EEE Space Component Supply Chain Challenges in Europe

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All European Space Agency programmes are dependent on the continuous access to key EEE technologies and manufacturing processes.

A major risk is the increasing obsolescence from within the supply chain.

- Each disruption of the supply chain leads to high requalification costs and subsequent delays to ESA space programme schedules.

The two main drivers of obsolescence issues in Europe today are still:

- **Legal**: “environmental driven legislation” (REACH, RoHS) is reducing dramatically the availability of critical substances in Europe.
  - GaAs, InP, Alodine 1200, Hydrazine, are currently in the pipeline for regulated usage in Europe or total withdrawal from the European Union market.

- **Industrial**: continuous pressure for cost reductions in the terrestrial market leads to continuous restructuring of the industrial supply chain.
  - Space is a niche “low volume” market with a high exposure to changing industrial landscape and has little influence.

Active measures have been put in place in 2004 via European Component Initiative (ECI) to secure the availability of the European EEE-component supply chain.
“Industrial trend towards product based solutions”
- ESA suppliers are increasingly relying on recurring products and platforms.
  - Recurring products and platforms save on the design and manufacturing costs, they also expose European space projects widely to the volatility of the supply chain.
- Evolution of the terrestrial industry is decoupled from the interest of the space industry creating potential obsolescence issues in the space sector.

“Evolution in the regulatory environment is creating serious obsolescence issues”
- New European legislation (REACH/RoHS) is increasingly limiting the usable portfolio of materials and processes for space.
  - Impacting the competitiveness of the European Space industry.
- Legislation is addressing substances of high strategic importance for space which cannot be expected to be solved by the terrestrial industry.
  - Medium term: re-qualify processes,
  - Long term: accelerate alternative technology development.

“Technology gap still exists”
- With strategic activities like GaN and DSM technology development the gap can be reduced.
- In an environment where the cost of access to technology is going up, as mission requirements and technology integration level is increasing, there is a need to secure independent access to critical “building blocks”.
- Need both funding and end-user commitment on key enabling technologies.
The ESA objective is to reduce project risks and costs by:

- **Generating a pool of qualified technology “building blocks”**;
  - by aggregating end user requirements and investing on advance development and qualification of critical technologies.

- **Securing priority access and lower cost to utilise critical technologies**;
  - by performing consolidated advance procurement for technologies under development.

- **Mitigating medium and long term obsolescence issues**;
  - by identifying and accelerating the technology development of potentially obsolete technologies.

- **Mitigating the risk of short term supply chain interruptions**;
  - by identifying and investing on critical suppliers within the supply chain.
The European Components Initiative.....

1. Aims at maintaining and enhancing a European industrial base for critical technologies needed by Europe’s space missions.

2. Exists to reduce the dependence of Europe’s space sector on non European component suppliers, by focusing on one of the building bocks of space missions – Electrical, Electronic and Electromechanical (EEE) components.

3. Increases the availability of European EEE components used in European space missions by developing capabilities to manufacture and qualify critical technologies within Europe.

4. ECI has in the last years managed to start turning Europe from a net importer of components slowly into an exporter. – but we still have a long way to go.
ECI Phase 3
“Providing access to strategic components and technologies”
Identified Key Technologies for ESA (EEE 2020 Roadmap)

- Space qualified supply chain for **65nm Deep SubMicron ASIC technology**, ADC/DAC, HSSL, Flip-chip, DDR memories, high pin count packaging
- Rad hard Large re-programmable European **FPGA**.
- European space qualified **Gallium Nitride (GaN) supply chain** for POWER and RF.
- Space qualification of **Non Hermetic** packaged devices (e.g. Class Y)
- Space qualification of **European Mixed Signal ASIC technology**.
- Extended range of **advanced VLSI** products:
  - DC-DC Converters, MOSFETS, Pulse Width Modulators, Line drivers etc...
- Next Generation general purpose Micro-Processor (**NGMP**)
- European high performance **CMOS image sensor technology** supply chain.
- Space qualified European **RF MEMS process**.
- Qualification of non-European foundry processes (Far-East foundries)
- Process re-qualification due to **REACH/RoHs** induced changes
- Evaluation of **Commercial EEE** Components for Space applications.
Timeline from R&D to Commercialization

**Initial Investment**
- TRL 2-TRL3/4 (Technology developed)

**Extended Development/contingencies**
- Up to 2-3 years

**Evaluation/Qualification**
- Typ 1-2 years

**Product in Service**
- Typ 5-20 years

Typically 10 years!

**Return on Investment**
- TRL 8 (System test, launch and operation)

Examples of qualified products in service:
- AVX Type 1 capacitors since 1983, Infineon CFY66/67 GaAs HEMT since 1994....
In order to understand the evolution of the business feedback loop, ESA contracted a survey in 2014 with ALTER Technology (Spain).

