Future-ready mobility: When intelligence becomes visible

2026 TCS Digital Twindex report series

Future-ready mobility

Partnering in your journey toward a resilient, sustainable, and human-centric automotive enterprise.

Foreword

Anupam Singhal
President, Manufacturing,
Tata Consultancy Services

For the most of us, a car has always been a simple promise—a safe, secure, and comfortable way to move from one place to another. It helps us get to work, bring our families together, and navigate everyday life reliably and quietly.

That relationship is now evolving.

Mobility is not just about moving faster; it is about moving responsibly—toward cleaner cities, safer roads, and experiences that respect people's time and the planet. The car is no longer just a means of transport. It is becoming an inseparable part of how we live and work—an extension of our living room, our workplace, and our personal space.

It is where conversations continue, entertainment travels with us, and moments of focus or relaxation unfold. This shift is not driven by novelty or features alone, but by technology that is increasingly embedded, responsive, and intelligent.

What makes this moment different is not the presence of digital technology in vehicles—we have seen that before. What is different is how intelligence is now being woven into the entire mobility ecosystem. Artificial Intelligence, and increasingly agentic AI, is no longer confined to isolated functions. It is shaping how vehicles learn, how factories adapt, how supply networks respond, and how decisions are made across the automotive value chain.

As a result, mobility is becoming more intuitive and more humane.

For the common citizen, this does not show up as algorithms or architectures. It shows up as trust. As reliability. As experiences that feel smoother, safer, and more personal with every journey.

This is the essence of **Future-Ready Mobility**—not mobility defined by technology alone, but mobility defined by how seamlessly intelligence enhances everyday life.

This edition of the TCS Digital Twindex brings together voices from the automotive ecosystem—leaders who are not speculating about the future of mobility, but actively building it across vehicles, factories, supply networks, and digital platforms. Their insights reveal a transformation that has been unfolding quietly for years, and is now beginning to be felt in ways that matter to people.

The future of mobility is taking shape in everyday experiences.
This report explores how and why of this transformative shift.

Executive champions

Ajay Wadhwa
CEO, Tata Motors Global Services Limited

Matt McLarty
Chief Technology Officer, Boomi

Karen Langona
Global Partner Sales Director, Automotive & Manufacturing, Amazon Web Services (AWS)

Rohit Bhargava
Founder, Non-Obvious Company

Alper Celik
Senior Director, Automotive and Manufacturing Strategy & Digital Transformation, Oracle

Kristian Kozole
Vice President Automotive, Siemens Digital Industries Software

John Dougherty
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Naresh Mehta
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Laksh Parthasarathy
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Futurist, Tata Consultancy Services

Subhash Sakorikar
Global Head of Industry Excellence and Advisory, Manufacturing, Tata Consultancy Services

Executive summary

The automotive industry is often described as being in constant transition—toward electrification, autonomy, software-defined vehicles, and AI. Yet for many customers, and even for some industry leaders, progress has felt incremental and uneven.

This perception obscures a deeper reality.

Automotive has not been slow to transform. Instead, it has been rebuilding itself—quietly and systematically—around **intelligence**.

Over the past several years, intelligence originated upstream into engineering architectures, software platforms, factories, and data ecosystems. Vehicles have been re-architected as **software-defined systems**. Digital twins have evolved from design tools into decision infrastructure. Manufacturing has begun shifting from rigid production lines to adaptive, learning environments. Artificial Intelligence—and increasingly **agentic AI**—is now embedded in how decisions are made across the automotive value chain.

Much of this transformation remained invisible to customers, shaped by long product cycles and complex ecosystems. What drivers experience today often reflects decisions made years earlier—before intelligence became central to the system.

That dynamic is now changing.

As intelligence layers mature and converge, their impact is becoming tangible. Vehicles are evolving through software updates. Factories are responding dynamically to variability and disruption. Fleets are learning collectively, improving safety, reliability, and performance at scale. Sustainability is moving from aspiration to measurable outcome, driven by system-level design choices.

This marks a **critical inflection point**: the shift from building intelligence to experiencing its effects.

