Fault Campaign Framework for FuSa Verification of ISO 26262 Compliant Automotive Products

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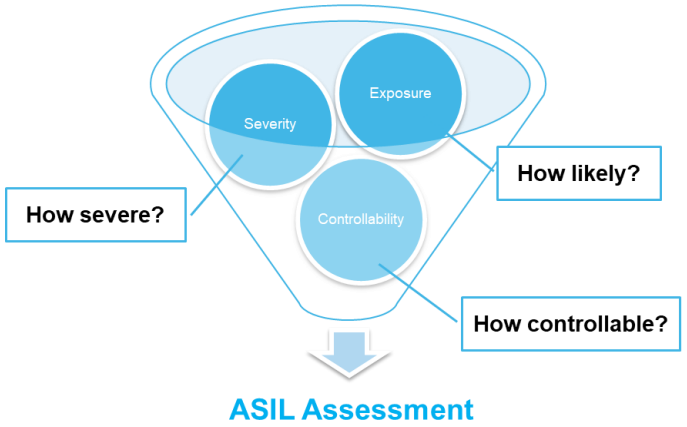
Introduction

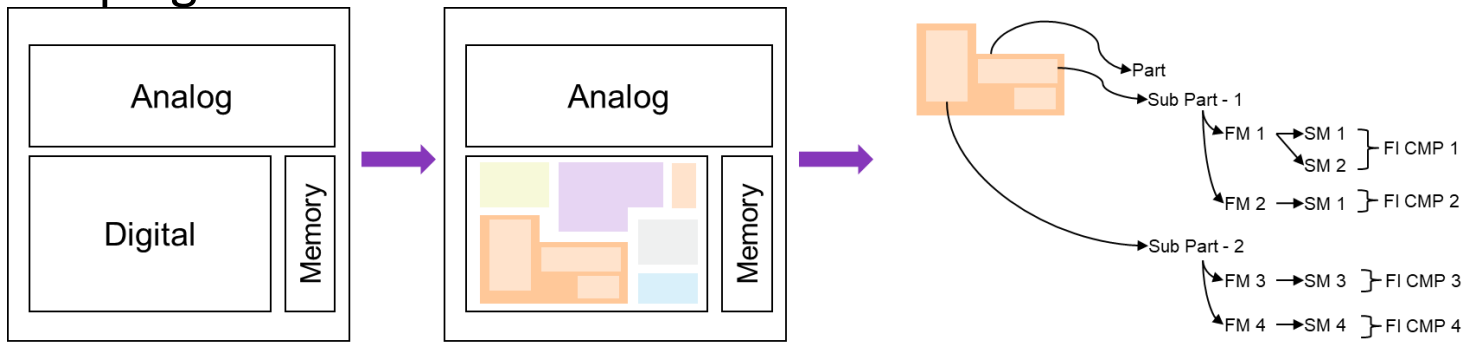
- Electrification of Automobiles + Battery EVs = Complex Automotive Electronics
- FuSa is critical to assure safety-critical systems offer risk reduction to ensure safety



ISO 26262 recommends Fault Injection as a methodology for

- Supporting the evaluation of the HW architectural metrics
- Pre-silicon SM Verification

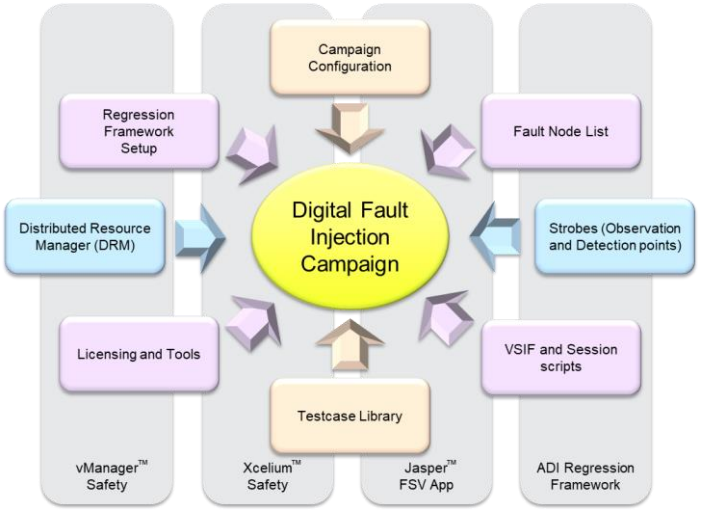
Planning a fault campaign to validate FMEDA metrics:



