



SMS as a Management Decision Making Tool

EASA SMS Workshop
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Applying the very best of aviation,
because we know and we care.

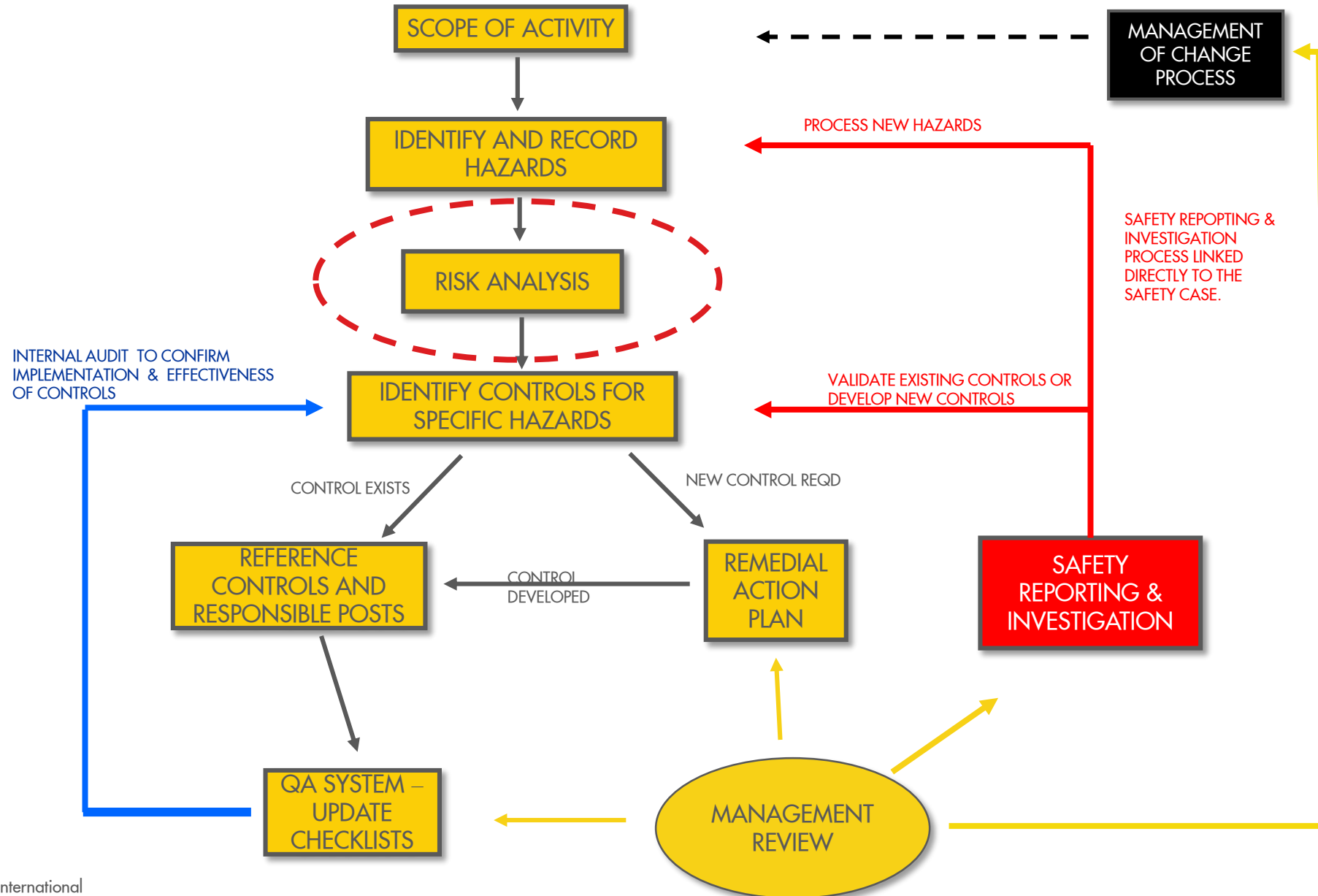




How to get the buy-in of senior management?

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- **Quantify** the risk (consistently).
 - **Develop** effective and practicable solutions.
 - **Communicate** the risk and options.

