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**AUTOMOTIVE
WHITE PAPER**

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**THE MEGA-TRENDS
RESHAPING THE**

AUTOMOTIVE INDUSTRY

A STABLE BUSINESS MODEL STARTS TO CHANGE

The motor car first appeared at the end of the 19th century and, though technologies have changed almost out of recognition, it is surprising to consider how little the concept of the car has altered in all that time. A metal box with 4 wheels, a drive train that is still largely built on 130 year old technology, and a business model based on selling to private owners, who maintain, insure, tax and learn to drive it for themselves.

Yes, we have now installed entertainment systems and increasingly sophisticated electronics, and yes there are now many ways to avoid full ownership (lease, rental, long-term payment plans...) but really, is there any other concept of such critical importance to the lives of us all that has changed so little over such a long period?

Let's in particular consider the core business model of automotive companies, which is very much based on the belief that whatever the engineers develop will be accepted – and bought- by the public. The admirable focus on product design, safety, drivability and safety, vital though these are, has been driven by the assumption that drivers will buy what they are offered. This is no longer necessarily the case.

This somewhat stable picture is being transformed, and the shock of change will be all the greater because transformation is happening at extraordinary speed and is impacting every aspect of car design, ownership, usage and maintenance. After decades in which really very little changed (except for those desirable new features and style makeovers that look important but really are not), everything is changing, and predicting who will win and lose from a period of unprecedented turmoil in the market will not be easy.

This story has been written about a lot in the past two to three years and by many different commentators. We do not want to cover the same ground all over again, so we are going to focus on one big strategic issue: how do automotive manufacturers stay competitive and relevant as the business models that support them disappear? What do they need to do, when and how? What are their most urgent priorities and how can they balance the need for long-term transformational change with the equally vital need to stay profitable in the meantime?

THE KEY TRENDS

The classic automotive business model is being transformed by trends that are overwhelming in their importance and cannot be resisted. It is possible to define these in a variety of ways, and no single analysis can be either complete or absolutely correct, so in this paper we will focus on the three areas that are of highest strategic importance: Environment; Data and Connectivity; Ownership. These are not only vital in themselves but are driving a range of subsidiary changes, all of which impact on the automotive business model in their own ways.



Environment

The most public aspect of this change is the move from fossil fuel drivetrains to electric vehicles (EVs), but this is probably the least important aspect of environmentally-driven change. After all, battery technology presents its own environmental challenges and it is quite likely that Lithium mining will soon be as controversial as Oil & Gas exploration is today. In any case, to achieve wider adoption electric vehicles need to improve battery life, reduce price, and dramatically improve both energy-based charging grids and availability of rapid charging points. All of these issues, however, are now progressively being addressed, and the tipping point for change over to electric vehicles is now coming closer.

Going electric is not a panacea to environmental ills, but the growing public concern about everything from climate change to air pollution is fueling demand for wider, more strategic changes to usage, behaviors and connectivity of automotive technology with smart city investment and public transport. The goal is to reduce emissions and cut negative impact holistically, not just transferring pollution from the engine of an individual car to the production plant or power generation facility.

On every practical factor derived from the rise in electric vehicles is this: the entry barriers for newcomers are being lowered. That's because the engine was always the single most expensive item in a car, and the need to develop increasingly sophisticated and high performing powertrains made it harder for non-traditional businesses to enter the market. As we move towards often standardized battery-based propulsion, so the potential for differentiation diminishes and the opportunities for new entrants grow.

The entire raison d'être of the industry has come under question as never before. The impact of this new consciousness may be felt in other ways (reduced car ownership, greater emphasis on low-pollution public transport, stricter controls on usage), but the driver for all of these changes is the same: the environment and our fears for the future.



Data and Connectivity

Every part of the automotive industry is affected by the more sophisticated and granular use of rich data flows and the analytics that turn this into actionable insights. The Industry 4.0 concept, widely accepted under different titles by every kind of manufacturer, focuses on use of data to improve operational efficiency in the factory, itself, through such concepts as predictive maintenance, end to end automation and more responsive build to proven demand.

