Accident Data and the Helicopter Offshore Safety Case

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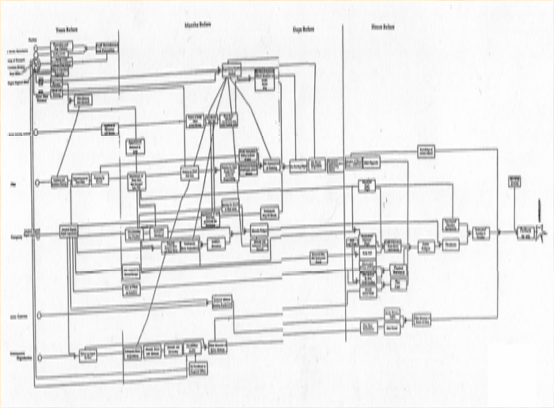
Accident Causation and Prevention

Zotov Error Mapping

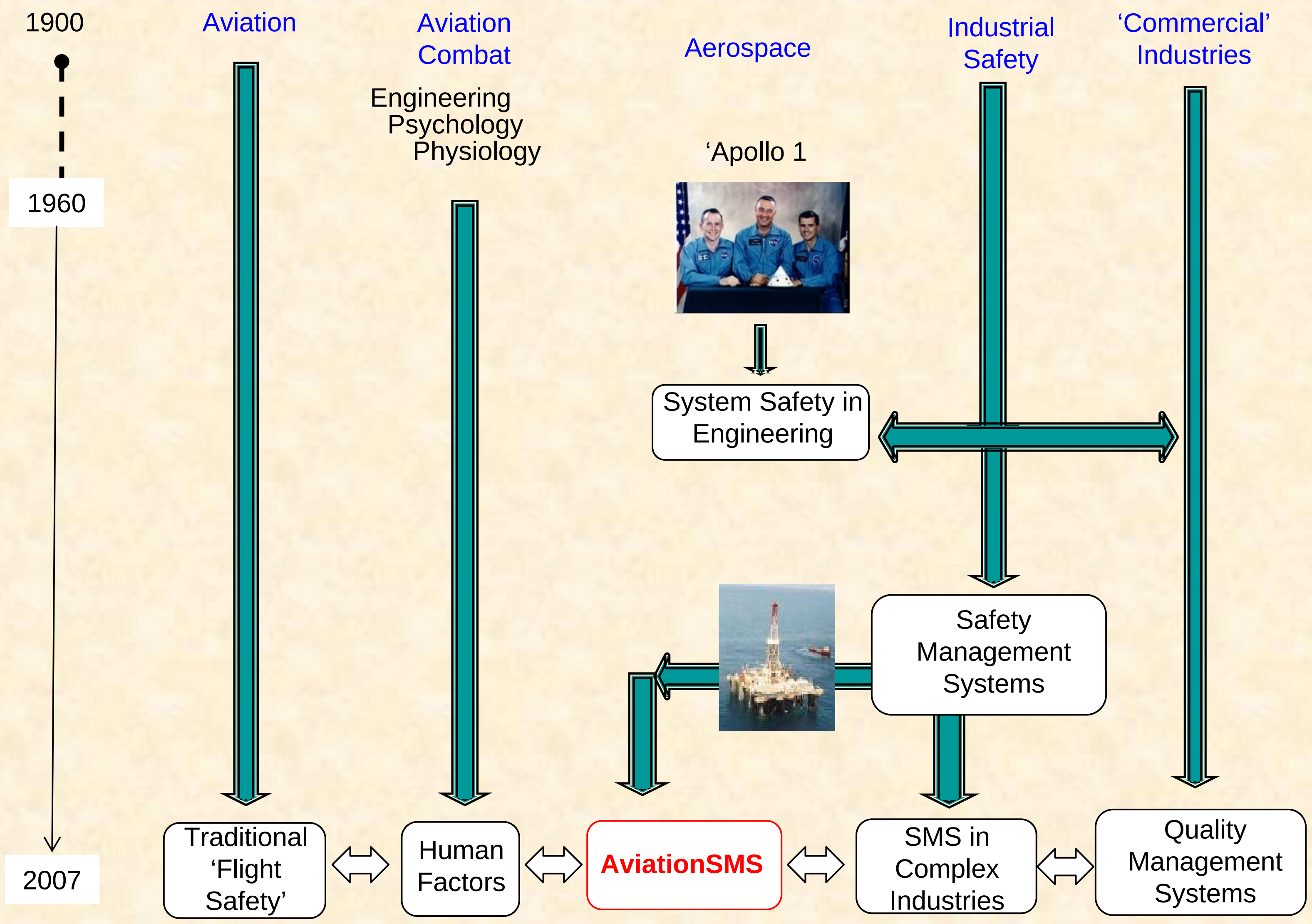


- Aircraft accidents are the result of multiple **risk-factor chains that interact and cumulate over** time
- Operational errors immediately prior to an accident tend to be but part of a much larger error sequence at Organizational or 'system' level that causes individuals to be ***'set up for failure'***
- Accident have systemic roots and require a systemic solution: Safety Management Systems: ensures teams and individuals are ***'set up for success'***

- SMS is not new: it has evolved over 50 years in complex industries (e.g. nuclear, maritime, rail)
- Aviation SMS is not yet widely regulated in the aviation industry, but is gaining momentum: Air Transport Canada, CASA, UK CAA, ICAO requirement from 2009. All these current models tend to share similar features
- Considerable experience has been built in the application of SMS to helicopter operations, primarily through the major Clients (Shell, ExxonMobil, Woodside, OGP etc): this experience currently represents 'industry best practice'