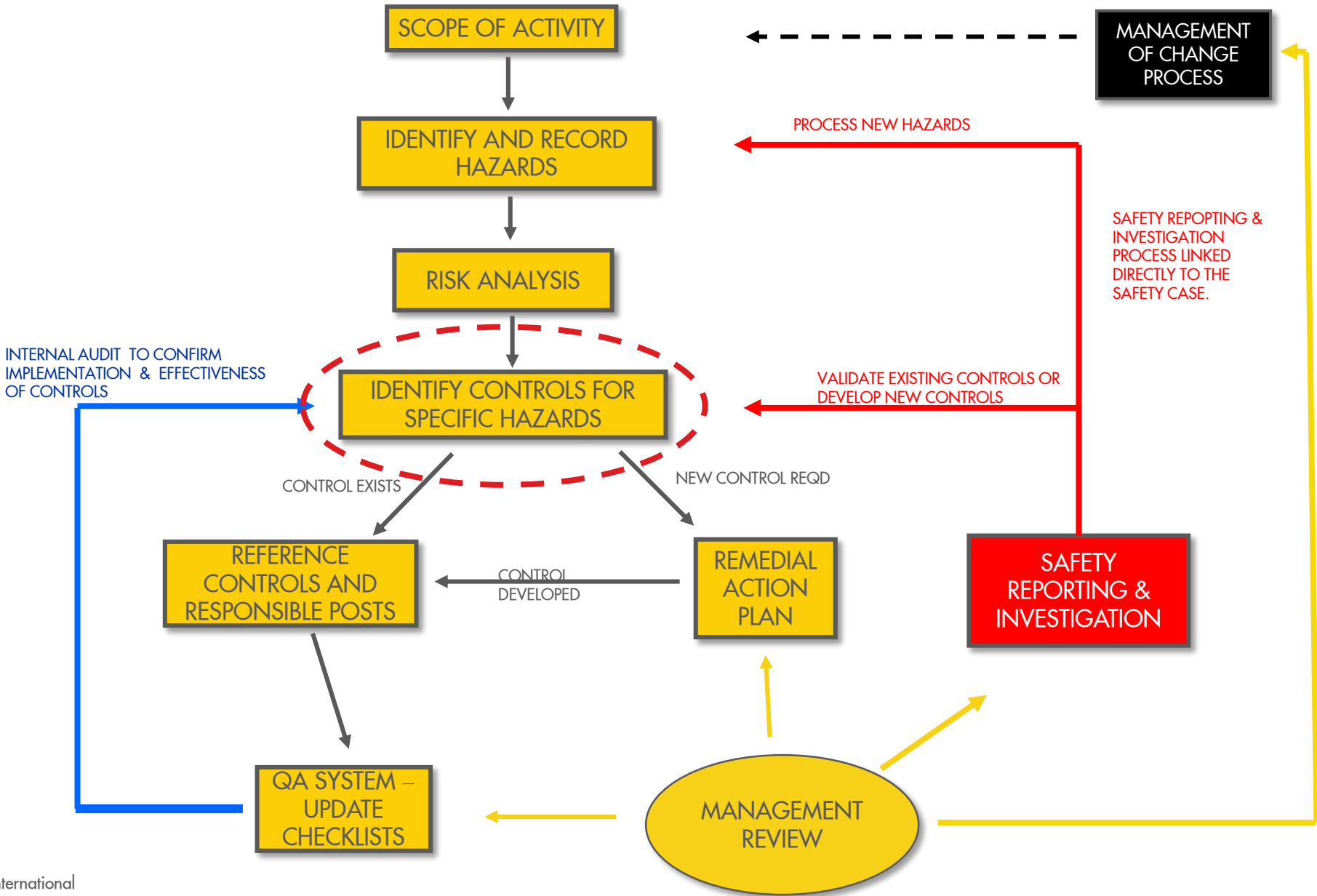
Hazard/Risk Management Process



Consistently quantify risk.

Severity	CONSEQUENCES				INCREASING LIKELIHOOD				
	People	Assets	Environment	Reputation	A	B	C	D	E
					Never heard of in the Industry	Heard of in the Industry	Has happened in the Organisation or more than once per year in the Industry	Has happened at the Location or more than once per year in the Organisation	Has happened more than once per year at the Location
0	No injury or health effect	No damage	No effect	No impact					
1	Slight injury or health effect	Slight damage	Slight effect	Slight impact					
2	Minor injury or health effect	Minor damage	Minor effect	Minor impact					
3	Major injury or health effect	Moderate damage	Moderate effect	Moderate impact					
4	PTD or up to 3 fatalities	Major damage	Major effect	Major impact					
5	More than 3 fatalities	Massive damage	Massive effect	Massive impact					

