Status USCAR project

”Automotive strategies for EOS problem resolution”

OEM’s: FCA US, Ford, GM
Tier1’s: Bosch, Continental, Nexteer
Semi’s: Infineon, NXP, Renesas

Status: April 2017

USCAR EOS Initiative Introduction

- Electrical OverStress (EOS) is probably the most frequent source of returns sent back to automotive Tier1 and semi suppliers for failure analysis.
- Root cause finding for EOS:
  - Challenging and time consuming process
  - For single occurrences the success rate is very low
  - Depends on information sharing and a close co-operation between the tier levels and OEM
  - A common expectation and misperception in the industry is to determine the exact EOS event based on the observed damage signature on silicon chip level

USCAR EOS Initiative Objectives

Since Sept 2015, 3 companies from each of the 3 tier levels (OEM, Tier1 and Semiconductor supplier) have met at USCAR:

Focus on the right things to be more efficient in the EOS root cause finding process

This presentation shows our 2 step approach:

- Details what information is to be shared between the tiers for 3 different occurrence levels
- A systematic approach for the tier levels for root cause finding using the Fault Tree published in the *"Industry Council on ESD Target Levels"* Whitepaper 4

USCAR EOS Initiative
2 Step Approach

Step 1: "Give" information

Lack or loss of Info

Lack or loss of Info

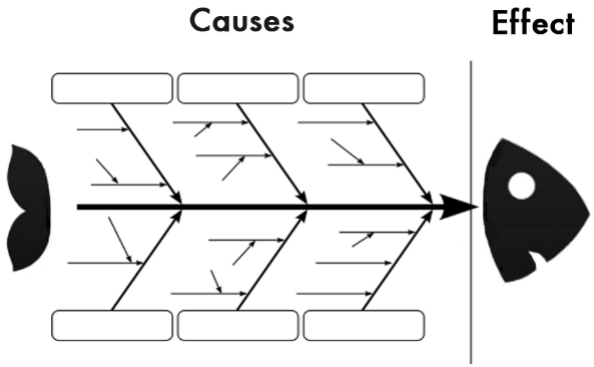
Transparent info

OEM

TIER1

SEMI

Step 2: Collaboration



Problem solving guideline

USCAR EOS Initiative
Definition of Support Level

Random versus Systemic occurrences require different levels of support. "Spend your resources wisely!"

Level	Typical examples / situations	Support
1A	**Random / Single** occurrences in production within a 12 month period that have no evidence of a systemic signature.	Regular support; standard info, comes with every case
1B	**Random / Single** occurrences that happen in - safety relevant applications - production validation (PV) - design verification (DV) - the safe launch period.	Extended support ; additional information required to drive rapid resolution
2	**Systemic / Repeat** incidents (evidence of systemic signature) - safety relevant applications - production verification (PV) - design verification (DV) - during the safe launch period - normal production within a 12 month period.	Extensive support; additional information required in order for tier chain to support problem solving. Good cooperation required between **all** tiers to support the solving of the problem.

NOTE: Level 1A, 1B or Level 2 can be assigned by OEM but could also be assigned upstream, i.e. observed at Semiconductor or Tier 1 level

Step 1
Up and Down Stream "Give" Info Approach

Sharing

Support Level	Info block	OEM	Tier1	Semiconductor
1A	- General - Process data - Look across	- …. - …. - ….	- …. - …. - ….	- …. - …. - ….
1B	- General - Process data - Look across	- …. - …. - ….	- …. - …. - ….	- …. - …. - ….
2	- General - Process data - Look across	- …. - …. - ….	- …. - …. - ….	- …. - …. - ….

Step 1
"Give" – OEM Information Level 1 2

General Information

The OEM should provide relevant vehicle information:

- Which model is affected?
- When and where (assembly plant location) was the vehicle built?
- Did the damage happen at the end of the vehicle assembly line (0 km) or at the end user? (If yes to end user, at what mileage?, is this a warranty case?)
- Type of module that was damaged (i.e., which application).
- Where in the vehicle was the module mounted (e.g., hood or dash).
- Proper damage description on vehicle level with diagnostic trouble code (DTC).
- Other modules/components damaged in this vehicle.

