AUTONOMOUS DRIVING A MAJOR DISRUPTION FOR AUTOMOTIVE INDUSTRY

Rémi BASTIEN



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DECEMBER 2017

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AUTONOMOUS DRIVING MORE AND MORE ON STAGE



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FOUR HIGH STAKES FOR MOBILITY

- 90% accidents due to human errors
- 78 minutes each day in car, in lle de France
- 45% of French population with access to public transport
 30% to 60% delivery time for driving in urban city



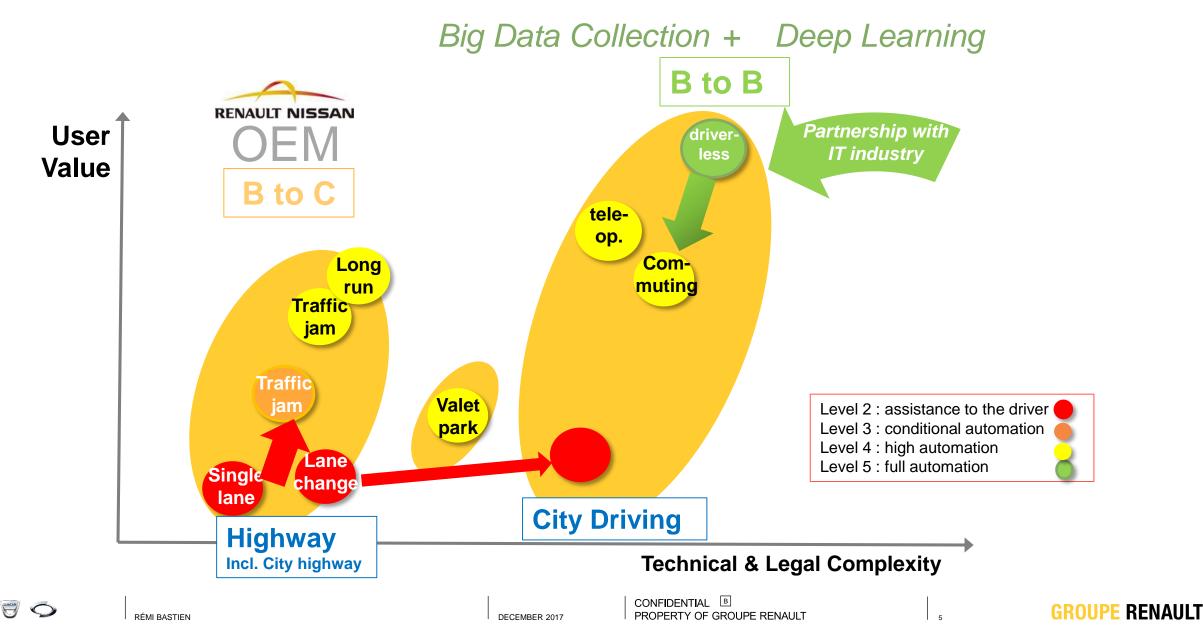


TRUE AUTOMATION STARTS FROM LEVEL 3 (SAE)

Driver continuously performs the longitudinal <u>and</u> lateral dynamic driving task	Driver continuously performs the longitudinal <u>or</u> lateral dynamic driving task	Driver <u>must</u> monitor the dynamic driving task and the driving environment <u>at</u> <u>all times</u> System performs longitudinal <u>and</u> lateral driving task in a defined use case	Driver <u>does not</u> need to monitor the dynamic driving task nor the driving environment at all times; however he must be attentive to and follow system's requests / warnings to resume the dynamic driving task. System performs longitudinal <u>and</u> lateral driving task in a defined use case. Recognizes its performance limits and requests driver to resume the dynamic driving task with sufficient time margin.	Driver is not required during <u>defined use</u> <u>case</u> System performs the lateral <u>and</u> longitudinal dynamic driving task in all situations in a <u>defined use</u> <u>case</u> .	System performs the lateral <u>and</u> longitudinal dynamic driving task in all situations encountered during the <u>entire</u> journey. No driver required.
Level 0 Driver Only	Level 1 Assisted	Level 2 Partial Automation	Level 3 Conditional Automation	Level 4 High Automation *terms acc. te	Level 5 Full Automation

