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# TAI – TURKISH AEROSPACE INDUSTRIES, INC.

## SMS APPROACH IN THE DESIGN PROCESS

27 May 2016 @SMICG-ROME

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# About TAI

TUSAS Aerospace Industries, Inc. (TAI) was established in 1984 with the decision of meeting the combat aircraft requirement of Turkish Air Force (TurAF) with F-16s.

In the beginning our aim is to realize the manufacture, systems integration and flight tests of F-16.





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# BRIEF INTRODUCTION

- Turkish Aerospace Industries, Inc. (TAI) has become Turkey's center of technology in design, development, modernization, manufacturing, integration and life cycle support of integrated aerospace systems, from fixed and rotary wing air platforms to UAVs and satellites.

**Aerostructures**


**Integrated Systems**





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# MANAGEMENT SYSTEMS & APPROVALS


- **TAI meets the stringest quality standards in the world satisfying :**
  - *AQAP-2110*
  - *ISO-9001 : 2008*
  - ***AS EN 9100***
  - ***AS 9110***
  - ***Production Organisation Approval (POA)***
  - ***Design Organization Approval (DOA)***
  - *NADCAP*
- **ISO/IEC 27001**
- **OHSAS 18001**
- **ISO/IEC 20000**

# ORGANIZATION

**TAI BOARD**

**CEO&President**

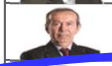
**Support Departments**

**Strategy & Corporate Governance**

**Facilites and Asset Management**

**Enterprise Management Systems**

**Industralization and Procurement**



**Strategy and Technology Management**

*(Acting)*

**Quality and Certification**

**Logistics**

**Flight**

**Human Resources**

**Finance and Subsidiaries**

**Business Units**

**Aerospace**

Aerostructures | Integrated Systems

***Aerostructures***

**Aircraft**

**UAS**

**Helicopter**

**Space Systems**

*(Acting)*

**AeroEngine**

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***JV with GE***

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# TAI SMS SCOPE

- TAI will establish and maintain SMS according to ICAO and Turkish DGCA in the scope of all of her aviation activities
- TAI's SMS scope includes: DOA, POA, MOA, Flight Operations, FTO and all other supporting departments.





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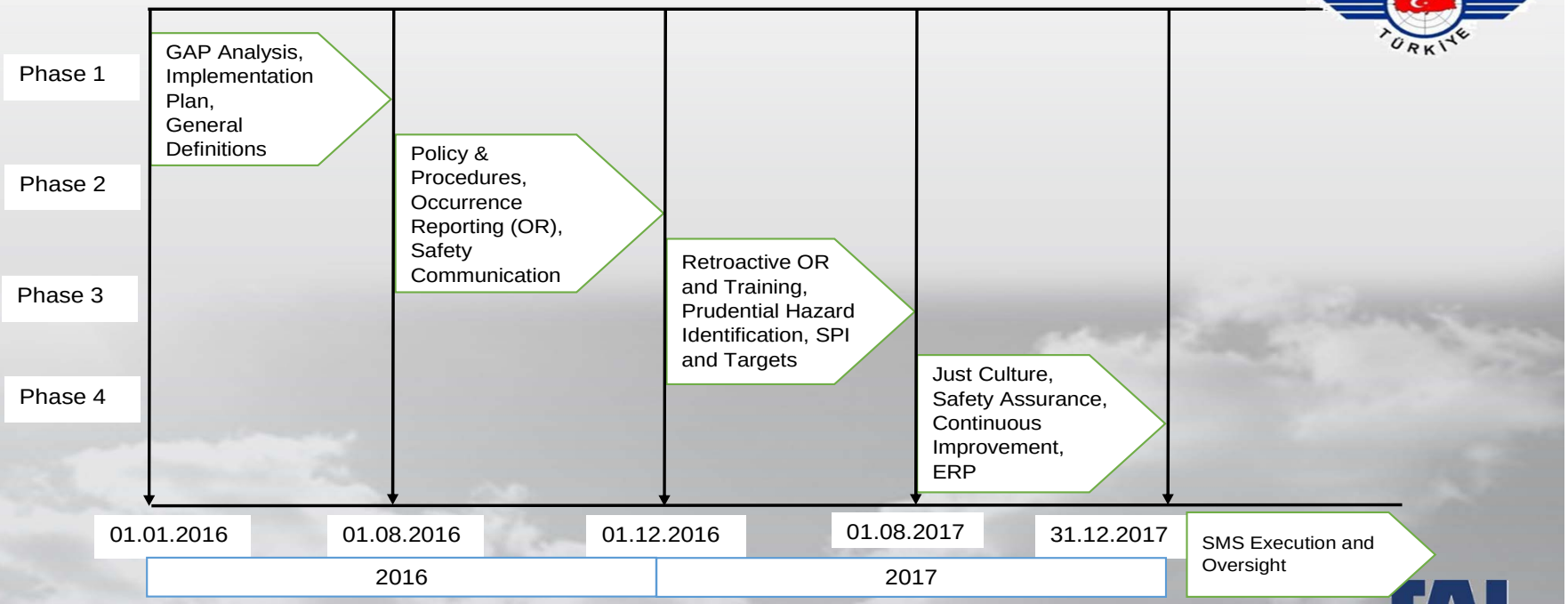
# DGCA SMS SCHEDULE