The Evolution of Aviation SMS

We can now apply the lessons learned over 100 years



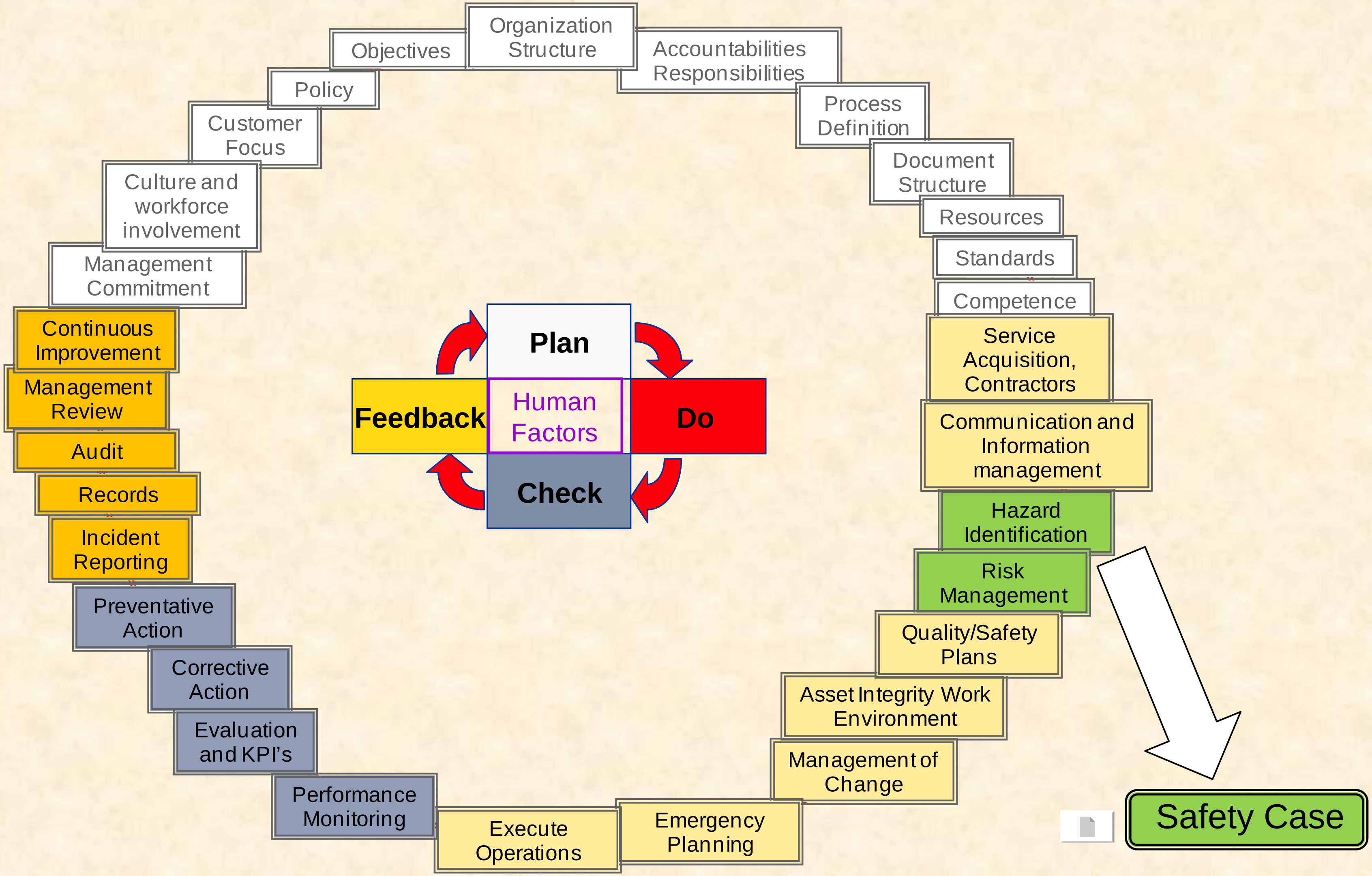
SMS Standards and Guidelines

SMS has been developing within aviation for the past ten years and is now guided by a widening range of Regulatory Standards, recommended practices, Client requirements and academic research, for example:

- The International Civil Aviation Organization (ICAO)
- Oil and Gas Producers Forum (OGP)
- Shell, ExxonMobil, Woodside etc
- United Kingdom Civil Aviation Authority
- International Business Aircraft Operators Organization
- Air Transport Canada
- Australia Civil Aviation Safety Authority
- The US Federal Aviation Authority

These Guidelines and Regulations represent the blending of QMS, complex industry SMS, aviation human factors and traditional flight safety.

The Primary Elements of an SMS



Safety Case: Purpose

Is a good set of Rules and Procedures not enough?

A comprehensive set of Rules, standards and procedures in aviation operations will assure a certain level of human reliability, however:

- Aviation takes place in a dynamic environment: changes may render Rules, standards and procedures obsolete or inadequate
