

USING STPA FOR EVALUATING AVIATION SAFETY MANAGEMENT SYSTEMS (SMS)

Dr. Nektarios Karanikas
Mohamed Abrini

Aviation Academy

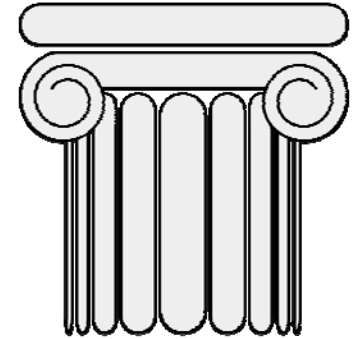
MIT STAMP Workshop, 21-24 March 2016, Cambridge, MA



BACKGROUND

www.international.hva.nl

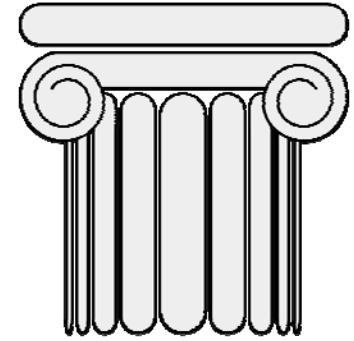




THE SMS ELEMENTS (1/2)

- Policy & Objectives
 - Management commitment & responsibility
 - Safety accountabilities
 - Appointment of safety key personnel
 - Coordination of emergency response planning
 - SMS documentation
- Safety Risk Management
 - Hazard identification
 - Safety risk assessment and mitigation

(ICAO, 2013)



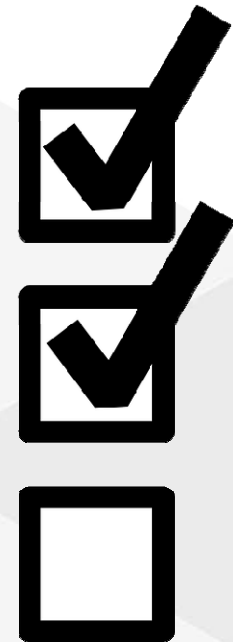
THE SMS ELEMENTS (2/2)

- Safety Assurance
 - Safety performance measurement and monitoring
 - Management of change
 - Continuous improvement of SMS
- Safety Promotion
 - Training and education
 - Safety communication

(ICAO, 2013)

SMS EVALUATION: CURRENT SITUATION

- Compliance checks are a long-established practice:
 - SMS is designed according to standards.
 - SMS activities are performed according to SMS documentation.



SMS EVALUATION: CURRENT SITUATION

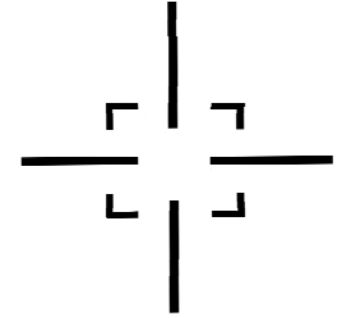
- Recent focus on performance-based evaluation: work is done as planned and generates the desired output.
- However:
 - Performance-based evaluation is still solely linked to process outputs.
 - SMS elements are evaluated individually without considering their interactivity and interdependency.



RESEARCH METHODOLOGY

www.international.hva.nl





RESEARCH SCOPE

- Comparison of indicative aviation SMS evaluation tools.
- Identification of weaknesses and strengths of current tools based on comments from experts.
- Application of the STPA method on SMS.
- Development of requirements and respective evaluation topics to be used by auditors as means to assess performance of SMS in an efficient and inclusive way.



ANALYSIS OF CURRENT TOOLS

- Analysis of indicative SMS evaluation tools in order to assess:
 - Coverage of each of the four SMS pillars.
 - Level of system maturity addressed (Plan – Do – Check – Act).
- Identification of strengths and weaknesses of SMS evaluation tools through content analysis of comments provided by 5 experts.