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TWO MAJOR FIELDS FOR AUTOMOTIVE CAR MAKERS



RENAULT VISION FOR AUTONOMOUS DRIVING

AUTONOMOUS DRIVE

SAFETY BENEFIT

STRESS-FREE BENEFIT







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MANUAL DRIVE

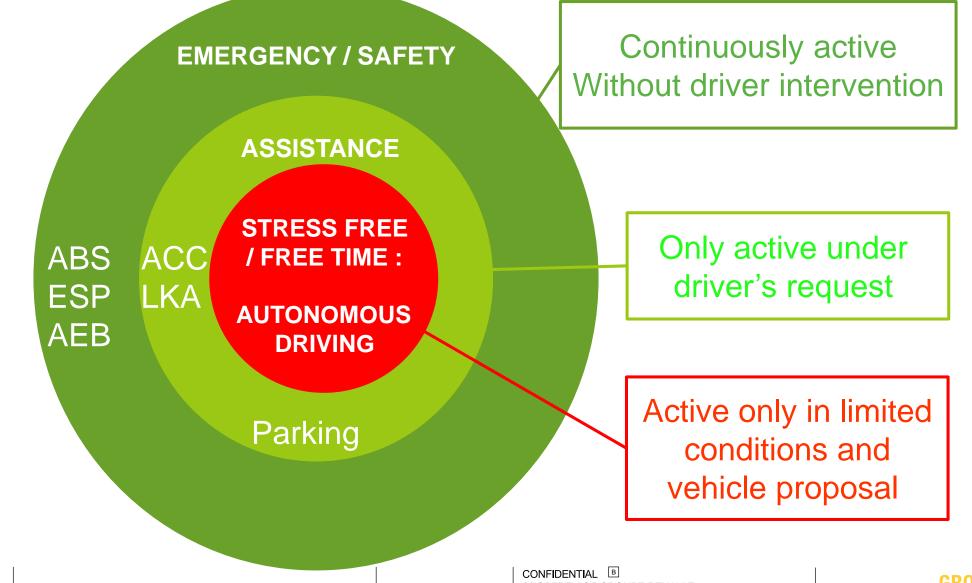
DRIVING PLEASURE





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AUTONOMOUS DRIVING BEYOND ADAS



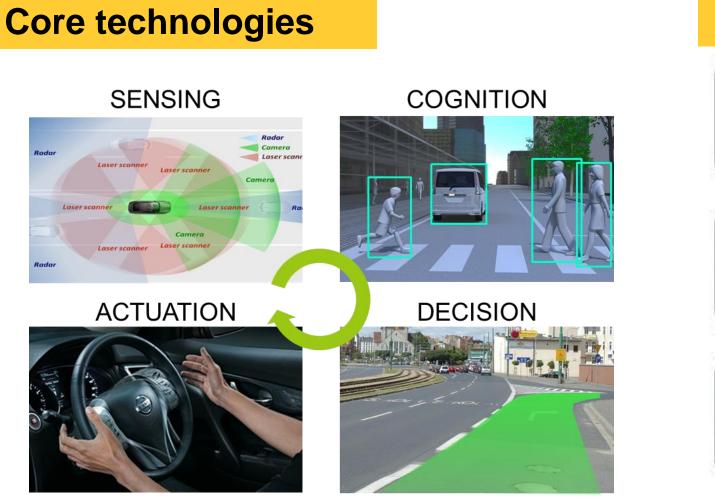
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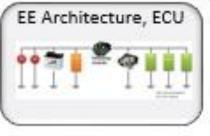
THE NECESSARY TECHNOLOGY FOR AD



Redundacy









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SUCCESS CONDITIONS : SOCIAL ACCEPTANCE

Social acceptance

Experimentation

- Regulations
- Product Liability
- Infrastructure
- Insurance
- Consumer awareness
- Driver Education

