



SYSTEM DEVELOPMENT CHALLENGES OF AUTOMATED DRIVING FOR THE RELATIONSHIP OF OEM & TIER1

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Outline



- ❑ Automotive and Automated Driving Today
- ❑ Technical Challenges for Automated Driving
- ❑ Challenges for Automated Driving Projects and Potential Solutions
- ❑ New Partnership between OEM and Tier 1
- ❑ Summary



Who is Driving Automated Driving



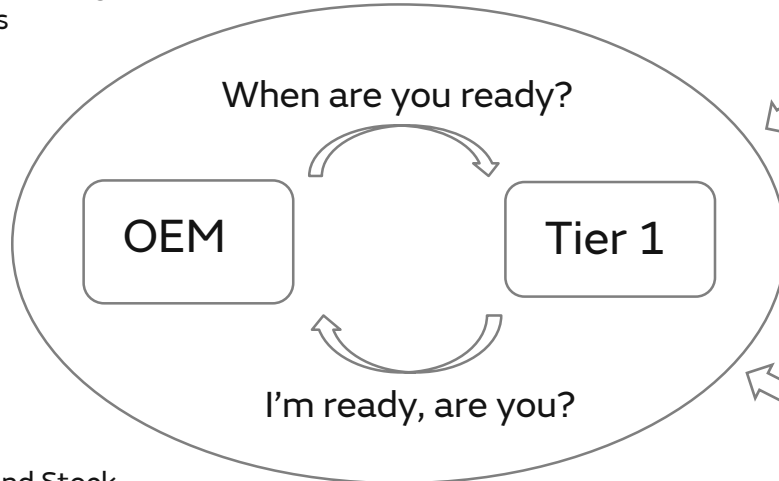
Capital

Investors are seeking opportunities



Shareholder

Dividend and Stock price must increase



Let car drive safer than human!

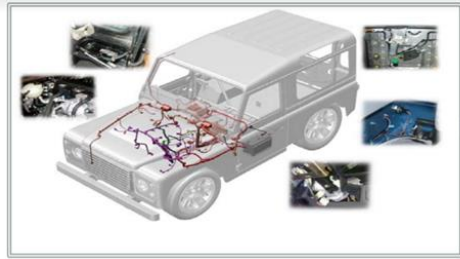
If there are ADS devices for NCAP, why don't do more



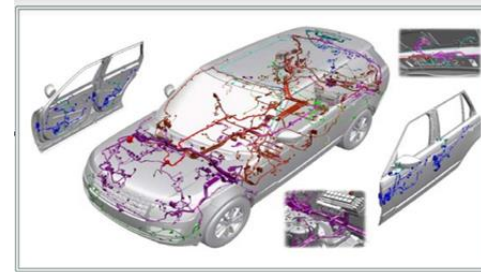
Engineers would like to take on the challenge. Good engineers would leave the traditional OEMs/Tier1s if there is no such opportunity/project.