- Rules, standards and procedures may be based on a given level of knowledge that is imperfect
- Although individual procedures may be well considered, there may be a lack of coherence between individual procedures
- Conditions may be such that procedures are disobeyed, cannot be obeyed or are not adequately understood

Latent Risk Factors

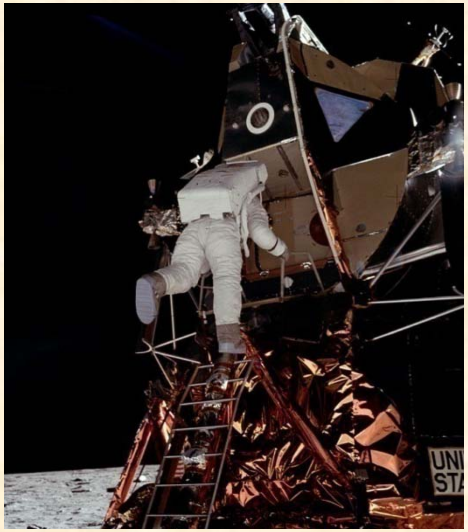
A Safety Case is the ***primary tool*** for seeking out and controlling latent risk factors within any given scope of operations so that conditions and procedures may be improved accordingly

The Nature of Aviation

"There is no evil here, just the tension between the goals we set and the risks we take and the limits of human and machine"

A Safety Case is a formal method for balancing goals against risks and to compensate for the limits of human and machine

The Safety Case



A Safety Case is defined as "**The documented description of the major hazards inherent in the scope of activities and the process and means employed to control these hazards to a level that is considered to be As Low As is Reasonably Practicable (ALARP)"**

