TATA ELXSI

AUTOMOTIVE

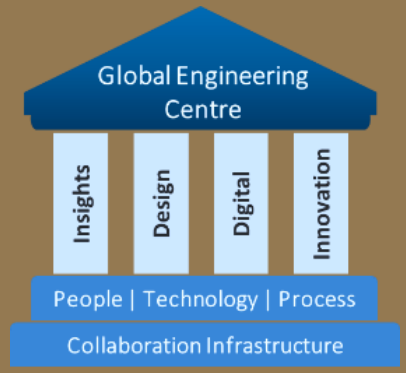
PRODUCTS & SERVICES

www.tataelxsi.com

Software Defined Vehicle | Connected | Autonomous | AI/Gen AI | Sustainable

Tata Elxsi Business Overview

Home to a Billion Possibilities



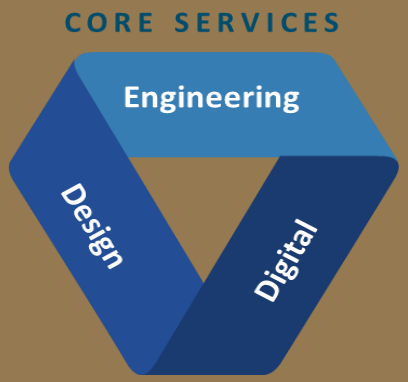
35+ Years in Business

12800+ Strong Engineers

Annual Revenue **$425** Million FY '24

13% YoY Growth FY'24

33 Cities Worldwide



Transportation

AUTOMOTIVE | OFF HIGHWAY

- User Experience
- Connected & Autonomous
- Electrification

AEROSPACE | MARINE | RAIL

- Embedded & Industrial
- Service design
- Rolling Stock

Media & Communication

BROADCAST & MEDIA

- OTT Streaming
- RDK, Android TV, CPE
- QoE, QoS, Customer Experience

COMMUNICATIONS

- 5G, SDWAN
- Network Transformation
- Digital Transformation

Healthcare

MEDICAL DEVICES

- Product Design
- Systems Engineering
- Regulatory Compliance

PHARMACEUTICALS

- Safety
- Packaging & Labelling
- Pharmacovigilance

Established 1989 **Global HQ Bangalore**

Leading Automotive Design & Engineering Service Provider for SDV and C.A.S.E

Tata Elxsi Automotive Practice Aligned to Address Future Mobility Solutions

Passenger Vehicle

Commercial Vehicle

Electric Vehicle

Software-Defined Vehicles

ADAS/AD | Cockpit Electronics | Electrification

Sys/SW Requirements, Architecture to Vehicle Integration & Validation

8000+
Talent Pool

AI & Design CoE

25+
Years of Automotive Engineering

AUTOMOTIVE SERVICES

C.A.S.E

Software Defined Vehicles

Connected Car & Cloud Services, Virtualization
5G & OTA, V2X, Telematics
Shared Mobility
IVI, Digital Cockpit, HuD

Automated Driving

ADAS/AD
Sensor Fusion
Vision Systems

Electrification

BMS, DC-DC Converter
Inverter, Motor controls
Charging systems
EMS, Transmission, Driveline

AI/Gen AI Services

Data analytics
Cognition / Self Learning
Vehicle Prognostics
Test Case Generation

VEHICLE SYSTEMS

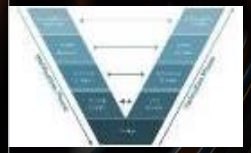
Body & Chassis

Brakes, Steering & Suspension
Underbody
BIW Development
Seat, HVAC, Sunroof
Door controls, Lighting

Conventional Powertrain

Engine Systems
Transmission Systems – Manual & Automatic
Torque Converters, Axles

Testing



System Testing & HILS
Functional/Diagnostic/Network testing
Benchmarking, Teardown

Mechanical

Vehicle Engineering, Powertrain Systems, EDS Harness Design, Styling & Surfacing, Body & Chassis Systems, Thermal Management, EEDS Design, Electrical Packaging