Executive summary

This edition of the **TCS Digital Twindex for Automotive** examines how intelligence, once embedded upstream, is now shaping visible outcomes across the automotive ecosystem. Drawing on conversations with automotive manufacturers, technology platforms, and ecosystem leaders, the report identifies four converging shifts defining this moment:

Intelligence is shifting from design intent and planning into real-world outcomes

Engineering and manufacturing are becoming adaptive, intelligence-led systems

Factories and supply networks are evolving into cognitive assets

Vehicles are evolving from standalone products into connected Physical AI assets that learn collectively over time

Together, these shifts mark the transition to **Future-Ready Mobility**, as intelligence is translated into scale, resilience, and real-world performance. The automotive industry has completed much of the foundational work for this next phase. What will differentiate leaders now is the ability to **operationalize intelligence at scale—**turning it into trust, experience, and sustained advantage.

The future of mobility is no longer being imagined.
It is being experienced—across vehicles, factories, and everyday journeys.
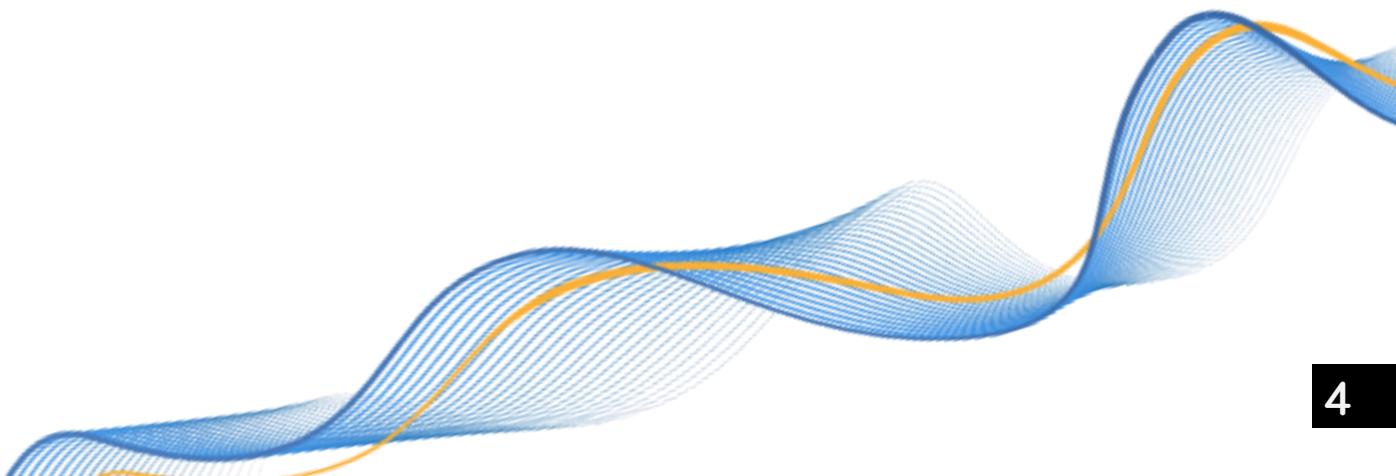
Key findings

The following key findings reflect convergence across conversations with automotive manufacturers, platform providers, and ecosystem leaders. While each organization described transformation through a different lens—vehicle architecture, factory systems, enterprise workflows, or customer experience—the underlying signals were consistent. Together, these findings capture what has changed beneath the surface of automotive, and why intelligence is now moving from infrastructure into everyday outcomes.

The automotive industry has been rebuilding "below the dashboard" first.
The biggest change has not been what drivers can see—it has been the intelligence embedded upstream in engineering systems, factories, enterprise workflows, and compliance platforms. This is why progress looked incremental, even while the system was being re-wired.

Software-defined is not a feature story—it is a control-plane story.
Centralized and edge compute, decoupled hardware and software, digital twins, and governed data/workflow orchestration are turning the vehicle into a system that can be updated, managed, and improved continuously—more like a living product than a finished build.

Factories became proving ground for learning at scale.
In parallel with connected vehicles, intelligence matured in plants—where software-defined operations, physical AI, robotics, and closed-loop feedback made variability manageable and flexibility scalable. The factory is where adaptation became operational, not theoretical.

The new unit of competition is the mobility ecosystem—and the experiences it delivers.
OEM advantage is shifting from isolated features to collective learning—where fleets improve safety, reliability, sustainability outcomes, and customer experience through shared signals and faster decision loops. This is where intelligence becomes visible: not as novelty, but as trust in everyday journeys.