More details about the system level schematics, such as what type of loads have been used during EOL testing, grounding path, vehicle application conditions, etc.

Process Data

The OEM should provide data for the affected vehicle that cover assembly, handling or use steps outside the normal processes such as special software upgrades or addition of any extra features at the dealer (after-market upgrades). If available, information about offline repair work or testing should be added.

Repair history, other modules damaged, powering up sequences, after market upgrade, etc.

Look Across

Details should be provided whether the same electronic module is used on other vehicles, on other platforms and/or in other plants without any problems.

More details provided, such as whether the same electronic component is used on other modules, on other platforms and/or in other plants without any problems, uniqueness special built options, etc.

Step 1
"Give" – Tier 1 Information Level 1 2

General Information

The Tier 1 should provide relevant board/PCBA information:

- Electrical characterization of the suspect device on module or IC component level (e.g. measurements of the leakage current (I-V plots) or input resistance).
- Circuit characteristic of a damaged IC relevant to the failure signature on module/PCBA level compared to a good reference.
- Complaint analysis report with the steps performed after the module/PCBA was received from OEM
- Whether only one component was damaged on the board/PCBA or whether other components affected.

Operation conditions, temperature profiles, details on ICT and EOL testing, changes made to design, etc.

Process Data

The Tier 1 is requested to provide:

- Specific board test data (ICT or EOL) for the affected device.
- Have test limits been set in an effective and appropriate way?
- The traceability data like date, time, and location of board manufacturing and testing.
- Tests the module has seen to validate failure.
- If the board was reworked, share details, third party programming. / non-standard handling.

Yield losses for this component, changes in process software / hardware, etc.

Look Across

The Tier 1 is requested to check:

- Whether this is the first damaged component for this application.
- Whether this component is used in any other OEM modules.

More details provided, such as whether the same electronic component is used on other modules, on other platforms and/or in other plants without any problems, assembly lines dependencies, etc.

Step 1
"Give" – Semi Information Level 1 2

General Information

The semiconductor manufacturer provides failure analysis data, which may include:

- Confirmation of the customer reported failure mode using standard FA flow.
- Signal/curve trace analysis of components at relevant temperature.
- Results of functional test.
- Pins affected.
- What (high level) functional blocks are affected by removal of component mold compound for die surface visual analysis.

Depending on condition, deeper dive failure analysis, what stress levels could cause such damage on the silicon, review of application schematic, support ideas for potential re-creation of such signature, etc.

Process Data

Process data is required for specific device test data for the affected pins and whether the limits have been set in an effective and appropriate way.

