The selection, procurement and use of commercial components (including automotive) in space applications

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DEFENCE AND SPACE

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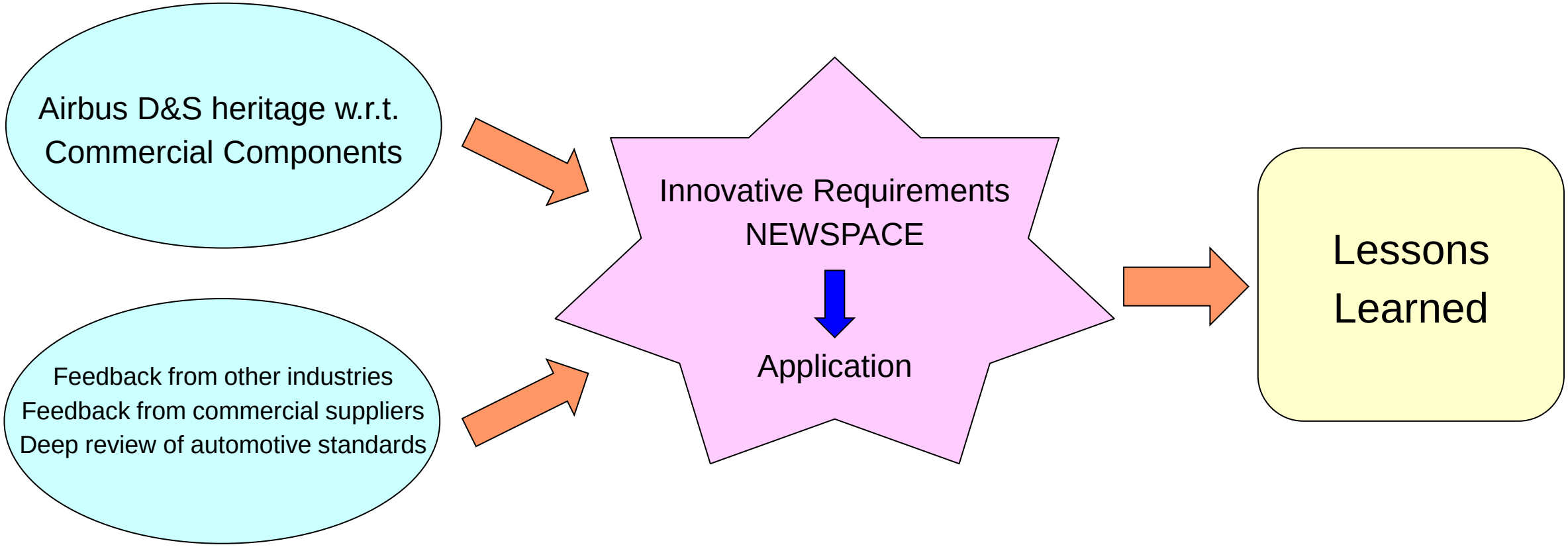
What is today presented



Agenda

1. Heritage (use of commercial components)
2. Strategy for definition of Airbus D&S Newspace EEE parts requirements
3. Airbus D&S Newspace EEE parts requirements
4. Ratio of use of AEC-Q components at system level
5. Airbus D&S lessons learned before launch

1. Heritage (use of commercial components)

Commercial EEE parts in European space systems is already **a reality since 15 years !**

- Airbus-D&S programs : commercial EEE parts introduced in earth observation programs since 2004.
- CNES programs : more than 20 programs (class 1 to 3) including commercial EEE parts.
- ESA programs : several programs (including class 1), already use commercial EEE parts.
- Some concrete examples
  - Ariane 5 : several operational equipment with 80% of active parts in commercial
  - FNP *(class 1)* : 6 microcircuits in commercial
  - Pleïades *(class 2)* : 36 active devices and some passive parts (resistors, capas, connect) in commercial
  - Myriades *(class 3)* : 80% of parts used in OBC in commercial
  - AS250 *(class 2)* : 6 active devices in commercial
  - Gaïa *(class 1)* : 5 microcircuits in commercial
  - Metop-SG *(class 1)* : several microcircuits in commercial

2. Strategy for definition of Airbus D&S Newspace EEE parts requirements

- The constellations programs are not experimental missions (as for cubesat or microsat) but are commercial requiring a high degree of quality/reliability. However, the objective is to find alternatives in term of management, selection, procurement and usage of components in order to access performing components not available in hirel quality level and drastically reduce the cost of ownership of components.