Hazard/Risk Management Process



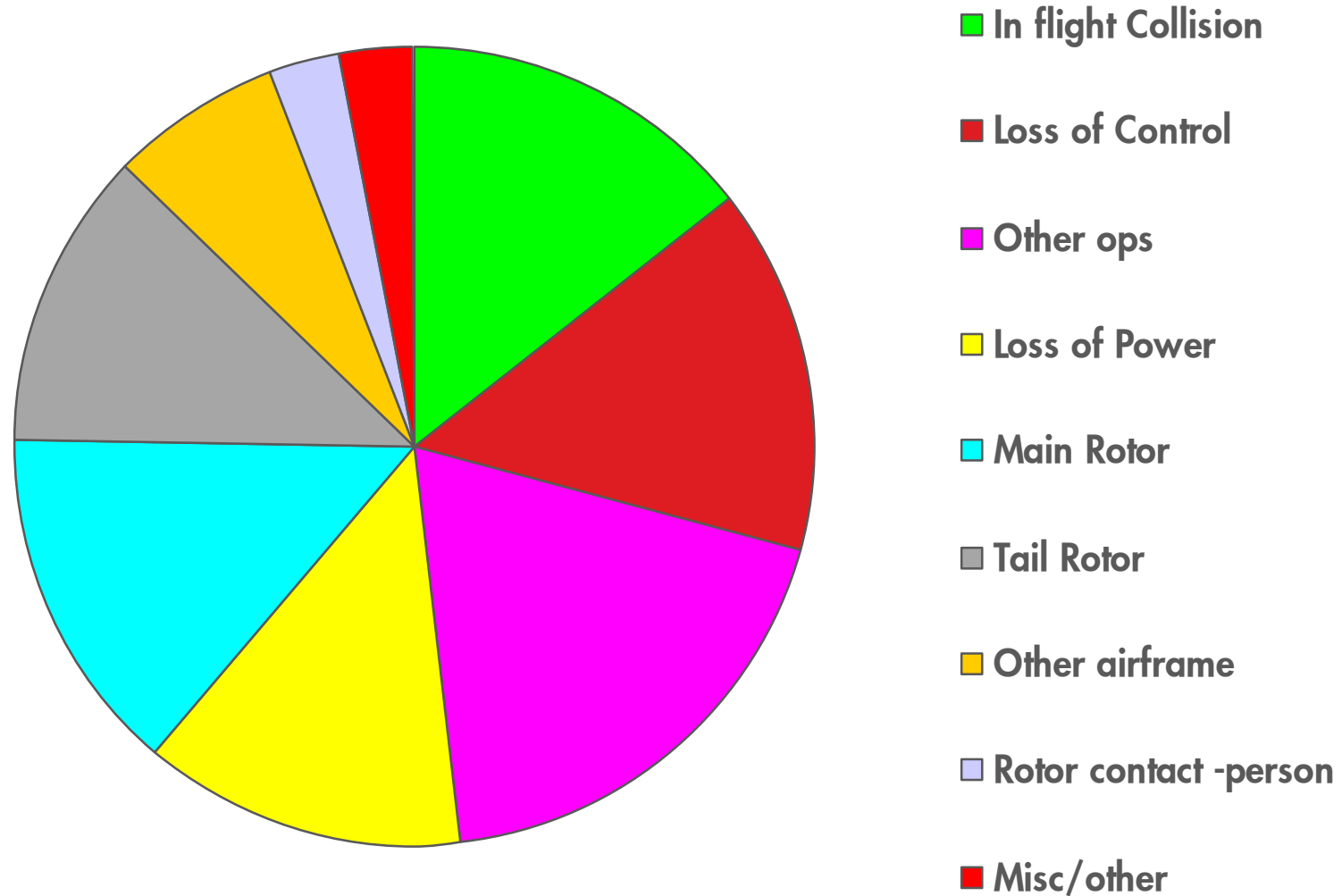
2004 study – Opportunities to improve helicopter safety

What had the airline industry done to achieve its safety record?

- Damage tolerant design; system redundancy; improved reliability
- Modern flight simulators
- Engine and vibration monitoring systems to identify incipient failures
- Safety Management Systems to reduce human errors
- Flight data monitoring programs (FOQA)
- Disciplined take-off and landing profiles (e.g. stabilised approach)
- EGPWS/TAWS; TCAS

All are available for helicopters, but not yet routinely used.

Twin Engine Helicopters – Accident Cause – NASA Study



We used the Dec 2000 NASA study as our baseline for accident causes.

Accident Analysis - Generic Twin - NASA Data

1 Pilot related (in air)	%
In flight collision with object	14.3
Airport/helipad/fence	5.7
Wire	4.3
Other-trees, brush, acft	4.3
Loss of control	14.6
Handling	6.3
Loss of reference/disorientation	3.0
System deficiency	2.3
Misc/undetermined	3.0
In flight collision with terrain	5.7
Weather	4.0
On ground/water collision with	3.3
Hard landing	2.7
Mid air collision	2.0
Rollover/Noseover	1.3
Subtotal %	48.0%
2 Technical	
Loss of engine power	13.0
Engine structure	5.0
Fuel system related	5.7
Other	2.3
Airframe component/system	29.5
Main rotor	6.3
Main rotor drive train	4.3
Main rotor control system	3.7
Tail rotor	3.3
Tail rotor drive train	6.3
Tail rotor control system	2.3
Other airframe	3.3
Fire/explosion	1.7
Gear collapsed	2.0
Subtotal %	46.3%
3 Other	
Rotor contact -person	2.7
Misc/other	3.0
Subtotal %	5.7

Risk Mitigation Measures

Assigned Effectiveness of mitigation measures %			Key	
DR	Late FAR 29	50%	DR	Design requirements - late amendt FAR/JAR 29
DR/HQ	Late FAR + HQ	60%	DR/HQ	Handling qualities/advanced cockpit design + late FAR 29
Training - 12 monthly	Sim/CRM/LOFT	45%	Training	FFS level C/D + CRM + LOFT
HUMS	Incl effective mgt	65%	HUMS	Health & Usage Monitoring System
SMS/OC/QA/Helideck	Enhanced SMS/QA	55%	OC/QA	JAR Ops 3 /SMS/QA/CAP 437 helideck management
HOMP	Incl effective mgt	50%	HOMP	Helicopter Operational Monitoring Programme
EGPWS/TCAS		75%	EGPWS	Enhanced Ground Proximity Warning System
			TCAS	Traffic Alert & Collision Avoidance System
PC1/2e	Incl 1D decks	65%	PC1/2e	Perf Class 1 or enhanced Perf Class 2
IW	New design	50%	IW	Impact warning system
			CRM	Crew Resource Management
			LOFT	Line oriented flight training
			SMS	Safety Management System

