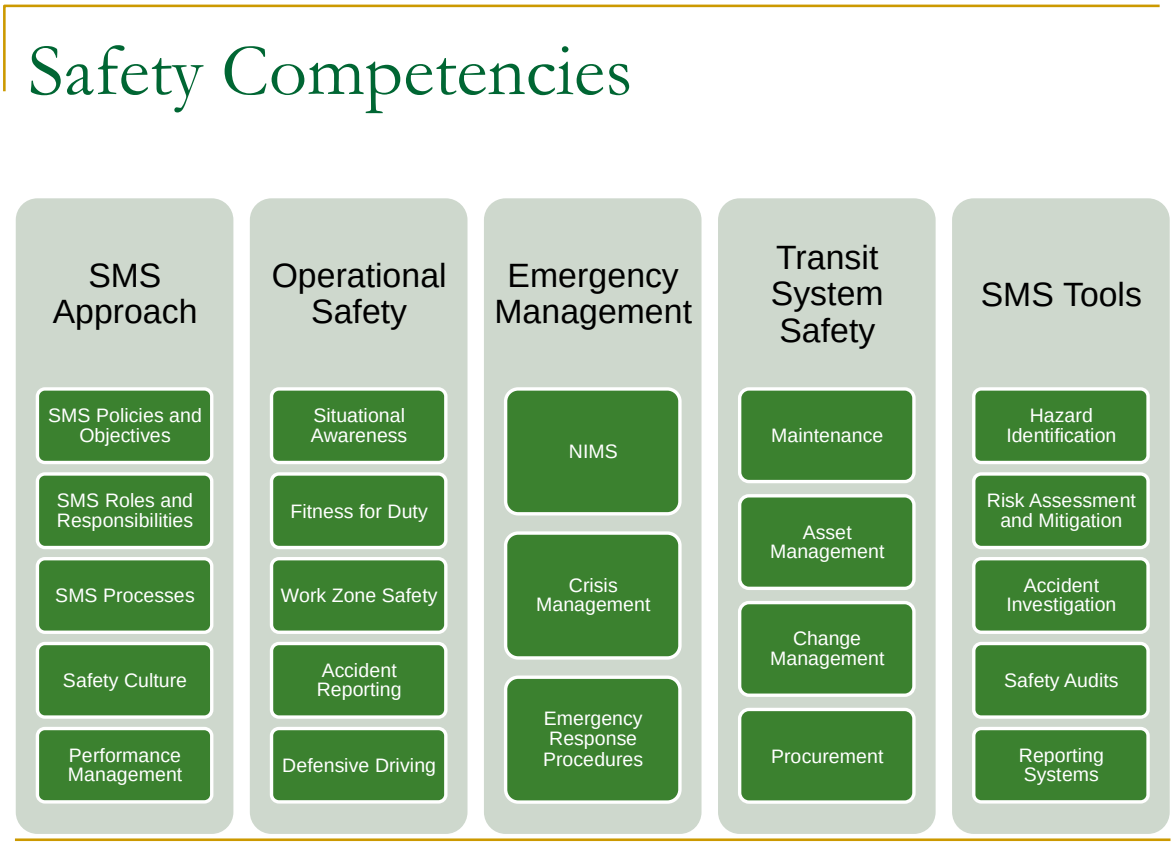
The purpose of safety training is:

- To ensure that all employees, contractors and suppliers of a transit agency understand their roles and responsibilities and they relate to safety
- Adopt the norms, practices and attitudes associated with a safety management systems approach and safety culture
- Reduce the exposure of employees, customers and the public to safety risks.

Training goals should be linked to agency safety goals as described in the agency Safety Plan. A needs assessment should be done regularly to assess the needs of the agency as well as different target audiences. Training evaluation should include an evaluation of the training program implementation as well as the effectiveness of training strategies (outcomes).

Figure 1 shows the types of training courses that will be required within the agency: SMS approach; operational safety; emergency management; safety; and SMS tools

Figure 1
Safety Competencies



Safety Communication

The agency should develop and maintain a several forms of safety communication that ensures that all personnel are aware and knowledgeable about the SMS and safety-critical information. This overlapping communication system provides a redundant means of sharing critical safety information. Communication up and down the organization is needed and management should always take the opportunity for providing feedback to explain why safety actions are taken and why safety procedures have changes. Essential to a positive safety culture are effective communications where all levels of employees, contractors and the public can express safety concerns without fear of reprisal.