- DGCA SMS implementation schedule are shown below for Design and Production Organization responsible for Type Design according to SHT-SMS.



# SMS FRAMEWORK

ICAO ANNEX 19
SAFETY MANAGEMENT SYSTEM

## Safety Policy and Objectives

1.1 Management commitment and responsibility
1.2 Safety accountabilities
1.3 Appointment of key safety personnel
1.4 Coordination of emergency response planning
1.5 SMS documentation

## Safety Risk Management

2.1 Hazard identification
2.2 Safety risk assessment and mitigation

## Safety Assurance

3.1 Safety performance monitoring and measurement
3.2 The management of change
3.3 Continuous improvement of the SMS

## Safety Promotion

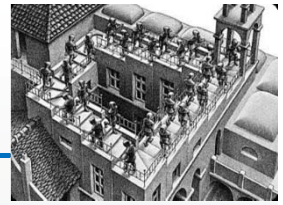
4.1 Training and education
4.2 Safety communication

**TAI SMS Implementation split into two phases**

***Phase 1- Implementation and Pre-Applications***

***Phase 2- Continuous Improvement and Effective Execution***

# SMS IN DESIGN PROCESS



*Challenge is integrating SMS into design even system safety had been there for decays.*

*(MIL-STD-882E – System Safety (DoD))*

Questions?

- Q1-Which novelties SMS will introduce to design organization where system safety is already being implemented?
- Q2-Could there be a systematic approach for identifying hazards in design processes?





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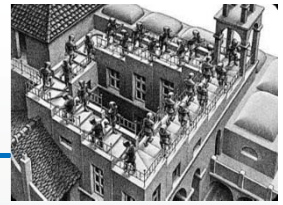
# QUESTION#1



- System safety; is a planned, disciplined, and systematic approach for identifying, analyzing, and controlling hazards throughout the life cycle of a system in order to prevent or reduce accidents.
- *System safety emphasizes building in safety, not adding it on to a completed design:* Safety considerations must be part of the initial stage of concept development and requirements definition
- *System safety takes a larger view of hazards than just failures:* Hazards are not always caused by failures, and all failures do not cause hazards. Serious accidents have occurred while system components were all functioning exactly as specified—that is, without failure.If failures only are considered in a safety analysis, many potential accidents will be missed.

*Reference :White Paper on Approaches to Safety Engineering -Nancy Leveson*





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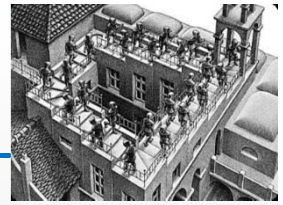
# QUESTION#2



- The aim is to point out how system safety process is affected when there is an erroneous or inadequate performance of a development process function.