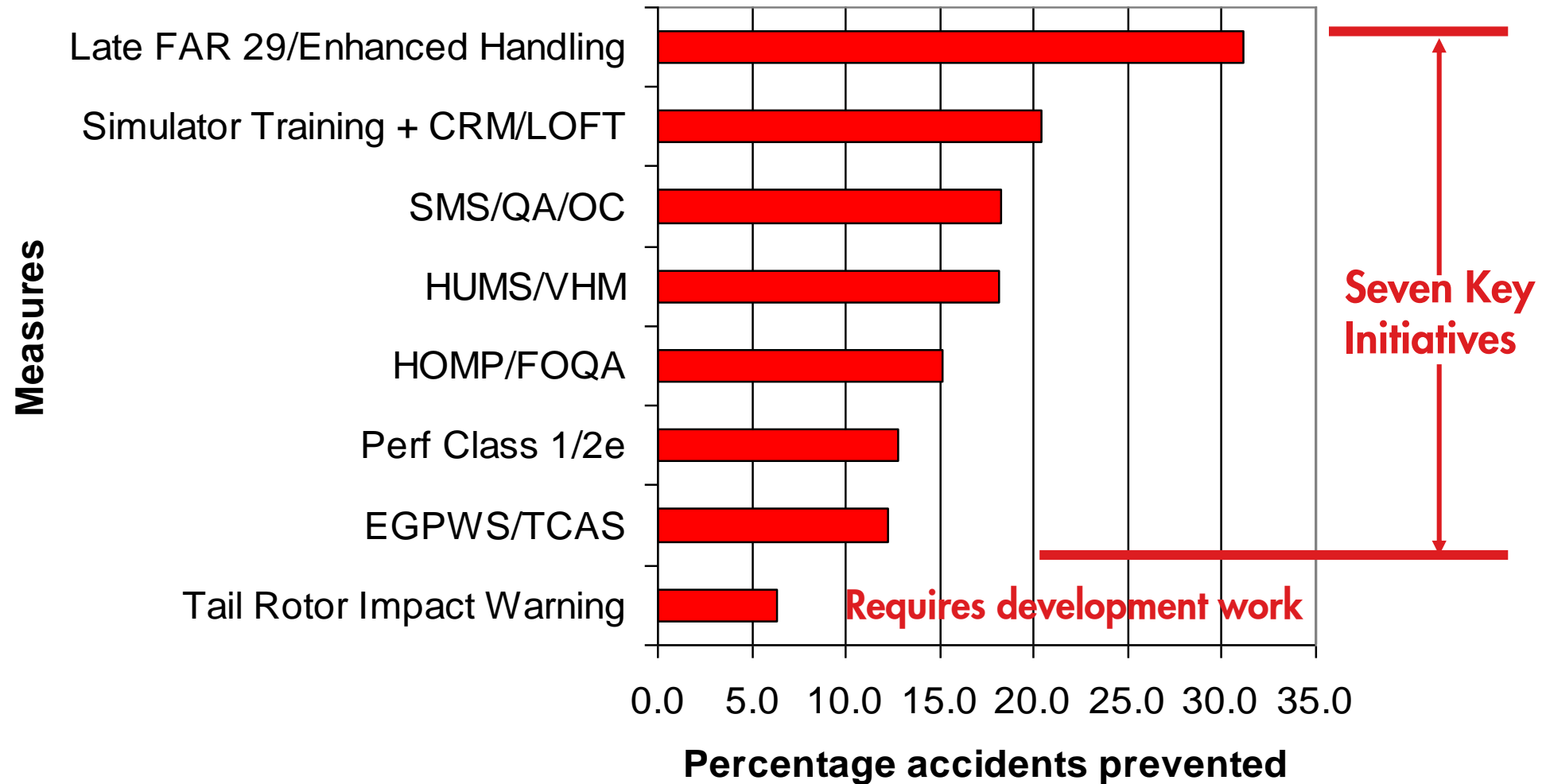
As we analysed the accidents, we evaluated risk mitigation measures and a panel of experts assigned potential effectiveness levels for each of these risk mitigation measures against the applicable hazards