STUDY SAMPLE: TOOLS ANALYSED BY RESEARCHERS

- Australian Civil Aviation Safety Authority
- Eurocontrol
- French Safety Directorate of Civil Aviation
- SHEL Aircraft International (2 tools)
- Singapore Civil Aviation Authority
- Transport Canada Civil Aviation
- UK Civil Aviation Authority



STUDY SAMPLE: TOOLS COMMENTED BY EXPERTS

- Safety Management International Collaboration Group
- Civil Air Navigation Services Organisation (2 tools)
- Transport Canada Civil Aviation
- SHEL Aircraft International
- Civil Aviation Authority Singapore





APPLICATION OF STPA (1/2)

- Application of STPA on the SMS (ICAO Safety Management Manual).
- Depiction of interactions amongst SMS controllers and processes.
- Statement of UCAs and requirements.
- Responsibilities per controller.
- Suggestion for SMS evaluation topics.
- Comparison of results with current SMS evaluation tools.



APPLICATION OF STPA (2/2)

- Causal factors were not stated under the concept that:
 - SMS evaluation will initially focus on the fulfilment of requirements sourcing from Unsafe Control Actions (STPA step 1) and depicting system performance.
 - If a requirement is not met, organization shall identify causal factors and apply remedies (STPA step 2).

RESULTS

www.international.hva.nl



ANALYSIS OF CURRENT TOOLS: SMS PILLARS & MATURITY LEVEL

POLICY & OBJECTIVES	SAFETY RISK MANAGEMENT	SAFETY ASSURANCE	SAFETY PROMOTION
44%	23%	21%	12%
15 - 88 topics Median: 25	0 – 69 topics Median: 12.5	1 – 45 topics Median: 13	1 – 35 topics Median: 4.5
Total topics: 22 – 237 (median: 49.5)			

PLAN (DESIGN)	DO (OPERATION)	CHECK (MONITORING)	ACT (IMPROVEMENT)
38%	38%	19%	5%
5 – 97 topics Median: 23	8 – 82 topics Median: 22	1 – 46 topics Median: 11	0 – 12 topics Median: 1.5

50% of the tools do not include surveys as method of evaluating system performance