The Safety Case *proves* (**demonstrates**) that safety is being managed as a **critical business function** and that the Organization is showing 'due care' – first line of legal defence to counter:

- ✓ Corporate Negligence: Where no risk assessment was carried out, and the risk therefore not identified
- ✓ Corporate Complacency: Where the risk was identified and assessed but then ignored
- ✓ Corporate Inactivity: Where the risk was identified and assessed, but inappropriate action was taken

A Safety Case is primarily **Proactive** is that it creates the potential for safer operations

A Safety Case is also **Reactive** in that it provides Corporate defense in the unfortunate event of an accident

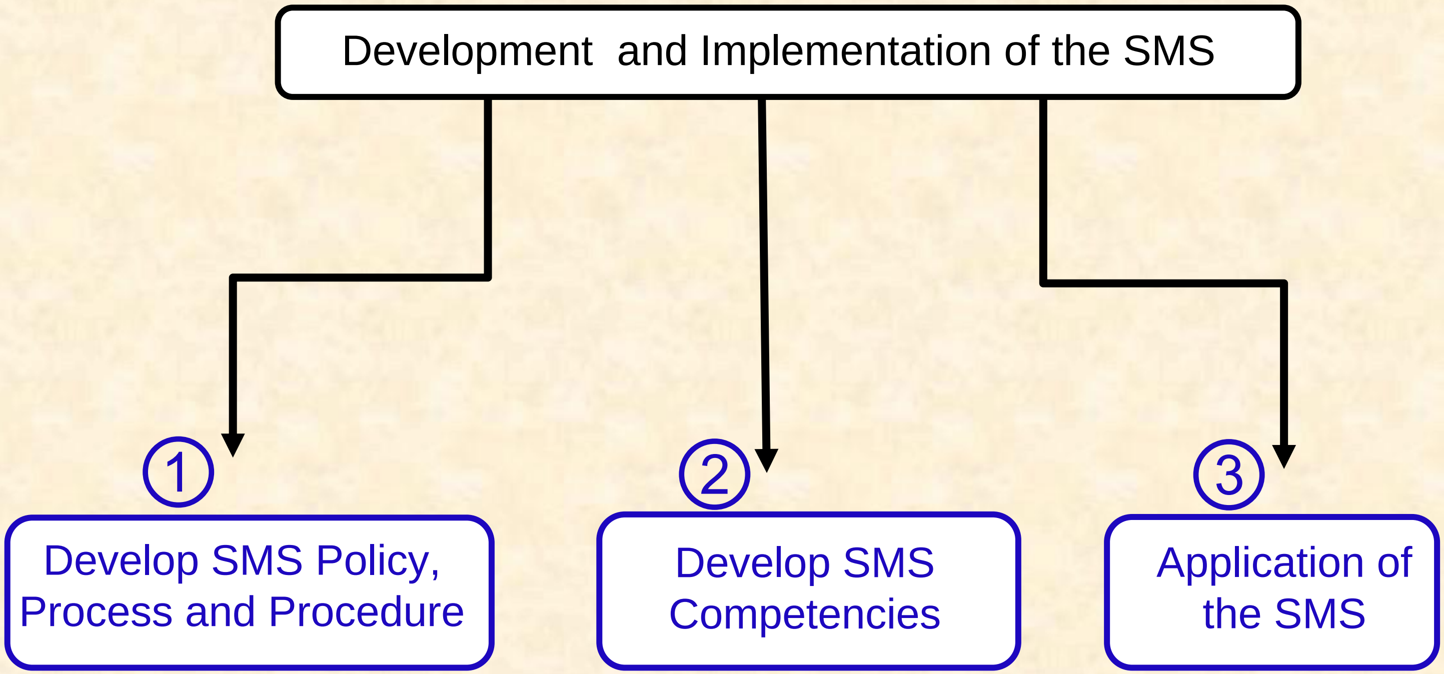
Key Features of an Aviation Safety Case

A Safety is a **Process** that culminates in a **Document**. This Document:

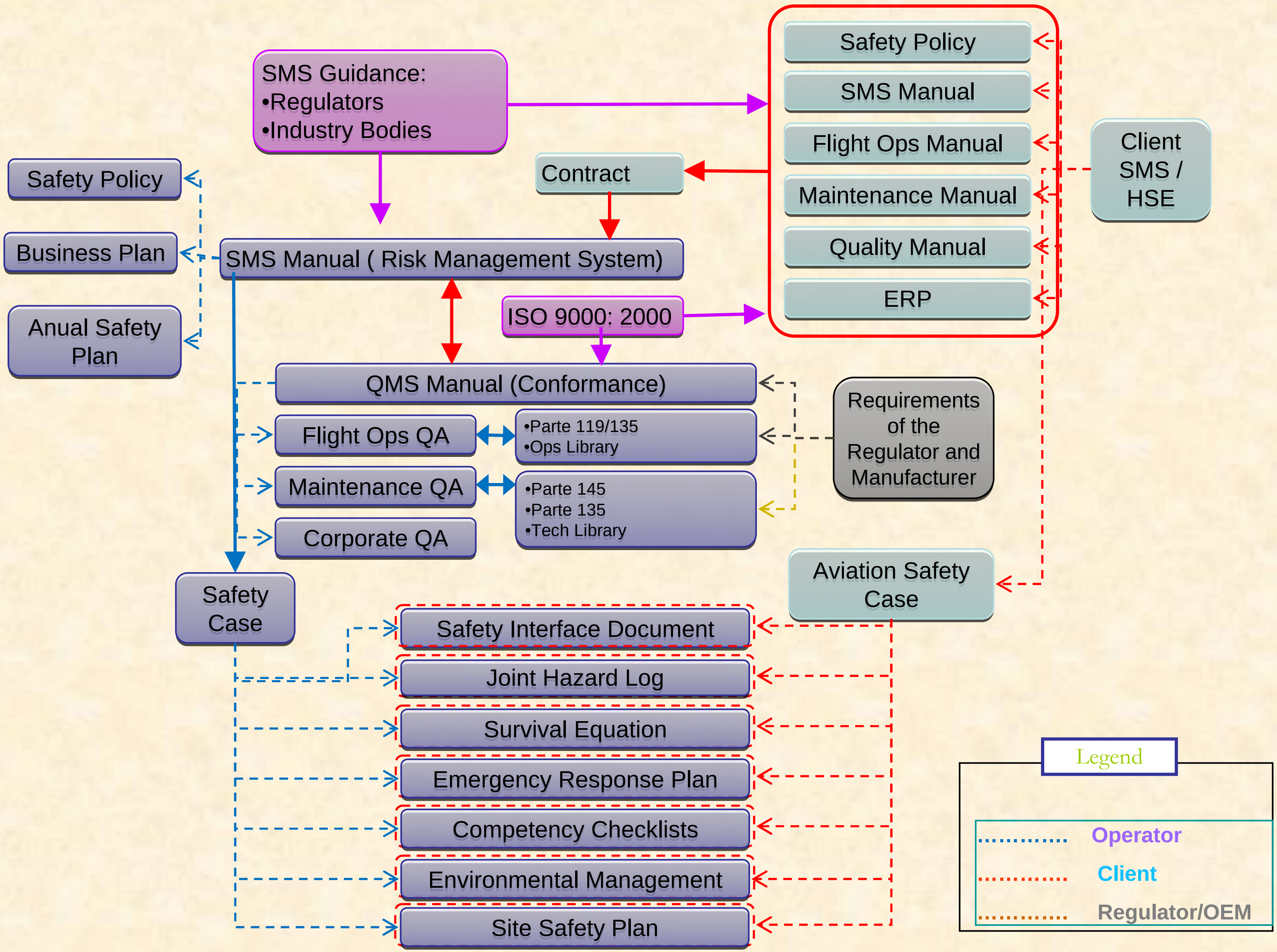
- Describes the scope of the particular operation
- Summarises how the SMS elements are applied to the particular operation
- Identifies and describes the safety critical activities associated with the operation
- Provides evidence that all potentially significant hazards and associated effects have been identified, the risks fully assessed and adequate hazard management controls are in place
- Lists any safety deficiencies and provides a targeted work program to achieve safety improvement
- Presents the conclusions reached in the Safety Case
- Contains a formal Statement of Fitness for the operation