Behind the scenes → **What people experience**

Engineering systems

Vehicles that improve over time

Connected intelligence

Factories & operations

Smarter fleets

Enterprise & supply networks

Better everyday experiences
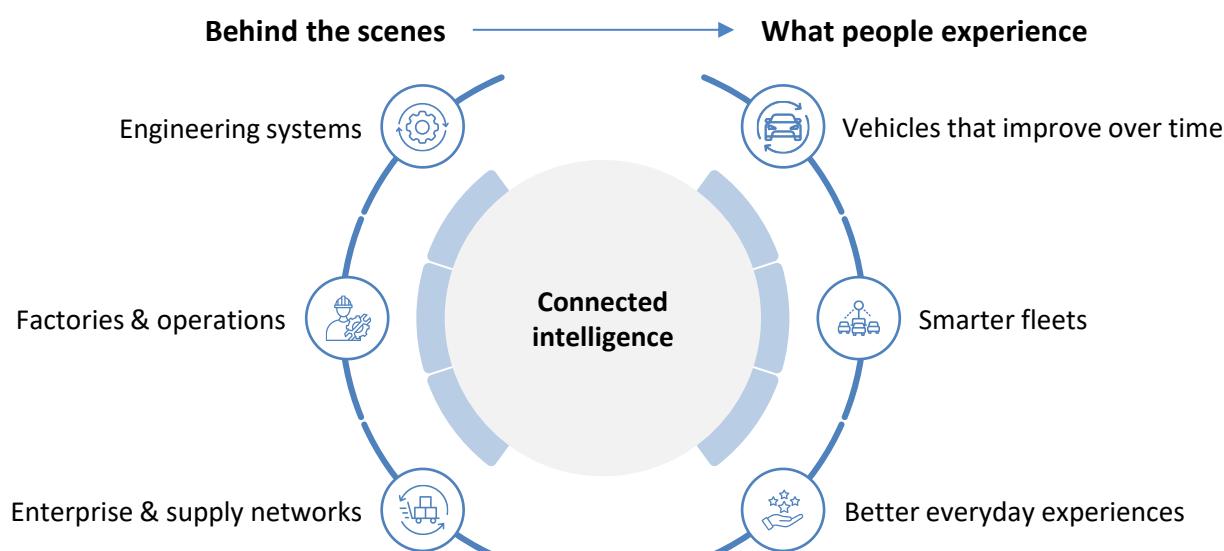
Chapter 1 : The invisible revolution

For much of the past decade, the automotive industry has been described as slow to change. Vehicles still look familiar. Model refresh cycles remain measured. From the outside, progress has often appeared incremental.

Inside the system, however, a different transformation has been underway.

Across interviews with OEMs, platform providers, and ecosystem leaders, a consistent signal emerged: the most significant advances in automotive intelligence occurred far from the customer interface. Innovation moved first into engineering systems, factory operations, and enterprise platforms—long before its effects could be felt on the road.

This explains a persistent disconnect. Automotive invested heavily in intelligence, yet customers perceived limited change—not because innovation stalled, but because it was concentrated upstream.

Automotive's long product cycles mean that early decisions take years to surface as experience. Intelligence embedded in design and manufacturing must pass through production, regulation, and deployment at scale before becoming visible. During this period, progress remains largely hidden, even as capability accelerates beneath the surface.

> " There's so many layers to the whole ecosystem. You've got the driver experience, manufacturing, suppliers, infrastructure to support the experience, and self driving. All of those reflect this reality of the complexity not going away. "

Matt McLarty
Chief Technology Officer, Boomi

Leaders described this phase not as delay, but as necessary groundwork. Intelligence was built into the system before it could be expressed reliably through experience. Engineering shifted toward software-led architectures. Factories evolved into adaptive environments. Enterprise workflows became orchestrated and governed. Without these foundations, customer-facing intelligence would remain fragile and fragmented.

What is changing now is readiness.

The difference this time is that intelligence is no longer confined to design and production—it is beginning to express itself through real-world performance.

As these layers mature and converge, effects are starting to surface. Vehicles evolve through software updates. Manufacturing systems respond dynamically to variability.

Compliance, sustainability, and quality are increasingly designed into processes rather than verified after outcomes occur.

> " The world changes constantly, but we keep circling back to human values—meaning, trust, purpose. If we don't find those answers, we push back. The future of mobility will win only when the technology serves those human needs. "

Rohit Bhargava
Founder, Non-Obvious Company

One leader summarized the shift simply: intelligence was never missing—it was "below the dashboard."

This invisible revolution has reset expectations inside automotive organizations. The focus has moved from experimentation to execution—operationalizing intelligence without compromising safety, reliability, or trust.

