IDC FutureScape

IDC FutureScape: Worldwide Next-Generation Automotive 2020 Predictions

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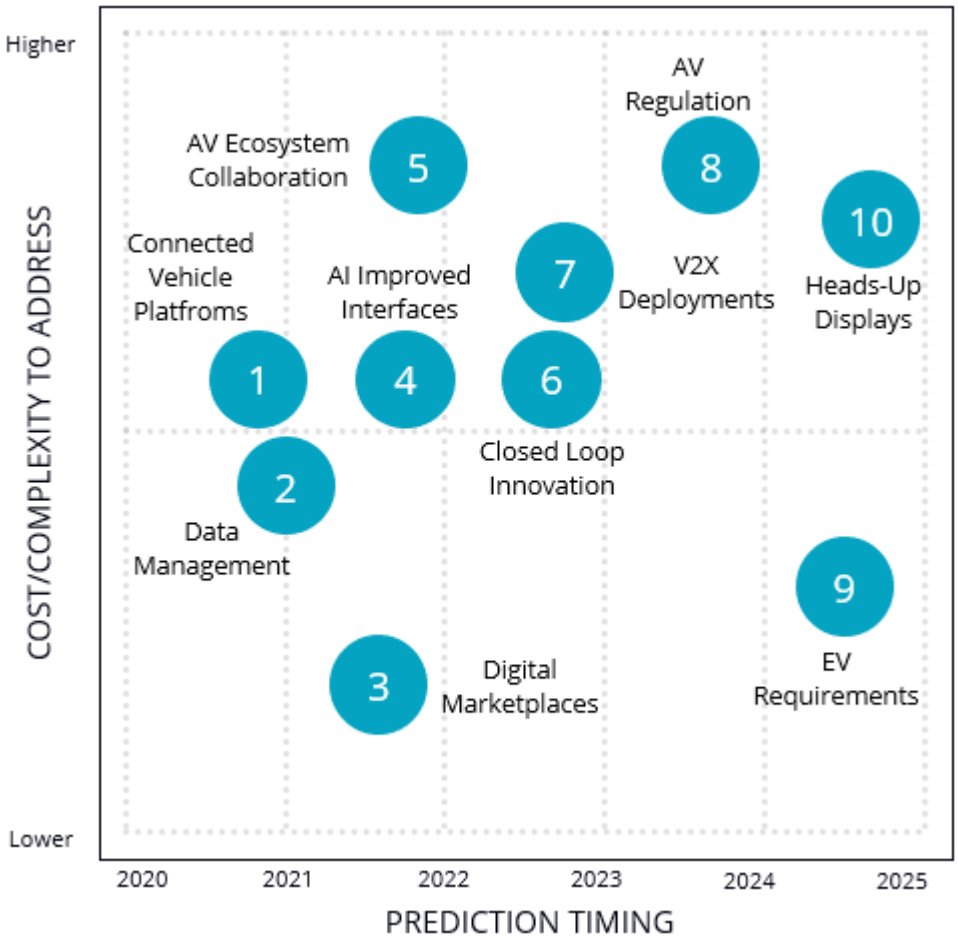
IDC FUTURESCAPE FIGURE

FIGURE 1

IDC FutureScape: Worldwide Next-Generation Automotive 2020 Top Predictions



Note: Marker number refers only to the order the prediction appears in the document and does not indicate rank or importance, unless otherwise noted in the Executive Summary.

Source: IDC, 2019

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EXECUTIVE SUMMARY

IDC's top 10 predictions for the 2020 worldwide next-generation automotive market are developed with input from technology and product vendors, service providers, and technology buyers in the automotive, IT, and government segments as well as from IDC analysts. These predictions focus on providing guidance on key trends that impact the automotive service and supply value chains, from manufacturers (OEMs) and tiered suppliers to wireless network operators, fleet operators, government regulators, and road operators.

IDC defines the next-generation automotive market, at its broadest, as any vehicle and related infrastructure that utilizes the internet, Internet of Things (IoT), and 3rd Platform technologies (mobile technologies, social networking, cloud services, and big data and analytics). These next-generation automotive digital technologies, products, and services are implemented to improve costs, performance, capabilities, and collaboration.