Integrated Services

User Experience

Mobile App & HMI Design
Design Research & experience
Mechanical Engineering
Concept Styling & Surfacing
Sales Experience - AR/VR/XR

Professional Services

IT Operations & Infrastructure
Consulting Services
Enterprise Infrastructure

Safety & Security

Functional Safety
ASPICE Process Consulting
Cybersecurity

Systems development

AUTOSAR- Adaptive, Classic
Hardware Engineering
Model Based Development
Model Based System Engineering

Showcasing Tata Elxsi AVENIR : SDV Framework

Demonstration for passenger, commercial, and off highway vehicles

Passenger

V2X
Intersection Collision Warning (ICW) Green Light Optimized Speed Advisory

ADAS
Lane Departure Warning

BCM
Adaptive Drive Beam

EV
Range Estimation
Smart Range Polygon

Commercial

V2X
Intersection Collision Warning (ICW) Green Light Optimized Speed Advisory

ADAS
Lane Departure Warning

BCM
Adaptive Drive Beam

SDV- Plugin/Plug-out Vehicle Addons
Trailer Discovery

EV
Range Estimation
Smart Range Polygon

Off Highway

(Earth Movers, Tractors, Mining Vehicles)

Safe Operating Environment
Remote Operations

Digital Twin
Prognostics

Autonomous Driving
Auto maneuver

SDV
Plugin/Plugout Vehicle Addons

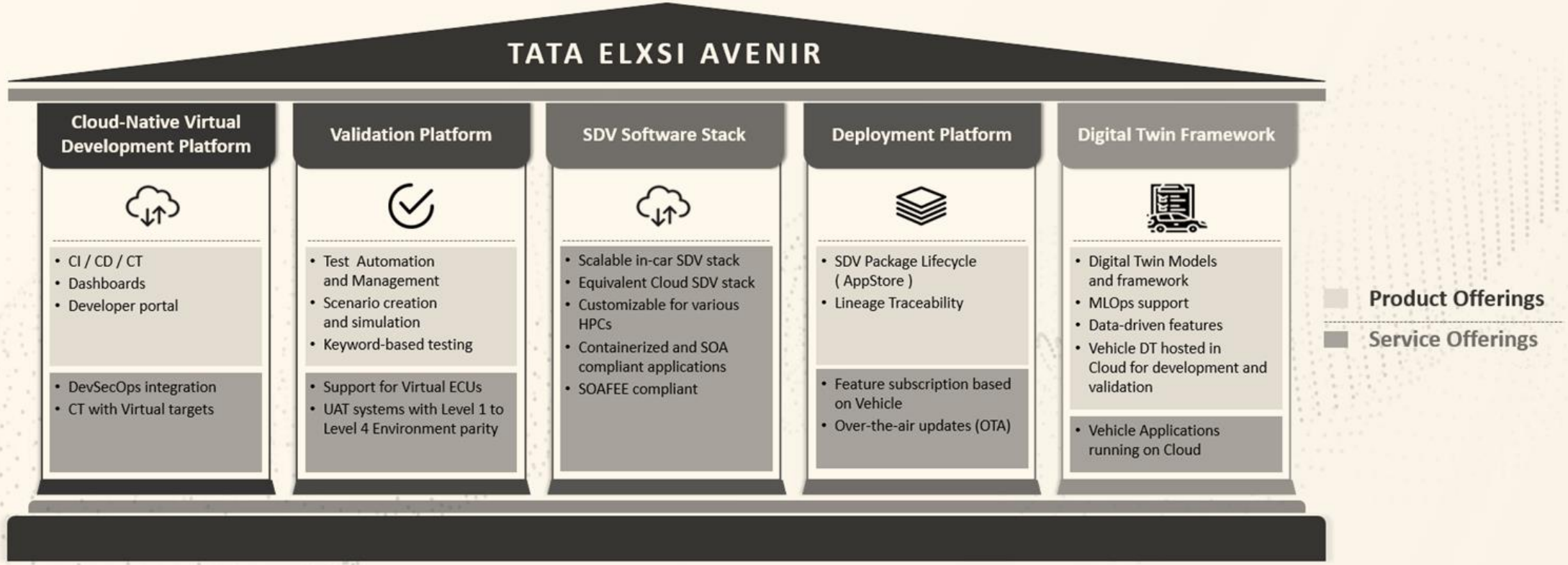
Digital Twin
Prognostics

Autonomous Driving
Auto maneuver

Tata Elxsi AVENIR

A Cloud-native SDV Development, Validation & Deployment Framework

Tata Elxsi AVENIR is a suite of cloud-native SDV development, validation, and deployment frameworks that enable our customers to develop, integrate, build, test, and deploy the SDV with ease.