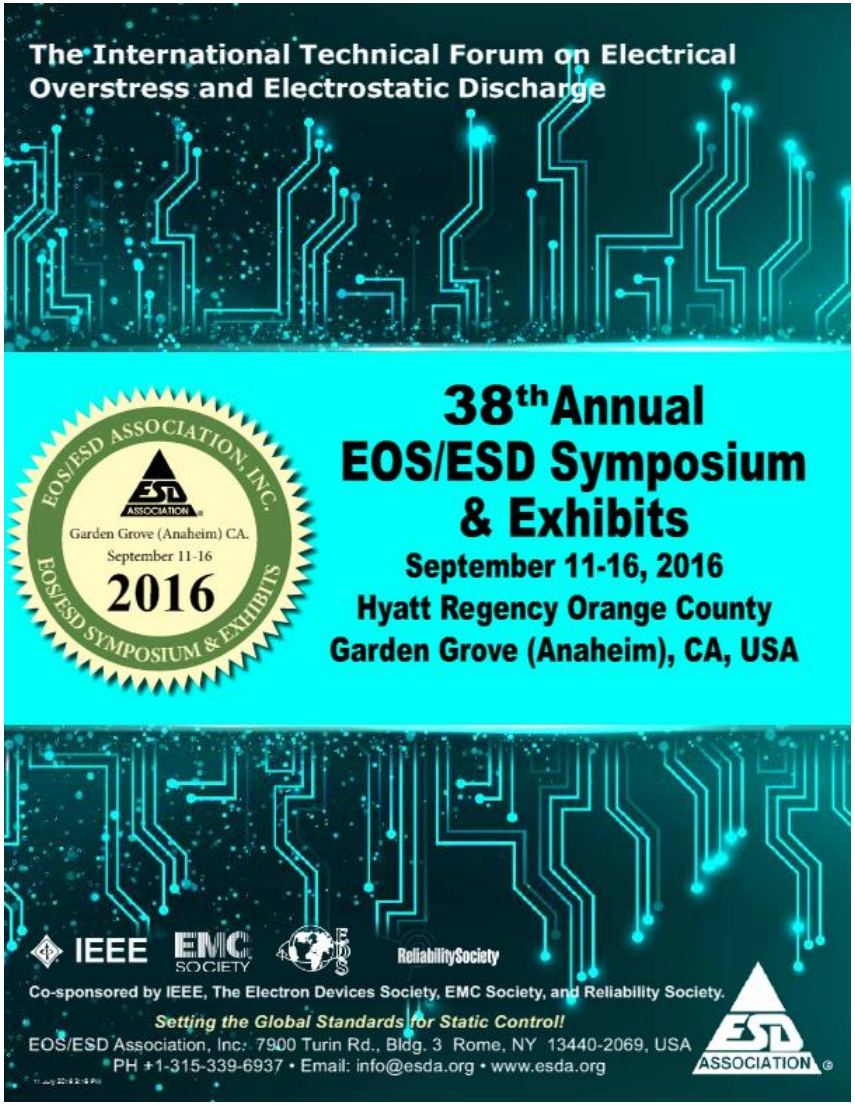
Test yield for the affected pin, event mapping tester/handler, etc.

