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Indra Deimos

25/03/2025

Introduction of Mission and Safety Assurance (MSA) concepts with AMA approach

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ALTER | esa

ACCEDE | ESCCON

2025

Seville - Spain

25 to 27th March

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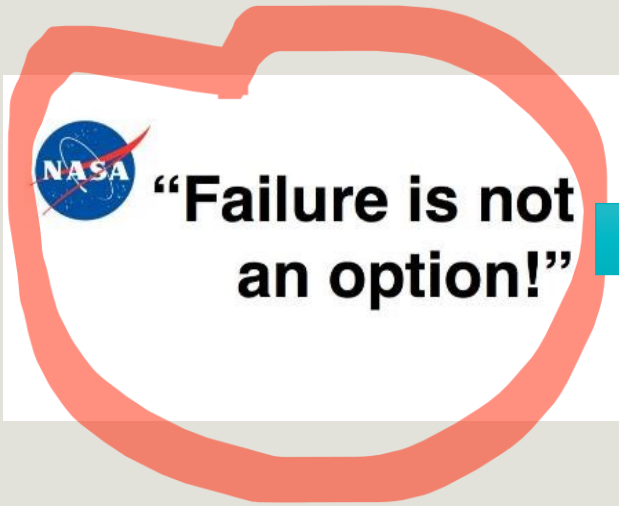
01

Introduction

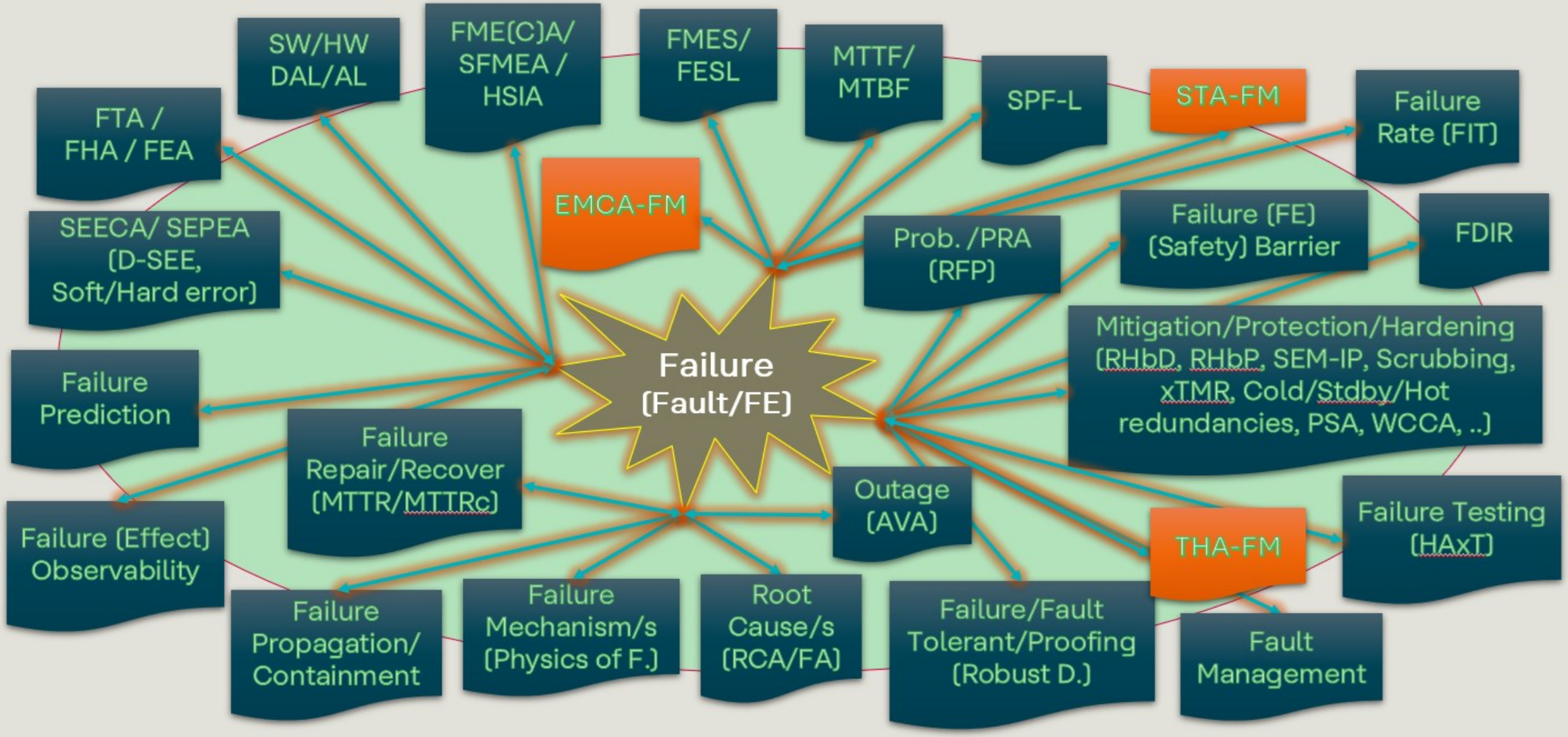
Failure is (not) an option ??