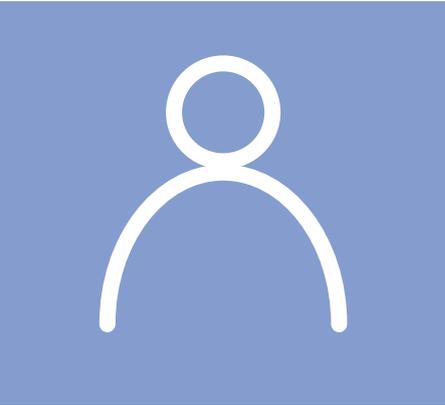
The automotive industry is as much impacted by these changes as any other branch of discrete manufacturing, but the impact of connectivity added to data is more relevant to the car market than any comparable sector. That's because the growing synthesis between IT and Operational Technology (OT), which is the key to Industry 4.0 as a concept, is felt more strongly outside the factory in automotive than anywhere else.

Connectivity and autonomous driving are converting motor vehicles into software devices, and that requires new capabilities and skills, the need for radical rethinking of core processes and redesign of core IT. The growing use of Artificial Intelligence in design, manufacture and usage will also have a major impact on all aspects of the automotive industry. OEMs and their suppliers are now engaged in a rapid process of development to transform their skill base and develop new working methods.

What began with enhanced entertainment and navigation options is now a top-level strategic process that is feeding through into all of these radical new concepts:

- Vehicles are increasingly sold with their own unique digital identity. This enables easy tracking for use cases such as insurance, driver safety, predictive maintenance and fleet management. All of these, of course, lead to major questions about information security, privacy and regulatory compliance.
- Smart services, ranging from better navigation aids to finding parking spaces in a crowded city through connection to smart city functionality, through to accessing all the functionality you would expect from your own digital devices, all built into the fabric of your vehicle.
- Support services that range from the optional (proactive intervention in response to sensor data), through to insurance incentives (lower costs in return for an on-board monitoring device) to pay as you go options, based on mileage and driving behavior.

All of these lead into the most disruptive trend of all, driving radical changes to:

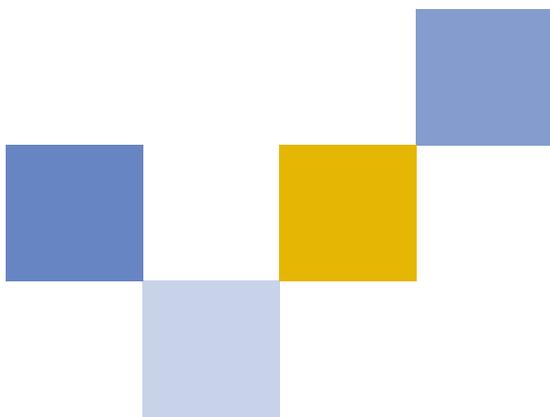


Ownership

In a world where autonomous vehicles will become reality in the foreseeable future, and in which complete connectivity to and integration with smart infrastructure services is the norm, what does this mean for ownership? Is conventional ownership necessary or desirable? Will you buy through existing conventional purchase arrangements in the future? Will there be completely different arrangements, based on short term lease or part time access to vehicles, perhaps brokered by a finance or insurance business? Might we start to see the rise of MaaS (Mobility as a Service), bringing the IT models of usage even further into the physical world?

This potential revolution in ownership may well be accelerated by the move to autonomous vehicles, with assisted or completely self-driving capabilities. It's the ultimate in the union of data and connectivity, in which the individual driver ceases to have a function at all.

Will we see completely new players shaping this market? Players related to the Silicon Valley giants or major service providers in other markets? Will design and manufacture of vehicles remain a value-added market or just another commodity play, with market leadership no longer remaining with a combination of OEMs and Oil Majors but rent businesses?