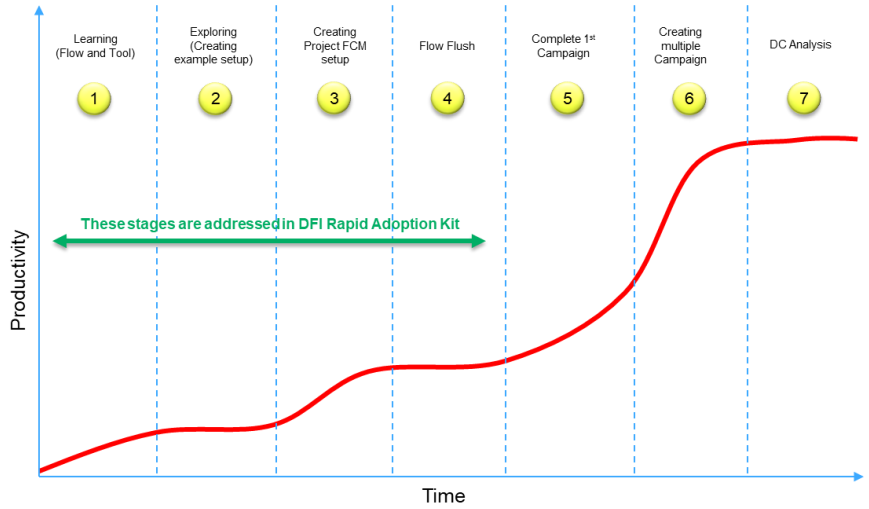
Challenges

- FMEDA is quantitative in nature, and this is over and above the SM verification
- FMEDA metrics validation requires highly automated EDA solution

Deploying EDA Safety Solution



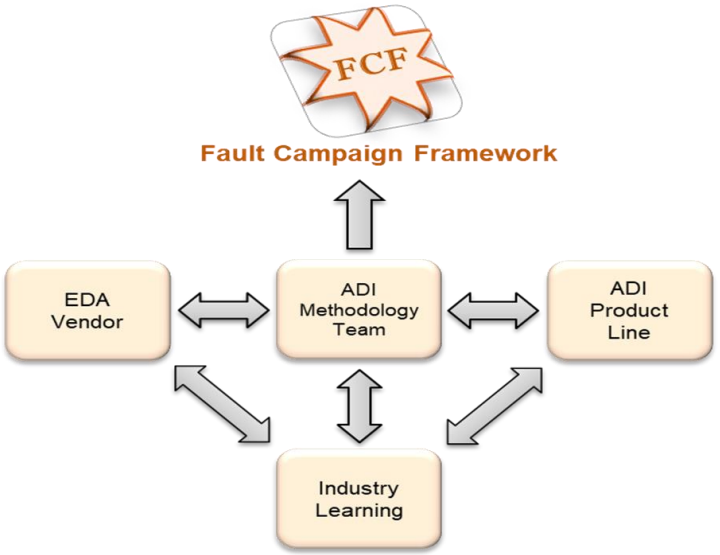
Time v/s Productivity Graph



Challenges:

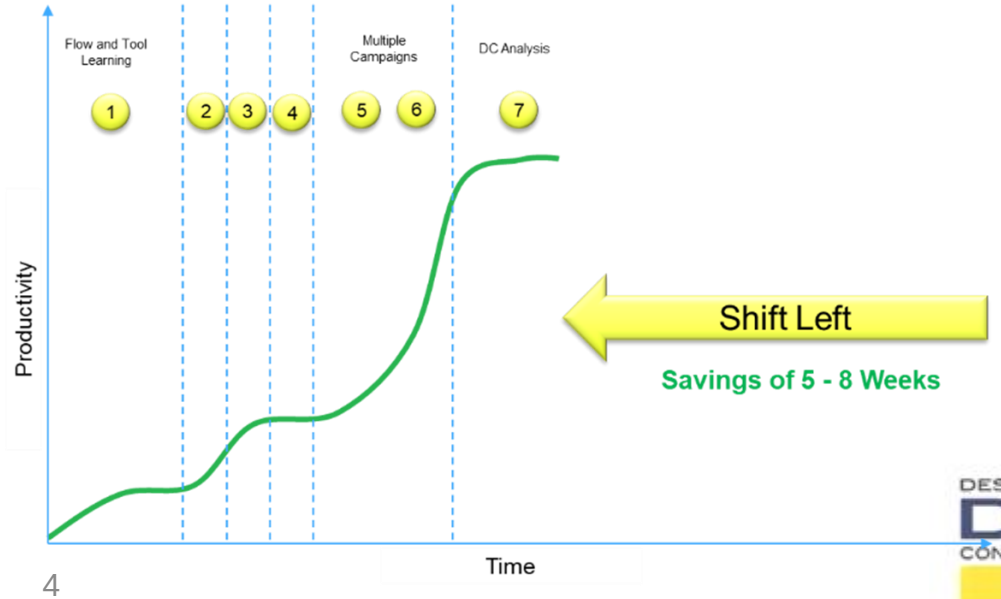
- Learning curve
- Setup bring-up time
- Setup complexities
- Flow failures
- Large fault node list
- Long campaign run-time
- Large set of UU faults
- Detailed analysis of fault/s