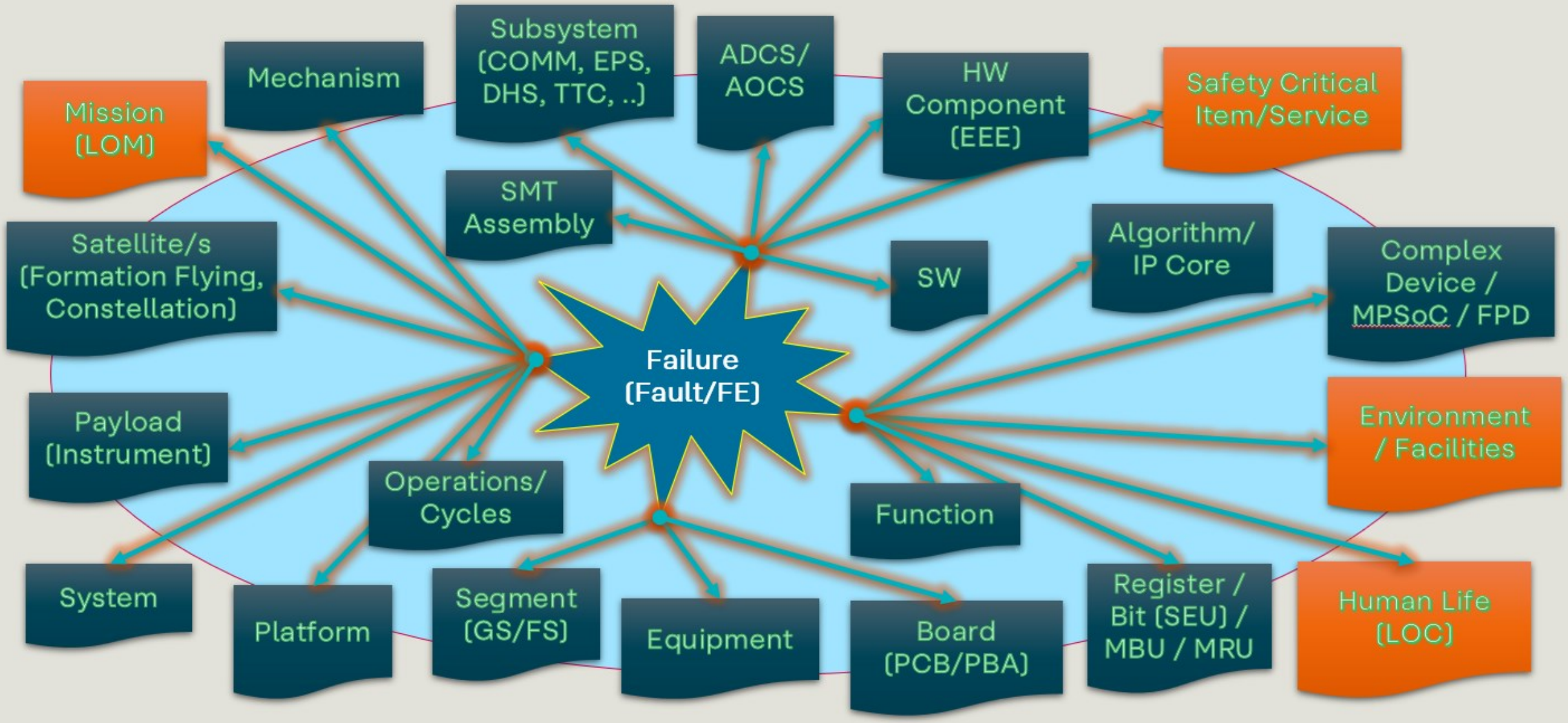
#FailureIsNotAnOption was probably never said during Apollo 13 by NASA - National Aeronautics and Space Administration.

Apart from different interpretations, #FromFailureWeLearn could be another valid and suitable tag for past, current and future missions!!

“Failure-centric” Disciplines, Methods, Artifacts, Tools & VM’s



“Failure” (Fault / FE) Management: Effects at different levels (crit.)



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02

Mission Success vs Mission Assurance

Mission & Safety Assurance (MSA) along Phases (Failure management & REX/LL)

Mission M1

Phase 0 Mission Analysis & Identification

Phases A+B+C+D Feasibility, Preliminary & Detailed Definition, Qualification & Production

Phase E Utilization (OPS & FDIR)

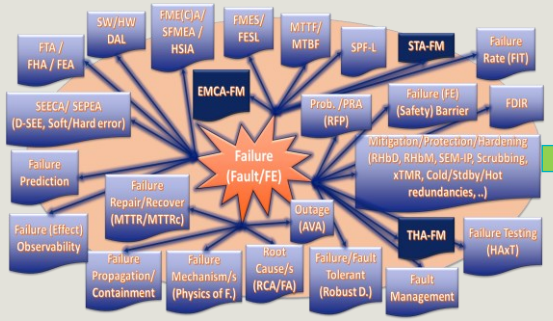
Phase F Disposal (EoM)

REX / LL DB

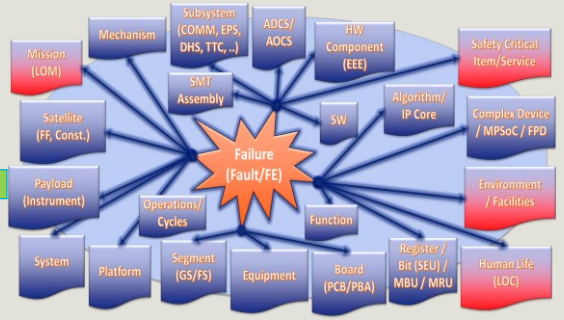
Mission M1+n

Mission Assurance (i.e. Mission Success !!)

- ✓ Defined/Consolidated at different Phases (Operational and Non-Op, BOL to EOL)
- ✓ Adapted to mission CLASS & needs
- ✓ Continuous evaluation of acceptable "RISK" on each Review (Decision Gates) → f (DATA exch.)
- ✓ Based on Return on Experience / Lessons Learnt
- ✓ Fully dependent on FAILURE (fault/FE) management



"Failure Centric" Disciplines, Methods Artifacts, Tools & VM's



Failure / Fault / FE Management

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03

Adaptative Mission Assurance (AMA) Approach

Failure “AS AN” Option (NASA AMA APPROACH) – 1 (Intro)

Adaptive Mission Assurance (AMA) – A Conceptual Guide for NASA Missions (ATR-2023-01224)

- ❑ **“Failure” is not always the opposite of “Mission Success”**
- ❑ **“Failure” is useful to learning** since the whole reason organizations test, experiment, and demonstrate concepts and technology is to learn.
  - ➢ **Class D missions (NASA)** are typically research & development, science and technology, or technology demonstrations for maturing technology on a roadmap to full operational use.
- ❑ A **traditional (requirements-driven) mission assurance mindset** that insists “failure is not an option” is still valid for missions that are highly risk intolerant.
- ❑ **Constraints-driven missions**, however, must adopt a mindset that accepts risk and some probability of failure

Failure “AS AN” Option (NASA AMA APPROACH) – 2 (RD vs CD)

Adaptive Mission Assurance (AMA) – A Conceptual Guide for NASA Missions (ATR-2023-01224)

- **requirements-driven mission** where strict performance, and risk requirements drive cost and schedule.
  - ✓ These missions can adjust cost and schedule for achieving the lowest risk possible while delivering highly specified performance

- **constraints-driven mission** where strict cost and schedule constraints drive performance and risk.
  - ✓ These missions must tune performance and risk for staying within acceptable cost and schedule while still achieving mission objectives.