**TRANSFORMATION
AND**

COLLABORATION

Predicting the future in this uncertain landscape is not always a productive activity. Yet automotive enterprises, not just the OEMs but also their Tier 1 and Tier 2 suppliers, need to build their own strategic plans. From manufacturers of major assemblies to parts and tire builders, they all need to make big bets on where and how they will stay ahead and stay profitable, despite the underlying uncertainty they face. In reality, the thought leaders among them are preparing for all potential eventualities, and investing heavily in all these areas:

IOT, AI AND SENSOR ENABLED SYSTEMS

Application of machine intelligence and machine learning is transforming all aspects of core manufacturing processes. Sensor data is enabling predictive maintenance to reduce downtime and avoid unplanned outages, while extending the life of capital equipment. Fleets of production assets can be managed through “single pane of glass” control systems, and that makes it possible for manufacturing to become more responsive to emerging trends and signals from the market.

Digital transformation of the manufacturing processes is becoming more prevalent, while the same predictive maintenance techniques that are avoiding downtime in factory production systems will be used to maintain vehicles on the road in better condition. This will not only be a matter of convenience for drivers, it will also enable vehicles to perform at their best, which will have a positive effect on the environment.

When products enter service in the marketplace, the same forms of sensor technology, rich data flows and analytics can be used to monitor performance, spot potential faults and manage the product, itself, in a more granular and efficient manner. On-board technology, enabled in many cases by the OEM’s own systems, can interface with sensors operated by national governments, specialist agencies, municipalities and a wealth of private service delivery organizations to surround the vehicle itself with a world of responsive services.

The rise of sensor-based, AI enabled technologies is already proving a game changer for car ownership. It is also giving rise to a non-negotiable need for the most advanced cyber-security procedures and solutions. These have now become an essential factor in the life of an automotive manufacturer, and will be covered in more depth below.

INTELLIGENT AND AGILE VALUE CHAINS

Integration of IT and OT enables automotive companies to create a common environment for managing all aspects of their business, from relationships with suppliers through to finance, customer relationships and beyond. This area of change permits development of value chains that are fundamentally more responsive and agile than anything that has existed in the past. It represents the next strategic shift in manufacturing, as important as the move from craft-based coach building to production line, and from traditional production line to cellular manufacturer, enabled by Lean and Agile methods, as developed originally in Japan over half a century ago.

The industry has been dominated by build for stock, based on Just In Time supply chains, with relatively predictable demand in key markets, which have always been manageable via marketing incentives through an extended dealer chain. That model is being replaced by build to order through extremely flexible supply chains, that may well become less depend on long distance supply of sub-assemblies traded repeatedly across national borders.

Rational, sensitive and highly interventionist management of these complex value chains will become increasingly a differentiator for successful OEMs in the future. Participants in supply chains will also change, as service delivery technologies become an integral part of the overall product. Once again, single pane of glass management across these very complex and distributed chains is essential. There cannot be any awkward handover points between systems of record, business systems and production systems. Complete integration, complete security and moment by moment sensitivity to market fluctuations is the key.

CONNECTIVITY FOR PERSONALIZED CUSTOMER EXPERIENCE

Perhaps the most radical change that is impacting automotive OEMs today is the need to move from being pure-play makers of finished goods to becoming service providers. This is a step further on from the current reality, which is that all modern cars are connected to external communication capabilities, and will serve added value options to their passengers as a matter of course. Entertainment and navigation services are required as standard today. The very near future, however, will see more ambitious uses of connectivity.

Some cars are already factory-fitted with sim cards so they can report on their mechanical condition, on component and system performance and also on other matters, such as driver behavior. Changes in ownership options also make it likely that vehicles may carry devices provided by insurance or lease companies to monitor how the vehicle is used and to verify that drivers keep within the parameters set by a lease or insurance agreement. From fine tuning product specifications (leading to a “market of one” approach to personalization), through to delivering an experience that is specifically defined by the drivers, delivering a unique experience is increasingly the key to success in this market.

As we move closer to use of autonomous vehicles, so we will see more clearly that automotive products are following along the same path as that taken by other manufactured goods. For computers, handheld devices and related systems, we begin by focusing on the device, itself, then realize that the software running on the device is more important than the hardware, and finally that services, rather than individually owned software packages are what really count.

Certainly we can assume that the vehicle will always have a primary role of taking people from point A to point B, but along the way the services consumed by passengers will be far more important than the engineering reputation of the company that makes the vehicle concerned. Some companies will find it easier to make the big conceptual change needed to become an effective player in the services marketplace, while others may find it impossible.