- To this end, the following actions were led :
  - Consideration of ECSS-Q-ST-60-13 requirements *(Space Product Assurance - Commercial EEE components)*
  - Lessons learned exercise from past space experience by ADS with commercial components.
  - Deep technical review of AEC-Q documents (requirements for automotive EEE components).
  - Meetings with several industries dealing with commercial components : Aircrafts (Airbus), Defense (MBDA) and Launchers (AGS).
  - Meetings with several EEE manufacturers (European & US) dealing with commercial components.

- A global approach ! The innovative requirements proposed for Newspace EEE components are deployed and managed together with their mounting processes and tests at board/equipment levels (testability) to meet the mission requirements.

- These innovative requirements are shared and approved with the end customer.

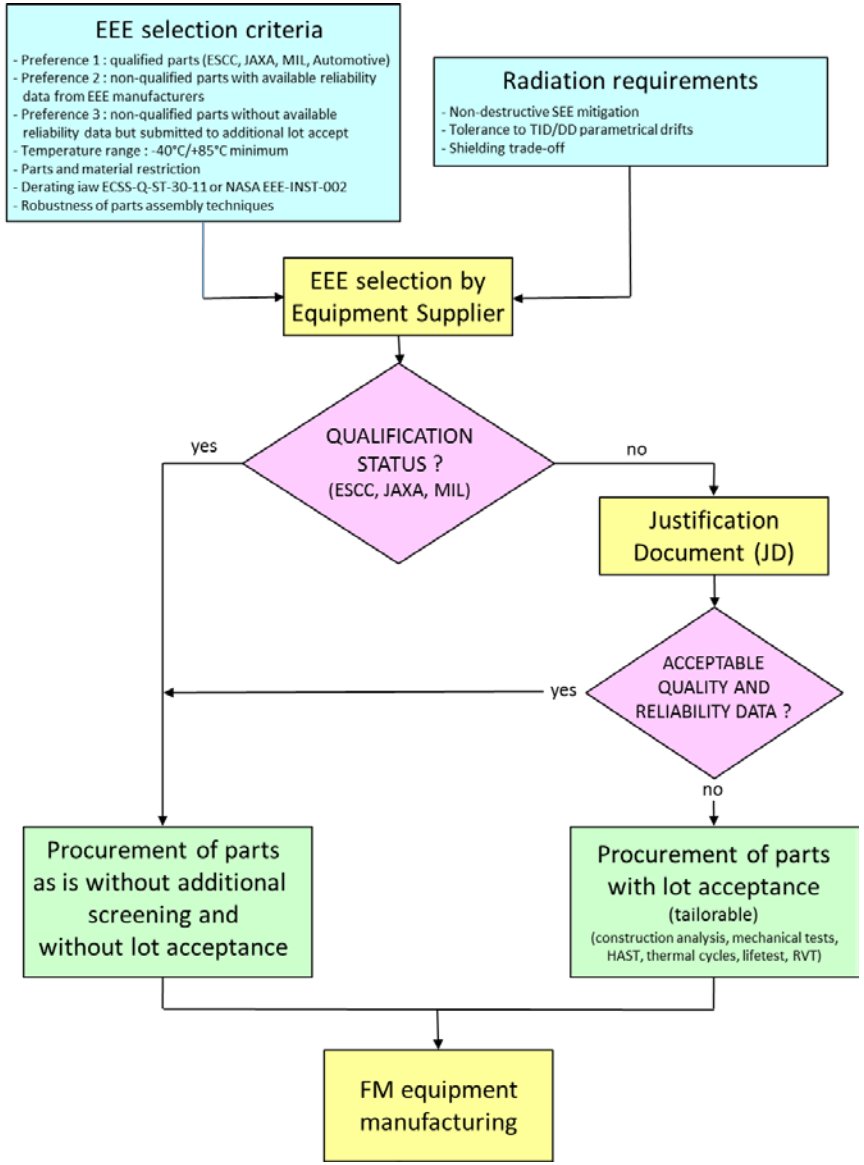
3. Airbus D&S Newspace EEE parts requirements (1/3)

- Simplified management requirements.
- Commercial components (except relays) possible with minimum temperature -40C/+85C.
- Automotive qualified components, supported by JD (Justification Document), may be used as is.
- Other commercial components, supported by JD, may be used provided satisfactory quality/reliability data, possibly supported by lot test.
- Pure tin finished allowed provided JEDEC qualified, not used in power applications and not screwed on board.
- Derating requirements applied (ECSS or NASA requirements)

3. Airbus D&S Newspace EEE parts requirements (2/3)

- Standard radiation requirements (imposing heavy traceability requirements).
- Procurement management rules imposed (franchised distributors and configuration control for non-qualified parts).
- No additional screening for commercial components.
- Uprating not proposed.
- Lot test in absence of valid quality & reliability data.
- Components > 15 years not allowed and storage conditions to be approved by Airbus D&S.
- EEE alerts process applied.