EXPERTS' COMMENTS ON CURRENT TOOLS

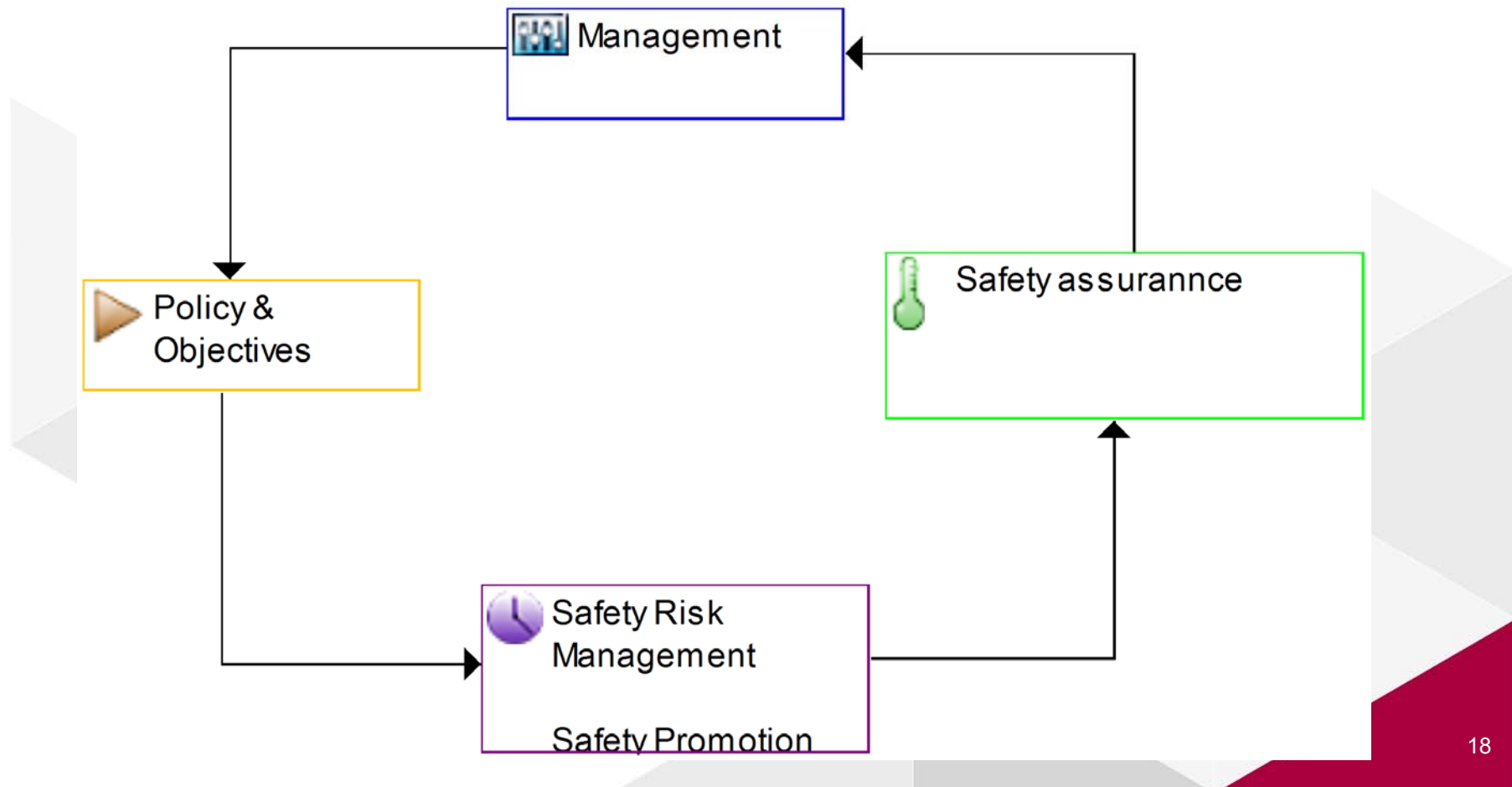
Characteristic	Strengths	Weaknesses
Completeness (ICAO SMS / SMM pillars & elements)	67%	33%
Performance & effectiveness addressed	25%	75%
Guidance for use of the tool	54%	46%
Comprehensibility	62%	38%
Structure	14%	86%