Finally, let’s return to the topic of cyber security. In every industry connectivity brings huge benefits in terms of cost saving, operational efficiency and proactive management, but there is also a major downside. As soon as any item becomes connected to the Internet, it by definition becomes vulnerable to attack by bad actors of every kind.

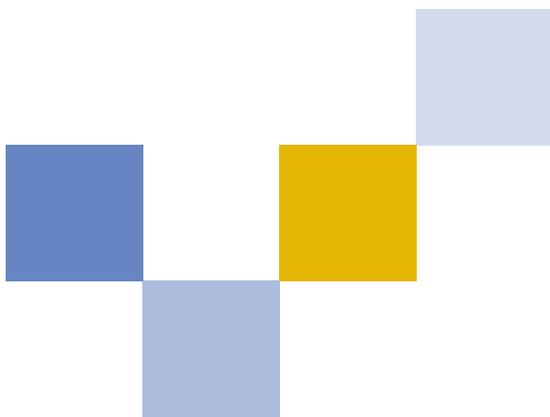
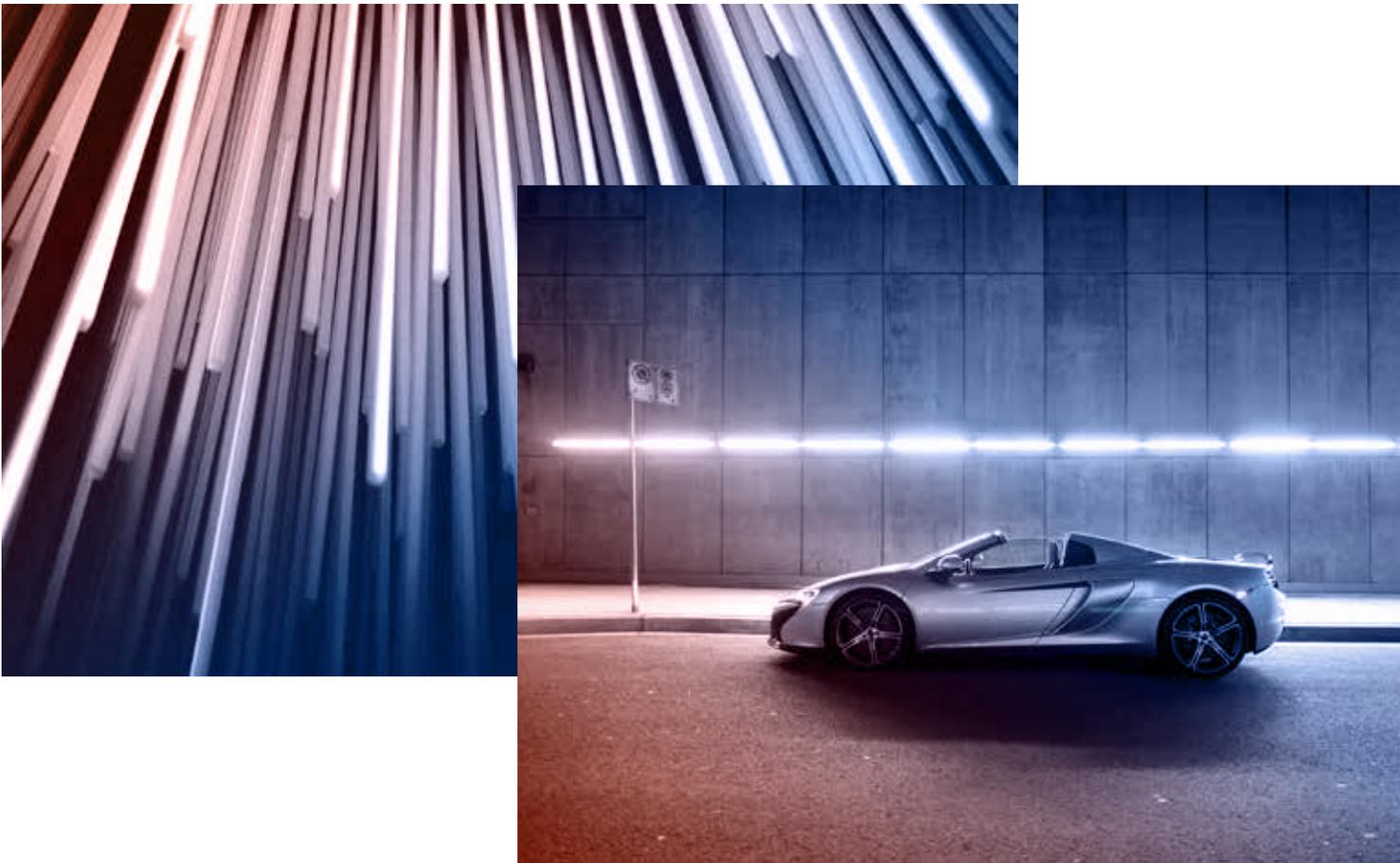
We have seen this reality in critical infrastructure, where security once meant a high fence around a power plant, but now involves a constant battle against external attack. The same is now true for automotive manufacturers. They provide connected products in a connected world. The idea of hackers taking control of autonomous vehicles is a serious concern. Security has now become one of the very highest priorities for every manufacturer.