Proof by FOT on certified roads





THE MAJOR STAKE IS SAFETY

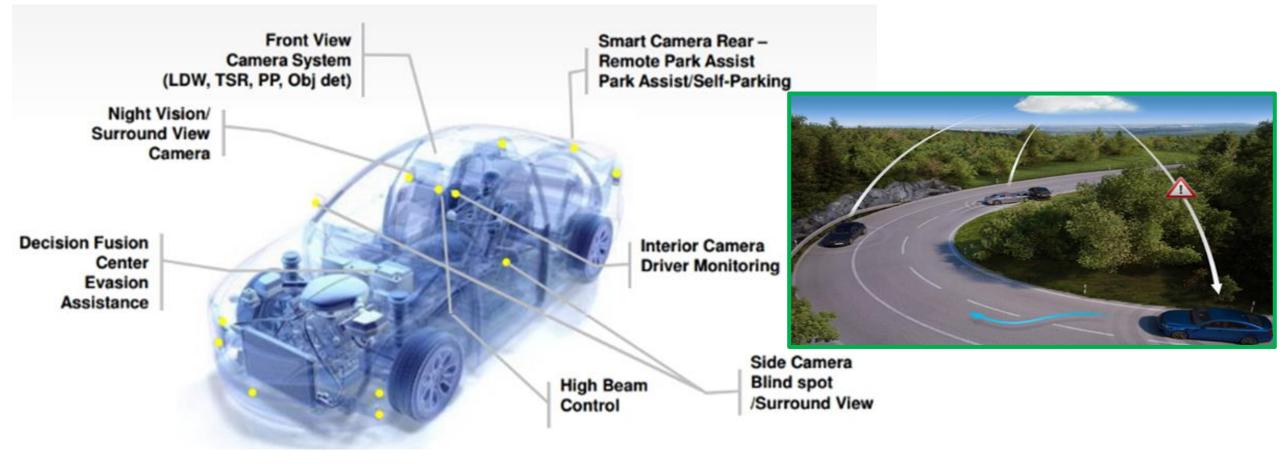


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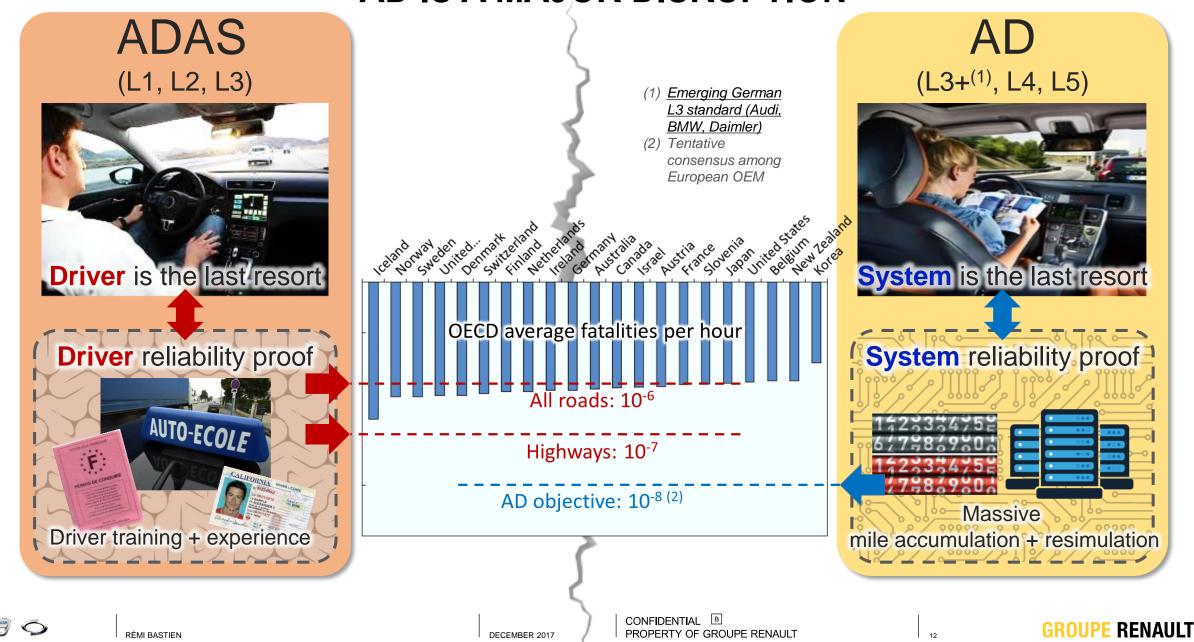
SYSTEM OF SYSTEM & LOCALIZATION