The Helicopter Offshore Safety Case is based on a template formed through the analysis of some 2000 helicopter accidents and evolved through practical application over a period of ten years

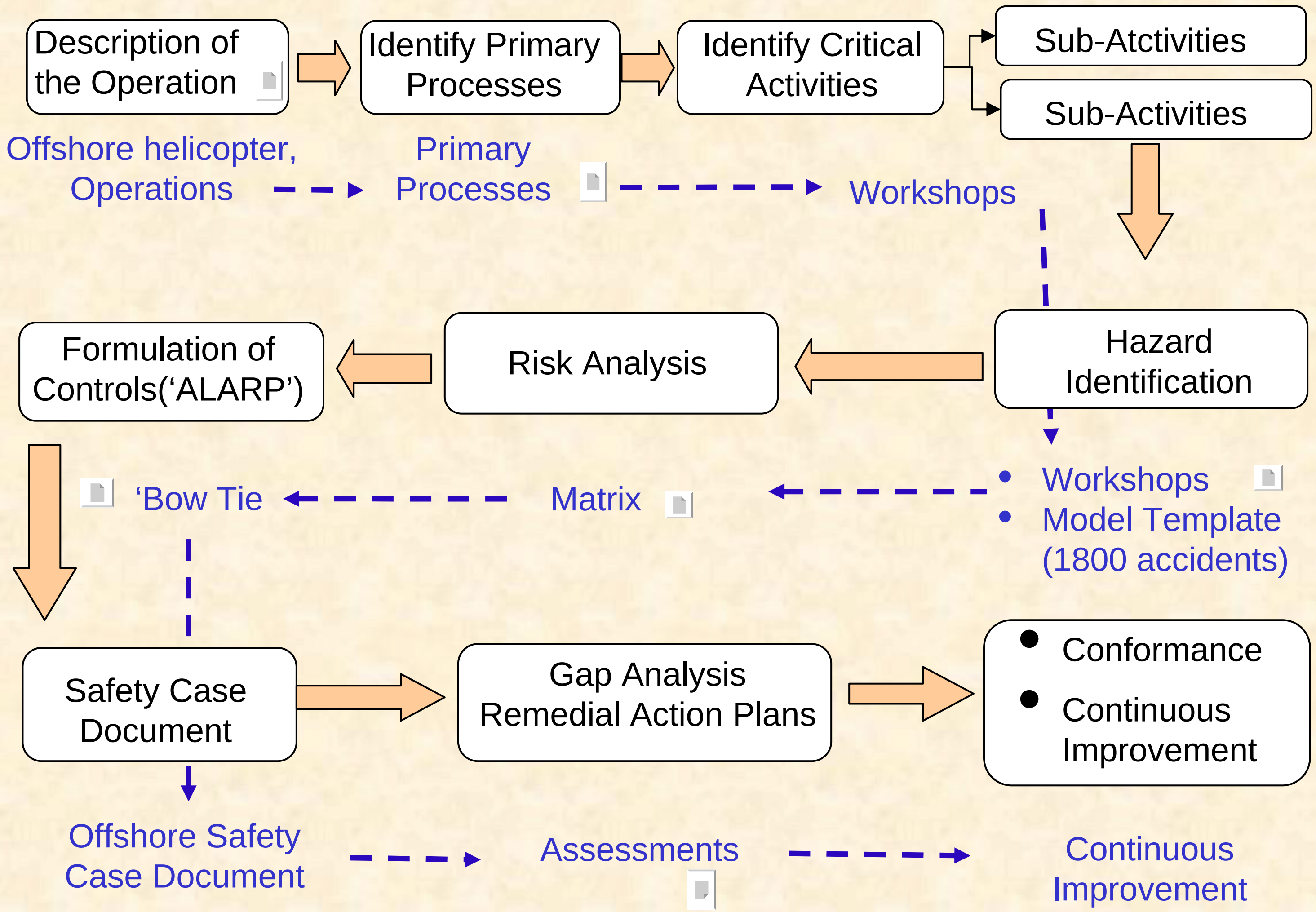
SMS Implementation Model



SMS Document Map



Application of the SMS ③ Generic Safety Case Process : Offshore



Primary Sources of Hazard Identification

Internal Sources

- *In-House Safety Audits*
- *(Safety) Meetings*
- *Hazard Reporting Systems*
- *Company Experience*
- *'Brainstorming'*
- *Workforce Input*
- *Company Systems*