Failure “AS AN” Option (NASA AMA APPROACH) – 3 (Agile Manifesto)

Adaptive Mission Assurance (AMA) – A Conceptual Guide for NASA Missions (ATR-2023-01224)

- ❑ The AMA approach is derived from “Agile” concepts as defined in the Agile manifesto and principles.
- ❑ AMA relies on knowledge from experience, decisions based in observations, and lean thinking which strives to reduce lower value tasks while focusing on the essentials.
- ❑ AMA is not intended as an additional layer of activity but rather a different way of approaching the same tasks that are already part of any mission development process
- ❑ AMA employs a different mindset with several essential points of view that distinguish it from a typical mission assurance approach.

The Agile Manifesto

for Mission Assurance

We are committed to understanding how to best improve chances of mission success for all types of missions. Through this work we have come to value:

Individuals and interactions over processes and tools

Mission Success over comprehensive documentation

Stakeholder collaboration over prescriptive requirements and checklists

Responding to change over following a plan

That is, while there is value in the items on the right, **we value the items on the left more.**

Failure “AS AN” Option (NASA AMA APPROACH) – 4 (12 Agile principles)

Adaptive Mission Assurance (AMA) – A Conceptual Guide for NASA Missions (ATR-2023-01224)

Mission Assurance [NPR 8715.3]

Providing increased confidence that applicable requirements, processes, and standards for the mission are being fulfilled.

The 12 Agile Principles

for Mission Assurance (MA)

1. Our highest priority is mission success through early and continuous delivery of the most valuable mission assurance activities.
2. Change is inevitable, even late in the development. An agile approach to MA embraces change for learning, discovery, and competitive advantage
3. Monitor results, revisit planning, and update risk frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale.
4. Program, institutional, and mission team representation must work together daily with a preference to face-to-face interaction
5. Build projects around motivated individuals. Give them the environment and support they need and trust them to get the job done.
6. The most efficient and effective method of conveying information to and within a mission team is face-to-face conversation.
7. A continuous consensus understanding of what constitutes mission success and risk among stakeholders is the primary measure of progress.
8. Agile processes promote optimal mission assurance within constraints. Programs, functional groups and the mission team should be able to maintain consensus on optimal, achievable MA for limited budgets, resources and time.
9. Continuous attention to technical excellence and good systems engineering enhances agility.
10. Simplicity—the art of maximizing the amount of work not done—is essential.
11. The best opportunity of success for constraints-driven, risk tolerant missions emerges from self-organizing teams.
12. At regular intervals, the mission team reflects on how to become more effective, then tunes and adjusts its behavior accordingly.

Mission Assurance tailored to Mission CLASS

ESA's Product Assurance and Safety (PA&S) engineers are responsible for **failure-proofing missions** by ensuring that the materials, mechanical parts, processes and electrical components used to assemble a spacecraft or launcher shall be fit for purpose over the entire life of a mission.

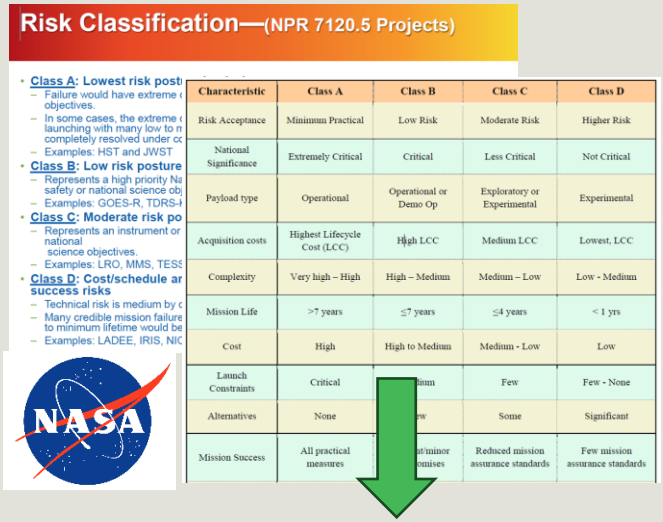
Mission Assurance Process Matrix [NPR 8705.6]
The mission assurance process matrix is constructed to identify program life cycle assurance agents and specific assurance activities, processes, responsibilities, accountability, depth of penetration, and independence. The matrix includes **key assurance personnel in Engineering, Manufacturing, Program Management, Operations, and SMA (Safety & Mission Assurance).**

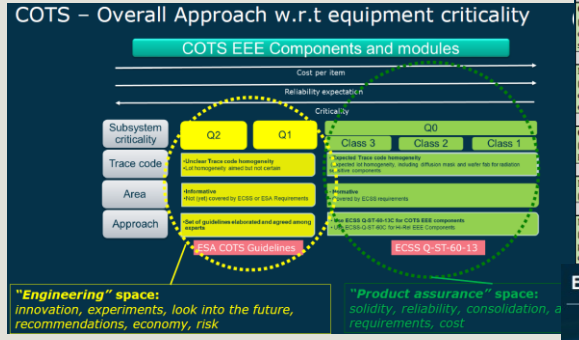
Mission Assurance is supported by multidisciplinary engineering & managerial disciplines (EEE+RAMS+RHA+PA/QA+SE+CADM+RM+...) with "exchanges" (Physical/Logical deliverable items) on each Phase and **"adapted" (tailored) to Mission CLASS**