3. Airbus D&S Newspace EEE Requirements – Summary (3/3)



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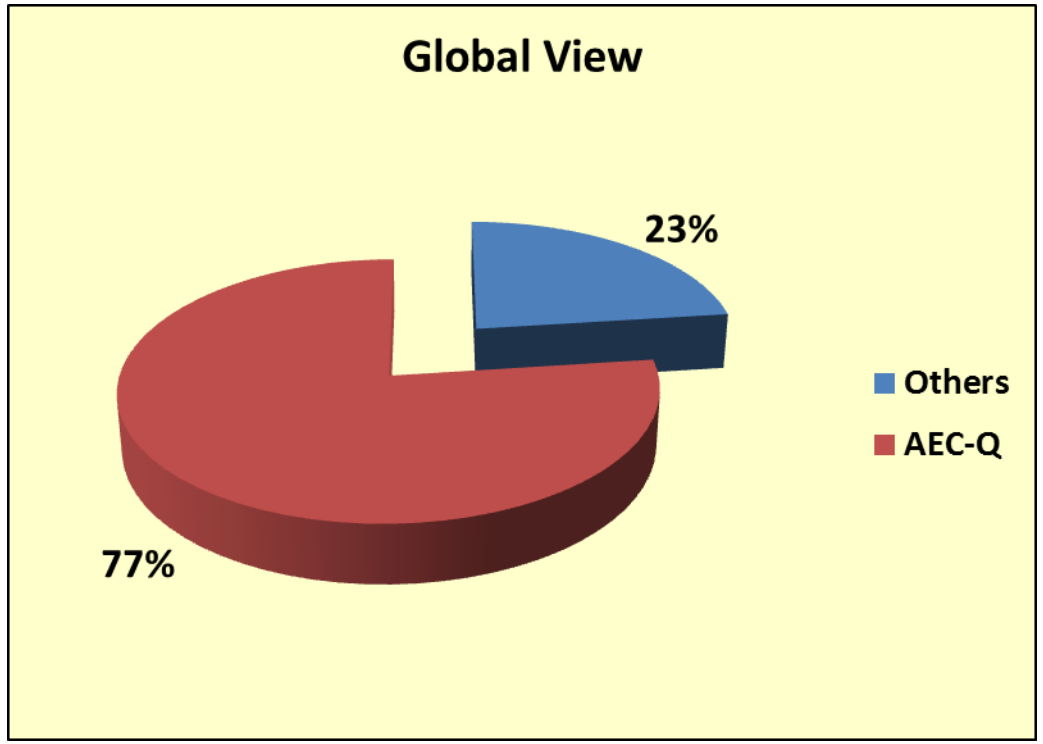
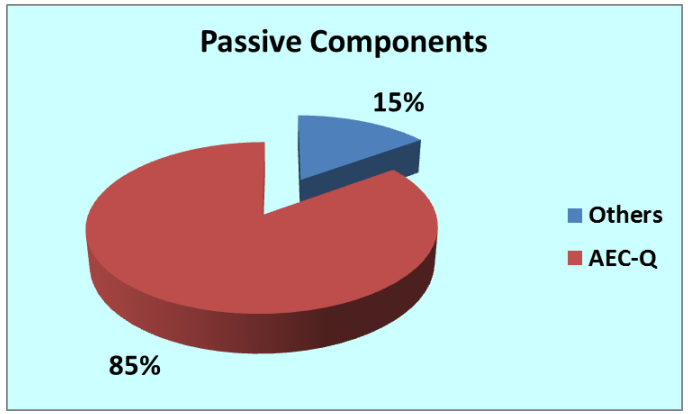
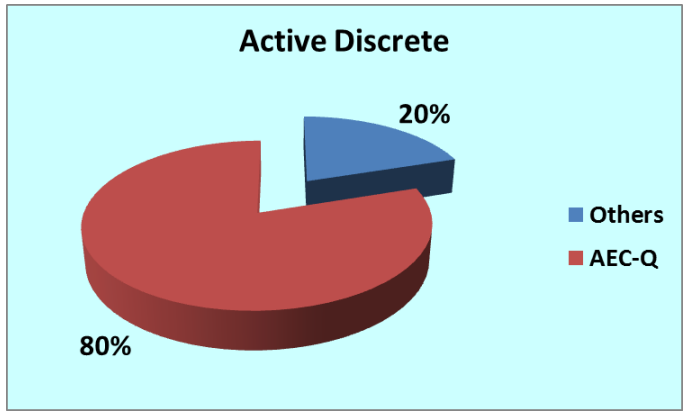
4. Ratio of use of AEC-Q components at system level (concrete achievement)