SOFTWARE-DEFINED VEHICLES

DESIGN | DEVELOP | DEPLOY

OPPORTUNITIES ADDRESSED

Exponential increase in the Software for automotive leads to integration complexity

- Multiple ECUs are consolidated to form Domain/Zone which in turn form high-computed entities.
- New-Gen Communication Interconnects Consolidated Compute Entities

Balancing functionality between car and cloud

- Re-think design from distinct vehicle (embedded) and cloud components. Evolve to the unified view that the vehicle is Car+Cloud.
- Implement updates, keeping the experiences current and evolving.

Movement towards a subscription revenue streams for OEMS

- To consider Cloud+Car and OTA as a base enables constant updates of features and functionality.
- Enable a service revenue stream based on subscriptions.

SOAFEE
Scalable Open Architecture for Embedded Edge

TETHER AUTO : Connected Vehicle Platform

Award-winning cloud-neutral, vendor agnostic, hyper-scalar IoT connected vehicle platform

SOA
Service Oriented Architecture

Modular & Layered

Cloud Agnostic

Horizontally & Vertically scalable

Resilience by clustering of micro services

Seamless DevOps

Leverages Proven scalable Open-Source solutions

Optimized for Cost. Predictable TCO

Multi-cluster for hyper scaling

Ability to add new protocols and signal seamlessly

Unified data platform

Platform live since **Jan 2020**

***1.7M**
VEHICLES ON – ROAD & **COUNTING**

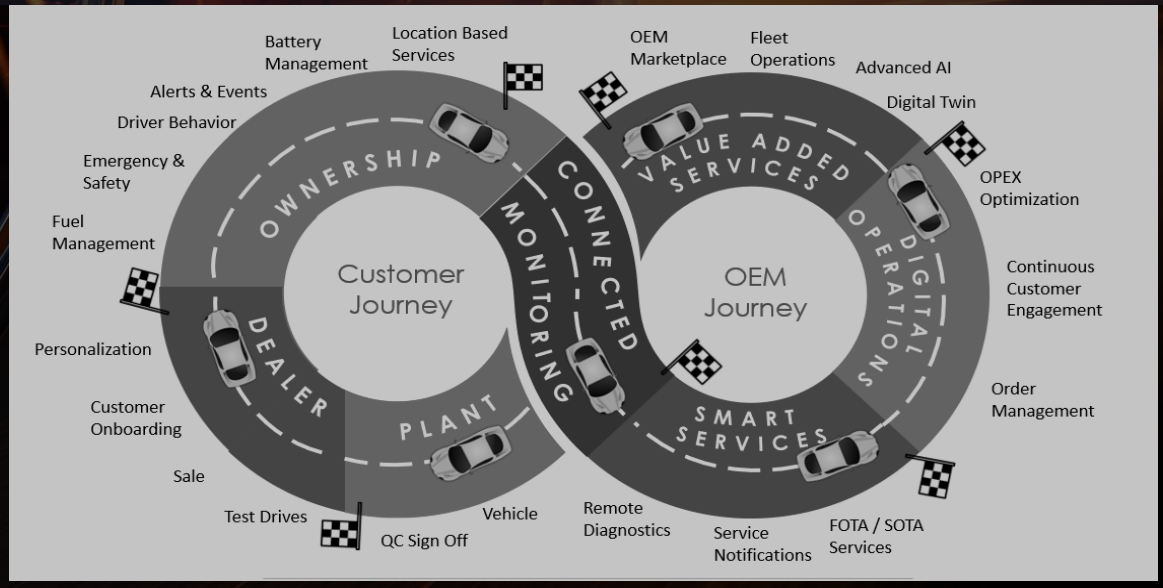
600+ TB
DATA **INGESTED** AND **ENRICHED** Per Month