For customers, the change is becoming perceptible. Experiences feel more responsive. Systems adapt instead of breaking. Improvement becomes continuous rather than episodic.

> " Over the past decade, we have witnessed a series of incremental changes. This gradual evolution accelerated significantly in the most recent two to three years, marking a period of rapid progress. However, despite these advancements, the widespread adoption of new technologies and the essential foundational work still need to catch up across many companies. As the pace of innovation continues to quicken, the coming years are poised to be truly revolutionary, ushering in profound shifts that will redefine the ways of working. "

Ajay Wadhwa
CEO, Tata Motors Global Services Limited

The industry's next phase is no longer about inventing intelligence, but about making it visible—responsibly, consistently, and at scale.

Chapter 2: Intelligence takes shape upstream

The question now is structural: where did intelligence take root first?

Across interviews, leaders were consistent on one point. Intelligence did not enter automotive through dashboards or features. It moved upstream—into the architectures that define how vehicles are engineered, built, governed, and updated over time.

Karen Langona
Global Partner Sales Director,
Automotive & Manufacturing,
Amazon Web Services (AWS)

" The software-defined vehicle really starts on the cloud. You can model the program, decide chipsets and system-on-chip, and plan storage with buffer so future features can be delivered over the air without replacing hardware. That changes the dynamics of car ownership. "

Engineering is the first proof point. Organizations described a shift from sequential, document-driven development to software-led, model-based systems. Digital twins have evolved from simulation tools into living representations of products, continuously informed by real-world data. Decisions are increasingly validated virtually, long before physical builds begin. The objective is no longer to finalize a design and then execute it, but to **continuously evolve the product through its lifecycle**.

Naresh Mehta
Global Chief Technology and
Innovation Officer, Manufacturing,
Tata Consultancy Services

" From the ICE vehicles to the CASE model (Connected, Autonomous, Shared, Electrified), the last decade has moved EVs from niche to mainstream, transformed in vehicle tech into personalized digital cockpits, and made ADAS features standard. Business models are diversifying beyond selling cars to shared mobility, data driven services, and software updates as revenue. "

This architectural reset extends into the vehicle platform itself. Centralized compute and the decoupling of hardware and software are changing how complexity is managed. Software-defined vehicles are engineered to be updated, governed, and improved long after they leave the factory. Over-the-air evolution and faster response to issues become viable only when upstream foundations are designed for control, not just speed.

Manufacturing leaders described a parallel evolution across plants and products. Factories are becoming programmable systems aligned to engineering intent. Digital twins increasingly connect product design directly to plant configuration, while physical AI and adaptive automation allow plants to respond to variation without sacrificing quality or throughput.

> "The biggest change now is the rise of connected vehicles, the software defined car. It is decoupling hardware from software, turning cars into smartphones on wheels. You no longer buy a static product; you keep updating it throughout its life. This shift will completely redesign the industry.

Alper Celik
Senior Director, Automotive and Manufacturing Strategy & Digital Transformation, Oracle

What makes this work at scale is the enterprise layer. Workflow orchestration, integration, and governance prevent intelligence from fragmenting into isolated capabilities. Without this coordination, leaders warned, complexity turns into operational risk.

> "If I predict 2035, the production line is no longer rigid, it will be a mosaic of reconfigurable modular cells. The comprehensive digital twin will be the heart of everything, so close to reality that every cell decides in real time the next best action. Engineers will use AR glasses to see exactly what needs to be done, based on the comprehensive digital twin, and work in an industrial metaverse environment with AI agents making faster decisions. Productivity will reach unprecedented heights, and humanoid robots will likely become integral to future manufacturing solutions. Industrial AI will transform the way companies innovate and manufacture."

Kristian Kozole
Vice President Automotive, Siemens Digital Industries Software

The result is a **new control plane for automotive**. Risk is addressed earlier. Quality is designed in rather than inspected out. Sustainability and compliance are embedded into workflows instead of managed as parallel processes.

> Cars are becoming software defined. Engineers are already designing concepts like augmented reality windows, seats that rotate for social interaction, and dashboards that transform into workstations. The future isn't as far away as we think, it is only as far as the physical world will allow us to build.

Michael Deittrick
Futurist, Tata Consultancy Services

What emerges now is an integrated system—where engineering, manufacturing, enterprise platforms, and vehicles operate as part of a continuous intelligence loop. The first place this upstream intelligence reached operational maturity was not the vehicle—it was the factory.