The survey was implemented by questionnaires to 16 space equipment suppliers.
Recent survey of Equipment Providers - Selection Criteria

Question 1

<table>
<thead>
<tr>
<th>In your design/projects, the criteria for selection of EEE parts is based upon</th>
<th>Most important criteria</th>
<th>Important</th>
<th>Not important</th>
<th>Not relevant at all</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free of Export restrictions</td>
<td>8</td>
<td>7</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Cost</td>
<td>9</td>
<td>5</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Availability (lead time)</td>
<td>9</td>
<td>4</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>European Source</td>
<td>2</td>
<td>3</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>Non-european Source</td>
<td>5</td>
<td>7</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Performance</td>
<td>9</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accessibility to the supplier</td>
<td>3</td>
<td>10</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Previously used in your designs</td>
<td>7</td>
<td>7</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

- As expected, the export restriction constrains, cost and availability are the main drivers for the decision at the time of selecting the EEE parts in a design.
- It is not surprising that around 70% of the users consider that it is not especially important whether the part is coming from a European source or outside of Europe.
- Performance and heritage are very important for the parts selection.
Recent survey of Equipment Providers - Availability and lead times

Question 2

<table>
<thead>
<tr>
<th>In terms of availability/Lead time, what would you consider to increase the utilisation of European EEE parts in your designs</th>
<th>Most important criteria</th>
<th>Important</th>
<th>Not important</th>
<th>Not relevant at all</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establishment of a qualified list of distributors</td>
<td>4</td>
<td>6</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Access to stock from previous programs</td>
<td>4</td>
<td>9</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Common Database to find stocks</td>
<td>6</td>
<td>8</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Increase the manufacturing capabilities of European manufacturers</td>
<td>6</td>
<td>8</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

additional points addressed by one major end-user:

“......It is important to ensure that the introduction of new ESCC components brings technical, performance and/or economic advantages compared to other components...”.
Recent survey of Equipment Providers - Performance and Price

**As expected, decreasing the unit price and non recurrent charges are considered the main factors to increase the utilization of European EEE-parts.**

### Question 3

**In terms of technology & Costs, what would increase the Utilization of European EEE parts in your designs?**

<table>
<thead>
<tr>
<th>Most important criteria</th>
<th>Important</th>
<th>Not important</th>
<th>Not relevant at all</th>
</tr>
</thead>
<tbody>
<tr>
<td>To decrease manufacturing Unit Price</td>
<td>8</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>To decrease manufacturing additional cost (No-recurrent charges)</td>
<td>7</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>To have ESCC parts with better/higher performance</td>
<td>5</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>To have a Cross-Reference between ESCC and Non ESCC parts</td>
<td>2</td>
<td>12</td>
<td>1</td>
</tr>
<tr>
<td>To have more radiation information for ESCC parts</td>
<td>6</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Better overview/promotion of existing ESCC parts</td>
<td>4</td>
<td>8</td>
<td>4</td>
</tr>
</tbody>
</table>
Question 4

<table>
<thead>
<tr>
<th>In the coming 5 years, what are the perspectives of procurement for the following types?</th>
<th>High Increase</th>
<th>Increase</th>
<th>Steady</th>
<th>Decrease</th>
<th>High Decrease</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESCC QPL/QML types</td>
<td>2</td>
<td>9</td>
<td>4</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>ESCC not EQPL types</td>
<td>1</td>
<td>4</td>
<td>9</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>US QPL/QML types</td>
<td>5</td>
<td>7</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>US not QPL/QML types</td>
<td>4</td>
<td>9</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>JAXA qualified types</td>
<td>4</td>
<td>10</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>CECC types1</td>
<td></td>
<td>13</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Commercial types</td>
<td>1</td>
<td>5</td>
<td>8</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

In general, an increase of ESCC QPL types and slight increase for MIL QPL types is expected in the coming years by most users.

It is important to follow the mid term evolution of the use of commercial types, since a third of the users expect an increase in the utilization of COTS in the coming years.
Some Early Conclusions from the Survey

- Unit price and non-recurrent cost, independent of the specification system, are the main drivers for the parts selection. Furthermore, having the qualification for the assembly process is also confirmed as key factor for the selection of EEE-parts.
- The export constraints for some part types plays an important role for the consideration of European solutions (but cost and lead time are still the main drivers).
  - The unpredictable dynamics of the export licenses leads to a residual risk in the supply chain.
- For new developments, early promotion is essential for the parts to be successfully introduced to the market.
- Significant mid-term growth of the percentage of commercial parts is expected. The controlled use of COTS needs to addressed in the evolution of the specification systems and standards.
- The harmonization and mutual recognition of the ESCC and JAXA qualification systems is leading to increased interest and utilization of JAXA qualified components in European missions.