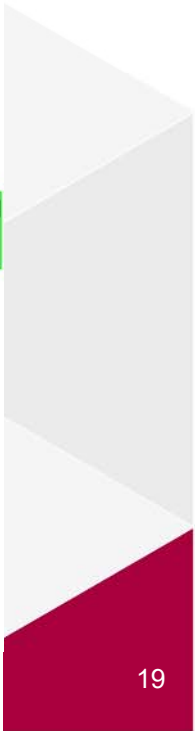
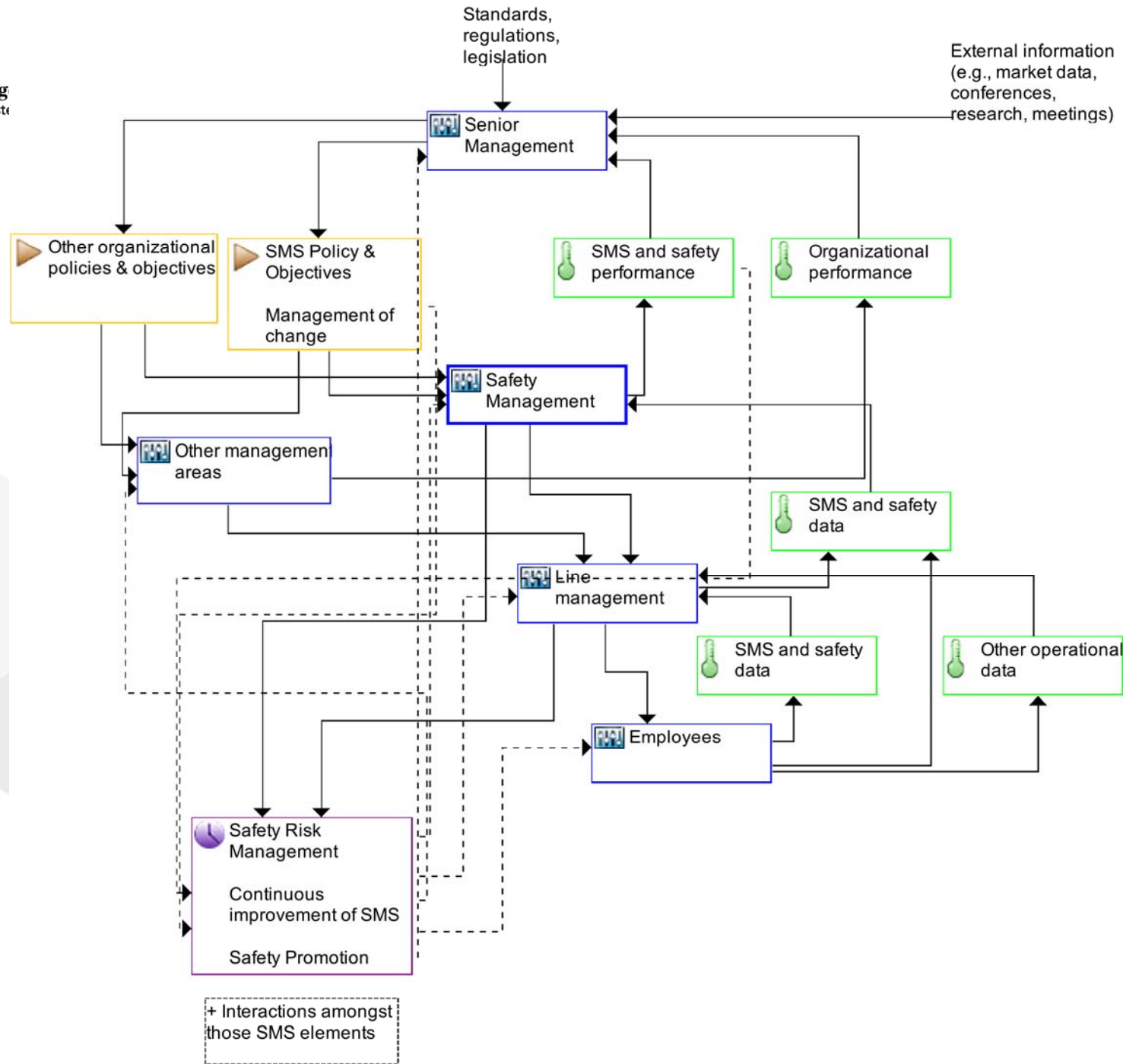


STAMP: ACCIDENTS, HAZARDS & REQUIREMENTS

- Accidents
 - A-1: Operations' certification is suspended
 - A-2: Safety events lead to losses beyond acceptable limits
- Hazards
 - H-1: SMS design flaws (A-1, A-2)
 - H-2: Large gap between design & implementation of SMS (A-1, A-2).
- High-level requirements
 - SMS shall be designed according to standards and address operation, monitoring and improvement of all SMS processes
 - Gap between SMS design and implementation shall be maintained under a predetermined threshold

STAMP: SIMPLE CONTROL STRUCTURE





STPA STEP 1: UCA



- 78 Unsafe Control Actions:
 - Policy & Objectives: 28
 - Safety Risk Management: 18
 - Safety Assurance: 22
 - Safety Promotion: 10