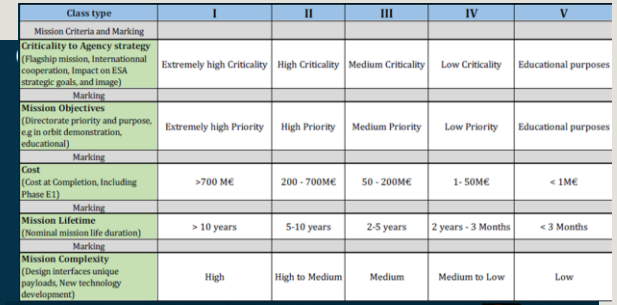
“Adaptative” INDRA-DEIMOS Mission Q-Classes

ThalesAlenia Space
a Thales / Leonardo company

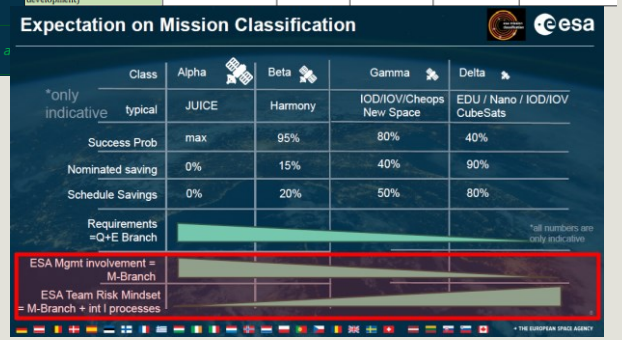
- Low End Missions
- Medium End Missions
- High End Missions







Class type	I	II	III	IV	V
Mission Criteria and Marking					
Criticality to Agency strategy (Flagship mission, International cooperation, Impact on ESA strategic goals, and image)	Extremely high Criticality	High Criticality	Medium Criticality	Low Criticality	Educational purposes
Marking					
Mission Objectives (Directorate priority and purpose, e.g in orbit demonstration, educational)	Extremely high Priority	High Priority	Medium Priority	Low Priority	Educational purposes
Marking					
Cost (Cost at Completion, Including Phase E1)	>700 M€	200 - 700M€	50 - 200M€	1- 50M€	< 1M€
Marking					
Mission Lifetime (Nominal mission life duration)	> 10 years	5-10 years	2-5 years	2 years - 3 Months	< 3 Months
Marking					
Mission Complexity (Design interfaces unique payloads, New technology development)	High	High to Medium	Medium	Medium to Low	Low



esa
European Space Agency

“Adaptative” INDRA- DEIMOS Mission Q-Classes

Other criteria (MSA)

DEIMOS Class Type	Q-Alpha	Q-Beta	Q-Gamma	Q-Delta	Q-Epsilon
Criticality (for Client or Deimos; Flagship, strategic, impact, priority, etc)	Extremely High	High	Medium	Low	Very Low
Safety (manned, debris, etc)	Very high	High	Medium	Low	Very Low
Cost (for Deimos)	>xxxM€	xxM - xxM€	xxM – xxM€	xxM – xxM€	< xM€
Lifetime	> 10 years	6 – 10 years	3- 6 years	1 – 3 years	< 1 year
Complexity	Very high	High	Medium	Low	Very Low

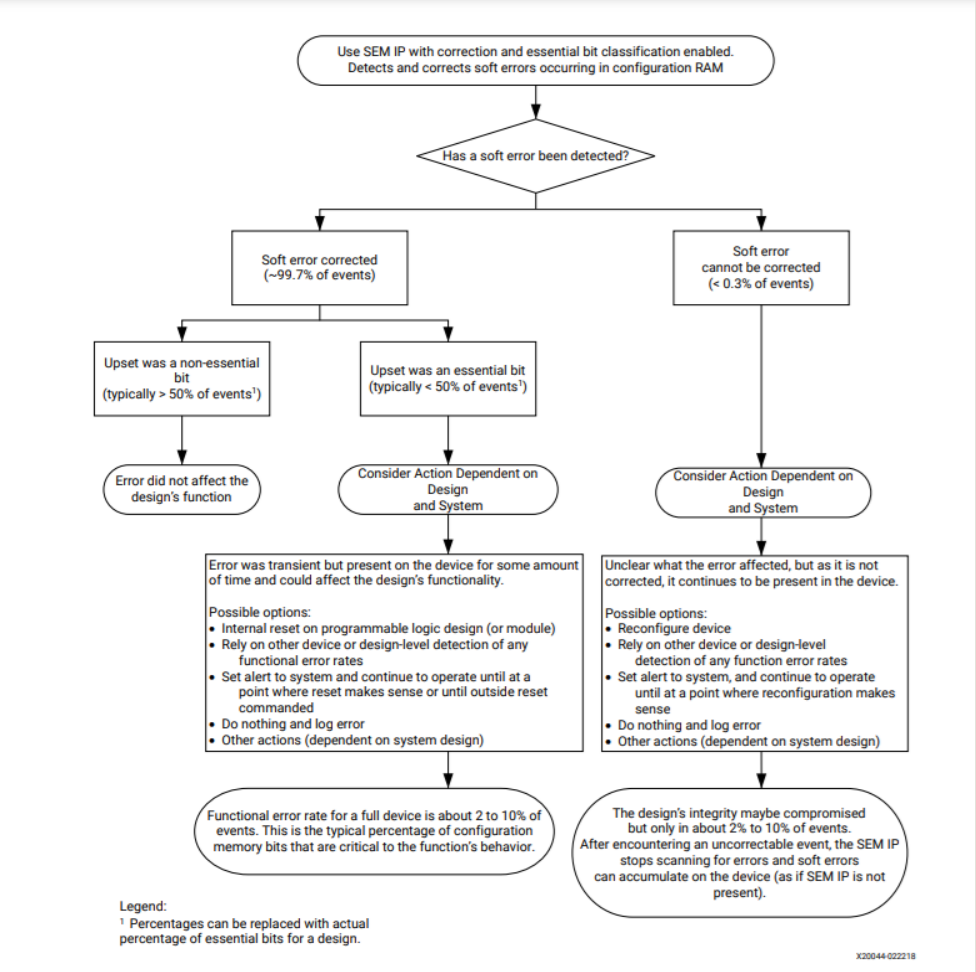
Use Case: Adaptable and Configurable Missions (SDx) with FPD's