Mitigation Analysis - Generic Twin - NASA Data

1	Pilot related (in air)	%	Level 1 Mitigation	MF1	Level 2 Mitigation	MF2	Level 3 Mitigation	MF3	Overall MF	Accidents prevented %
	In flight collision with object	14.3								
	Airport/helipad/fence	5.7	IW	0.50	OC/QA	0.43	HOMP	0.38	0.82	4.65
	Wire	4.3	EGPWS/TCAS	0.75	OC/QA	0.43	HOMP	0.38	0.91	3.94
	Other-trees, brush, acft	4.3	EGPWS/TCAS	0.75	IW	0.43	Training	0.34	0.90	3.92
	Loss of control	14.6								
	Handling	6.3	DR/HQ	0.60	HOMP	0.43	Training	0.34	0.85	5.37
	Loss of reference/disorientation	3.0	Training	0.45	DR/HQ	0.51	HOMP	0.38	0.83	2.49
	System deficiency	2.3	DR	0.50	HOMP	0.43	Training	0.34	0.81	1.89
	Misc/undetermined	3.0	Training	0.45	HOMP	0.43	PC 1/2e	0.49	0.84	2.51
	In flight collision with terrain	5.7	EGPWS/TCAS	0.75	HOMP	0.43	Training	0.34	0.90	5.12
	Weather	4.0	Training	0.45	OC/QA	0.43	PC 1/2e	0.49	0.84	3.35
	On ground/water collision with	3.3	IW	0.50	OC/QA	0.43	Training	0.34	0.81	2.70
	Hard landing	2.7	Training	0.45	PC 1/2e	0.55	DR/HQ	0.45	0.86	2.30
	Mid air collision	2.0	EGPWS/TCAS	0.75	Training	0.38	HOMP	0.38	0.90	1.81
	Rollover/Noseover	1.3	HOMP	0.50	DR/HQ	0.51	Training	0.34	0.84	1.11
	Subtotal %	48.0	%							41.16
2	Technical									
	Loss of engine power	13.0								
	Engine structure	5.0	DR	0.50	PC 1/2e	0.55	HUMS	0.49	0.89	4.43
	Fuel system related	5.7	PC 1/2e	0.65	DR	0.43	OC/QA	0.38	0.87	4.95
	Other	2.3	PC 1/2e	0.65	DR	0.43	HUMS	0.49	0.90	2.09
	Airframe component/system	29.5								
	Main rotor	6.3	DR	0.50	HUMS	0.55	OC/QA	0.38	0.86	5.44
	Main rotor drive train	4.3	DR	0.50	HUMS	0.55	Training	0.34	0.85	3.69
	Main rotor control system	3.7	DR	0.50	HUMS	0.55	Training	0.34	0.85	3.12
	Tail rotor	3.3	DR/HQ	0.60	HUMS	0.55	OC/QA	0.38	0.89	2.96
	Tail rotor drive train	6.3	DR/HQ	0.60	HUMS	0.55	Training	0.34	0.88	5.58
	Tail rotor control system	2.3	DR/HQ	0.60	HUMS	0.55	Training	0.34	0.88	2.05
	Other airframe	3.3	DR	0.50	OC/QA	0.43	Training	0.34	0.81	2.70
	Fire/explosion	1.7	DR	0.50	OC/QA	0.43	Training	0.34	0.81	1.34
	Gear collapsed	2.0	DR	0.50	OC/QA	0.43	Training	0.34	0.81	1.62
	Subtotal %	46.3	%							38.36
3	Other									
	Rotor contact -person	2.7	OC/QA	0.50	OC/QA	0.43	Training	0.34	0.81	2.16
	Misc/other	3.0	HOMP	0.50	Training	0.38	OC/QA	0.38	0.81	2.42
	Subtotal %	5.7	%							4.58
					Factor	0.85	Factor	0.75		
	Total accidents prevented (= % effectivity of mitigation measures)									84.10

Risk mitigation measures applied to accident causes with 3 levels of diminishing efficacy.

Percentage accidents reported in NASA study preventable by individual mitigation measures



Risk Mitigation Options

OPTION A – Baseline NASA

FAR Part 135/Part 91 Twin Engine – early FAR 29

OPTION B – Typical global offshore (OGP)

Baseline/early FAR 29 + Limited SMS/QA and Ops Controls + part HUMS + CRM, part simulator, LOFT + part helideck management