JOINT WORKING WITH OTHER PLAYERS

The first “modern” motor manufacturer was a fully integrated and standalone operation. The Ford plants of the early to mid 20th century made all components in-house and controlled every aspect of the production process, from raw material to the car leaving the factory, fully formed. The Just In Time revolution made car manufacturing much more of a collaborative process, with major suppliers embraced as part of the overall manufacturing strategy. Now we are moving further along the path to fully distributed, joint working in a future market where providers of specialized communication capability will be as important as the engineering team that develops the core product.

Whether conventionally powered or electric, drivable or fully autonomous, vehicles will be highly connected to their surrounding environments, to selected service providers and to the responsible authorities. Knowing who provides the connectivity capability will be a key decision factor, and even the greatest of OEM brands will need to demonstrate that they understand this and are able to develop, build and deliver products that are truly collaborative systems at the deepest design level.

For companies that in some cases have roots going back a century or even more, and that have seen themselves as the true manufacturing elite for most of that time, this will be a challenge in terms of self-perception and an even greater challenge when it comes to execution.





**COLLABORATIVE,
ENGAGED,**

IN TEGRA ————— **TED**

AN UNCERTAIN FUTURE

Everything said so far confirms our view that the automotive market is impacted by uncertainty, and this can have both positive and negative potential. The growing focus on vehicles as platforms for connected services, and also as the proving ground for disruptive new technologies, such as autonomous vehicles, presents huge opportunities. For existing OEMs, however, there is also a threat, as radical change makes it easier and sometimes more attractive for new entrants, often with a great deal of new capital from technology investors, to restructure the market and cream off the rewards.

The large automotive companies need to analyse trends accurately and place their bets in the right way, at the right time in order to stay competitive and become more profitable than they are today. Even in the most optimistic scenario, however, there will be losers, and these may include whole industry sectors, from driver training to dealer networks, and from specific component manufacturers to logistics specialists.

We also need to be clear there is nothing we, or anyone else can do to reduce the current levels of uncertainty: all we can do is be prepared for anything. So how do we manage complex investment decisions at a time like this?



**HERE ARE OUR
SUGGESTIONS.**

CHOOSE YOUR FUTURE

In this world, there are several different potential future directions for large automotive companies. The most basic strategic decision, and this is not something that such businesses have had to think about for many decades, is “what do you want to be”?

As consumers become more attuned to new forms of ownership, and new, integrated options for mobility, the hard lines that have always divided transport options will increasingly blur. Do you want to “own” customer loyalty as a primary supplier of mobility services? In which case your focus must be more than ever on the car as platform and on the complete personal experience, rather than on selling through engineering, which is taken for granted, almost as a commodity, these days.

