THE CHALLENGE OF ENSURING QUALITY IN A NON-INTEGRATED SUPPLY CHAIN
About TÜV NORD Group

Business unit level

Lead company (Spain)

Subsidiaries (France & Italy)
OFFER TO CUSTOMERS

• Comprehensive experience in the Space market.

• Parts engineering expertise capable to provide direct support on the selection and design-in of products.

• Testing capability for any screening test required for a space applications.

• Establishment of a direct link between suppliers and customers, simplifying the product selection, access to technical information and definition of most proper procurement approach.
The Space Transformation
- Market requirements, SWAP-C

New Requirements
- Non Integrated Supply Chain, Solutions

Procurement issues
- Integrated vs Non-Integrated supply chain

Conclusions
The complete supply chain for a EEE part links the Manufacturer to the End User.

The Quality Assurance function must be implemented along the entire supply chain process, from the electronic functionality identification stage till the EEE component is installed and operating in the final hardware / application.
Each step of the supply chain requires specific **Quality Assurance** steps to be considered and the **proper data transfer** between all the different elements. This integrated process is well established and known by the Space community.
Most manufacturing steps are managed / controlled by a single interface, with a deep technical knowledge of the overall process.

- **Design Verification**
  - Dedicated Design Rules for Space: spacing, layout ...
  - Design aligned with PVT/Radiation performance target, NPE & NPI checklists, Design For Quality, DFM etc…

- **Wafer fabrication**
  - Total control on wafer fabs and technologies (SPC)
  - Probe test: BIST, Highest Test coverage, Maverick lots

- **Assembly**
  - Validated and controlled processes
  - Defined rules in accordance with existing standards

- **Testing**
  - Maximum Test coverage: target 100%
  - Manufacturability (> min Test yield), Defined rules in accordance with existing standards

- **Qualification Industrialization**
  - Product Qualification: HTOL, TC, THB, ESD, Latch-up...
  - Reliability / Radiation monitoring
  - Unique point of contact for technical and logistic needs
Example: EEE part Mfr Quality Systems

- Scorecards / Engineering Review
- Process Control
- Audits
- QA Inspections
- Corrective Actions Request (CAR)
- Wafer Lot Acceptance Test (WLAT)
- Material Review Board (MRB)
- Wafer Sort / Final Test
- Return Material Agreement (RMA)
- Reliability Monitors
- Statistical Analysis
- Data Center
- Fab Change Control

Quality / Yield Improvement

Data Analysis

Product Conformance

PLAN

DO

CHECK

ACT

Quality / Yield Improvement

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ACT
This approach generates obvious advantages being all Quality Assurance requirements properly defined and controlled.

- **Customers**
  - Parts are provided as finished products
  - Quality is under control
  - Liabilities and warranties are clearly defined

- **Agencies and primes**
  - Minimize the number of required controls
  - Simplify the validation process

- **Manufacturers**
  - Standard rules are applied
  - All actors recognize their roles
THE SPACE TRANSFORMATION

Today’s Space platforms must be
- Precision guided,
- Rapidly deployable,
- Joint service,
- Modular,
- and Secure.

So, Space System engineers are looking for
- Flexible and re-useable platforms,
- Integrating complex signal processing algorithms on-board,
- System On Chip (SoC) capabilities (feeds SWaP-C)
- Time to Market (TTM),
- Security of HW vs SW.
SWaP-C

- Stands for Size, Weight and Power + Cost (Budget sensitive)

Systems must be
- Smaller
- Lighter
- Using small batteries

Systems must fit with limited budget
- Generic platforms
- Re-useable platforms
- Longer life cycle
These requirements might render the existing Integrated Supply Chain *insufficient* to provide *the required response* to the current market demands.

In a Non Integrated EEE Component supply chain, the final product is generated by a number of different entities, specialised in specific disciplines, who contribute to a portion of the final device process, but without a unique overall responsible.
The answer to these demands can be found sometimes making use of a Non-Integrated Supply Chain for manufacturing.

Among others, the most typical solutions will be:

1. *Space dice in special configurations*
2. *Specific developments*
3. *Commercial dice on hermetic or space compatible packages*
4. *Use of COTS*

Whenever these solutions are provided by a manufacturer as a «product», such product is considered as coming from an integrated supply chain, being that manufacturer the unique responsible for the final product.
NEW REQUIREMENTS 1

SPACE DICE IN SPECIAL CONFIGURATIONS

Design and wafer acceptance based on the manufacturer

Package and configuration are customized

How is assembly house selected?
How are performances guaranteed?

Testing

In accordance with which specification (DC / AC, 100%, Temp.range)?
In case of failure, is it die/Mfr or packaging/Assembly house related?