Our predictions aim to highlight the advances and innovations enabled or supported by next-generation automotive over the next five years. The following is the list of the top 10 areas of impact predicted for technology buyers in the next-generation automotive market:

- **Prediction 1:** By 2021, 50% of automotive OEMs will enable mobile edge computing in new vehicles as part of their connected vehicle platform to support enhanced applications, services, and operational efficiency.
- **Prediction 2:** By 2021, 70% of OEMs will expand the reach of their data management and monetization partnerships to open new business opportunities and reduce the impact of external data market pressures.
- **Prediction 3:** By 2022, 75% of OEMs will employ cross-industry digital innovation platforms to aid product development, supplier collaboration, and simplify big data strategies, resulting in a 10% opex improvement.
- **Prediction 4:** By 2022, over 70% of automotive OEMs will integrate technologies such as AI and IoT in new vehicle models to more seamlessly integrate automation systems and in-vehicle infotainment.
- **Prediction 5:** By 2022, the cost of independently developing complex AV systems will drive over 50% of OEMs to acquire and/or partner with autonomous vehicle platform providers to reach market.
- **Prediction 6:** Due to the need to personalize and enhance the customer experience, by 2023, 65% of automotive OEMs will design using real-time data, increasing revenue by 40% and reducing recalls by 25%.
- **Prediction 7:** By 2023, 60% of OEMs will begin voluntarily manufacturing V2X-capable vehicles driven by the cost, technology, and ecosystem maturation of C-V2X and DSRC and increased regulatory clarity.
- **Prediction 8:** By 2024, G8 countries will mandate that SAE Level 4– and Level 5–capable AVs include a human-operated backup mode for added safety.
- **Prediction 9:** By 2025, 60% of global OEMs will partner with utilities to aid EV battery development, energy storage, distribution, and charging, driving a 5% further increase to expected global EV sales.

- **Prediction 10:** By 2025, 10% of Levels 2 and 3 autonomous vehicles will incorporate enhanced heads-up displays to improve driver safety, awareness, and productivity by 20%.

This IDC study provides our top 10 predictions for the worldwide next-generation automotive market. These predictions reflect IDC's vision for the 10 most important trends in this market over the next 60 months (through 2025). Technology buyers from automotive manufacturers, tiered suppliers, wireless network operators, and fleet and road operators should use this IDC FutureScape to help inform their purchasing decisions over the next three to five years.

According to Matt Arcaro, research manager, Next Generation Automotive research at IDC, "In 2019, the pace of change in the automotive ecosystem only seemed to accelerate. As the industry looks to adopt more and more horizontal IT technologies and platforms with the goal of bringing autonomy and electrification to market sooner, the opportunities for supplier and manufacturer disruption and disintermediation have increased."

IDC FUTURESCAPE PREDICTIONS

Next-generation automotive technology continues to scale and mature as existing automotive suppliers, manufacturers, and new, disruptive entrants look to participate in the growth of the key areas of connected technologies, vehicle autonomy, shared service models, and vehicle electrification (often referred to as CASE). This shift towards more services, software, and data utilization creates risk as well as opportunity for the participants best able to manage, analyze, and utilize real-time vehicle, roadway, and user data for improved operations, customer experience, and feature and capability improvements.

Summary of External Drivers

Many external factors have a direct or an indirect impact on the technology, operations, and investments of technology buyers in the connected vehicle industry. These factors include issues and trends from the political, government, economic, social, environmental, legal, and technological realms. IDC has identified seven drivers that represent significant forces affecting technology adoption and deployment decisions for technology buyers:

- **The age of innovation:** Driving the future enterprise
- **Crisis of digital trust:** Escalating threats mandate strategic responses
- **Economies of intelligence:** AI, human, and organizational "learning" fuels asymmetrical advantage
- **Intelligence everywhere:** AI's opportunity and implications
- **Rising customer expectations:** More convenience, customization, and control
- **Sense, compute, act:** Maximizing data value
- **The platform economy:** Competing at hyperscale

Predictions: Impact on Technology Buyers

Prediction 1: By 2021, 50% of Automotive OEMs Will Enable Mobile Edge Computing in New Vehicles as Part of Their Connected Vehicle Platform to Support Enhanced Applications, Services, and Operational Efficiency

Automotive manufacturers and suppliers are increasingly facing disruption from four key areas – connected services and capabilities, vehicle autonomy, shared services business models, and electric

and alternative energy vehicles (often referred to as CASE). In addition to these key CASE domains, vehicle owners desire a vehicle that enables seamless access to their preferred services (and applications) and personalization to allow them to be more effective, connected drivers.

