MathWorks Automotive Conference 2022

Key Note - Defining the future of sustainable mobility

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Mobility Megatrends – Vision of sustainable disruptions

Zero accidents

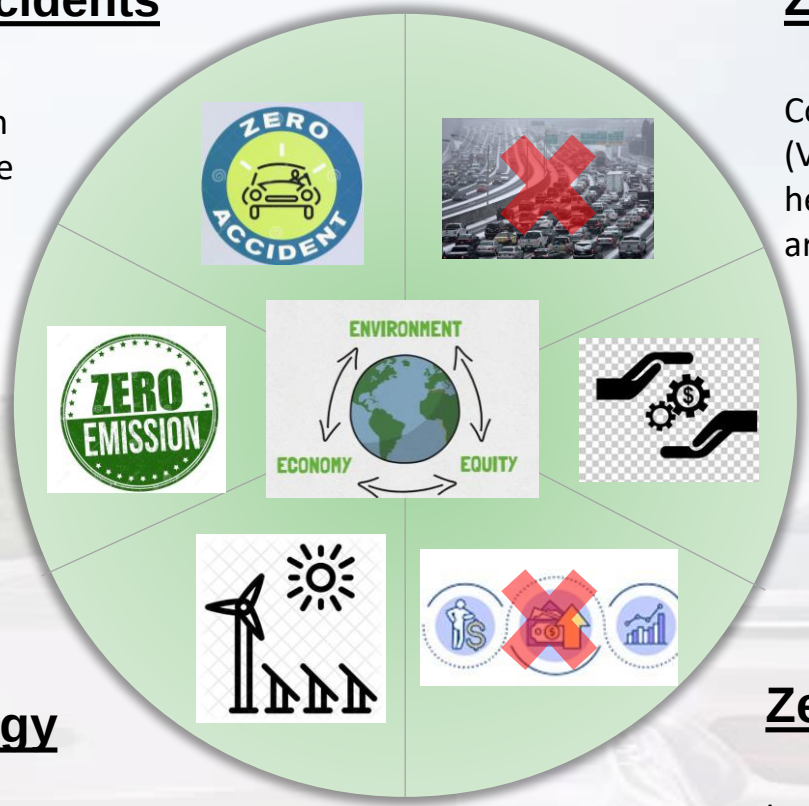
Autonomous vehicles and overall communication system between the car and the environment whereby real-time data are shared between different users of the traffic infrastructure are some of the enablers.

Zero emissions

Shift from ICE to ZEV (BEV and FCEV) are at the core of this transformation.This is integral to larger sustainability goals and targets as laid down by various organization's and essentially cover scope 1, scope 2 and sustainable circular economy.

Zero energy

Renewable energy driving the energy needs from well to wheel. This mandates energy efficiency targets wherein we can harvest more energy from renewable sources including utilization of waste energy, better regen utilization.



Zero Congestion

Cooperative traffic management system , adaptive driving (V2V,V2X,V2I and V2P are some of the enablers).Routing heuristics, dynamic ride sharing and paratransit services are some the initiatives around this mission.

Zero Empty

Shared mobility will drive better asset utilization for passenger vehicles and similarly collaborative logistics will drive fleet utilization for cargo vehicles. Collaborative connectivity , intermodal transport and aggregation of freight

Zero cost

Increasing penetration of SW defined features will drive zero marginal costs, MaaS driving additional revenue, Technology driving better productive time optimizing overall cost of mobility.

Mobility Megatrends – In the context of computation tools

New mode of automotive testing

Legacy approach - SIL,HIL and MIL testing frameworks
New approach – **Driver in loop analysis** virtual Reality
Future – Simulate real world traffic situations