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AD IS A MAJOR DISRUPTION



SAFETY DEVELOPMENT AND VALIDATION

ISO 26262 defines how to assess a risk and the necessary activities to perform for each step:

- System
- Software
- ✤ Hardware
- Production...

Redundancy for Autonomous Driving:

- Redundant Sensors & Actuators
- Redundant Communication Networks

12V

Battery

12V

Battery

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Redundant Power supply Networks

	1.	1. Vo	cabulary	10 B		
5 6 5	345 B	2. Management	of functional safety	15 - 14 -	1	
2-6 Overall safety management		2-4 Safety management during the concept phase and the product development phases			2-7 Safety management during production, operation, service and decommissioning	
3. Concept phase	and the second se	Product develop		7. Production, operation, service and		
3-6 item definition	4-6 General topics f development at the	system level	4-9 Safety validation		decommissioning	
3-6 Hazard analysis and risk assessment	4-8 Technic at failety concept 4-8 System and item integration and verification				7-5 Planning for production, operation, service and decommissioning	
3-7 Functional safety concept		7-6 Production				
					7-7 Operation, service and	
12. Adaptation of ISO 26262 for motorcycles 12-6 Safety culture	6. Product devel hardware 5-6 General topics development at the	level	6. Product deve softwar 6-5 General loges development at 9	e level	decommissioning	
12-6 Confirmation measures	5-6 Specification of safety requirements	hardware	6-6 Specification of acquirements	of software safety		
12-7 Hazard analysis and risk assessment	5-7 Hardware desig 5-8 Evaluation of the larchitectural metrics	e hardware	6-7 Software arch 6-8 Software unit implementation	nectural design		
12-8 vehicle integration and testing	5-9 Evaluation of the violations due to ran failures	he salety gout, ndom hardware	6-9 Software unit 6-10 Software Intervention			
12-9 Safety validation	5-10 Hardware inter verification	gration and	and 6-11 Testing of the Software			
		8. Support	ing processes			
6-5 interfaces within distributed developments 6-5 Specification and management of safety requirements 6-7 Configuration management 8-8 Change management		8-9 Verification 8-10 Documentation management 8-11 Confidence in the use of software tools 8-12 Qualification of software components 8-13 Evaluation of hardware elements		8-16 Interfacin application out 8-16 Integratio	8-14 Proven in use argument 8-16 Interfacing a base vehicle or item in an application out of scope of ISO 26262 8-16 integration of safety related systems not developed according to ISO 26262	
	9.7	ASIL-oriented and	safety-oriented analyses			
9-5 Requirements decomposition with 9-6 Criteria for coexistence of elemen		ng	9-7 Analysis of dep 9-8 Safety analyse			

Additional Safety Stakes:

12V Network

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- For Autonomous Driving, Automotive EE Architecture has to switch from Fail Safe design to Fail Operational.
- Safety has also to consider SOTIF (Safety of the Intended Functionality)

8V Belt Drive Motar with integrated Inverter

48V

Battery

SAFETY & SOTIF



Does a camera can identify a target in a very large roundabout without lane ?

Does a radar will be accurate on a metallic bridge ?