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# SAE ARP 4754A

- SAE ARP 4754A– Guideline for Development of Civil Aircraft and Systems:
  - gives a guideline to design aircraft systems with a process approach
  - discusses the development of aircraft systems taking into account the overall aircraft operating environment and functions
  - addresses the development cycle for aircraft and systems that implement aircraft functions
  - refers to DO-178/ED 12 and DO-254/ED-80 for software and hardware development processes respectively.





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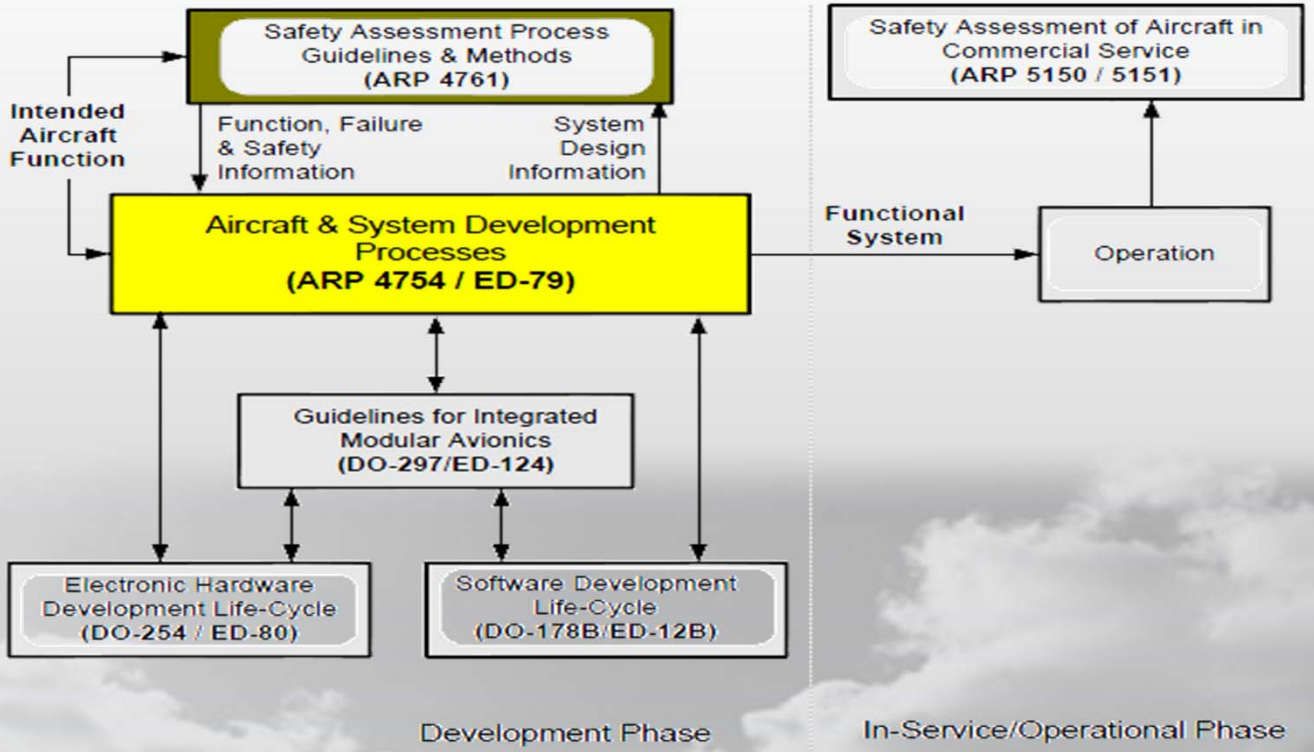
# SAE ARP 4754A





