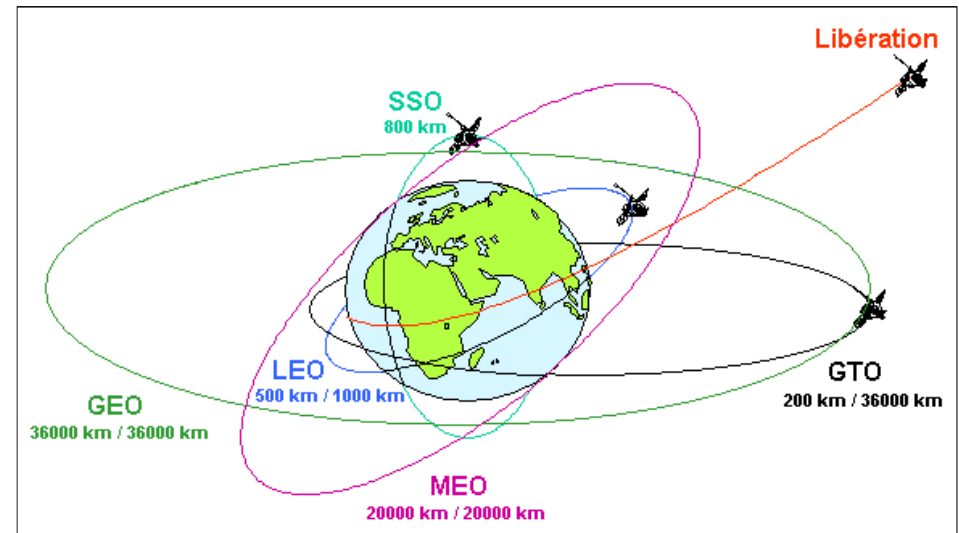




## Space components vs parts for automotive applications

ESCCON  
1-3 March 2016



# Content

- Automotive methodology overview
- Space vs. Automotive qualification methodologies comparison
- Quality targets
- Ways forward

# Automotive business model

Car Makers continuously challenging IC suppliers...

... to establish quality in the market place

## Share of electronic components

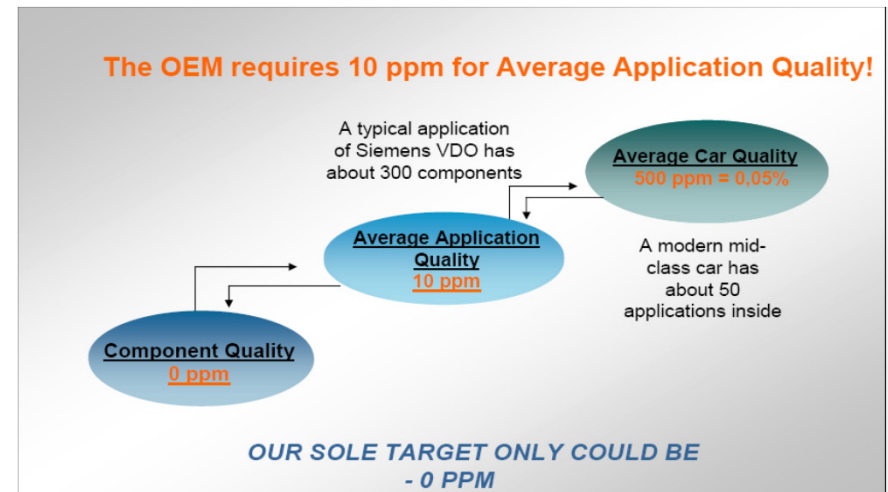
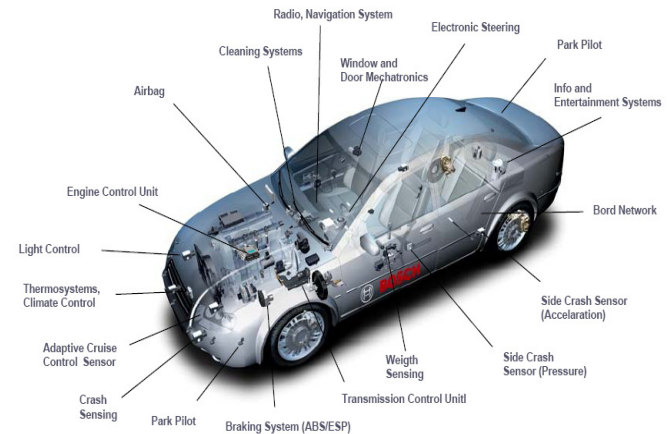
- Electronic modules: 50
- Components: 300/module
- Overall: 15000/car