***Largest** Deployment in India for **OEM**

<250 Milliseconds
Data Processing Latency

>100K
Vehicle **OTA** Updates Per Month

Connectivity Ownership of **Global OEM** in the new market



AUTOMOTIVE CYBERSECURITY
CONNECTED AND SAFER

OPPORTUNITIES ADDRESSED

Regulatory bodies are becoming aware of the cybersecurity risks in vehicles and proposing and adopting newer and more stringent regulations.

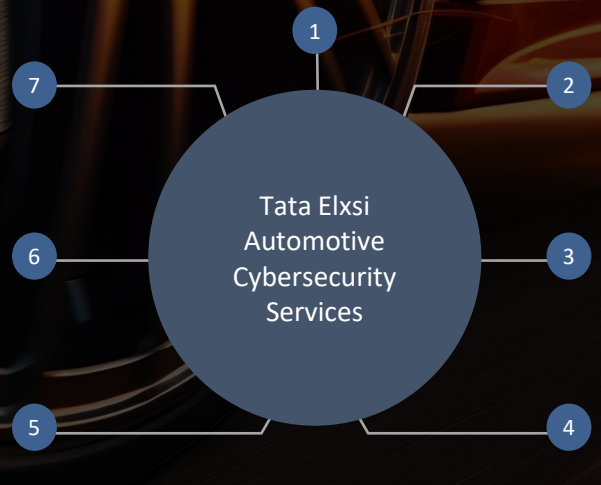
- Setting up the CMS (Certified Cybersecurity Management System)
- UNECE WP.29 Regulations R155 and 156: Compliance with the overall cybersecurity management

ISO 21434 process compliance and certification for secure development

Secure software development and testing to address the increasingly complex electronic structure in the passenger vehicle market.

- Secure the software development cycle from threat analysis, design, development, and testing.
- Maintaining security: continuous monitoring, incident management, and secure software updates
- Hardware acceleration of security functions
- Functional cybersecurity testing, fuzz, and penetration testing

Security Consultations: End to end security assurance for vehicle and its components



Cloud based services:
Security Telemetry, Backend Services (Secure Cloud)

Cybersecurity Process Compliance: ISO 21434, WP.29, GM/T, IEC62443, NIST

Continuous Monitoring:
Intrusion Detection, Security Operation Center, incident management

Cybersecurity Analysis:
TARA, DIA, Cybersecurity Concept and requirements

Security Testing:
Functional Security testing, Fuzzing and Penetration testing

ECU level Security Services:
Cybersecurity components development, integration and configuration

E-Cockpit SERVICES

CONNECTED AND USER-FRIENDLY

OPPORTUNITIES ADDRESSED

ECU consolidation to share resources, eliminate components, and reduce associated costs

- e-Cockpit: Capability demonstrator with integrated infotainment, instrument cluster, heads-up display, and ADAS features working from a single SoC
- Android, QNX, and Linux implementation and customization, OTA feature development, porting, and integration activities
- Access to pre-release Android versions

Multi-screen and multi-modal digital experience with minimal driver distraction

- UI/UX design and development
- 3D/2D visualization for instrument cluster and head unit
- Multi-modal interface: gesture control, voice recognition
- AR experience for heads-up display

AD-ADAS SERVICES
Perceive | Integrate | Validate

Design & Engineering Services

System & S/W Engineering	Hardware Design & Engineering	Embedded porting & optimization	Algorithm/ Framework Development	Image Processing Video Pipeline	HMI Graphic overlays, AR/ VR	Radar/LiDAR Processing	System / Vehicle Integration
AUTOSAR Classic / Adaptive	Functional Safety	Cyber security	Model Based Development	ASPICE	Digital Solutions AI/ML	Navigation HD Maps	Verification/ Validation (SIL, HIL, LAB, FIELD)