Look Across

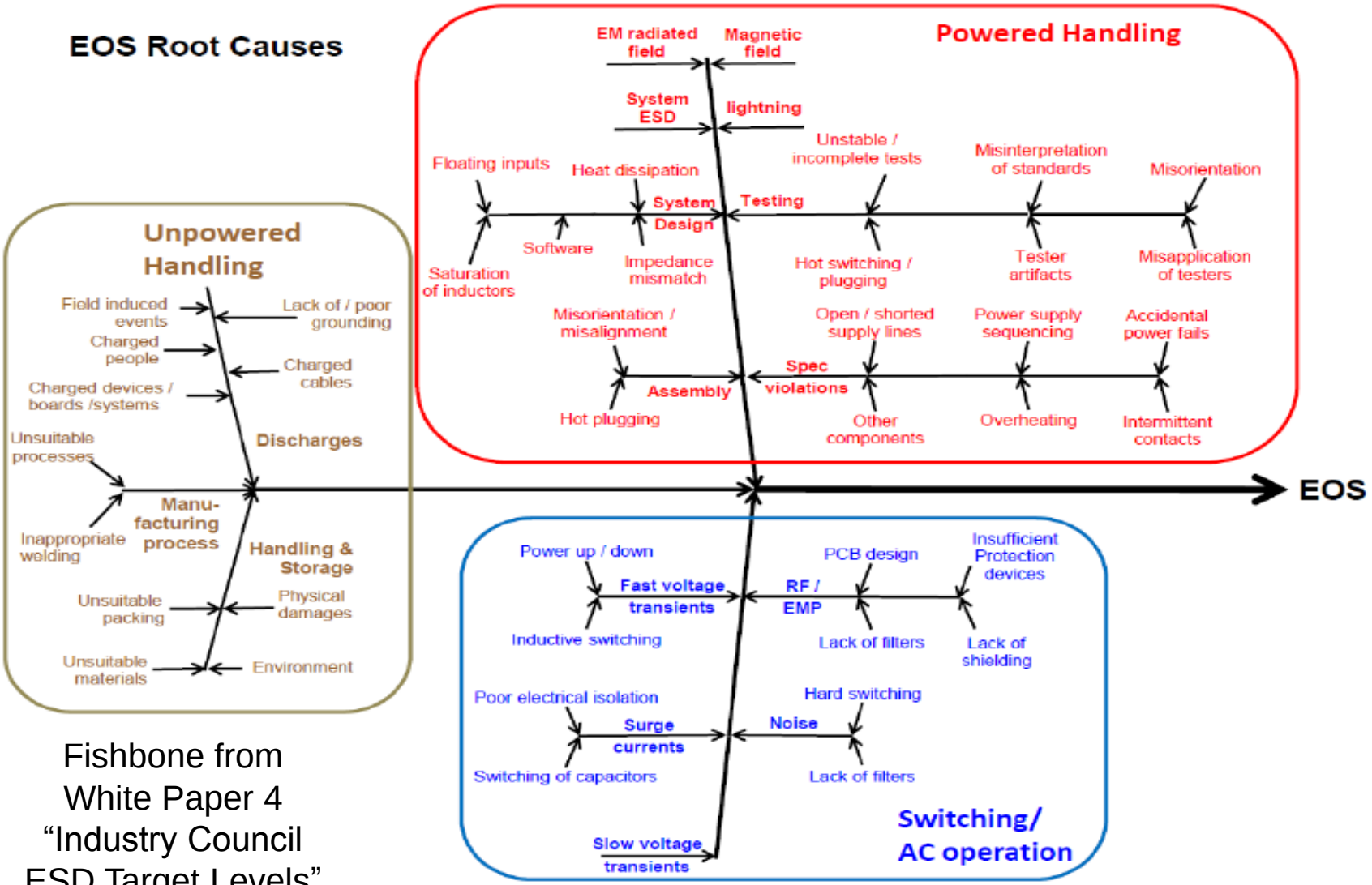
Check whether this is the first component with this specific damage signature

Same signature observed with other family type products, etc.

Step 1 Project Review at ESDA - Sept 2016



Step2
Collaboration / Root Cause FTA



Fishbone from White Paper 4 “Industry Council ESD Target Levels”

Step 2
FTA Assessment for OEM, Tier1, SEMI

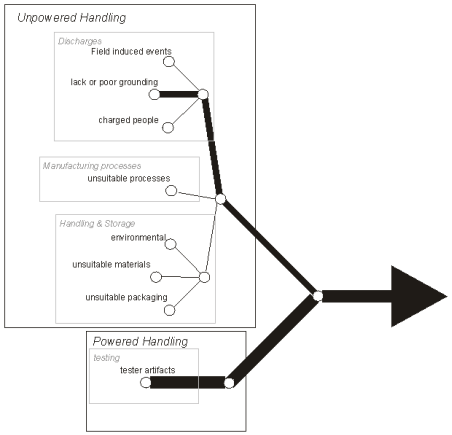
Category (SEMI)	Sub cat	Branch	Possible (H,M,L, NA)	Explanation rating	Historical Examples
Unpowered handling	Discharges	HBM	Low	No previous returns for part	none

Category (TIER1)	Sub cat	Branch	Possible (H,M,L, NA)	Explanation rating	Historical Examples	To investigate
Unpowered handling	Discharges	HBM	Low	Have not seen HBM discharge	Back to 2006 on this module	Suggest OEM