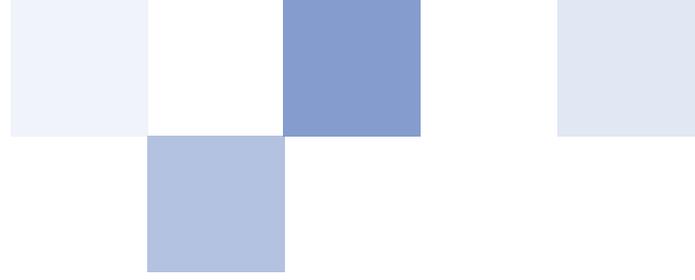
Or do you want to reduce corporate risk by supplying a range of platforms for adaptation and taking to market by others? By consumer experience providers, for whom the car is just one part of a seamless day-long experience, that includes work, entertainment and travel. Or by general mobility providers, which will offer a value proposition that involves end to end transportation, in which a private car may just be one leg of a service that includes train, light rail or tram, aircraft or even advanced concepts such as the rapid transit ideas we see personified by Silicon Valley entrepreneurs?

Instead of Daimler, BMW and Toyota in head on competition, we may in the future see leading automotive companies competing with Hertz, Deutsche Bahn and others for “ownership” of the value chain. Nothing should be ruled out, and everything needs to be carefully considered.

TAKE CARE OF THE CORE

You cannot simply decide to be more agile than before and hope that it will happen. Corporate agility is defined and enabled by the core systems you have in place. You, as an enterprise, can do no more than what is permitted by your systems of record, which will normally comprise a combination of solutions for CAD, ERP, MES, sales, and service management.

We expect some aspects of this vital infrastructure to be in place and to have been there for a long time. It is not possible to survive, let alone compete successfully in this demanding market without an integrated core of highly capable systems. In the past, these would have belonged in silos with little inter-communication. They might also have been defined, procured and managed by different departments, which are likely to have differing priorities and ways to measure success.



Today, there will be... in fact, there must be full end to end integration between these systems, enabling multi-disciplinary teams to collaborate intuitively and very quickly, pursuing common goals and using common measures for success.

This is a basic requirement, but it is nowhere near enough to guarantee success in the faster-moving, more capable market of the next decade. Large automotive enterprises need to refine their core so that it is agile by design, enabling a much faster response to stimuli from the market or other players in the wider value chain.

The truth is that, no matter how much we may want to focus on visionary new concepts, none of these will be viable without an agile set of integrated core systems that support and enable the rapid evolutionary changes required in the near-term future. The truth remains that the most outrageously visionary and disruptive concept still requires a heavyweight solution such as SAP S/4HANA to turn concept into reality. There are too many moving parts and too much complexity for any manufacturer to do without.

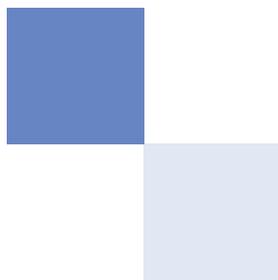
Most large manufacturers use a system of record that interfaces with MES on the one hand, primary design environments on the other, and then feeds through to main business systems (finance, sales, customer service and others). In most cases, earlier releases of SAP have been selected as the system of record for ERP. The burden of interfacing between different generations of system, often with built-in levels of incompatibility, however, cannot be tolerated in a market where a key requirement is to lower the risk and cost of change.

The move to SAP S4 Hana is becoming the basic first step in the long-term journey of change that all automotive manufacturers must take. This embeds designed-in flexibility into the heart of enterprise management systems. In turn, this reduces the technology burden, cuts out the time and cost represented by multiple interfaces, all of which need to be kept updated and fully operational, and all of which represent a vector for error and intrusion. This is neither a dramatic or exciting conclusion, but it is necessary. With a flexible, agile core in place, anything is potentially possible. Without it, nothing is.



THINK CONNECTIVITY

Change is happening in multiple dimensions within the industry but the most important of these is within the broad strategic area represented by connectivity. Vehicles are increasingly mobile, connected platforms, used for presenting and delivering a growing range of services, offered by different kinds of provider and enabled by a growing range of applications.





Connectivity is not something that can be added on as an afterthought: as with any other mobile device, connectivity is the key to everything. For this reason, we believe that automotive designers will not simply be consulting with experts in different engineering disciplines, and with specialist external companies (such as tire manufacturers, for example), but will be working with connectivity partners from the very start of the design process.