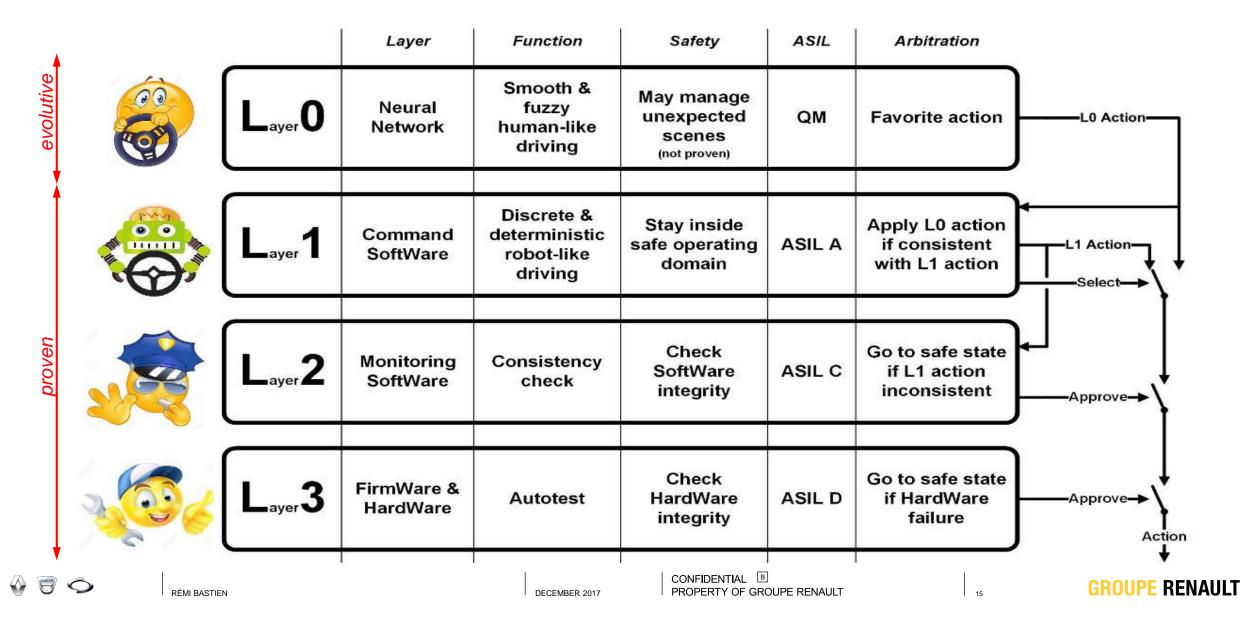
> Does an ultrasound sensor can detect a child with a wool sweater?

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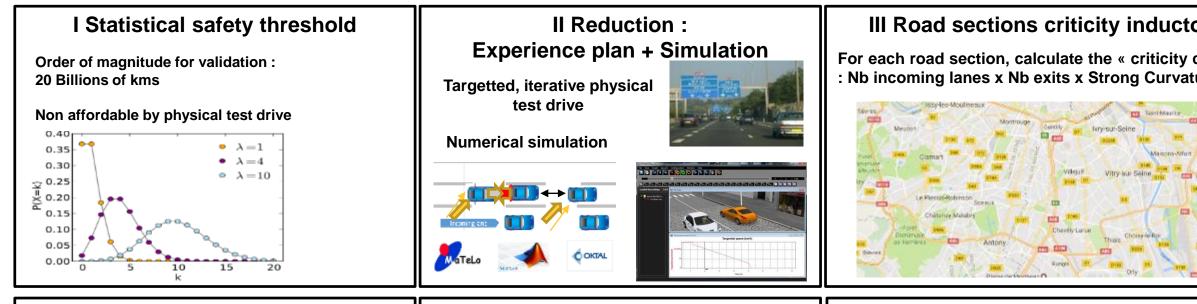
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FIRST CONDITION : E/E ARCHITECTURE BASED ON 4 LAYERS TO ENSURE ASILD



SECOND CONDITION : THE VALIDATION STRATEGY TO DEMONSTRATE ASIL D



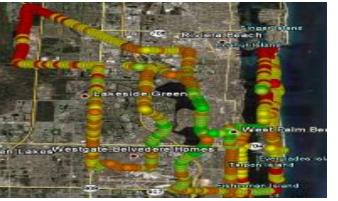
IV Map of road sections with criticity

Each road section is ranked by its criticity ratio = criticity cube volume / average criticity



V Clustered road tests

Distribution of clusters is proportional to the criticity ratio of the road sections



III Road sections criticity inductors

For each road section, calculate the « criticity cube » : Nb incoming lanes x Nb exits x Strong Curvature ...