## Design complexity

- Time to market: 2-3 years
- System options/car type
- Various cars
- Numerous soft variants
- ISO-26262: Functional safety of road vehicles

## Life cycle

- Car series: 5/8 years
- Spare parts: 10-15 years
- Component longevity: 5/8 years

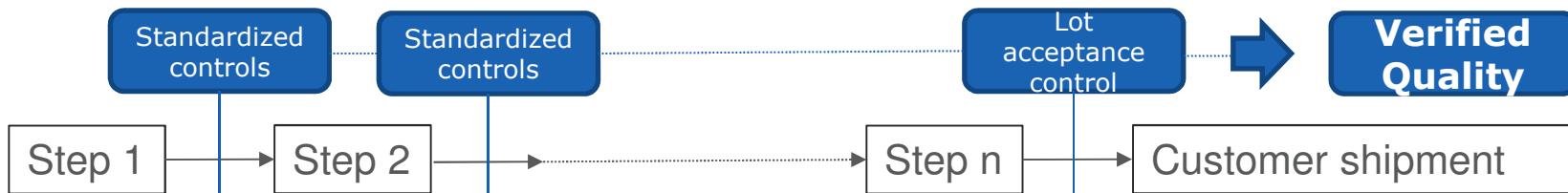


# Automotive Quality Assurance

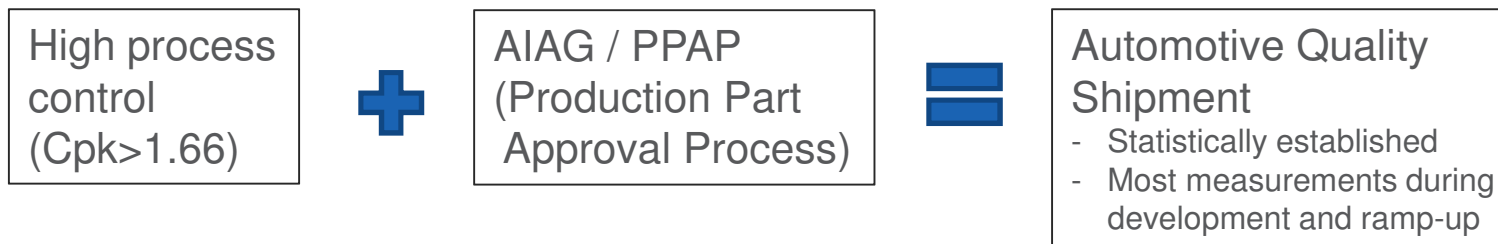
Robustness to harsh environment...