Safety Vigilance

Crucial to the success of the agency's SMS, the establishment of a positive safety culture and an environment conducive to achievement of the agency's safety objectives is the ability of an organization to retain a healthy respect for, and be wary of, hazards that could develop into safety risks. It is especially important for employees to be knowledgeable about risks that are considered accident precursors and be enabled to report or act on these hazards. Being watchful and maintaining a vigilant attitude are characteristics of a positive safety culture and affect the values, attitudes and behaviors of all employees. These activities support the higher reliability of the safety effort to become sustainable over the long term.

Safety Management System Implementation Phases

The agency's implementation of its Safety Management System is normally a multi-year process. Many agencies use a phased approach to SMS implementation. One method of phased implementation (extracted from *Safety Management Guide,* International Civil Aviation Organization, 2012) is to use four phases related to time and resources:

- Phase I occurs in the first 12 months
- Phase II occurs in the second 12 months
- Phase III occurs 12months from Phase II
- Phase IV occurs 12 months from Phase III.

For transit agency implementation, these times will be approximate and will vary with each agency, dependent upon available resources for implementation.

Activities during Phase I include the following:

- Identify the SMS accountable executive
- Establish the SMS implementation team
- Define the scope of the SMS
- Perform an analysis to understand how the agency's existing safety processes and procedures compare to SMS requirements
- Develop an SMS Implementation Plan
- Establish a key office/person responsible for administration and maintenance of the SMS
- Establish SMS training program for personnel
- Initiate SMS communication channels

Activities during Phase II include the following:

- Establish safety policy and objectives
- Define safety management responsibilities and accountabilities within the agency
- Establish SMS coordination committee
- Establish emergency response plan
- Initiate progressive development of SMS documentation

Activities during Phase III include the following:

- Establish voluntary hazards reporting procedure
- Establish safety risk management procedure
- Establish occurrence reporting and investigation procedure

- Establish safety data collection and processing system
- Develop high consequence safety performance indicators, identify accident precursors and associated targets and alert settings
- Establish management of change procedure that includes safety risk assessment
- Establish internal review program
- Establish external review program.

Activities during Phase IV include the following:

- Enhance existing disciplinary procedure/policy with consideration of unintentional errors/mistakes form deliberate/gross violations
- Integrate hazards identification from occurrence investigation reports with the voluntary hazard reporting procedure
- Integrate hazard identification and safety risk management procedures with contractors or customers where applicable
- Develop lower consequence safety performance indicators and associated targets and alert settings
- Establish or integrate SMS information into existing internal and external review programs
- Establish operational and safety culture review/survey programs where appropriate
- Ensure SMS training program for all relevant personnel is ongoing and relevant
- Promote safety information sharing and exchange internally and externally.

Evaluation of the Safety Management System

There are many ways to evaluate the agency SMS. A list of indicators of an effective SMS follows (from TRACS Task 10-01 *Implementing Safety Management System Principles in Transit Agencies,* 5/2011).

- The CEO or GM discusses and assists in resolving safety issues with members of the executive team. Safety issues are discussed openly at executive meetings. There is an executive-level safety meeting
- The executive team implements corrective actions when safety issues are raised
- The CEO or GM has his/her team participate at quarterly meetings with the State Safety Oversight Agency
- Employees assess their supervisor's concern about safety
- Employees are regularly surveyed regarding their perspective on the agency's safety climate
- A joint union-management committee identifies and resolves safety issues
- Supervisors' safety attitudes are assessed and corrective actions taken
- Front-line supervisors have performance measures associated with safety responsibilities
- Supervisors conduct safety inspections an monitor the work that employees are doing
- There is a process for the signing of safety briefing sheets
- Front-line employees are involved in developing safety policies and procedures (hazard analysis)
- Front-line employees are empowered to restrict or stop operations based on unsafe conditions
- Good faith challenge processes (safety dispute resolutions) are available to workers
- There is interdepartmental involvement in developing safety policies and procedures (hazard analysis)
- Involved departments conduct hazard analysis when new systems or changes are introduced. They use engineering solutions as the first method of solving problems (hierarchy of control)
- A hazard tracking system is in place. Corrective actions are taken and the results of countermeasures are evaluated and published
- The agency has a non-punitive near-miss/close call policy and a reporting, analysis, and correction system that is regularly used and trusted
- There is a safety hotline set up to report issues, conditions and behavioral problems
- Safety bulletins or newsletters are communicated across the agency. There are methods for taking in information and recommendations from workers

- There is a board-level safety committee, and it discusses safety issues on a regular basis
- An analysis of the board or executive team agenda shows that safety issues are given prominence
- If there is an injury, managers or executives get involved
- Leadership's safety rhetoric matches reality.

APPENDIX A
Rail Transit SMS Implementation Guide

APPENDIX B
Bus SMS Implementation Guide

APPENDIX C
Commuter and Intercity Rail SMS Implementation Guide

APPENDIX D
APTA Glossary of Transportation Safety Terms