The future of automotive lies in the ability to offer different kinds of services and, by definition, these can only be accessed through seamless and reliable connections to providers and many other forms of partner, such as municipalities and government agencies. We have reached the point where it is unacceptable for a motor vehicle to have an unexplained shut down or not to start in the morning (even though such events do still happen- though very rarely). We will also reach the point where unexpected connectivity outages will also become unusual and increasingly unacceptable events.

When manufacturers are delivering autonomous vehicles that are effectively either mobile work or leisure centers or both, continuity of service access will be a basic necessity. It is time to give connectivity the top priority it needs and deserves.

CHOOSE YOUR PARTNERS WITH CARE

No company, not even the largest and most capable, is going to navigate the tricky path to the future alone. They need the right partners and they need to choose carefully. We believe that most useful partner for evolution into the new world of automotive will not be a good IT generalist but will need to have specialist capabilities, including a good deal of original IP, in at least three areas:

- **Automotive industry knowledge**, understanding the industry at a very deep level and from the inside, as a long-term player with “skin in the game” and long-term commitment, demonstrated by innovation track record, patents and proven IP.
- **Connectivity knowledge**, based on being a telecommunications insider, with a proven ability to deliver resilient, high-capacity networked services over extended areas and with high performance levels.
- **Ability to integrate across the IT-OT divide**, based on a long-term presence inside manufacturing partners, and a proven knowledge of both SAP systems and all those formerly siloed external systems that now require seamless integration.

NTT DATA is an industry leader. We have been deeply engaged in the Automotive industry for over 50 years, based on its early partnership with leading automotive OEMs in Japan, where the very building blocks of current automotive manufacturing best practice was created. This outstanding industry heritage was greatly strengthened through acquisition of Cirquent GmbH, the in-house IT services unit of one of the leading German automotive OEMs. In automotive terms, therefore, NTT DATA combines the DNA of two exceptionally innovative companies, each with a great track record for bringing new concepts to market, and with great experience and know-how in this industry.

NTT DATA is also part of the world's 3rd largest connectivity company, Japan's national telecom provider, NTT, so all aspects of connectivity, mobility and communication are part of our core skill set. Being at the same time an industry, telecommunications and IT specialist makes it easier for us to operate across the traditional IT-OT divide, and that is a key factor in offering effective partnership in the very different marketplace of the future.

NTT DATA is an SAP champion, and one of the Top 10 worldwide SAP specialist partners, according to Gartner. Our global automotive practice combines all these specialist capabilities in one global team, skilled at addressing the key challenges facing the industry today and tomorrow from the most strategic position: leadership in core industry systems.

The three essential requirements for successful partnership in a market being transformed at speed are at the heart of NTT DATA and how it operates.

CONCLUSION

No automotive manufacturer or component provider can escape the consequences of the major changes that are reshaping the automotive market today. Announcements come on a weekly basis that may have potentially dramatic impacts on the market. One of the latest, dated late September 2020, is the statement from a leading Silicon Valley technology company that the company intends to launch a fully autonomous, electric and fully connected vehicle by late 2024.

An announcement, of course, does not guarantee that successful change will actually happen, but it is a clear statement that new entrants are targeting this market, companies unencumbered by traditional ways of thinking, not tied into long-term supply chains or ownership models, are fully attuned to the consumer market for connected devices.

Whether this or any other technology company is successful or not in making its planned new vehicle a reality hardly matters. What counts is that new thinking, from radically different sources, is now entering the market and will inevitably reshape it. Established OEMs and their suppliers have to think and act differently if they are to profit from the changes that will take place.

This will require unprecedented levels of agility, in thought and action. A transformed core is the necessary basic requirement for success. The sooner OEMs move the better for them.



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A woman with dark hair is sitting in the driver's seat of a car, looking out the window. Her hands are covering her mouth, and she has a concerned or nervous expression. The car's interior and window frame are visible. The background shows a bright, overcast sky and a blurred landscape. The text "JOIN US!" is overlaid in large white letters across the middle of the image. There are several semi-transparent colored squares (yellow, grey, blue) scattered around the image, some overlapping the text and the car's interior.

JOIN US!

2021