Industrialization

How is guarantee provided?
How is liability transferred from one step to the next?
# SPECIFIC DEVELOPMENTS

## Custom Design (ASIC)

*Experience on Radiation Tolerant design?*

*Liability on final product performance?*

## Package and configuration customized

*How is assembly house selected?*

*How are performances guaranteed?*

## Testing

*In accordance with which specification (DC/AC, 100%, Temp.range)?*

*In case of failure, is it die/Mfr or packaging/Assembly house related?*

## Industrialization

*How is guarantee provided?*

*How is liability transferred from one step to the next?*
## Packaging of Commercial Dice

### Commercial Design
- Not done in accordance with space rules

### Wafer Lot Acceptance
- Done on a custom basis
  - *Die manufacturer accepts no liability on performance*
  - *Are standard WLAT rules applicable?*

### Package and Configuration
- Customized

### Testing
- *How is assembly house selected?*
- *How are performances guaranteed?*

### Industrialization
- *In accordance with which specification (DC/AC, 100%, Temps.range)?*
- *In case of failure, is it die/Mfr or packaging/Assembly house related?*
- *How is guarantee provided?*
- *How is liability transferred from one step to the next?*
## NEW REQUIREMENTS 4

### USE OF COTS

<table>
<thead>
<tr>
<th>Commercial Design / not done in accordance with Space rules</th>
</tr>
</thead>
<tbody>
<tr>
<td>From which Waferfab location? With SPC? Die selection?</td>
</tr>
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<td>How is guarantee provided?</td>
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<tr>
<td>How is liability transferred from one step to the next?</td>
</tr>
<tr>
<td>Are results predictable and repeatable?</td>
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</table>
The Non-Integrated Supply Chain for parts manufacturing might appear as the only feasible solution in certain circumstances.

The fact that different uncoordinated actors are involved in the process increases the uncertainties, even if standards and space requirements are imposed.

The overall process control requires a strong infrastructure difficult to put in place for companies requiring these products.

The selection of reliable sources is difficult requiring high specialization and quality assurance process understanding.

Imposing a global control of the flow, ensuring all required steps are processed under controlled and approved procedures appears as the most efficient approach.

Liability on final product performance appears as the most complex issue to be resolved.
PROCUREMENT 1

INTEGRATED CHAIN
BY CUSTOMER

- Parts selection
- Direct purchasing from Manufacturer
- Follow-up and export control
- Acceptance and validation
- Internal logistics

NON INTEGRATED CHAIN
BY ATN

- External / ATN parts selection support
- Purchasing through buying channels / ATN
- Follow-up and export control linked to buying channel / ATN
- Incoming procedures subcontracted (to ATN)
- Logistics externalized (to ATN)

Both methodologies should live together to provide the users with the right options to cover their EEE Components demands.
Procurement of **Space level parts** requires additional steps, compared to standard parts purchasing.

There are no specific procedures and standards detailing many of the activities to be performed.

The selection and control of reliable source is a key element of the process and requires high specialization.

These **drawbacks** are particularly evident during the acceptance and validation tests.

Non Conformance management (NCR) can be a **tremendously** time consuming activity.

**Confidence** that all steps are properly covered requires prior and after activity controls.
CONCLUSIONS

Current market demands require the adoption of new processes and activities.

Space market requires normalized procedures sometimes difficult to apply to new activities and technologies.

The lack of procedures, standards and certifications require additional steps to guarantee reliability of some of the solutions provided.

Market needs are evolving faster than normalization procedures so we need to be ready to adapt our behaviour to the new environment.

Reduction on Quality Assurance requirements cannot be a response to this demand.

ALTER TECHNOLOGY encompasses the required experience and skills to harmonize all requirement and ensure an adequate processing, minimizing efforts.
THANKS FOR YOUR ATTENTION

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ALTER TECHNOLOGY TÜV NORD . spain . uk . france . Italy . china . russia
ACRONYMS

ASIC Application Specific Integrated Circuit
BIST Built-In Self-Test
CAR Corrective Actions review
COTS Commercial On-The-Shelves
DFM Design For Manufacturability
EEE Electrical, Electromechanical and Electronic
ESD Electro-Static Discharge
HTOL High temperature Operating Life
MRB Material review Board
NCR Non-Conformance Review
NPE New Product Evaluation
NPI New Product Introduction
PVT Process, Voltage and Temperature
RMA Return Material Agreement
SOC System On Chip
SPC Statistical Process Control
SWAP Size, Weight and Power
TC Thermal Cycling
THB Temperature Humidity Bias
TTM Time-To Market
WLAT Wafer Lot Acceptance Test