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# SAE ARP 4754A

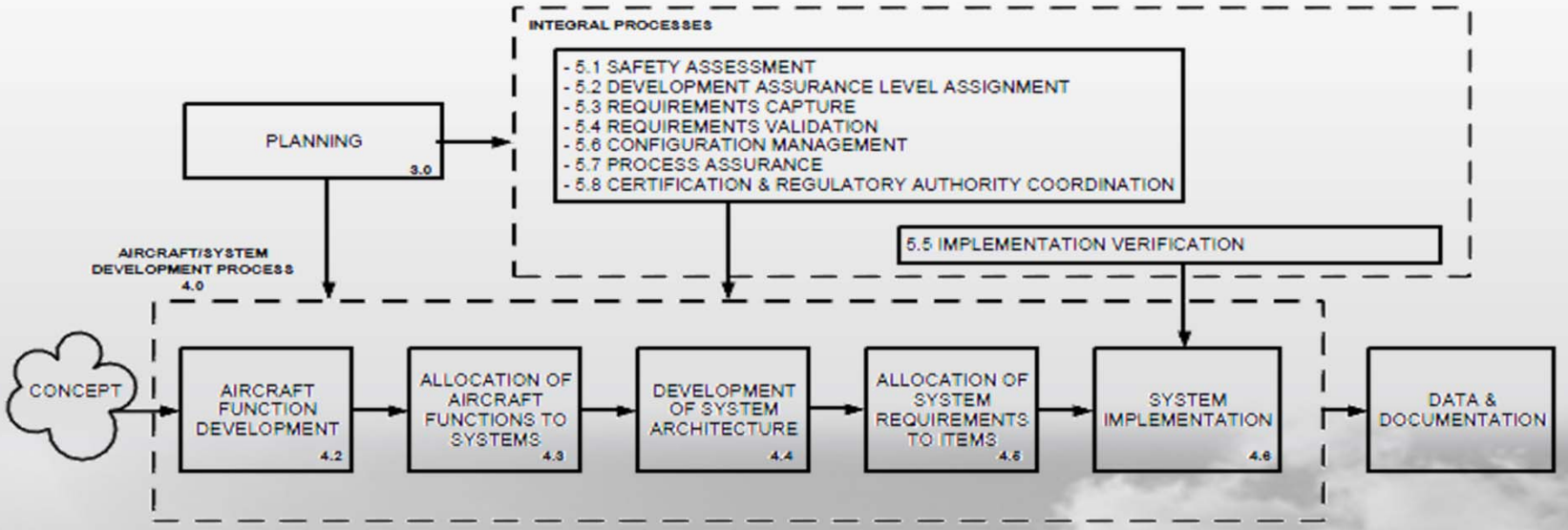


FIGURE 4 – AIRCRAFT OR SYSTEM DEVELOPMENT PROCESS MODEL





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# SMS IN DESIGN PROCESS

- The main assumption is; any divergence from the objectives of ARP4754A and ARP4761 and deficiencies or missing applications on design processes can induce a weakness in the end product safety.

- Even safety process, defined in ARP4754A, is perfectly applied, there could still be latent conditions in development processes that could endanger safety of product.