Ongoing hazard identification

- Relevant, 'Buy-In'
- 'Local thinking

Safety Critical Processes

- *Observation*
- *Analysis*

Key operational processes

- Reveals 'critical activities'
- Focuses on the 'status-quo'
- Buy-in
- Follows a logical sequence
- Very specific controls
- May miss high risks

External Sources

- *Internet databases*
- *Industry workgroups*
- *Government initiatives*
- *External Audit Reports*
- *Regulator's Opinion*
- *Safety Publications*
- *Client Inputs*

Big picture, high risk killer hazards

- Primary threats
- No buy-in

Formal Hazard Models

- *Shell*
- *NASA*

'One-off' corporate exercise

- Very thorough
- Huge resources

Primary Hazardous Events

Category	#/792	%
Loss of Tail Rotor Effectiveness	76	9.6%
Dynamic Rollover(+tiedown)	68	8.6%
Settling , power margins	22	2.7%
Unsuccessful autorotation	162	20.5%
External load/line	21	2.6%
Fuel exhaustion	29	3.6%
VMC $\Rightarrow$ IMC(inc white out)	86	10.8%
CFIT	51	6.4%
Wirestrike	64	8.1%
Obstacle strike	52	6.5%
Landing Surface condition	8	1.0%
Winds/gusts	10	1.0%
Icing induced (power loss)	11	1.0%
Density-altitude	20	2.5%
TR + Power Train	41	5.1%
Engine fail/ “Power loss”	146	18.4%
Hydr/Fuel/Oil Systems	47	5.9%
Air frame	6	<1.0%
False instr. indications	2	<1.0%

	Primary Event
1	Mechanical Failure / Power Loss
2	Failed Autorotation
3	Inadvertent VMC $\Rightarrow$ IMC
4	Controlled Flight Into Terrain
5	Loss of Tail Rotor Effectiveness
6	Dynamic Roll-Over
7	Wire/Obstacle Strike
8	Degraded Power Margins
9	External Load Handling
10	Fuel Exhaustion
11	Wind/Gusts
12	Passenger into Rotors
13	Misjudgment of landing surface
14	Mid-Air /Ground Collision
15	Pilot Incapacitation
16	Birdstrike

Primary Hazards

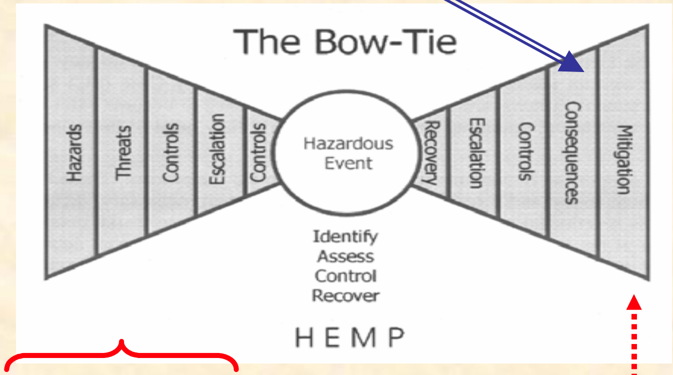
Step 1: Determine Primary Events

Accident Database Analysis

Event Categorisation

Specific Event

Step 2: Link Event to Bow Tie and 3 ‘Gates’ to Manage Risk



Predict and Prevent Prevent

Detect and Recover

Mitigate

Step 3: Link to Three Levels of Risk Control

	Predicting and Preventing the Event	Detecting and Recovering Prior to Final Consequence	Mitigating the Effects of the Final Consequence
Risk Controls: Organization			
Risk Controls: Team			
Risk Controls: Individual			

The SMS / Safety Case Loop