Digital Twins

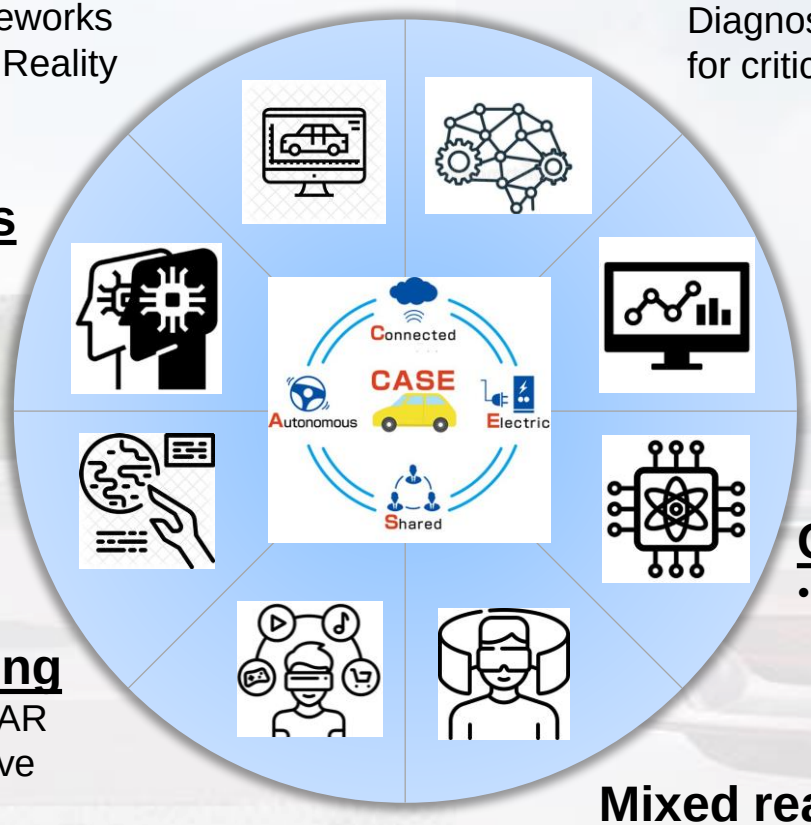
Leveraging digital transformation tools to create Digital version of real-world driving scenarios with diversity , scale and realism. Digital twins exist throughout the entire produce lifecycle. Over time, they acquire substantial quantities of real-time data that allow them to evolve and represent more accurately the current state of their physical counterparts,use actual data based simulations

Spatial Computing

Moving beyond the utilization of digital assets for AR and VR experience and creating a better immersive experience for the virtual testing and validation

Metaverse

Transitioning the virtual development platform experience to a multiverse enabled experience – platform virtualisation



Deep learning based plant models

Diagnostics and linear, non-linear regression analysis for critical mobility applications

Big data analytics

- Autonomous and connected vehicles are key drivers
- Large scale adoption on EV
- Damage models and RUL

Quantum computing

- Drivers – route optimization, fuel-cell optimization, and material durability, matching supply Vs demand for shared mobility providers

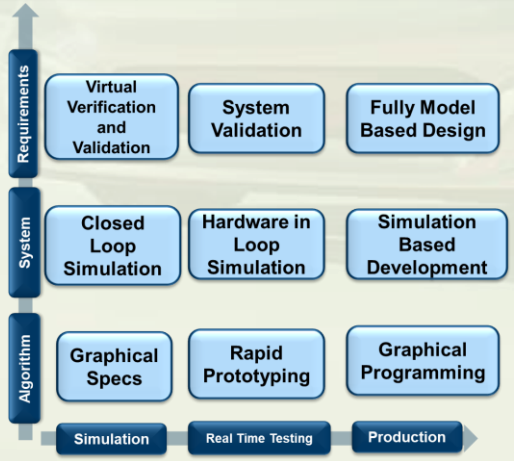
Mixed reality applications -Phygital

- Drivers – Multiple validation requirements, increased complexity and vehicle portfolio, Limits of physical testing