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# SMS IN DESIGN PROCESS

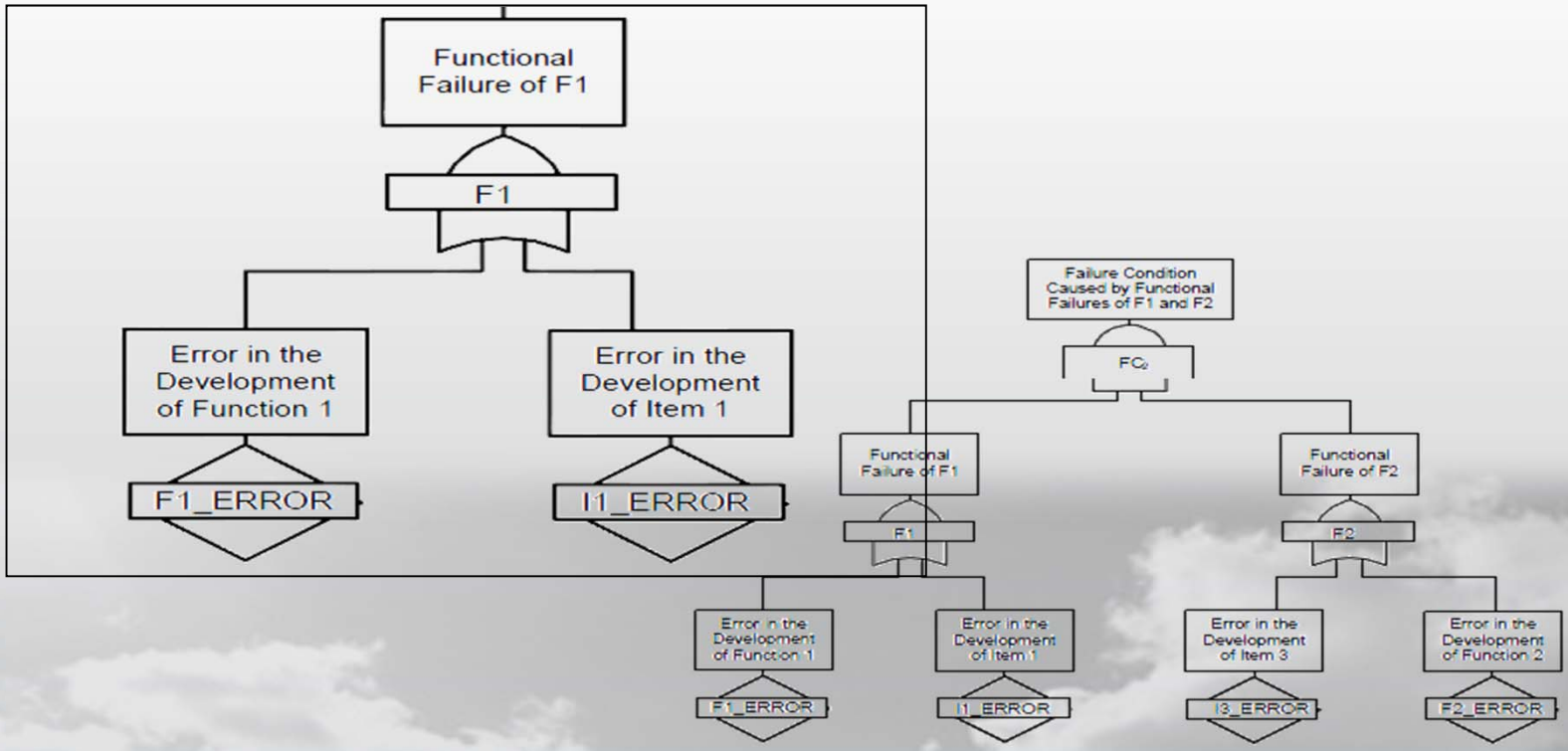


FIGURE 9 - FUNCTION INDEPENDENCE AND ITEM