... at cost of industrial products

## Space quality process flow



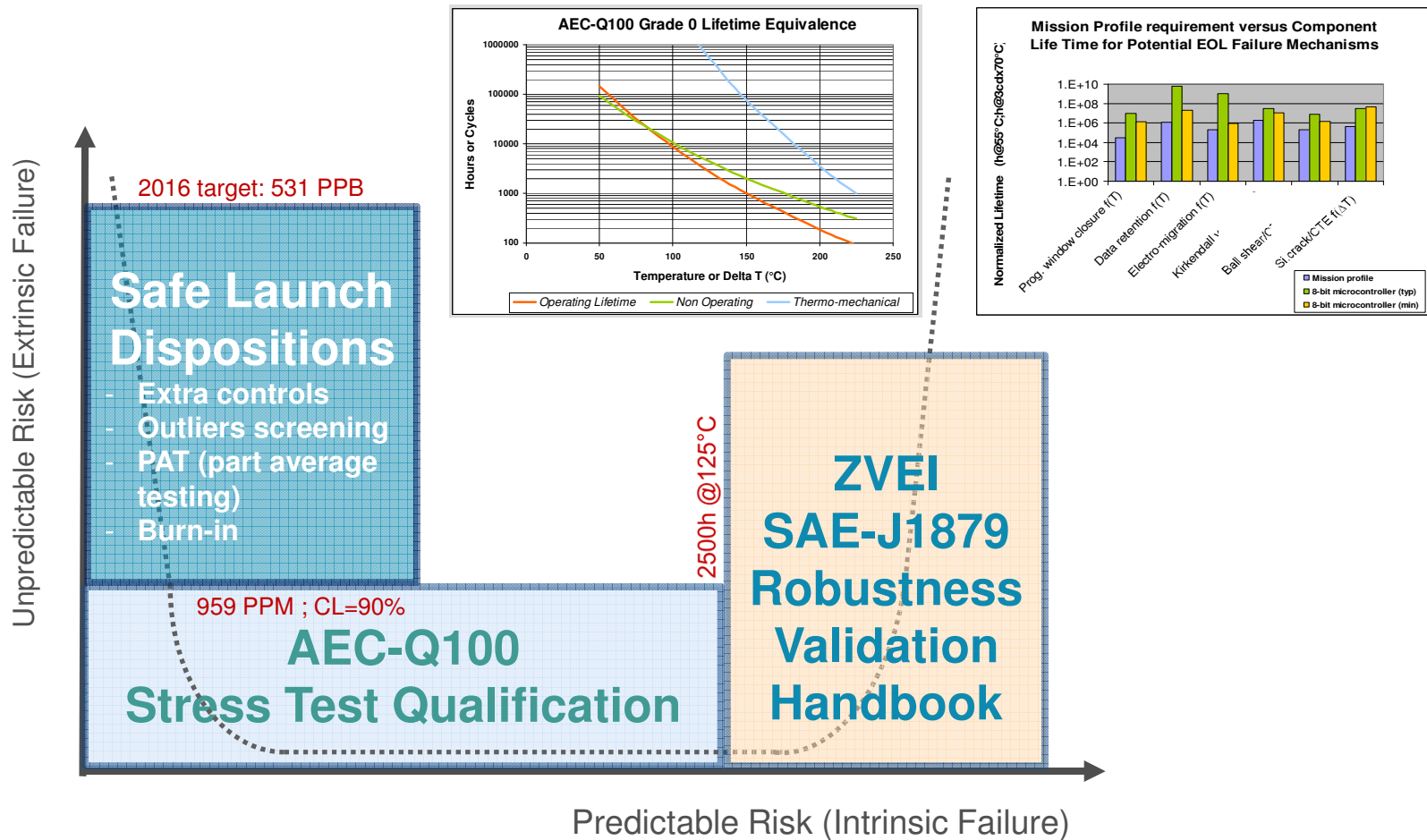
## Automotive quality process flow



# High Reliability / Zero Defects in the cars

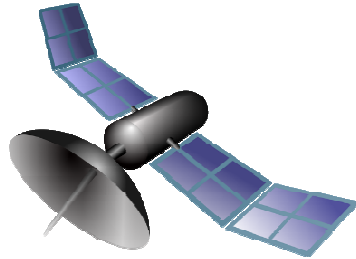
AEC-Q100 is the qualification baseline ...

... but Zero Defects goals require extended assessment methods



# Qualification methodology comparison

## Policies



ESCC & DLA  
surveys and controls

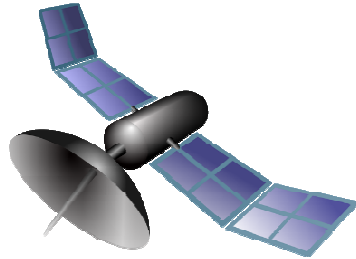
Customer/Manufacturer  
mutual agreement

- Organization & survey committees
- Set of requirement specifications and test methods
- Qualification certificate for a specific domain
- Periodical survey audits from space agencies

- Nothing equivalent
- AEC-Q100 & JESD
- Mutual qualification (Manufacturer/Customer)
- Customer audits