Chapter 3: The factory becomes the brain

The factory is where upstream intelligence first became operational.

While intelligence reached the vehicle, it scaled on the shop floor. Volatility in supply, labor constraints, quality pressures, and sustainability mandates forced factories to adapt faster than product cycles allowed. What emerged was not incremental automation, but a shift in how factories sense, decide, and respond.

Across interviews, manufacturing leaders described the same transition: factories are no longer optimized only for efficiency and throughput. They are being designed as **decision-making systems**.

> " Digital twins let you simulate the real factory environment ahead of time, so you can validate workflows, timing, and component fit much before they are on the shopfloor. Some twins also serve as a control layer: set parameters in the digital twin and see the physical twin follow, improving throughput and stability. "

Subhash Sakorikar
Global Head of Industry Excellence and Advisory, Manufacturing, Tata Consultancy Services

Sensors, machines, robots, and production assets generate continuous signals. Digital twins mirror physical operations in real time. AI models simulate scenarios, anticipate disruption, and recommend actions before issues materialize. In advanced environments, corrective decisions are no longer escalated—they are executed autonomously within defined guardrails.

This marks a shift from reactive manufacturing to cognitive production.

> " We are moving from hardware driven plants to software defined factories, where process controls can be changed through software. Robotics has evolved from simple automation to physical AI, enabling machines to perceive, reason, and act intelligently. It is not just moving data anymore; it is moving things in the plant with AI. "

Laksh Parthasarthy
Global Head of Smart Mobility and Automotive, Manufacturing, Tata Consultancy Services

Rather than absorbing variability through buffers and manual intervention, factories respond through intelligence. Line balancing adjusts dynamically. Quality deviations are detected at the source rather than downstream. Energy consumption, waste, and emissions are optimized continuously rather than reviewed after the fact.

Crucially, this intelligence does not stop at the plant boundary.

The same shift is extending into **supply and distribution networks**. As factories become more adaptive, intelligence must extend upstream to suppliers and logistics partners and downstream to distribution and services providers. Supply chains are increasingly treated as dynamic systems—sensing constraints, recalibrating plans, and triggering coordinated responses across enterprises. In this model, resilience is driven by faster, governed decision-making rather than excess inventory alone.

Decisions are made and improved in real time
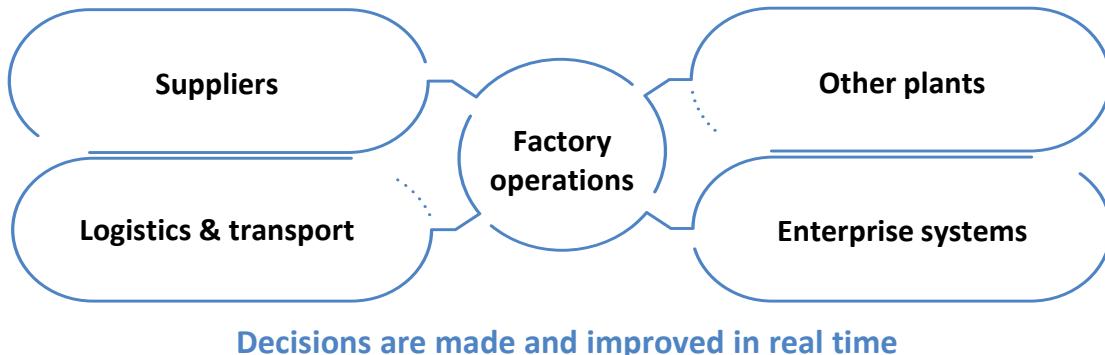
Leaders emphasized that factory intelligence compounds when connected across sites and partners. Learning from one disruption improves performance everywhere. What was once local optimization becomes enterprise-scale adaptation. What allows this to scale is **governance**.

Workflow orchestration, integration, and decision authority prevent factory and supply intelligence from fragmenting into disconnected pilots. Without this coordination, autonomy introduces risk rather than resilience. The result is a redefinition of the factory's role.

> A true smart factory must be digital, connected, and adaptive. Many plants have the digital part, but not the adaptive part, especially older facilities that cannot easily change layouts without massive capital expense. The goal is to get as close to that nirvana as possible with AI, data, workflows, and process mining to drive efficiency.

