

TOWARDS AN SMS ASSESSMENT FRAMEWORK BASED ON STAMP / STPA

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CREATING TOMORROW





PRESENTATION OVERVIEW

- Aviation Safety Management Systems (SMS)
- SMS assessment
- SMS modelling based on STAMP
- SMS assessment framework based on STPA
- Further research



SAFETY MANAGEMENT SYSTEMS

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AVIATION SMS: 4 PILLARS AND 12 ELEMENTS



- Safety policy and objectives
 - Management commitment and responsibility
 - Safety accountabilities
 - Appointment of key safety personnel
 - Coordination of emergency response planning
 - SMS documentation
- Safety risk management
 - Hazard identification
 - Safety risk assessment and mitigation



AVIATION SMS: 4 PILLARS AND 12 ELEMENTS



- Safety assurance
 - Safety performance monitoring and measurement
 - The management of change
 - Continuous improvement of SMS
- Safety promotion
 - Training and education
 - Safety communication



SMS ASSESSMENT









SMS ASSESSMENT

- Requirement: ".... regular assessment of the <u>appropriateness</u> and <u>effectiveness</u> of safety management activities". (ICAO Annex 19 and SMM).
- Current initiatives: transition from compliance-based to performance-based assessments.
- Inherent difficulties:
 - No standards have been set for appropriateness.
 - Effectiveness cannot be directly measured: there has been no scientifically proven relation between SMS and safety outcome.
 - Performance-based assessment is still linked to safety outcome and not SMS performance.





CURRENT SMS ASSESSMENT TOOLS: ICAO SMM

SMS element		Assessment question		
Management commitment and responsibilities [1.1]	1	The safety policy is relevant to the scope and complexity of the organization's operations.		
	2	There is evidence that the safety policy is communicated to all employees with the intent that they are made aware of their individual safety obligations.		
	3	There is a periodic review of the safety policy by senior management or the safety committee.		
	4	The accountable manager's terms of reference indicate his overall responsibility for all safety issues.		
Safety accountabilities [1.2]	1	There is a safety committee (or equivalent mechanism) that reviews the SMS and its safety performance.		
	2	The accountable manager's final authority over all operations conducted under his organization's certificate(s) is indicated in his terms of reference.		







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CURRENT SMS ASSESSMENT TOOLS: SMICG

INDICATORS OF COMPLIANCE + PERFORMANCE		Ρ	S	0	E	How it is achieved	Verification
1.1.1	There is a safety policy that includes a commitment towards achieving the highest safety standards signed by the Accountable Executive.						
1.1.2	The organisation has based its safety management system on the safety policy.						
1.1.3	The Accountable Executive and the senior management team promote and demonstrate their commitment to the Safety Policy through active and visible participation in the safety management system.						
1.1.4	The safety policy is communicated to all personnel with the intent that they are made aware of their individual contributions and obligations with regard to Safety.						
1.1.5	The safety policy includes a commitment to observe all applicable legal requirements, standards and best practice providing appropriate resources and defining safety as a primary responsibility of all Managers.						





CURRENT SMS ASSESSMENT TOOLS: EVALUATION OF MATURITY LEVEL









OBSERVATIONS ON CURRENT SMS ASSESSMENT TOOLS

- ICAO tool: Focused on compliance.
- SMICG and Maturity Level tools:
 - Decomposition of SMS pillars and elements into more specific safety initiatives and activities.
 - Effort to address effective operation of SMS in addition to compliance.

BUT:

- SMS is still seen as sum of individual components.
- Interactions among components are not considered.
- SMS operation is approached at a single-dimension.



SMS MODELLING BASED ON STAMP







BASIC CONTROL STRUCTURE









DETAILED CONTROL STRUCTURE: LEVEL 1







DETAILED CONTROL STRUCTURE: LEVEL 2







DETAILED CONTROL STRUCTURE: LEVEL 3









FIRST OBSERVATIONS FROM CONTROL STRUCTURE

- SMS elements are not independent entities in the system.
- SMS documentation, safety communication and safety training & education are present across all hierarchical levels.
- Formal hierarchical structures do not address the informal communication channels (i.e. actuators and sensors) amongst all organizational levels.