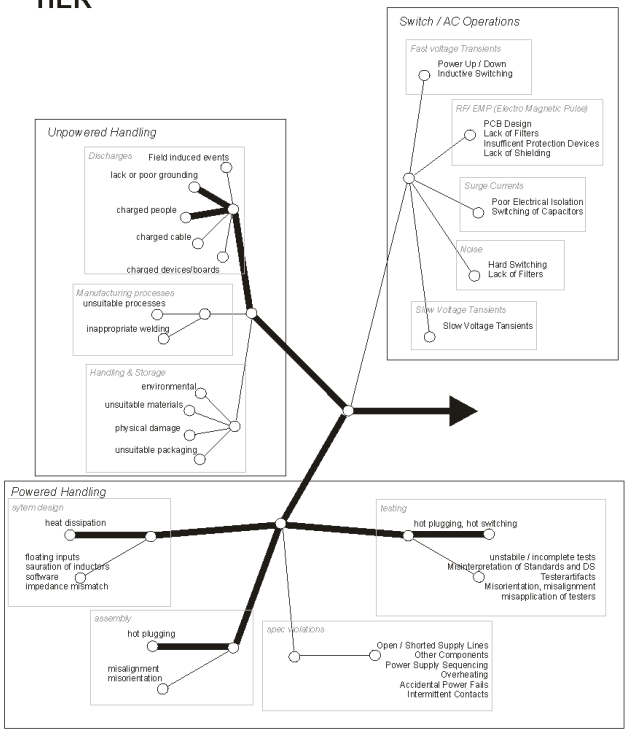
Category (OEM)	Sub cat	Branch	Possible (H,M,L, NA)	Explanation rating	Historical Examples	To investigate
Unpowered handling	Discharges	HBM	Medium	Cabling cinched too tight	Seen on another vehicle with same mode in 2015	OEM
	…	…				
	…	…				
Powered handling	…	…				
	…	…				

Example Fishbone
Weighing Most Common Cause Area

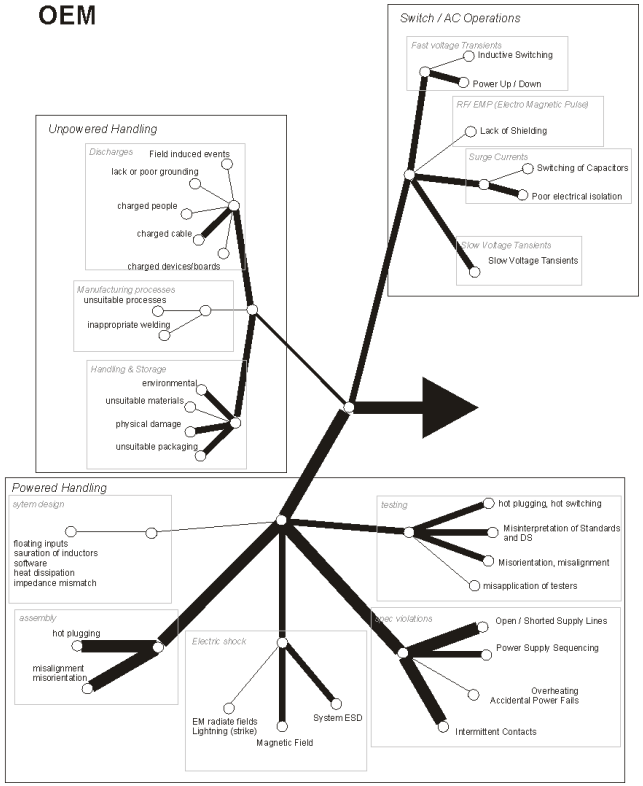
SEMI



TIER



OEM



Thickness of the arrows indicate more likely path to resolution of the problem
This activity is still “Work In Progress”

USCAR/ESDA EOS Initiative Next Steps

- Final review ANSI/ESDA document at ESDA by July 2017
  - Publication / Industry process release July 2017 onwards
- Presentation in:
  - AEC workshop session, Novi Mi, by April 2017
  - ESDA working group meeting, Tucson AZ, September 2017
- Finalize EOS fishbone root cause review of Whitepaper 4.0, June 2017
  - Add as supplement to ANSI/ESDA document September 2017
- Define training concept for industry using USCAR and ESDA for solving guideline centered around collaboration within the industry
  - Roll out and best practice sharing for all tier levels, Detroit area MI, December 2017
- Continuous improvement of the process after learning cycle
  - Best practice sharing process to avoid EOS by March 2018