DEVELOPMENT INDEPENDENCE





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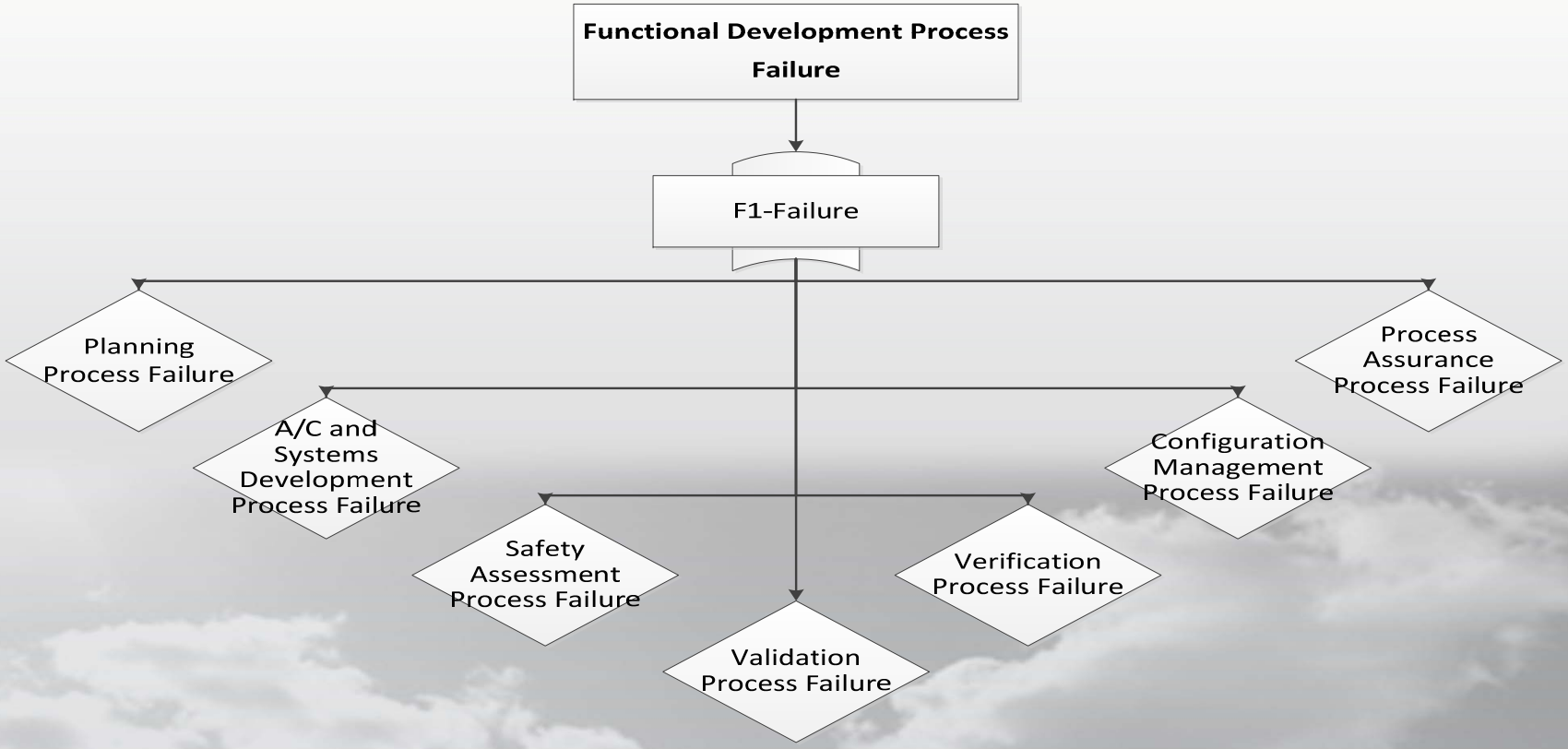
# FUNCTIONAL DEVELOPMENT PROCESS FAILURE