FIRST OBSERVATIONS FROM CONTROL STRUCTURE

- Various SMS elements represent processes that can be further decomposed in order to depict their internal structure (e.g., safety training & education, reporting system, safety investigations).
- Further decomposition of SMS processes will illustrate even more the high complexity of the system.
- Complete assessment of the SMS, including all types of interactions and evaluation of structures to the level of individual SMS processes, would be highly resource demanding and is not possible under existing audit practices.





PROPOSED AUDIT/ASSURANCE LEVELS





SMS ASSESSMENT FRAMEWORK BASED ON STPA

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STPA: DEFINE ACCIDENTS

No.	Title	Description
1	Loss of license or certificate	Level 1 SMS audit findings might result to suspension of the license or certificate for all or part of operations
2	Decrease of safety performance	Poor SMS implemetantion might result to low safety performance, the latter measured through accident and incident rates
3	Inability to function	Over-proceduralization of safety impedes the operability of the organization





STPA: DEFINE HAZARDS

No. Title

- 1 SMS not properly designed
- 2 SMS not properly operated
- 3 SMS not properly monitored
- 4 SMS not continously improved





STPA: FORMULATE SAFETY CONSTRAINTS

No.	Safety Constraint	Description
1	SMS must be designed based on a variety of requirements and conditions	According to legislation, regulations and standards. Taking into account all organizational goals. Based on internal and external information (safety, market, competition, economy etc.). Considering interfaces with other organization and subcontractors.
2	SMS must be implemented as designed	Sufficiently trained and educated staff. Continuous flow of internal and external safety information. Availability of time and technological resources.
3	SMS must be timely monitored	Appropriate SMS and safety performance indicators. Sufficiently trained and educated personnel. Availability of suitable technology. Continuous flow of safety related data from all sources . Timely monitoring.
4	SMS must be continously improved based on the findings of the monitoring activities	Sufficiently trained and educated personnel. Continuous flow from monitoring activities. Minimizing the distance between work-a-planned and work-as-done.





STPA: IDENTIFY UNSAFE CONTROL ACTIONS (EXAMPLE)

Control Action	Not Given	Given Incorrectly	Wrong Timing or Order	Stopped too soon or applied too long
Design the SMS based on a variety of requirements and conditions	Organization does not conform to regulations and legislation. The organization follows a fragmeneted and unstructured approach to safety. [1, 2, 3, 4]	SMS does not conform to established standards. SMS is not aligned with other organizational goals. Assigned resources are not effectively and efficiently used. [1, 2, 3, 4]	Too early: SMS is not aligned with other organizational goals. The organization does not have the resources to design an SMS. Too late: (see hazards in not given CA). [1, 2, 3, 4]	Stopped too soon: (see hazards in not given CA). Applied too long: The organization does not meet the deadlines set by the authorities. The organization is subject to a fragmented and unstructured approach to safety. [1, 2, 3, 4]





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STPA: IDENTIFY CAUSAL FACTORS (EXAMPLE)

Component				Notes	
Senior Management	Organizational goals are not properly balanced	1, 2, 3, 4	Organization goals must be balanced based on a consistent, justified and documented approach.	_	
	Legislation and regulations are ignored or misinterpreted	1, 2, 3, 4	Legislation and regulation documents must be updated. Cooperation with other organizations must include a crosscheck of how legislation and regulations have been interpreted. Cases of ambiguity and vagueness must be communicated to authorities.		

FIRST OBSERVATIONS FROM THE STPA

- STPA offers the ability to:
 - Approach SMS by considering interfaces with other organizational systems.
 - Gradually and methodologically uncover SMS hazards than randomly addressing hazards based on experience through failures and "best practice".
 - Set the constraints of SMS and reveal potential causal factors that refer to each SMS element and controller at both individual and interaction levels.
 - Facilitate the auditors in regard to starting points and depth of audits.



FURTHER RESEARCH





CURRENT RESEARCH IN THE AVIATION ACADEMY

- Complete the application of STPA to SMS and provide an evaluation framework.
- Develop SMS assessment tools customized to different hierarchical levels.
- Refine the tools based on reviews from authorities and companies.
- Pilot the tools and compare their results with the ones of existing SMS assessment tools.



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