John Dougherty
Head of Manufacturing GTM,
AMS Enterprise Verticals,
Manufacturing

Factories are no longer just a point in the value chain. They function as intelligence hubs—translating design intent, operational reality, and enterprise priorities into action. In many organizations, this is where intelligence proved its value first, because impact could be measured immediately in yield, resilience, and cost.

The factory did not just adopt intelligence early. It showed the industry how intelligence works at scale.

Chapter 4: From vehicles to intelligent mobility ecosystems

For years, intelligence reshaped automotive systems largely out of sight.

Now, its effects are becoming apparent—through vehicles, fleets, and the ecosystems that connect them.

The modern vehicle is no longer a finished product at the point of sale. It is a software-defined system designed to evolve. Capabilities are added post-sale, refined, and corrected over time. Performance improves post-purchase. Safety systems learn. Interfaces adapt. What drivers experience today increasingly reflects decisions made after the vehicle leaves the factory, not before.

But the most significant shift is not happening at the level of individual vehicles. It is unfolding across connected fleets and the broader mobility ecosystem they operate within.
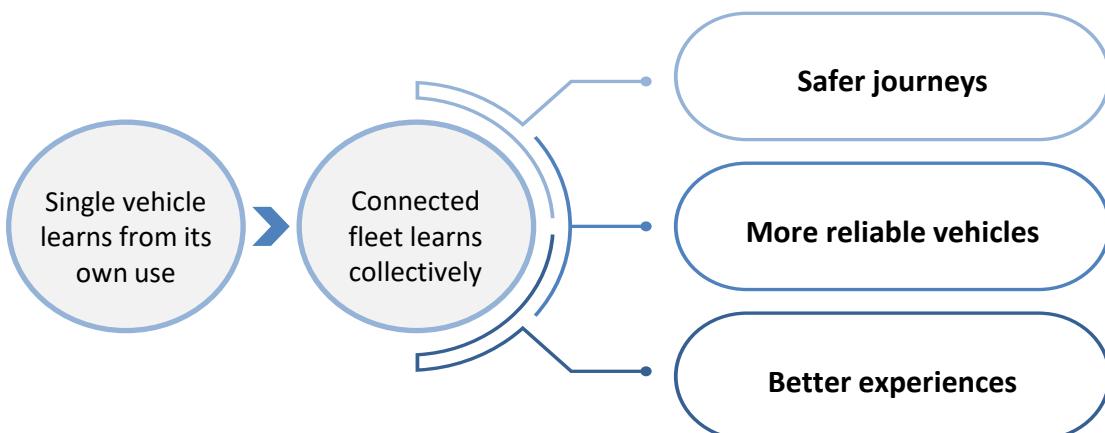
Across interviews, leaders described a transition from standalone products to **collective intelligence**. Vehicles are learning not only from their own operation, but from the experience of many others. Patterns detected in one geography inform updates deployed elsewhere. Rare edge cases become training data. Improvement compounds over time.

This changes how quality, safety, and reliability are defined.

Subhash Sakorikar
Global Head of Industry Excellence and Advisory, Manufacturing, Tata Consultancy Services

"In autonomous cars, the next driver actually learns from all the previous ones. The software continuously updates information, so the chances of repeating the same error drop dramatically, and it fine tunes how to navigate historically dangerous, accident prone turns and intersections each time at times including unforeseen situations.

This changes how quality, safety, and reliability are defined.

Instead of relying solely on pre-launch validation, issues are detected in operation and addressed systemically. Software-based remediation becomes continuous rather than episodic. Risk is managed dynamically, with learning distributed across the fleet rather than contained within individual vehicles.

Connected fleets increasingly act as sensing networks, generating insight into real-world usage, operating conditions, and component behavior at scale.

For customers, the systems behind this shift remain largely invisible. The outcomes are not. Experiences are smoother. Issues are resolved faster. Vehicles improve rather than degrade over time. For commercial operators, the impact is more explicit—higher uptime, better utilization, and decisions grounded in real-world behavior rather than assumptions.

Importantly, this shift reframes what mobility means. Vehicles are no longer static assets owned and maintained in isolation. They are participants in a broader ecosystem—connected to infrastructure, services, and other vehicles. Intelligence moves across that ecosystem, enabling coordination rather than fragmentation.

This is where automotive intelligence **is felt**.

Not as a single feature or interface, but as a pattern: systems that learn, adapt, and improve continuously—quietly embedded in everyday journeys.