# Qualification methodology comparison

## Product Qualification (1/2)



Long lifetime

*3 wafer lots*

*Preceded by an evaluation lot*

- Wearout reliability tests @20 years at 110°C
- Electrical: ESD CDM/HBM, LU
- SEM (each wafer lot)
- Internal visual inspections
- TID/SEE

Lifetime application dependent

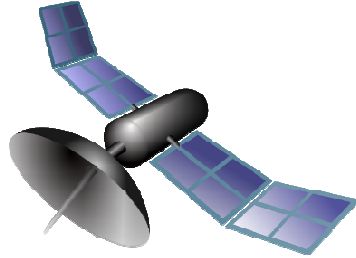
*3 wafer lots*

*Also some evaluation tests*

- 15 years @85°C / 15% operating
- Same
- N/A
- N/A
- N/A

# Qualification methodology comparison

## Product Qualification (2/2)



### Visual Inspections

- Life test 2000h/125°C
- Specific tests for NVM (cycling, endurance...)
- Packaging/assembly tests
  - Ceramic
  - Plastic
- External Visual Inspections



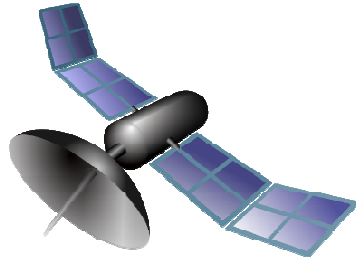
### Automatic inspections

- Equivalent 1000h/125 or 150°C (> in terms of device-hours)
- Equivalent
  - N/A
  - Equivalent (except outgassing)
- Automatic



# Qualification methodology comparison

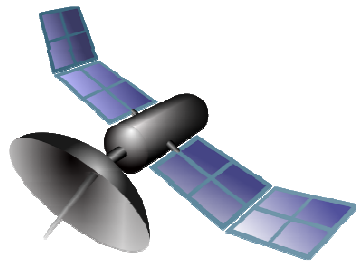
## Documentation/data control



- TRB set up by the company, including
  - Change Notification System
  - Qualification monitoring review
  - Customer returns analysis...
- Periodical reporting to agencies
- Agency alert system
- Qualification package and Radiation report
- Each Flight Model delivery done with data package (screening data and qualification summary)

- Change Notification System vs AEC-Q100
- N/A
- N/A
- PPAP
- NA

# Quality targets



- Quality by inspections
- Small qualification sampling
- Temp. Range -55/125°C
- 20 years at 110 °C
- Radiation hardening

- Quality by process control
- Large qualification sampling
- Temp. Range -40/125°C
- Typical = 15 years at 85 °C
- No radiation tolerance

# Level 1: reuse of Automotive parts for Space

- Use "as is"
- No design change
- Use Automotive part manufacturing flows
- Additional qualification & up-screening



Material out-gassing  
Radiation testing  
Additional screening tests upon request



- Leverage on automotive quality commitments
- Low cost



- No Space specific IP
- No space specification
- Lower temperature range
- No / low radiation tolerance
- Lead-free terminals

# Level 2: upgrading existing Automotive products for Space



**Wafer Processing:  
Automotive  
technology  
enhanced for SEL  
free**

- Long technology life time
- Repeatability
- Capability

- Temperature range
- TID

**Packaging:  
ceramic hermetic**

- Fits Space qualification standards
- In line inspections

- Cost

- ➔ ATMEGAS128 radiation tolerant product
  - CQFP64 and TQPF64 package
  - SEL = 60 Mev.cm<sup>2</sup>/mg
  - TID = 30 krad (evaluation)
  - Qualification = Jun-16

# Level 3: upgrading Automotive designs for Space



**Product Design:  
port onto  
radiation proven  
library, add IPs**

- Proven robust design platform
- Faster design cycle

➤ N/A

- ➔ ARM M7 micro-controller SAMV71RHBD
  - Automotive SAM7 platform
  - Adding 1553 and Space Wire
  - On ATMX150RHA
    - Latch-up free
    - TID = 300 krad tested
  - Ceramic or plastic packaging options
  - Samples on Q1-17



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