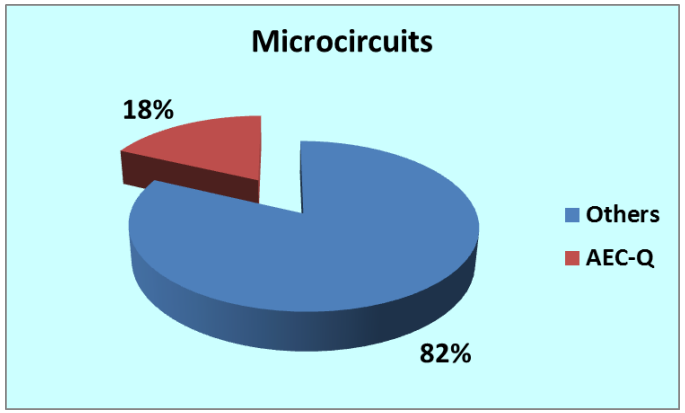
77% of line items used at system level
are automotive qualified (AEC-Q) !



Passive : Large usage of Automotive Components
(>95% of resistors and capacitors, few RF passives)



Active : Very few MOSFETs (due to radiation constraints)
and no RF parts (limited offer)



Microcircuits : Limited number of automotive components
due to radiation constraints.

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5. Airbus D&S lessons learned before launch (1/4)

- **SCREENING**
  - Most of automotive components have no screening (e.g. burn-in).
  - ADS considers the absence of screening as acceptable for automotive parts, based on AEC-Q qualification results.
  - Additional screening at component level may induce more risk (additional handling of components)
    => *screening necessary at board or equipment level.*
  - Screening at board level to be seen as also for mounting.

- **PROCUREMENT**
  - Risk of severe allocations (production booked for years) or shortage with automotive and commercial components.
  - No direct (or very difficult) communication with the EEE manufacturers (only via distributors).
  - EEE manufacturers often put in place mirror plants (without PCN or information) in order to :
    + increase their production in case of (not expected) demand
    + have a redundant fabrication site in case of collapse of nominal plant

- **OBSOLESCENCE & PCN (Product Change Notice)**
  - Turnover of commercial components (including automotive parts) is higher than hirel => obsolescence to be managed.
  - Many PCNs are generated for commercial components (including automotive parts).

  => This requires to be managed, representing additional efforts at subs and prime level => efforts and tools are necessary.

5. Airbus D&S lessons learned before launch (2/4)

- **TESTING OF AUTOMOTIVE COMPONENTS**
  - Dispersion within date code, even with different ones, is very low at ambient, high and low temperatures.
  - Less dispersion with automotive compare to hirel.
  - No huge dispersion between parts even after radiation testing.

- **PURE TIN**
  - Forget the SnPb finish on terminations for commercial (including automotive) parts !
  - Pb free components does not systematically mean “pure tin” components (e.g. SAC305, NiAuPd are more & more common).
  - In case of pure tin, only matte tin to be used (bright tin not allowed).
  - No risk to deal with pure tin if JESD-201 class 2 validated *(remark AEC-Q qualified parts are JESD-201 class 2 qualified)*.
  - When JESD-201 class 2 is not demonstrated, the use of conformal coating is considered as an acceptable risk mitigation.

- **RF COMPONENTS**

  Few RF components are available as AEC-Q qualified parts.

5. Airbus D&S lessons learned before launch (3/4)

- **TRACEABILITY**
  - Tracecode is enough to manage the quality aspects but insufficient to handle radiation requirements.
  - The automotive industry (users) does not manage the traceability at its level (guarantee given by the EEE manufacturers and manufacturer responsiveness is possible due to market size).

- **RADIATIONS**
  - Depending on the environment, radiation requires to be managed per diffusion lot or per wafer fab.
  - A tracecode may include parts from several wafer fabs and several diffusion lots.
  - To manage radiations, traceability is key => following information is needed : die revision, mask set, wafer fab, diffusion lot, assembly lot.
  - So, solutions to use automotive parts are possible but are quite heavy.

- **“EP LIKE” PRODUCTS BRING A SIGNIFICANT ADDED VALUE (compare to AEC-Q)**
  - Guarantee to get traceability.
  - Single wafer plant and assembly site.
  - Qualification similar to AEC-Q.
  - Screening adapted to space needs (if needed).
  - Lower turnover of products.
  - Systematic PCNs.

  => *“ECQL” (Enhanced Commercial Quality Level) could be introduced in ESCC.*

5. Airbus D&S lessons learned before launch (4/4)

More feedback when in orbit

Thank you

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