- **MSA, MBMA (& MBSA) also can consider "adaptable" and "configurable" mission profiles**

- Current (and future) Missions are introducing **new technical risks, due to flexibility of SW Defined ecosystems, including SW Defined Satellites (SDS)** and other SW defined (SDx) elements (SD Tx-Rx, SD Networks, SD Wireless Networks, SD GNSS Rx, etc), **with onboard "configurability"** (beamforming, cryptography, protections, update of features, OBP, communication profiles, etc)

- Such configurability is based on "state of the art" devices (MPSoC), like **"FPD's" (functional programmed devices)**, which are sensitive to radiation, and require:
  - ✓ Radiation Hardening by Design (RHbD)
  - ✓ Radiation Hardening by Process (RHbP)

- As for SW/HW DAL (criticality levels), the **new** ECSS-Q-ST-60-03C and ECSS-E-ST-20-40C are introducing **criticality at DEVICE level** (i.e. HdS or FPD), which can take benefits of MSA & MBMA/MBSA



*For instance, **Soft Error Mitigation (SEM) IP cores** perform SEU detection, correction, and classification for configuration memory (with "residual" risk requiring actions at FDIR/System level)*

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04

Mission & Safety Assurance (MSA) Domains & Subdomains

MSA: Mission Classes vs Technical Domains / Disciplines (1)

based on "ESA Activities Related To COTS Usage In Space" (F. Tonicello, TEC-E, ESA ESTEC)

ESA	DEIMOS Class	Security (Cyber) & Resilience	Safety Assurance (Mission & System)	Environmental, V&V and Qualification plus CADM	RAMS (incl. RHA & SW/FW)	SOFTWARE/FIRMWARE /IP cores / FPD Assurance (SW DAL)	M&P
Q2 (DELTA)	ENGINEERING "MSA/QA" BASED ESA Mission Classes IV, V NASA Class D (NPR 8705.4A) **DEIMOS Delta, Epsilon (with overlappings)** *Recommendations based on REX/LL and Flight Heritage*	**As per project Security (& Cyber) and Resilience project needs, including Ground and Space segments (wired and wireless communications and sensitive data management)** **Vulnerability & Mitigation Analysis definition (Low)**	**As per project Safety Criticality classification** **Space Sustainability Requirements** **LOW SENSITIVITY**	**As per project QSL and OTS suitability file** **Environmental conditions and Lifetime -> LOW** **EQSR's like reviews**	**"Do not harm" approach** For safety related application, provide the same design features and qualification evidence than for Q 0 items (or not be used) No quantitative dependability requirements to respect. There should be ways to observe failures of critical nature Outage budget should be set **TO AVOID FAILURE PROPAGATION (Safety Barrier by DESIGN)**	SW Criticality levels defined but not mandatory FW to be considered (SW Defined ecosytem for Flight HW) for HdS (HW dependant SW) **SW Defined Satellites (SDS) and EQ --> Minor Coverage**	**"Do not harm" approach** for pure Sn finished parts follow GEIA STD 0005 02 level 1 for PCBs follow IPC 6012E class 3 or higher for soldering, the requirements of IPC J STD 001 class 2 maybe used, class 3 is recommended do not use materials which may cause safety hazards outgassing properties to be controlled if it is a concern
Q1 (GAMMA)	ENGINEERING "MSA/QA" BASED ESA Mission Classes IV, V NASA Class D (NPR 8705.4A) **DEIMOS Gamma, Delta, Epsilon (with overlappings)** *Recommendations based on REX/LL and Flight Heritage*	**As per project Security (& Cyber) and Resilience project needs, including Ground and Space segments (wired and wireless communications and sensitive data management)** **Vulnerability & Mitigation Analysis definition (Mid)**	**As per project Safety Criticality classification** **Space Sustainability Requirements** **MID SENSITIVITY**	**As per project QSL and OTS suitability file** **Environmental conditions and Lifetime -> MID**	**"Do not harm" approach** For safety related application, provide the same design features and qualification evidence than for Q 0 items (or not be used) Quantitative dependability recommendations (FIDES approach) There should be ways to observe failures of critical nature Autonomous recovery **Robust FDIR at system level** **Autonomous functions to be listed & tested** **TO AVOID FAILURE PROPAGATION (Safety Barrier by DESIGN) and Robust FDIR (Failure Containment)**	SW Criticality levels defined but not mandatory FW to be considered (SW Defined ecosytem for Flight HW) for HdS (HW dependant SW) **SW Defined Satellites (SDS) and EQ --> Medium Coverage**	**"Do not harm" approach** for pure Sn finished parts follow GEIA STD 0005 02 (at least control level 2B) for PCBs see document annex 5 for soldering, document annex 6 do not use materials which may cause safety hazards outgassing properties to be controlled if it is a concern DML, DPL and DMPL provision
Q0 (ALPHA, BETA)	MSA & PA "SPACE" (with MSA/PA/QA Engineering) ESA Mission Classes I, II, III NASA Classes A, B, C (NPR 8705.4A) **DEIMOS Alfa, Beta, Gamma (with overlappings)** *Full Requirements Traceability*	**As per project Security (& Cyber) and Resilience project needs, including Ground and Space segments (wired and wireless communications and sensitive data management)** **Vulnerability & Mitigation Analysis definition (High)**	**As per project Safety Criticality classification** **Space Sustainability Requirements** **HIGH SENSITIVITY**	**As per project QSL and OTS suitability file** **Environmental conditions and Lifetime -> HIGH**	As per applicable ECSS RAMS standards **TO AVOID SPFs (Redundancy implemented in different ways) and FAILURE PROPAGATION (Safety Barrier by DESIGN) in different DOMAINS with Robust FDIR (Failure Containment)** **Full RAMS-REQ coverage**	Criticality levels (DAL) depending on Project Requirements SCAR and related ISVV activities (based on DAL/Crit. Definitions) **SW Defined Satellites (SDS) and EQ --> High Coverage**	As per applicable ECSS M&P standards For pure Sn finished parts follow GEIA STD 0005 02 (control level 2C) Assembly processes verification for Q0 class 3 should comply with the approaches defined in document Annex 6