Control action	Not providing	Providing	Too late, Too early, or Out of sequence
Safety promotion			
Safety department provides safety communication (SC)	Safety department does not provide SC when safety information is available from internal and external sources	<p>Safety department provides SC when complete background of communication information is not available</p> <p>Safety department provides SC when safety communication is not customized to each position</p>	Too late: Safety department provides SC after effective dates of SMS and safety related changes

STPA STEP 1: REQUIREMENTS AND EVALUATION TOPICS FROM UCA

SMS Pillar	Number of requirements	Requirements check	
		Documentation / records check topics	Survey topics
Policy & Objectives	10	15	8
Safety Risk Management	5	4	3
Safety Assurance	6	7	3
Safety Promotion	4	4	2
Total:	25	30	16

STPA STEP 1: EXAMPLE OF A REQUIREMENT AND ITS CHECK

SMS Pillar	Requirement	Requirement check	
		Documentation / records check	Survey topic
Policy & Objectives	SMS and safety objectives shall be balanced with other organizational objectives based on predefined method / criteria	Check whether safety objectives have been achieved at about the same extent as other organizational objectives (e.g., finance, production, quality)	Ask staff whether balance of various organizational objectives (e.g., safety, efficiency, quality, security) is maintained
		Check for documented decision criteria referring to maintenance of balance when establishing or changing various organizational objectives	

RESPONSIBILITIES PER CONTROLLER

Controller	Safety Policy & Objectives	Safety Risk Management	Safety Assurance	Safety Promotion	Total
Senior management	7	-	1	-	8
Safety department	5	2	5	4	16
Managers	6	3	4	3	16
Employees	1	3	3	-	7
Quality department	-	1	-	-	1
External organizations	1	-	-	-	1

COMPARISON OF STPA RESULTS WITH TOOL ANALYSIS RESULTS

Pillar	Audit topics		
	STPA based (checks & surveys)	Other tools (range)	Other tools (median)
Policy & Objectives	23	15 - 88	25
Safety Risk Management	7	0 - 69	12.5
Safety Assurance	10	1 - 45	13
Safety promotion	6	1 - 35	4.5
Total	46	22 - 237	49.5

CONCLUSIONS & NEXT STEPS

www.international.hva.nl





CONCLUSIONS: CURRENT TOOLS

- Incorporate professional experience but are not based on a systematic analysis of the SMS.
- Are highly variable in the extent they cover SMS processes and evaluate system maturity level.
- Assess SMS processes individually without considering interconnections.
- Address mainly compliance and operation.
- Some extensive tools include “failures” of system components.



CONCLUSIONS: STPA BASED APPROACH (1/2)

- Combination of systematic analysis and professional experience.
- Requirements address individual SMS elements and their interactions.
- Evaluation activities combine documentation checks and survey questions that collectively provide information for SMS performance.
- Addresses the highest level of maturity: if a system consistently performs well, then it exists, is running and is subject to improvements.



CONCLUSIONS: STPA BASED APPROACH (2/2)

- It initially focus on HOW SMS performs and NOT WHY performance might not have been achieved.
- It consists of a manageable set of 46 evaluation topics, a number close and lower than the median of current SMS evaluation tools.
- If used, might reduce the workload of auditors and duration of audits, leading to saving of resources.
- Although it is based on ICAO SMS, it can be used in other industry sectors.



NEXT STEPS

- Compile a document including an SMS performance-based evaluation tool and respective guidance for its use.
- Ask from organizations to try the tool and provide feedback.
- Adjust the tool according to comments, and publish it.
- Proceed to STPA step 2 and populate the list of requirements, so to enable organizations assess their SMS deeper.

USING STPA FOR EVALUATING AVIATION SAFETY MANAGEMENT SYSTEMS (SMS)

Dr. Nektarios Karanikas
Mohamed Abrini

Aviation Academy

Thanks! Questions time!

STAMP Workshop, 21-24 March 2016, MIT, MA