VI Final proof of reliability

Reliable and efficient validation <<< 20 Billions km



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JOINT PRECOMPETITIVE **WORKS IN** FRANCE



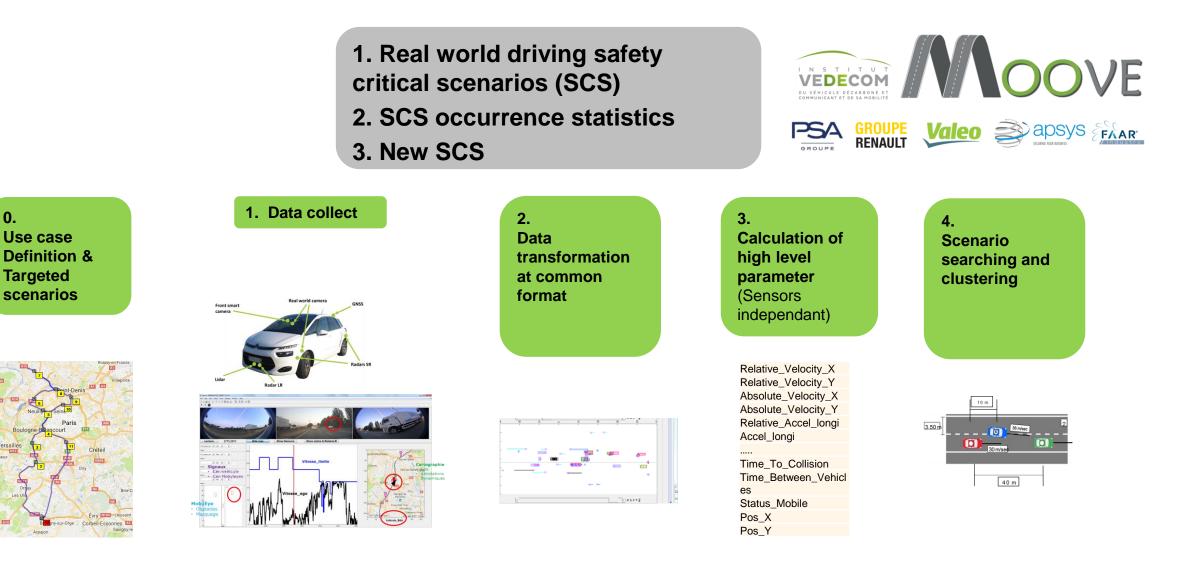
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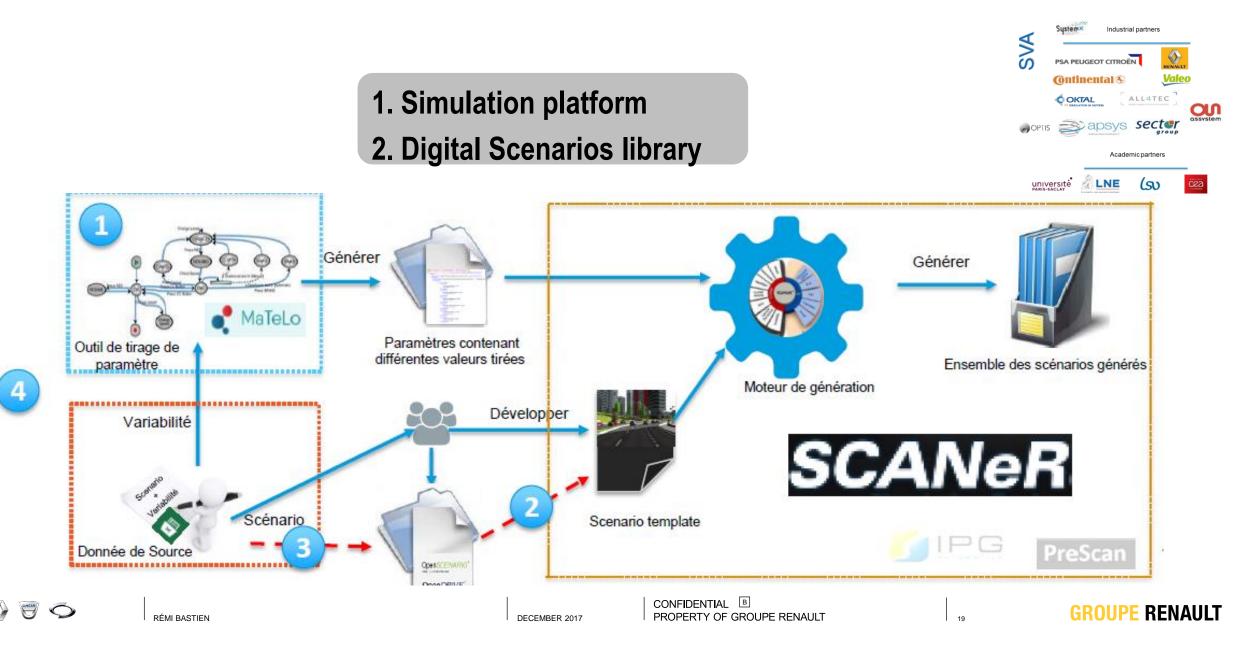
SCENARIO IDENTIFICATION (MOOVE PROJECT)