Fault Campaign Framework



- Standardized, Unified framework based on Cadence® Safety Solution
- Adapted for internal tools, flows and methodologies
- Agnostic to tool/scripting complexities

- Incorporate recommendations from
  - FuSa experts (Internal and Vendor)
  - Industry-standard practices
- Bring up project fault campaign setup in less than a day
- Flow failures are easy to debug



Fault Campaign Improvement Methodolgies

Fault Space Reduction

FST and FSV TC

FST Step

FSV Summary

Total:	3973		(3973)	
Equivalent:	0			
Unobservable	725	[18%]	(725	[18%])
COI: 588				
Constant: 96				
Unpropagatable: 41				
Dangerous:	0	[0%]	(0	[0%])
Unknown:	3248	[81%]	(3248	[81%])
Unprocessed:	0	[0%]	(0	[0%])
Undetectable:	1579	[39%]	(1579	[39%])
COI: 1442				
Constant: 96				
Undetectable: 41				
Detected: 0		[0%]	(0	[0%])
Unknown:	0	[0%]	(0	[0%])
Unprocessed:	2394	[60%]	(2394	[60%])
To be injected:	3248 of 3973	[81%]		
Reduction:	**725 of 3973**	**[18%]**		

FSV_TC Step

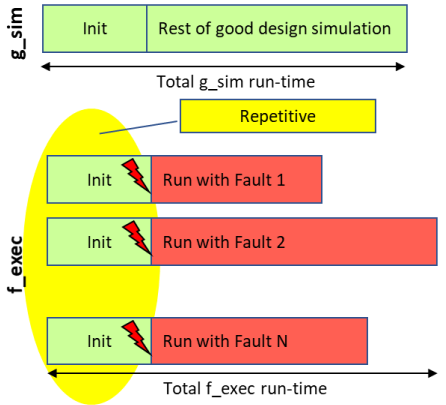
FSV Summary

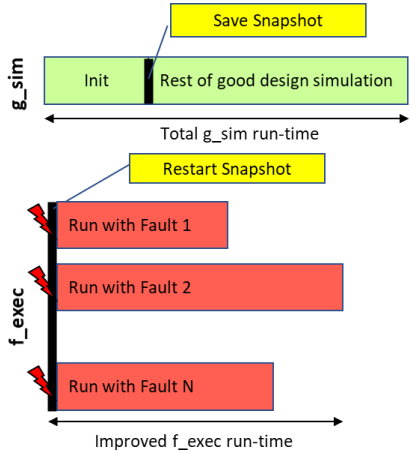
Total:	3248		(2334)	
Equivalent:	914			
Unobservable	1498	[46%]	(1024	[43%])
COI: 0				
Constant: 1118				
Unpropagatable: 380				
Dangerous:	0	[0%]	(0	[0%])
Unknown:	1750	[53%]	(1310	[56%])
Unprocessed:	0	[0%]	(0	[0%])
Undetectable:	1883	[57%]	(1321	[56%])
COI: 910				
Constant: 733				
Undetectable: 240				
Detected: 0		[0%]	(0	[0%])
Unknown:	0	[0%]	(0	[0%])
Unprocessed:	1365	[42%]	(1013	[43%])
To be injected:	1310 of 3248	[40%]		
Reduction:	**1938 of 3248**	**[59%]**		

>50% reduction in fault space

Fault Sim Optimization

Save and Restart





15 - 30% improvement in f_exec run-time

Fault Campaign Improvement Methodolgies

Throughput Improvement

Concurrent FI

- Setup: GLS + w/o SDF + STL
- Fault nodes: 38k
- 2k faults per sim
- 21 hrs with 5 parallel runs