MSA: Mission Classes vs Technical Domains / Disciplines (1)

based on "ESA Activities Related To COTS Usage In Space" (F. Tonicello, TEC-E, ESA ESTEC)

		Radiation Hardness Assurance (RHA)			
ESA	**DEIMOS Class**	**TID/TNID**	**SEE**	**Supply Chain (Supplier) QA Procurement aspects**	**SLA, Application & Peer Reviewing**
Q2 (DELTA)	ENGINEERING "MSA/QA" BASED ESA Mission Classes IV, V NASA Class D (NPR 8705.4A) **DEIMOS Delta, Epsilon (with overlappings)** *Recommendations based on REX/LL and Flight Heritage*	Radiation analysis to be provided If TIDL < 5KRad (Si) then untested COTS may be used Warning for components sensitive below 5KRad limit Reliance on design robust to TID parametric drifts TNIDL to be calculated for opto devices strong advice to test optoelectronic components for TNID in proton rich environments	Radiation analysis to be provided SEE experimental verification recommended, not required, with high energy protons strong reliance on SEE mitigation techniques at design level	Procure from official distributors only and directly from manufacturers if possible Procure complete reels of components - Keep traceability to date codes, aim for lot homogeneity. - Check of datasheet information by test for critical parameters Apply deratings equal or in excess of Q 0 standards, even though formal delivery of PSA is not required Consider degradation effects on WCA parameters (apart ageing, but taking into accout typical or specific effects of radiation), even though formal delivery of WCA is not required	Check of datasheet information by test for critical parameters Apply deratings equal or in excess of Q 0 standards, even though formal delivery of PSA is not required Consider degradation effects on WCA parameters (apart ageing, but taking into accout typical or specific effects of radiation), even though formal delivery of WCA is not required Apply design mitigation techniques at component, module/board and system/subsystem level to avoid radiation effects and random failures (lots of information provided in the document) Resort to reference application circuits SLA not defined or with LOW criticality Peer Reviews are essential (decission gates) for RISKS acceptance (based on NASA Class D criteria) **EQ (Engineering/Design Quality) Review --> HI**
Q1 (GAMMA)	ENGINEERING "MSA/QA" BASED ESA Mission Classes IV, V NASA Class D (NPR 8705.4A) **DEIMOS Gamma, Delta, Epsilon (with overlappings)** *Recommendations based on REX/LL and Flight Heritage*	Radiation analysis to be provided TID/TNID tests on components unless 3x margin can be demonstrated at board/module level If TIDL exceeds 5 KRad (Si), test according to ESCC 22900 If TNIDL exceeds 2E11 p/cm2 50 MeV equivalent proton fluence , test bipolar technologies according to ESCC 22500 Test Optoelectronic in any case according to ESCC 22500 Specific ERCB (Equipment Radiation Control Board) to be done	Radiation analysis to be provided If the EEE components can be delidded and the chip exposed, test for SEE heavy ion, otherwise test with high or very high energy HI facilities if the above cannot be done, test at least with high energy protons SEE tests at component or board/module level The following SEE LET threshold (LETth) acceptance levels should be * For any SEE effects (destructive and non destructive): LETth > 38 MeV.cm²/mg: EEE components or board is accepted (cont.. in previous) - The LETth levels as described above should be revised for EEE components made of a material other than Silicon (i.e. GaAs, GaN , SiC , The effectiveness of any SEL mitigation to be demonstrated during irradiation tests. **Specific URCB (Unit RCB) or ERCB (Equipment Radiation Control Board) to be done, linkded to RAMS**	Procure from official distributors only and directly from manufacturers if possible Procure complete reels of components - Keep traceability to date codes Aim for lot homegeneity and as needed check for procured lot (marking, visual, X ray, sample measurements) Re lifing possible following ECSS Q ST 60 14	Check of datasheet information by test for critical parameters Apply deratings equal or in excess of Q 0 standards Delivery of PSA Consider degradation effects on WCA parameters (including ageing, and taking into accout typical or specific effects of radiation) Delivery of WCA Apply design mitigation techniques at component, module/board and system/subsystem level to avoid radiation effects and random failures (lots of information provided in the document) Resort to reference application circuits Special provisions for COTS modules SLA not defined or with MID criticality Peer Reviews are essential (decission gates) for RISKS acceptance (based on NASA Class D criteria) **EQ (Engineering/Design Quality) Review --> MID to HI**
Q0 (ALPHA, BETA)	MSA & PA "SPACE" (with MSA/PA/QA Engineering) ESA Mission Classes I, II, III NASA Classes A, B, C (NPR 8705.4A) **DEIMOS Alfa, Beta, Gamma (with overlappings)** *Full Requirements Traceability*	As per applicable ECSS and ESCC TID/TNID standards	As per applicable ECSS and ESCC SEE standards	As per applicable ECSS and ESCC standards - Traceability of EEE components should be ensured between the parts subjected to evaluation, screening and lot tests on ground and the ones that are used for flight purposes	Check of datasheet information by test for critical parameters Apply deratings as per relevant ECSS standard Delivery of PSA Consider degradation effects on WCA parameters (including ageing, and taking into accout typical or specific effects of radiation) WCA to be done following relevant ECSS handbook Delivery of WCA Apply design mitigation techniques at component, module/board and system/subsystem level to avoid radiation effects and random failures (lots of information provided in the document) Resort to reference application circuits No COTS modules in Q0, the adoption of COTS parts is controlled at EEE components only SLA Defined with HIGH criticality (monitoring) Peer Reviews are essential (decission gates) for RISKS acceptance, but supported by Regular ones **EQ (Engineering/Design Quality) Review --> LOW to MID or MID to HI as is compensanted by xPCBs**

MSA: Technical Domains and Subdomains coverage by QSL (Qualification Status List) & EQSR framework