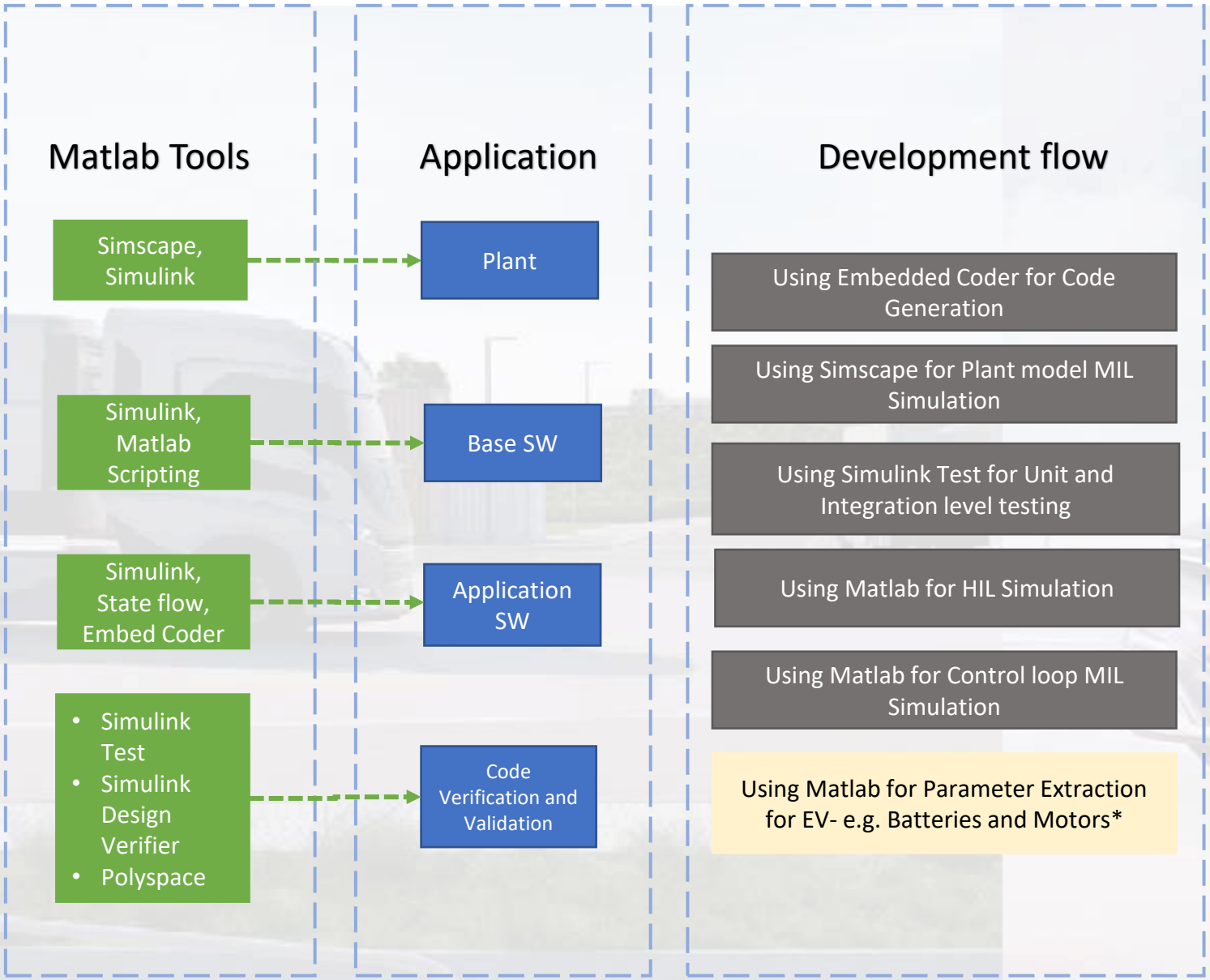
Competency Mapping to address Trends and digital product development

Major Mobility Trend	R&D Challenges	Skills Required	Infrastructure Required
Electrification	• Real time data parsing • Safety Considerations • Weight & Cost Constraints • Thermal Management • Material selection	• µ-processor Design & Testing • Deep Learning • Model Training & Testing • Natural Language Processing • Extract, Transform & Load • Machine Design & Simulation • Front-End & Back-End Development	• HW & SW tool-chain for modelling, simulation and testing • EV charging infrastructure • Testing infrastructure – Functional safety, Electrical safety, performance testing. • Testing infrastructure for FCEV and BOP
Connected, ADAS & Autonomous	• Integration Challenges • Technology limitations • Enhanced functional safety & regulations • Large data management • System robustness		

MBD- Digital product creation



MATLAB Tools & Applications – Typical case study



*Future Scope

Use Cases

- Traceability of Requirements
- MBSE
- Traceability of Code to Model
- Model Version Control
- Reporting and Visualizations
- Agile Software development
- Testing and Automation
- Generate Software as per Autosar
- FuSa-Software requirement
- Tuning Compensation loops

Work in progress

- Co-Simulation requires PC with High Configurations – Optimization study
- Third party tools integration
- Auto generated code optimization
- Code Profiling can be made more accurate
- Functional safety compliant auto generated code & compiler
- Improvement in test & verification tools like Simulink Design Verifier & Simulink Test