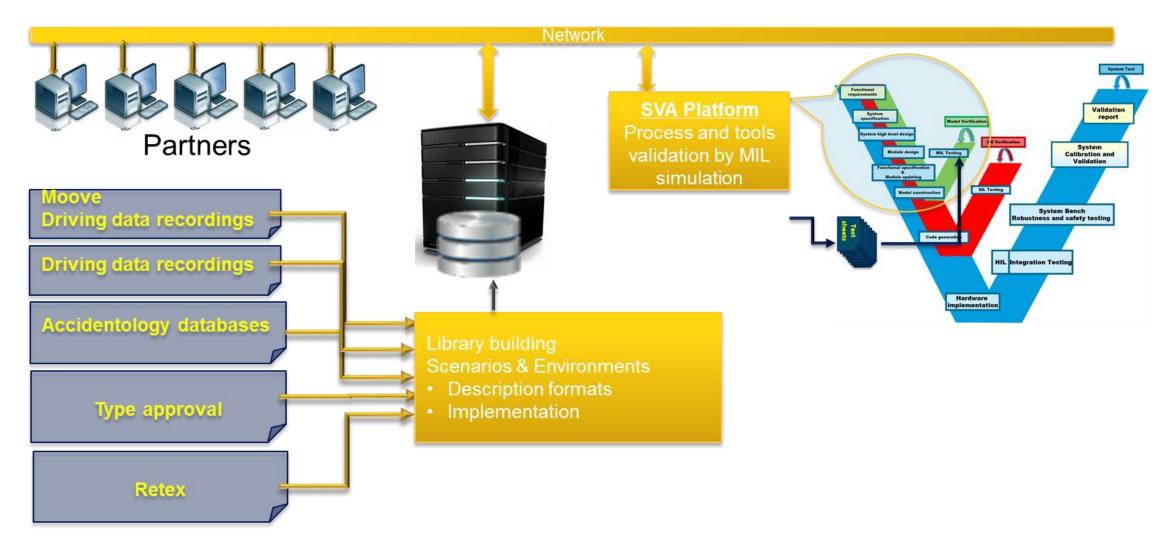
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DIGITAL SCENARIO LIBRARY & TEST CASE GENERATION (SVA PROJECT)



DIGITAL SCENARIO LIBRARY IMPLEMENTATION





CONCLUSION

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AUTONOMOUS & CONNECTED OFFER BY 2022

CONNECTED SERVICES AUTONOMOUS VEHICLES MOBILITY SERVICES



100% connected cars



15 models with autonomous driving technologies

ProvideYusoDeNAKARHOOKARHOOTransderEnclar

Robot –vehicles operations

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