Date:				
Filled by:				
Document/s & Reference/s				

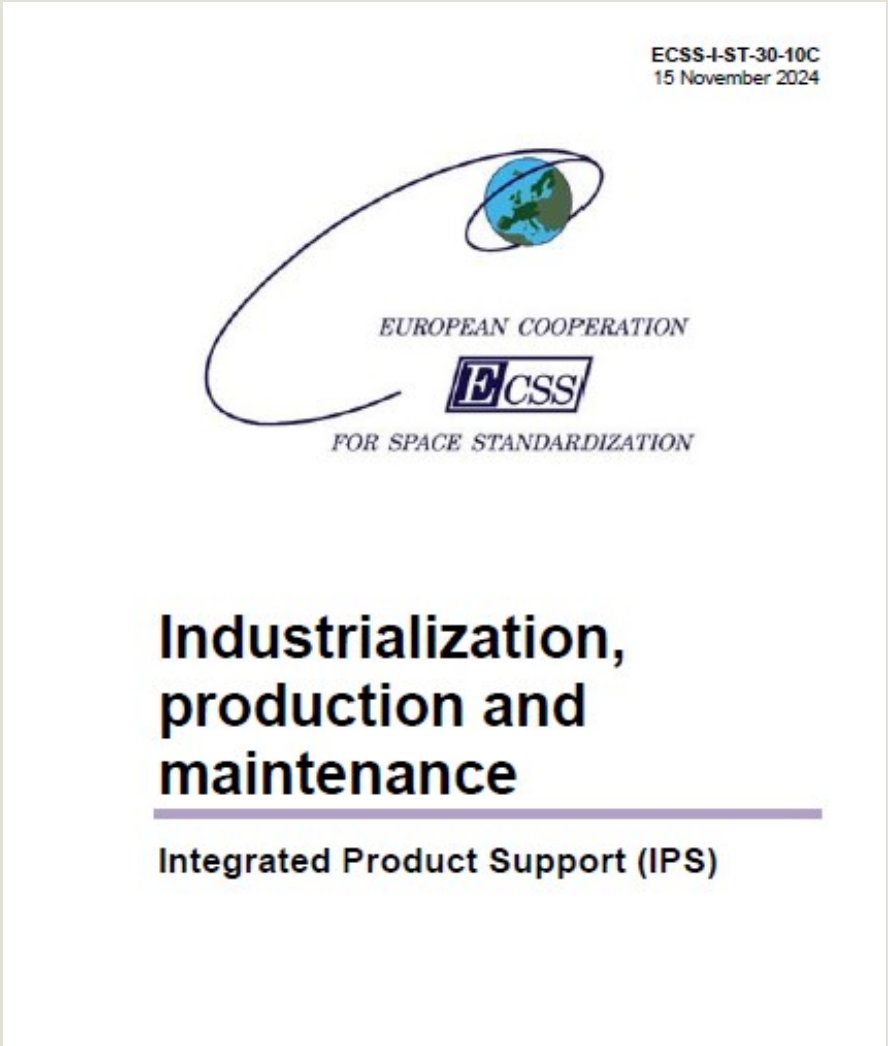
Qualification Status Summary (Qualification & Acceptance levels)		**Equipment-Item Description & P/N:** **Manufacturer:**		
Domain	**Subdomain**	**Levels on OTS/Reused items**	**Project Requirements**	**Remarks / Reports / Justifications**
Thermal				
	Operational			
	Non-Operational			
	Other			
Structural				
	Sine/Modal Survey			
	Vibration			
	Shock			
	Other			
	(Microvibrations)			
EMC				
	CE			
	CS			
	RE			
	RS			
	ESD			
	Inrush			
	Isolation			
	Grounding			
	Other			
Radiation (& RHA)				
	TID Tests			
	TNID (DD) Tests			
	SEE (HI/Proton) Tests			
	Radiation Analysis			
	Other			
EEE parts				
	DCL			
	PCB approval status			
	Use of COTS			
	Other			
MMPP				
	DML			
	DMPL			
	DPL			
	MPCB approval status			
	Other			
RAMS				
	REA			
	FMEA/FMECA			
	WCA			
	PSA			
	Hazards Analysis			
	Other			

INDRA-DEIMOS pre-QSL Template (example)