Automotive: From Mechanical to Software Industry

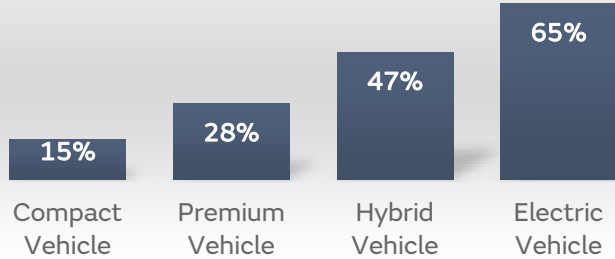


Defender 1990

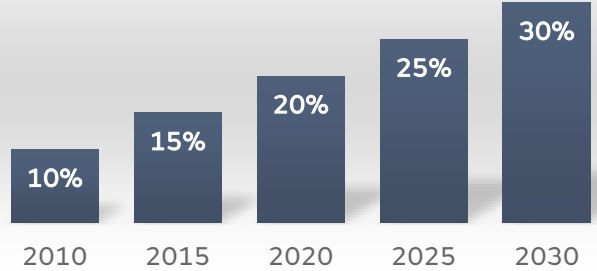


Range Rover 2010

Percentage of Electric Parts



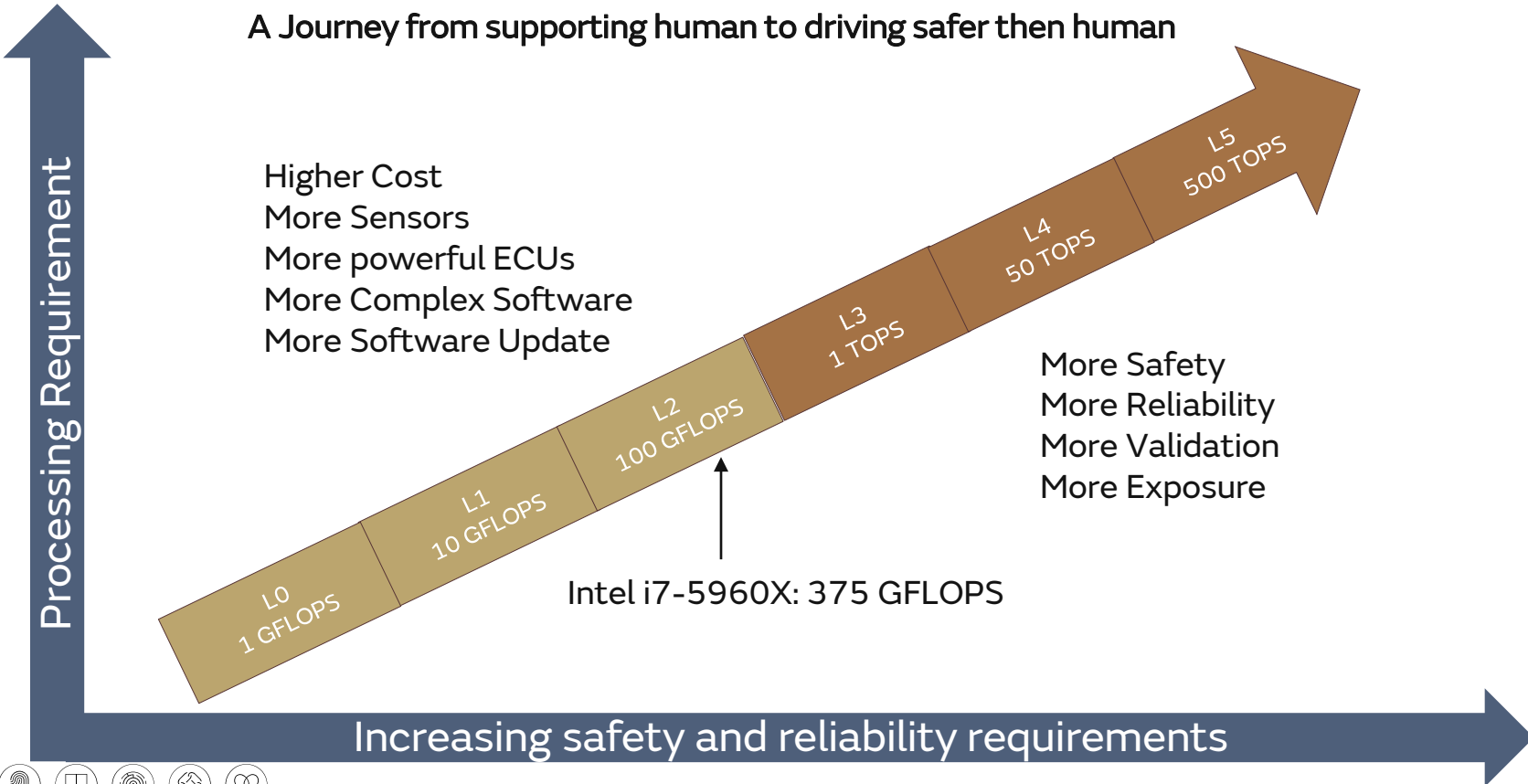
Percentage of Whole vehicle cost on Software



Automated Driving from L0 to L5



A Journey from supporting human to driving safer than human



Technical Challenges for Automated Driving



Perception Detection & Fusion



Technical:

- Accuracy
- Range
- Integration
- TP/FP
- Robustness all Weather/Light

Others:

- Homologation for Active Sensor, e.g. Radar

System Architecture & Algorithms



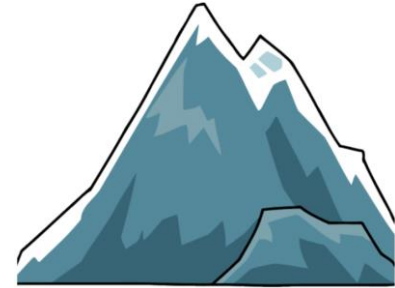
Technical:

- Redundancy
- Corner Cases
- Situation Analysis
- Path Planning
- Robustness

Others:

- Homologations in different countries
- SOTIF/ FUSA

Validation



Technical:

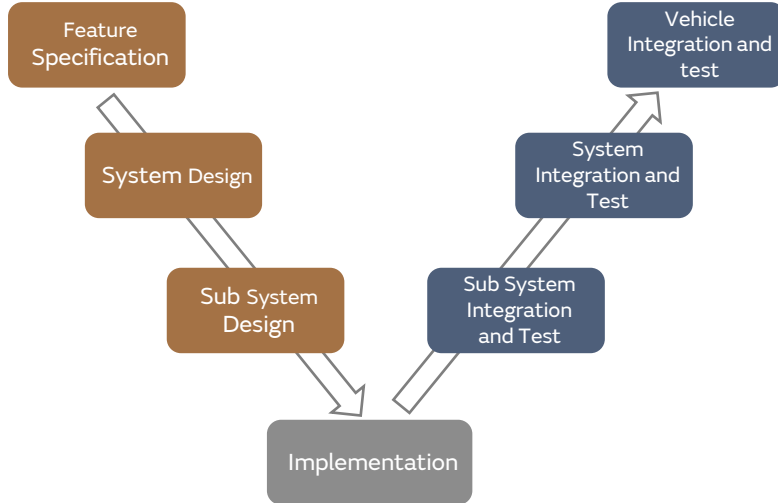
- Mileage
- Coverage
- Data Collection
- Reference
- Re-Simulation
- Data Storage

Others:

- Legal Requirements for public road test



Challenges for Automated Driving Projects



- Requirements will be more complex
- Integration will be more difficult
- Change Requests will come for anytime
- Validation will be more complex and expensive
- SOTA, a new challenge for Classic Project Cycle

Challenges with Requirements



- ❑ Automated Driving System must be reliable
- ❑ Automated Driving System must safer than human driver
- ❑ Therefore feature must be safer
- ❑ Therefore perception must be more perfect
- ❑ Requirements become more and more complex
- ❑ *“OEM is writing science fiction to push Tier ONE”*
- ❑ *“Tier One accepts everything since this is the rule of the game”*

“The Camera must always detect object in any weather/Light condition”

“The radar must report if target is wet or dry”

“The false positive rate should be less than $1/10^{12}$ km”



Whole Project will be destroyed by bad Requirements from beginning



Challenges with Integration



	USS	Radar	Camera	Lidar	ADSECU	HD-MAP	V2X	DMS
L0	0 - 12	1-3	1	0	0	No	No	No
L1	8-12	1-3	1	0	0	No	No	No
L2	8-12	5	1	0	1	May	No	May
L3	12+	5-8	5-7	1	2	Yes	May	Yes
L4	12+	8+	8 +	2	2	Yes	Yes	Yes

- ❑ More Sensors and ECUs will be integrated into limited space
- ❑ Strict integration guidelines for sensor performance conflict with design
- ❑ Required power consume increase continuously, challenging for electric vehicles
- ❑ Weight of Sensors and ECUs become sensitive for WLTP CO2 homologation
- ❑ More and better cleaning systems for system availability has been required but limited solution on the market



Performance Degradation

Design Conflict

High Fuel Consume

Safety Risk



Challenges with Change Requests



- ❑ Perception and decision algorithms must be continuously updated in the project cycle
- ❑ System limitation and corner cases will be continuously detected in the project cycle
- ❑ Feature requirements and interface must be modified based on findings from the project validation
- ❑ Change Requests during lifetime of deployment are inevitable
- ❑ Conflicts between OEM and Tier One because of impact on time and resource planning



Quality reduction

Project Delay

Additional cost

Safety Risk



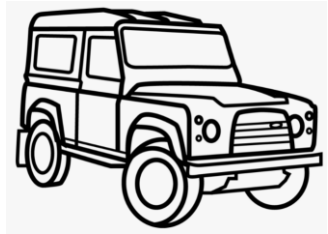
Challenges with Validation



- ❑ Legal and Homologation Requirements are increasing when level of Automated driving is increasing
- ❑ Required Validation Mileage and Scenarios is increasing exponentially
- ❑ Required Validation Data Storage is increasing exponentially
- ❑ Required Re-simulation Processing Power is increasing exponentially
- ❑ Even with huge validation mileage, 100 % Corner Cases coverage is still not possible
- ❑ Both OEM and TIER One will spend most of the financial benefit just for the validation



Challenges with SOTA: Project after Project

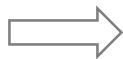


- ❑ Homologation update could force SOTA
- ❑ Performance Improvement require SOTA
- ❑ Bugfix require SOTA
- ❑ New SOTA SW requires the re-validation for OEM & Supplier after SOP
- ❑ Connectivity Infrastructure must be maintained
- ❑ Software updating process should not limit the vehicle availability
- ❑ Cyber security must be as high as possible

So many challenges, what should we do?