AD & ADAS Solution Accelerators

AI/ML based Algorithms

SenseFuse
Sensor fusion software

autonomai
AD Middleware stack

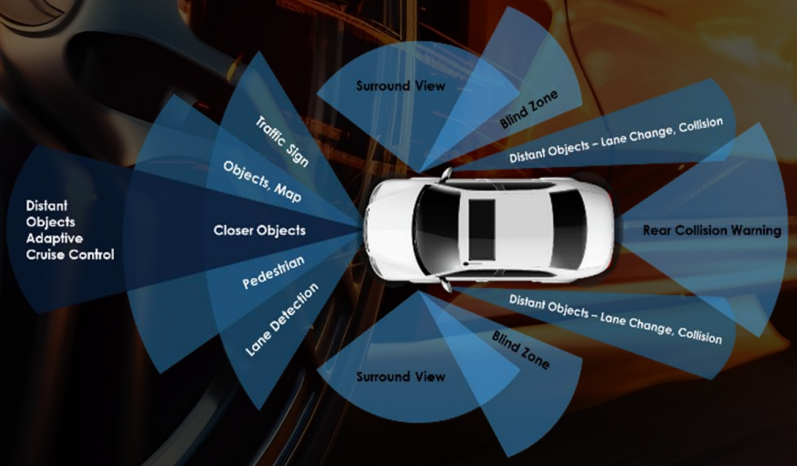
Smart Parking
Intelligent Parking

AICMS
Cabin Monitoring System

AIDMS
Driver Monitoring System

ObjDetect
Object Detection & Classification

TrafLane
Traffic Sign, Light & Lane Detection



Hardware Platform & Enablers

HWECU
Domain Controller & ITS Platform

AutoSAR
Classic/Adaptive Stack 3.X & 4.X

AI/ML Automation Tools Analytics & Simulation

SSGT
Synthetic Scene Generator Tool

TESA
Smart Annotation System

AIVA
AI-based Video Analytics

TEDAx
Data Analytics Platform

ANOMALAI
Anomaly Detection System

CANalytics
Vehicle Data Analytics Platform

PROGNOSE
Predictive Analytics System

VEHICLE ELECTRIFICATION
CLEAN | CONNECTED | SAFE

OPPORTUNITIES ADDRESSED

- EVs are upending the traditional vehicle landscape and reshaping the mobility and energy ecosystems.
- OEMs, Tier 1s, and partners are developing a portfolio of products and services that address multiple use cases and the changing regulatory landscape.
- Innovation and value creation through R&D, prototypes, production design, development, and validation

Service Framework

Services	System Engineering	Mechanical Design	Embedded Engineering	Simulation & Analysis	Cloud Engineering	Verification & Validation	Tech Support & Program Management	VAVE & Compliance Testing	Benchmarking & Teardown	Functional Safety	Cyber security

EV Systems (In-Vehicle & Ecosystem) Services

Power Convertor
DC-DC Convertor
On board chargers
Power Distribution unit
Thermal Management System

Vehicle Design
Skateboard, Rolling Chassis
E/E Architecture
Vehicle Thermal Management
Vehicle Integration

Energy Storage
Battery Pack
Battery Management System- Cloud
Frames/ Enclosures
Cooling system

Connectivity
Cloud
Wireless Connectivity
Telematics
Vehicle to Charger

Traction System
Motor/ Invertors
Control units
e-Transmission
Thermal Management System

Energy Infra Ecosystem
Home & Public Charger
V2G/H
Communication Protocols
Swappable modules

EV digital ecosystem
Digital Twin
Command centre platform
Monitoring & Management
Data Analytics & Insights
Ops. Efficiency optimization

Accelerators	OBC- DC-DC Combo Reference Design	AUTOSAR stack	CHAdeMO Stack Framework	EMobility HILS	EVSE/EVCC 15118 Stack Framework	IoT Software Platform	OBC, DC-DC, Motor, Inverter models- Plant/Controller	Battery & BMS models- Plant, SW & HW	PMSM Motor Design Framework

EV TESTING SERVICES

AGILE | SCALABLE | RE-USABLE

OPPORTUNITIES ADDRESSED

- Addressing the challenges in EV testing like validation at various integration points, design, and development of a flexible and cost-effective EV test system, Replicating Test Scenarios in the Real World
- Lab-based framework for the validation of electric vehicle systems, such as plugging in the device under test to fully functional hardware in loop simulation.