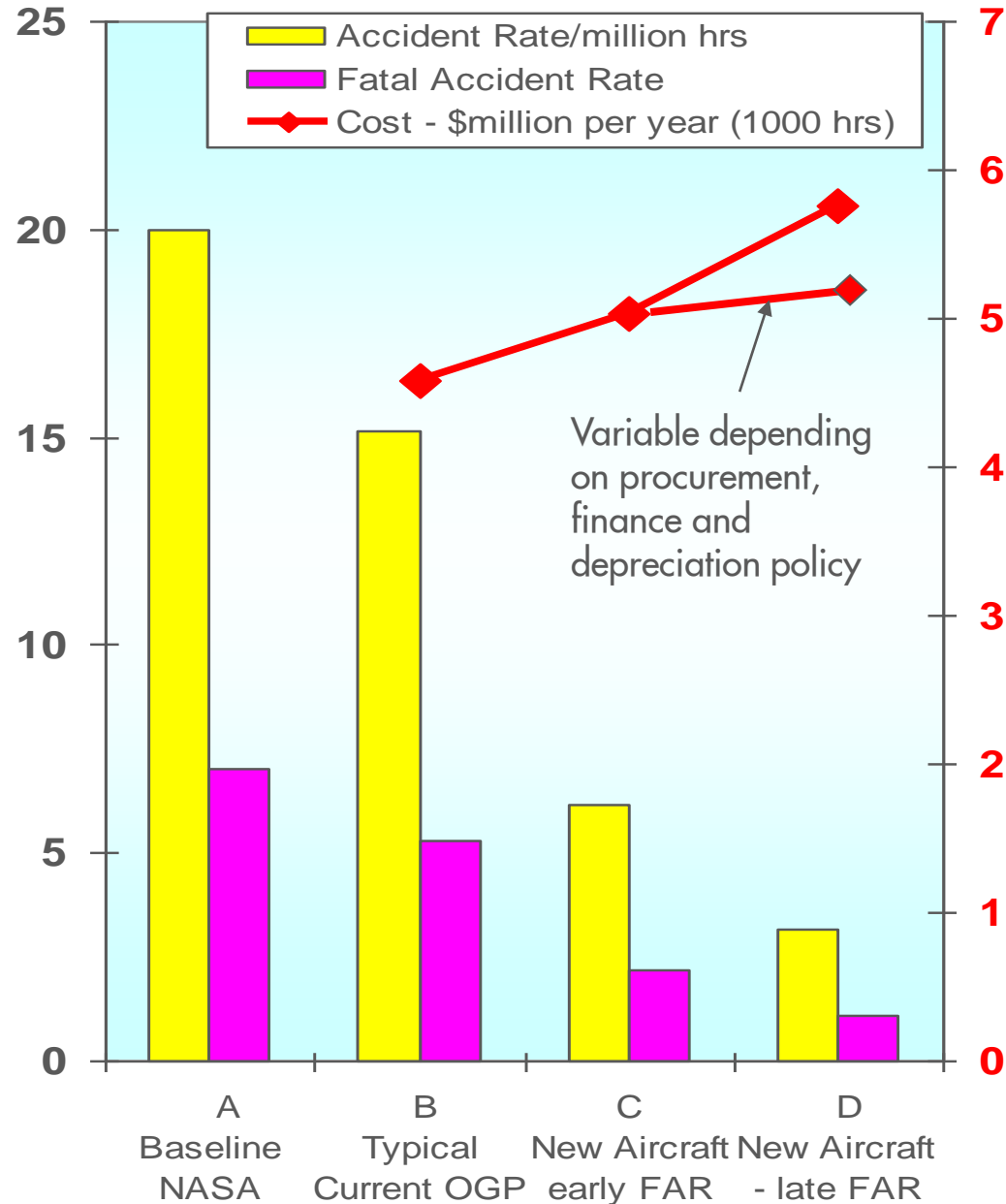
OPTION C – New aircraft – early/mid FAR

Option B + full SMS/QA + full HUMS + full simulator training + ICAO helidecks + Perf Class 2 + HOMP + TCAS/EGPWS