Conclusion: When intelligence becomes visible

For much of the past decade, automotive transformation was defined by what was being built rather than what was being experienced. Intelligence accumulated quietly—inside architectures, factories, platforms, and supply networks—long before its effects could be felt by customers or operators.

That phase is now complete.

Across the automotive ecosystem, intelligence has crossed a threshold. It has moved from isolated capabilities into connected systems. From experimentation into operations. From upstream foundations into everyday outcomes.

This is why the next phase of automotive transformation will feel sudden rather than gradual.

The industry did not arrive here through a single breakthrough. It arrived through years of structural change: re-architected vehicles, adaptive factories, governed platforms, and learning supply networks. Together, these layers created the conditions for intelligence to scale safely and consistently.

Manufacturing leaders described how digital twins are now used not only to simulate factories, but to validate workflows, tune production parameters, and stabilize operations before changes are applied on the shop floor.

What distinguishes this moment is not the presence of advanced technology, but its **expression**.

> " As the automotive industry moves into a new era of mobility, we bring the 'full stack AI capabilities' from hardware to EE & SDV architectures, vehicle OS and personalized experiences. We help our OEM and tiered partners to build engineering intelligence into every stage of the vehicle lifecycle. By embedding AI across design, development, validation, production and usage cycles, TCS stands as a trusted partner to accelerate innovation, deliver differentiated experiences, and shape the future of mobility through a unique Human + AI continuum. "

Sreenivasa Chakravarti
Vice President & Global Head - IoT & Digital Engineering, Tata Consultancy Services

Vehicles evolve after purchase. Factories adapt in real time. Fleets learn collectively.

Leaders described how connected vehicles now improve after purchase, with software updates informed by fleet-level learning—where rare edge cases encountered by one vehicle help prevent repetition across thousands of others.

Supply networks respond faster than disruption propagates. For customers and citizens, these shifts are not visible as systems—but they are felt as **trust, reliability, and experience** that improve rather than erode over time.

Several leaders emphasized that this trust emerges only when technology quietly removes friction, improves safety, and respects how people actually live and move.

This marks a redefinition of progress in automotive.

Leadership is no longer measured by how much intelligence is embedded, but by how effectively it is translated into outcomes. Not by isolated innovation, but by the ability to orchestrate intelligence across the value chain—without compromising **safety, responsibility, or scale**.

The automotive industry has entered a phase where intelligence no longer hides behind complexity. It shows up in how mobility works—quietly, continuously, and at scale.

The future of mobility is not arriving all at once.

It is becoming visible—one decision, one journey, one experience at a time.

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About the Report

This edition of the **TCS Digital Twindex Report for Automotive** examines how intelligence is becoming visible across the mobility ecosystem—moving from upstream engineering, manufacturing, and enterprise systems into real-world experiences. As vehicles become software-defined and operations increasingly AI-driven, mobility is shifting from static products to adaptive, learning systems.

The report is grounded in qualitative research, drawing on in-depth conversations with automotive manufacturers, technology and platform partners, futurists, and TCS leaders. These perspectives surface the architectural shifts and strategic choices shaping the next phase of automotive transformation.

The **TCS Digital Twindex Report for Automotive** reflects TCS' perspective on **Future-Ready Mobility**—where intelligence is no longer layered on, but built into how vehicles are designed, produced, operated, and experienced.

About Tata Consultancy Services

Tata Consultancy Services (TCS) (BSE: 532540, NSE: TCS) is a digital transformation and technology partner of choice for industry-leading organizations worldwide. Since its inception in 1968, TCS has upheld the highest standards of innovation, engineering excellence and customer service.

Rooted in the heritage of the Tata Group, TCS is focused on creating long term value for its clients, its investors, its employees, and the community at large. With a highly skilled workforce of 590,000 spread across 55 countries and 202 service delivery centers across the world, the company has been recognized as a top employer in six continents. With the ability to rapidly apply and scale new technologies, the company has built long term partnerships with its clients – helping them emerge as perpetually adaptive enterprises. Many of these relationships have endured into decades and navigated every technology cycle, from mainframes in the 1970s to Artificial Intelligence today.

TCS sponsors 14 of the world's most prestigious marathons and endurance events, including the TCS New York City Marathon, TCS London Marathon and TCS Sydney Marathon with a focus on promoting health, sustainability, and community empowerment.

TCS generated consolidated revenues of over US $30 billion in the fiscal year ended March 31, 2025. For more information, visit www.tcs.com.

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