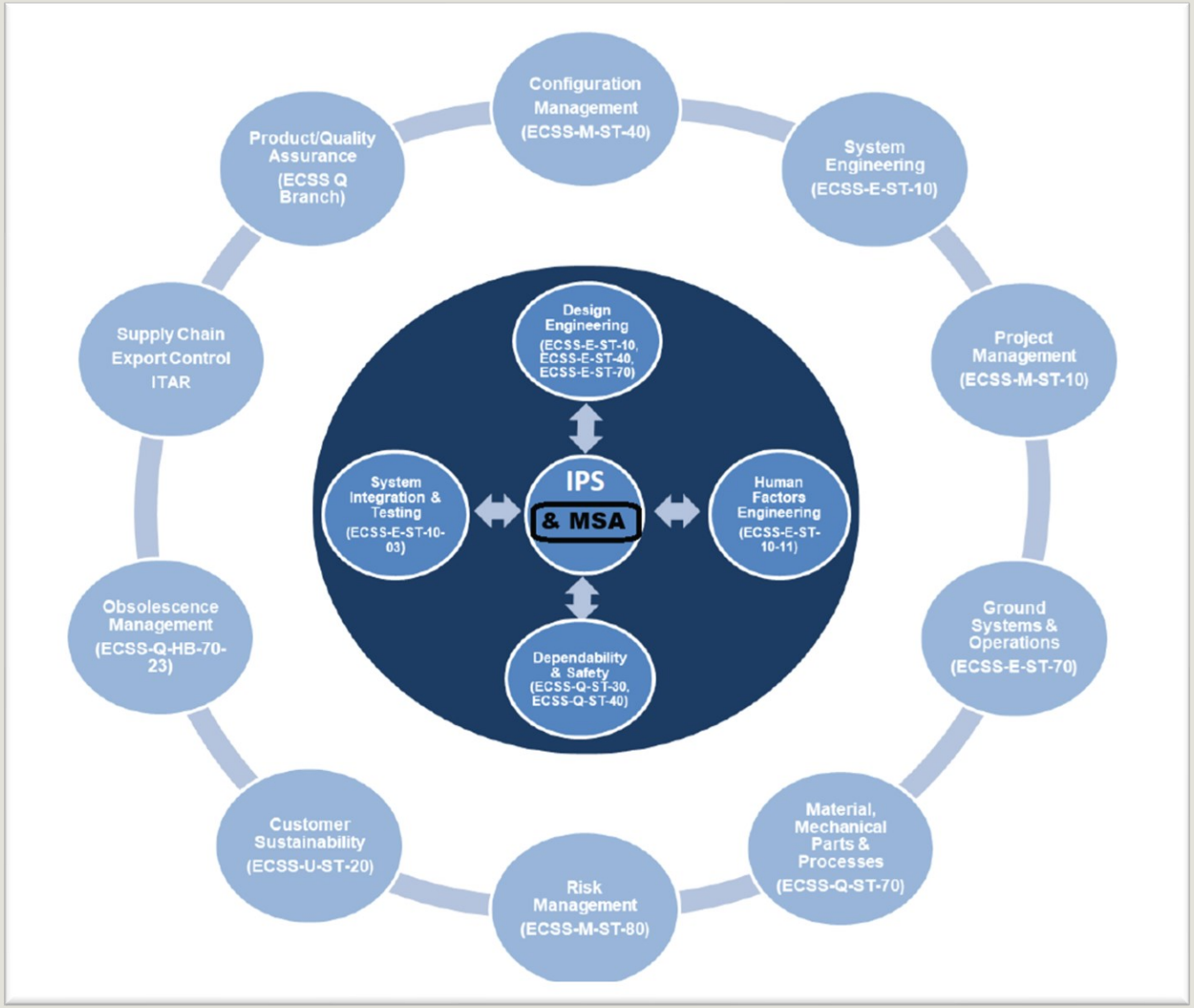
PA				
Critical Item List	CIL			
Long Lead Item List	LLIL			
Qualification Status List	QSL			
Product Assurance Plan	PAP			
	Other			
QA				
Manufacturing & Inspection/s Flowchart	MIFC			
Key/Mandatory Inspection Point	KIP-MIP plan			
Cleanliness & Contamination Control Plan	CCCP			
	EIDPs			
	OTHER			
SW/FW/IP/FPDs (check EEE)				
	SCAR (SW Criticality)			
	SW Reusability File			
	SFMEA			
	Other SW PA/Engineering			
Flight Heritage				
	Years			
	Hours			
	Anomalies in representative environment			
	Mission type			
	OTHER			
Lifetime				
	Years			
	Other			
Other Qualification Status inputs				
	Certifications			
	Suppliers or Subcontractors			
	Any other input/s			
Equipment CATEGORY/TRL				
	Category			
	TRL			
	Other			
Qualification STATUS (Q, I, TBQ)				
	Status			
	Schedule			
	Development models			
	Risk/s			
	Comments			

MSA: Relation with Industrialization & IPS (1)

- Mission & Safety Assurance (MSA) also linked to Industrialization
- Specially for Constellation-type products with specific requirements and needs, based on IPS (Integrated Product Support)
- Connection with PLM/PDM, ERP, EDA & In-Operation monitoring tools is mandatory
- New ECSS “I” (Industrialization) branch still under development (ST & HB under review process) with similar transversal coverage for multiple disciplines and domains
- P.I.D. (company level) is fully connected with REACH (& related ones), Ecodesign and Sustainable Products Regulation (EU-2024/1781) processes and their interactions for space materials and processes



MSA: Relation with Industrialization & IPS (2)



- Mission & Safety Assurance (MSA) and IPS (Integrated Product Support) have common transversal relationships
- Links with same ECSS Branches:
  - M → Management
  - E → Engineering
  - Q → Product Assurance
  - U → Sustainability
- Suitable for Model Based framework & Digital Twins implementation

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05

Conclusions

Conclusions (1)

- Continuous and **big transformation** in the way **different products** (from complex devices, IP-Cores, Software, Boards, Equipment, Subsystems, Payloads, Instruments, Spacecrafts to End to End systems) **and/or Services can be "qualified"** (or "certified")

- Essential to **ensure missions with different profiles** (**Traditional**, manned or unmanned, or **New-Space** ones) are successful, considering characterization of functionality and technical performances in different domains, selecting or defining subsets or adaptations ("tailoring") of potentially applicable requirements in **Mission and Safety Assurance (MSA)** disciplines:
  - ✓ RAMS (Reliability, Maintainability, Availability and Safety) and other "transversal" ones
  - ✓ CyberSecurity & Security
  - ✓ Product assurance & Risk evaluation
  - ✓ Quality Assurance & Manufacturing
  - ✓ EEE **parts engineering (COTS selection criteria well defined and balanced)**
  - ✓ Radiation Hardening assurance (RHA)
  - ✓ Design assurance & Engineering quality
  - ✓ Quality of Design/QoD and SW Quality metrics
  - ✓ Supply chain QA, Procurement (**OTS SW/Unit Suitability**), Requirements Management, etc

- but **keeping technical** (including margins policy based on maturity/reusability)**, schedule and cost budgets (design-to-cost) objectives**

Conclusions (2)

- An earlier and **extensive evaluation and categorization of the possible risks and balanced mitigation actions** (as part of Risk Management process) is crucial

- Selection of **more relevant (or essential) requirements, their categorization and weight** (for instance, as contribution to Mission Success) and their verification

- To **ensure mission with different profiles** (duration, complexity, environment, budget, objectives, etc) can be **successfully completed, taking benefits of "State-of-the-art" devices and other disruptive technologies**, will be necessary to assess
  - ✓ the **use of consolidated practices and legacy methods, with other innovative ones,** supported by
  - ✓ the definition of some **metrics (or key indicators)** to permit qualification acceptance, authorization for flight or respective end-to-end (E2E) system deployment (considering sustainability, functionality, reliability, security and safety aspects), further operation and final disposal,
  - ✓ with application of a **so-called AMA (Adaptative Mission Assurance) approach**


Thanks you for your attention!!