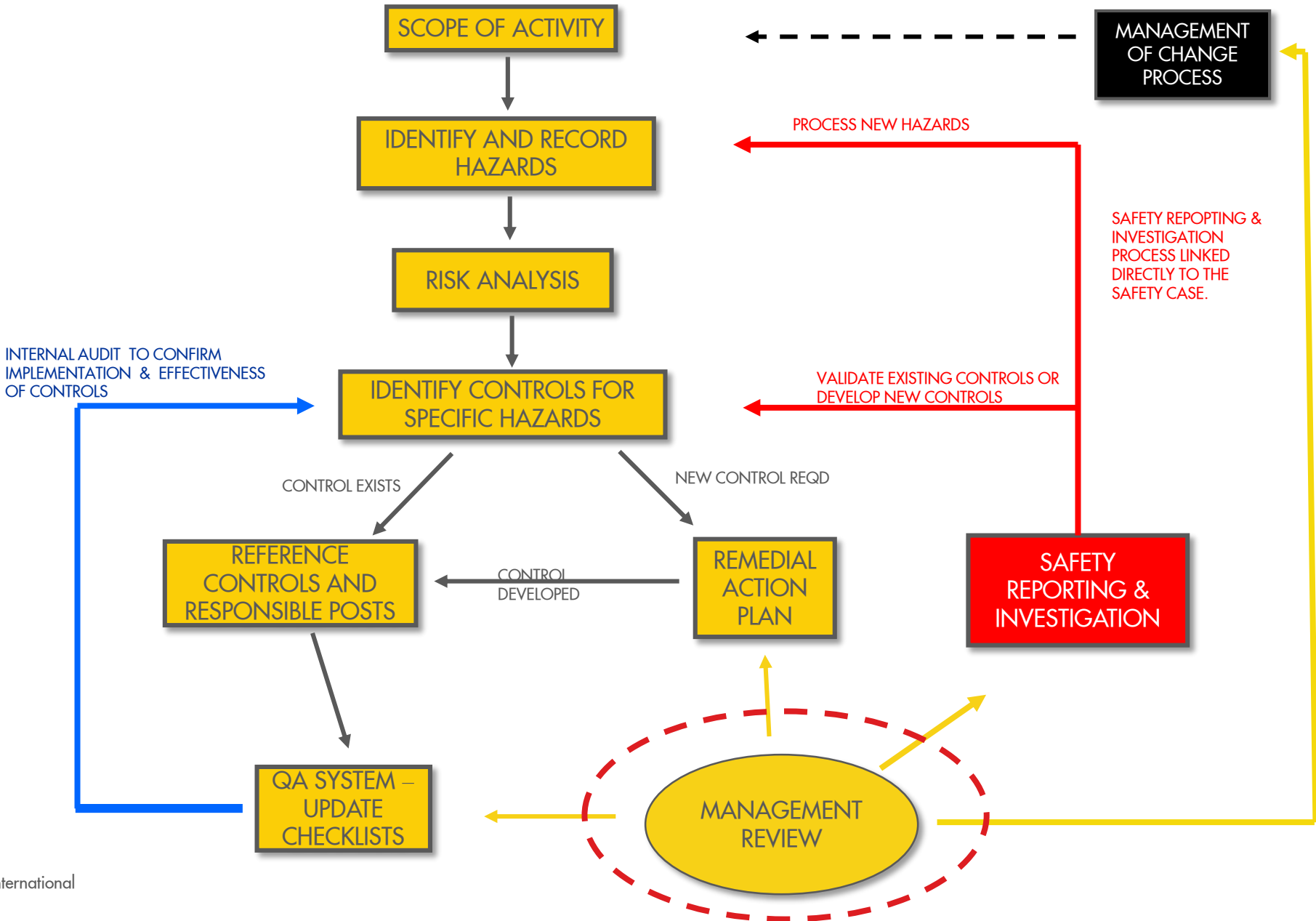
OPTION D - New aircraft - late FAR 29

Option C + enhanced cockpit/HQ + enhanced Perf Class 2/Class 1 + Impact Warning System

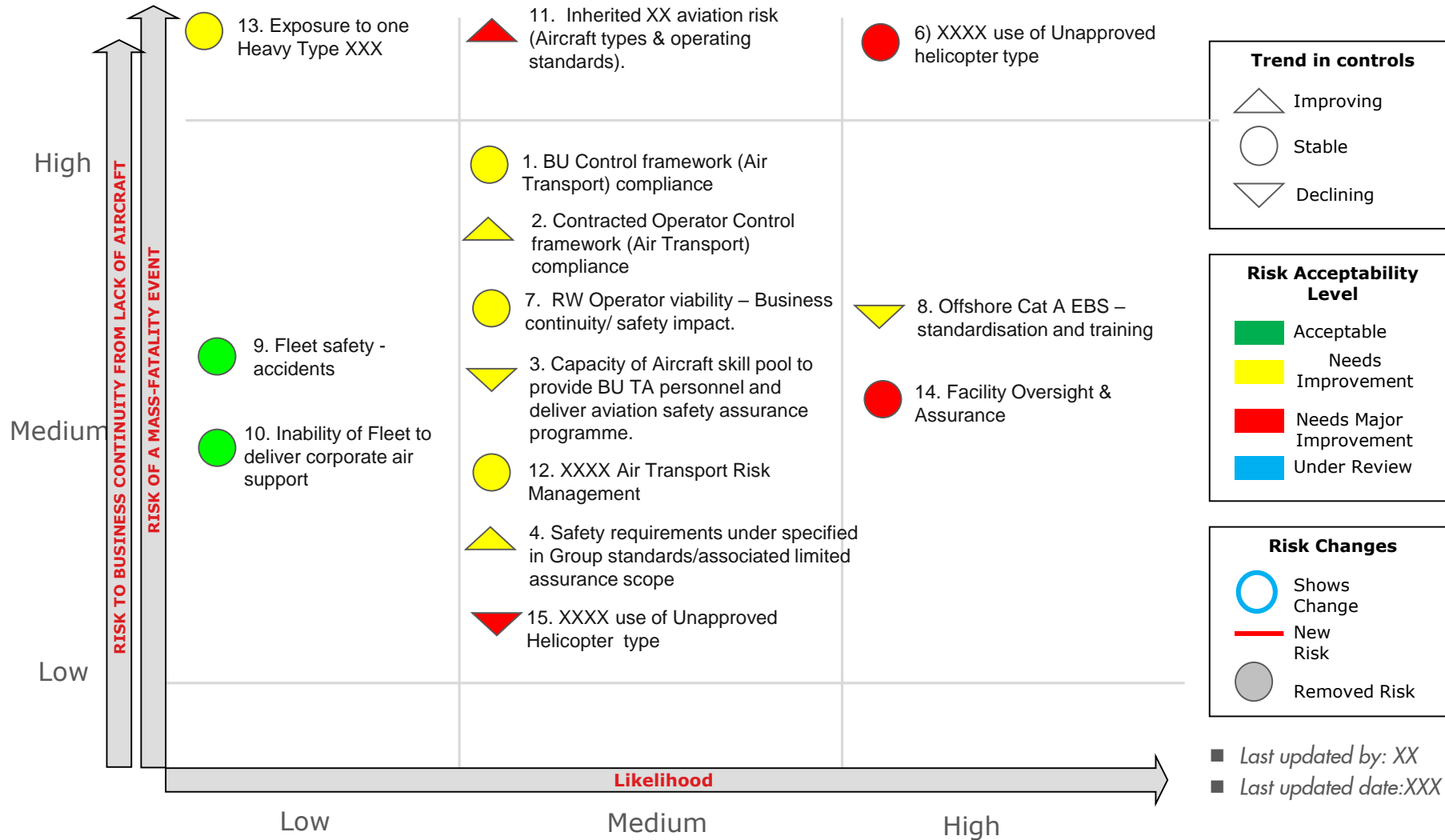
Cost assumes no action taken to reduce costs through efficiencies, e.g. smart procurement, higher utilisation, sharing etc