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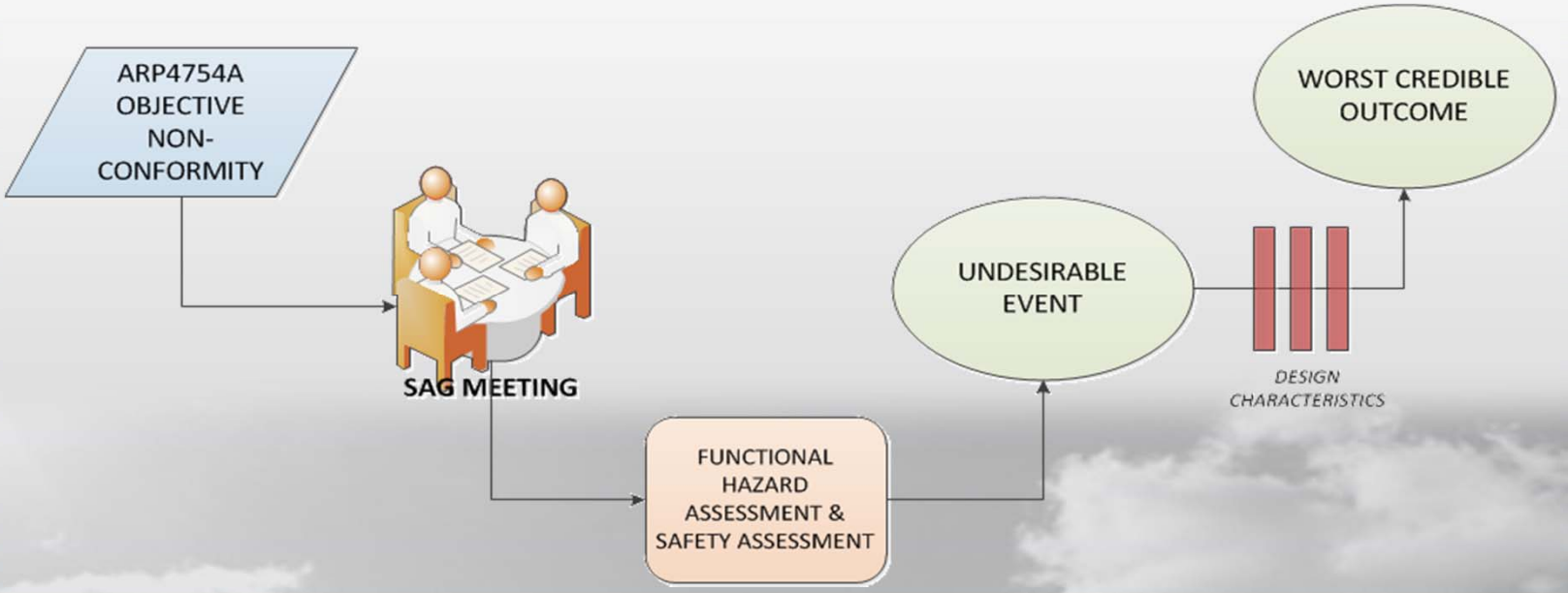
# BOWTIE IN DESIGN PROCESS





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# Case Study

- AIR1401 Auxiliary Power Unit Battery Fire / Japan Airlines Boeing 787-8, JA829J / Boston, Massachusetts / January 7, 2013


*Reference : NTSB/AIR-14/01 Aviation Incident Report*





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Case Study

# CASE STUDY

On January 7, 2013, about 1021 eastern standard time, smoke was discovered by cleaning personnel in the aft cabin of a Japan Airlines (JAL) Boeing 787-8, JA829J, which was at parked stage.

Shortly afterward, a mechanic opened the aft electronic equipment bay and found heavy smoke coming from the lid of the APU battery case and a fire with two distinct flames at the electrical connector on the front of the case.

*Reference : NTSB/AIR-14/01 Aviation Incident Report*





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# CASE STUDY

- From the report

'*ARP 4754A provides a structured process for managing and validating assumptions with steps that include ensuring that assumptions are explicitly stated, appropriately disseminated, and justified by supporting data*

*Development testing is often necessary to validate important design assumptions, but the nail penetration test performed by GS Yuasa did not adequately account for a number of factors that were relevant to propagation risk.*

*For example, the test was not conducted at the battery's maximum operating temperature of 158ºF, and the test setup did not fully represent the battery installation on the 787 airplane.137 Also, the test did not include repeated trials of inducing thermal runaway of a cell in multiple batteries to understand how the repeatability of these tests could impact the validity of the test results. Further, the test was performed using a development unit that did not incorporate the final battery design certified as part the 787 type design'*

*Reference : NTSB/AIR-14/01 Aviation Incident Report*





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# CONCLUSION

- This is just the beginning for SMS in design even system safety is there for years.
- Error in design processes can lead product safety weaknesses and eventually that may lead serious incidents.
- Design process effectiveness and problems must be monitored and measured. The output of this assurance process is an important mean to detect latent conditions in design.





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# CONCLUSION

Besides, in order to reveal latent conditions in design processes and increase product safety the following SMS basics should be in placed as for other aviation services;

- a reporting system (encouraged by top management),
- a risk management process for the product life-cycle (concept to disposal),
- a lessons learned system(sharing risks and experiences),
- a safety culture (promoting safety with training and communications).





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