>100x Raw Speed-up

~1000x Disk space savings

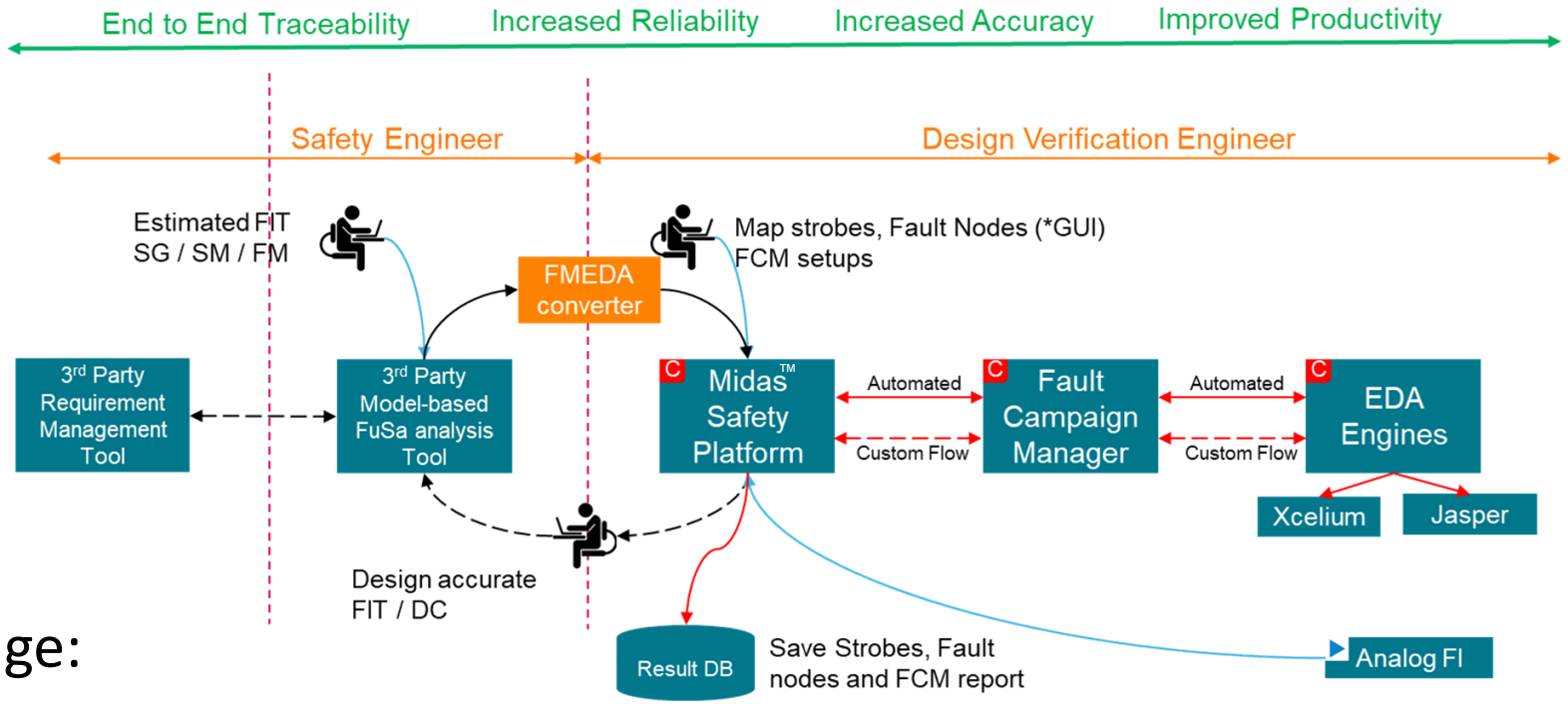
QoR : 100% Match with Serial

~2000x Less log files

Significant savings on compute resources

Bridging Safety Analysis and Safety Verification

- End-to-End traceability is a key requirement in safety verification and validation
- Unified flow with seamless integration is critical
- Cadence® Midas™ Safety Platform was evaluated for ADI usecases & flow



Key Challenge:

- Vendor tools/solutions do not have common/standard format for data exchange

Summary

- ISO 26262 compliance is quantitative and requires fully automated semiconductor specific solution
- Fault Campaign Framework built upon Cadence® Safety Solution significantly improves productivity of engineers and the efficiency of the fault campaigns
- Methodologies such as Formal, Save and Restart and Concurrent fault simulation improves the fault campaign throughput
- Fault campaigns must be thoughtfully planned to close on DC faster and efficiently
- Standardizing FS Data : Accellera FuSa WG's efforts could enable FS data sharing

Questions