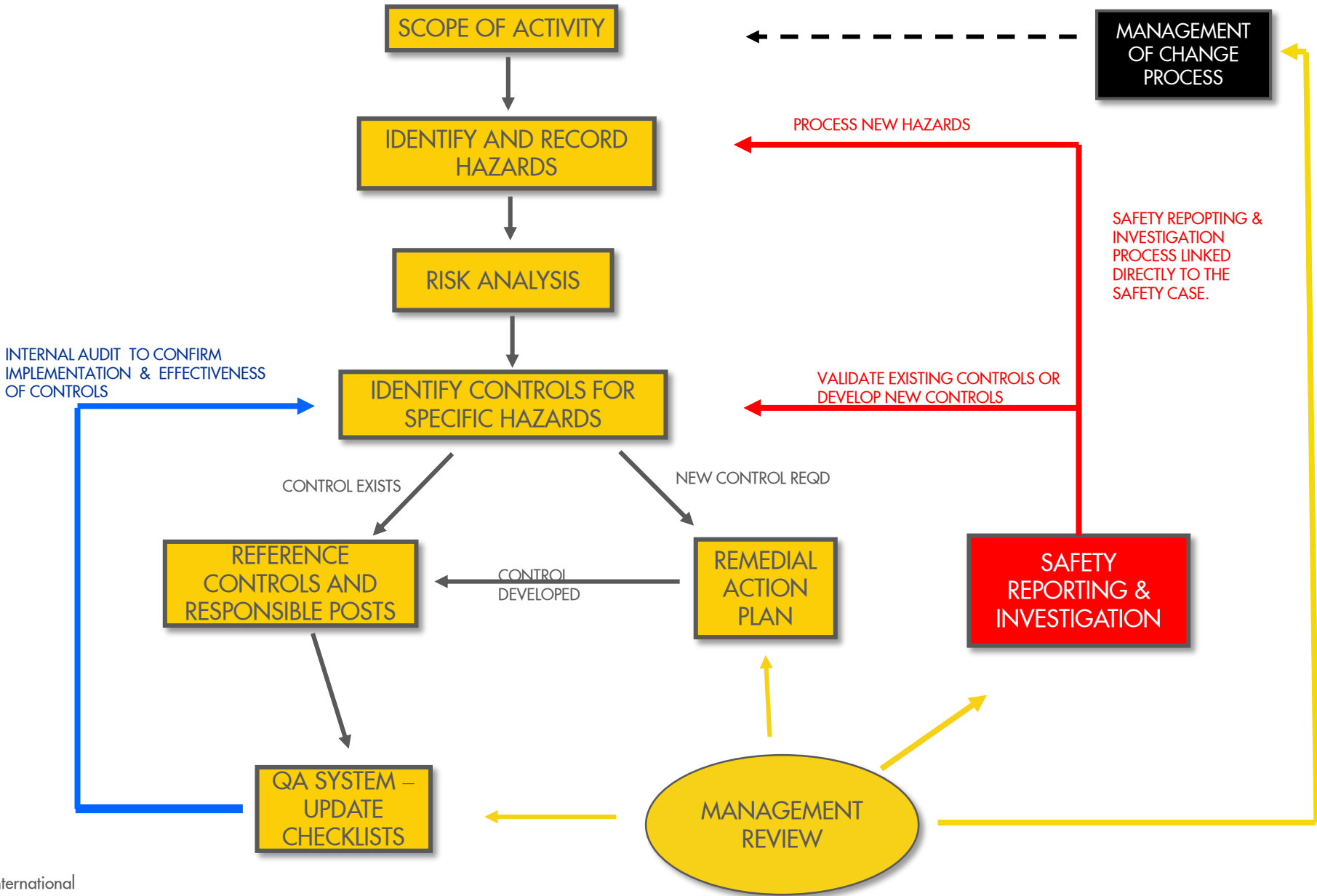
Hazard/Risk Management Process




Group Air Transport Risk Visual – April 2018



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