Service Framework

EV Testing Services

Software Qualification Testing
Integrated code tested in PC or in target HW with/without HILS (SWE.6)

System Integration Testing
System integration and integration testing w.r.t to HSIS, SYAD, Schematics (SYS.4)

System Qualification Testing
HILS/Vehicle based system level testing w.r.t SYS REQ (SYS.5)

Test Case Engineering

Test Case Development | Test System Design | Test System Development | Test Automation FW | Test Execution | ASPICE, ISO26262 compliant testing

Accelerator

EV Validation HILS Framework

- Readily available modular components
- Re-usable test framework, software, hardware
- Scalable to a wide range of power ratings
- Validation as a Service

HILS	Vehicle testing	Levels of testing	Scalability	Other offerings	Devices Tested
Onsite HILS Development	Vehicle data collection and testing	1. Test bench 2. Component, System, Vehicle level : HILS 3. LabCar 4. Vehicle	• Support test farm • Ramp up capability	• Benchmarking • Retrofitting • Cloud based EV • Homologation • Certification	• Vehicle Supervisory Control • On Board Charge Module • DC-DC Convertor • Battery Pack • BMS • Inverter • Motor Control Unit • Motor

e-Mobility HILS

SUSTAINABLE | FUTURISTIC | SMART

OPPORTUNITIES ADDRESSED

Test automation framework development for qualification addressing safety and reliability

- EV powertrains involve several solutions like OBC, DCDC converter, inverter, and BMS.
- Compliance with multiple standards
- Multiple system and component validations

- Functional Tests
- Diagnostics Tests
- Drive Scenarios
- Standards Verification
- Performance Analysis
- Drive Cycles
- Range Verification
- Electrical Compatibility
- Network Tests
- Load Tests

Scalable Test Automation Framework

- Scalable to accommodate component level, system level, and vehicle level validation
- Battery, motor, charger, power converters, and master controllers

HMI DESIGN SERVICES

RESEARCH AND STRATEGY | USER EXPERIENCE | VISUAL DESIGN

Re-imagining and redefining driver & passenger experiences and HMI Design across vehicle platforms and digital ecosystems

DESIGN RESEARCH & STRATEGY

- UX Research and benchmarking
- Platform HMI performance evaluation
- Understanding evolving driver / passenger behaviour
- Usability Benchmarking

UI/UX DESIGN

- HMI design concept solutions for current as well as evolving vehicle segments (EV and Autonomous)
- Visualization for advanced features like ADAS, V2X etc.

PROTOTYPING & SIMULATION

- Digital click-through prototypes and interactive simulations
- 2D/3D interactive HMI simulations
- E-Cockpit design and development

DESIGN VALIDATION & TESTING

- Usability testing
- A2B Verification - Pixel perfect UI screen verification, validation against specification
- Driver distraction testing through Occlusion/Eye tracking methodology.

TATA ELXSI

About Tata Elxsi

Tata Elxsi, a part of the $120+ billion Tata Group, is one of the fastest-growing and recognized as one of the leading global design and technology services firm. Tata Elxsi brings the experience of over 30 years in sophisticated product and software engineering, and an award-winning design team, to help customers re-imagine their products and services in three key verticals – Transportation, Media & Telecom, and Healthcare. Tata Elxsi's differentiated offerings and design-led approach have helped achieve win strategic deals with both Automotive OEMs and suppliers in autonomous, connected and EV technology, highlighting our technology and engineering leadership. Tata Elxsi is one of the leading players in these technology areas, helping its customers in development and launch of new and innovative products.

Canada | China | France | Germany | India | Ireland | Japan | Netherlands | Portugal | South Africa | Spain | UAE | UK | USA

info@tataelxsi.com