- ❑ Compare to classic automotive projects, Automated driving is extreme difficult with technologies and project operation, for OEM and Tier 1
- ❑ OEM needs TIER 1's collaboration already in roadmap and architecture definition phase
- ❑ For the technical challenges, except OEM and Tier 1, Tier 2 and Research must be also be involved in very early development phase
- ❑ The challenges from project operation could only be reduced, when OEM and Tier 1 could have a open, fair and trusting partnership
- ❑ Except the ADS teams, collaboration between OEM & TIER must also involve Simulation, Network, Body, Design, Quality and Business departments,



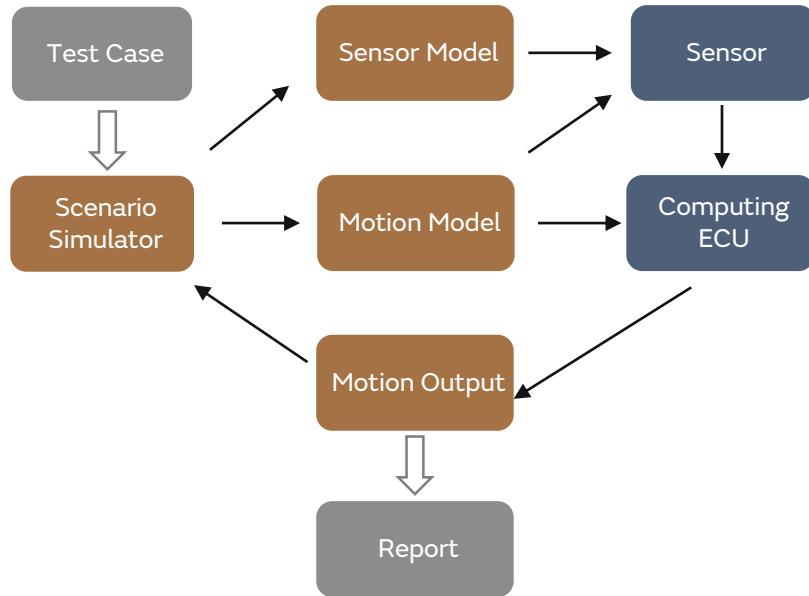
Let OEM and TIER 1 work like “ Two Brothers! “



Closed Loop HIL, Key solution for Validation



Closed Loop HIL



- ❑ Vehicle road validation is necessary but works like lottery
- ❑ Missing corner cases could be reduced only by huge amount of validation kilometres and hours
- ❑ Closed Loop HIL is the best tool to find system weakness and corner cases
- ❑ Quality of sensor model is the key to provide reliable and cost valuable validation solution
- ❑ Too less full solution suppliers on the market,

→ Driving Mio Kilometres without driving it! We are asking for more suppliers for this!

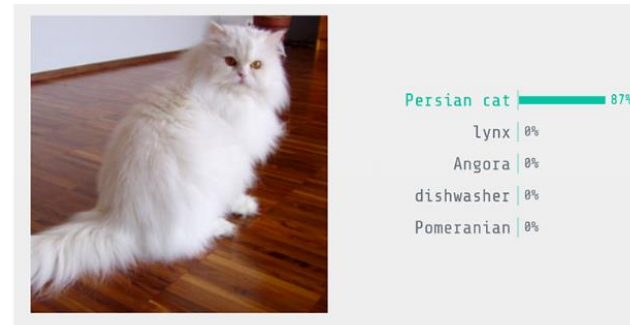


One more thing, how about Deep Learning?



- ❑ Everyone is talking about deep learning, everyone is using it to package the product as selling points.
- ❑ Is deep learning really controllable?
- ❑ How about if the classifier has been cheated?
 - Should we disable online training?
 - Should we still use classic decision tree to fuse the result?
 - And, for any time, for high level automated driving, we should have at least two additional redundancy sensor techniques to check the result!

Original



Hacked

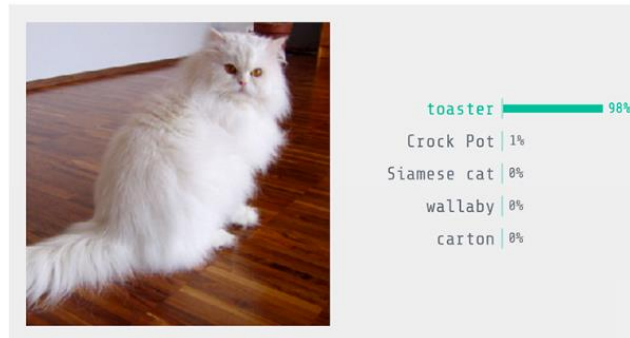


Image detection results from the [Keras.js web-based demo](#)



Summary



- ❑ Automated driving has and is disrupting the whole Automotive industry
- ❑ Perception, decision making under uncertainty, SOTIF and redundancy are the technical challenges
- ❑ Relationship between OEM and TIERS is not buyer and seller anymore: it is partnering!
- ❑ Validation becomes more important and challenging than ever
- ❑ OEM should be more careful to introduce high level automated driving
- ❑ Main goal of automated driving should make driving safer than human
- ❑ Respect to science and ethics



THANK YOU

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