Automotive manufacturers are deploying connected vehicle platforms as a means to gather and more effectively utilize the data emanating from the driver, the vehicle, and its environment. This has led to the development and implementation of new applications and services, including advanced fleet management software capabilities, remote vehicle services, and mobility-as-a-service (MaaS) car and ride sharing/hailing. As the automotive ecosystem becomes more accustomed to the use of vehicle data, IDC expects that the types of data gathered and the amount/frequency of this collected data will increase. This will drive the need for additional compute resources and data management schema to process, protect, and analyze this data.

There are three main approaches considered for the processing and storage of vehicle data. These approaches do not standalone, rather they are used cooperatively depending on the use case and/or service requirements:

- Cloud computing offloads resource-intensive algorithms from a capability and power-limited device to more powerful servers. Although this approach provides a near-limitless amount of computation and storage for the vehicle, it raises questions regarding latency and the need for network (cellular) connectivity.
- On-device edge computing leverages the computing and storage resources available within vehicle sensors and systems to process data. Manufacturers and suppliers work to limit the capabilities for these systems beyond initial requirements to reduce overall power consumption, (physical) size, manufacturability, and cost.
- Mobile edge computing (MEC) provides a middle ground between the other two approaches as it will allow automotive manufacturers to define service quality (i.e., QoS) and give access to scalable, configurable processing, and storage resources. In particular, MEC has been designed to be able to augment the vehicle's capabilities by allowing for low-latency transmissions, location awareness, wide-spread geographical distribution, and flexibility, all while leveraging the real-time capability of mobile networks (including 5G). The European Telecommunications Standards Institute (ETSI) launched the MEC Industry Specification Group (MEC ISG) in 2014 and has been working with the automotive ecosystem to develop a standardized environment for efficient and seamless integration of applications from ICT suppliers, service providers, and third parties (e.g., car OEMs) across multivendor computing platforms at the edge of mobile networks.

Associated Drivers

- **Intelligence everywhere:** AI's opportunity and implications
- **Sense, compute, act:** Maximizing data value
- **The platform economy:** Competing at hyperscale

IT Impact

- Designing and deploying services that utilize vehicle data and external communications for critical functions require a precise understanding of requirements including latency, availability, and throughput.
- As new connected vehicle use cases are developed and deployed, the demand for cellular connectivity will increase. This connectivity will be leveraged from embedded vehicle modems,

tethered connections via a user's smartphone, or provided via the capabilities of an aftermarket device (e.g., OBD-II).

- Connected vehicle platforms enable remote updates of vehicle systems to allow software and firmware upgrades as new capabilities, features, and security patches become available. This also helps supports the rollout of new potential communication modes, like the cooperative communications of V2X or strategies for the provisioning/decommissioning of external resources (e.g., cloud or MEC).

Guidance

- Align on both acceptable and ideal requirements for critical connected vehicle use cases for critical services and functions. If not sure what requirements are needed for a particular use case, collaborate with other ecosystem members for additional perspective, guidance, or to develop benchmarks.
- Deploy platforms that allow manufacturers and suppliers to leverage connectivity via available devices. Although there may be challenges trusting a user's brought-in device or third-party devices, manufacturers and suppliers must develop security and access controls to maximize functionality while minimizing critical system vulnerability risk.
- Work in cooperation with ecosystem players including manufacturers, suppliers, cloud providers, and mobile network operators to understand the capabilities and availability of external computing resources. Implement development schemes based on standards, especially with regard to MEC.

Prediction 2: By 2021, 70% of OEMs Will Expand the Reach of Their Data Management and Monetization Partnerships to Open New Business Opportunities and Reduce the Impact of External Data Market Pressures

In *IDC FutureScape: Worldwide Connected Vehicle 2019 Predictions* (IDC #US44390818, October 2018), IDC made the following prediction: Because of increases in driver assistance and workload data sharing via cloud platforms, 20% of OEMs implementing data management and monetization strategies will increase their market share by 2023. This prediction spoke to the recognition and action taken by automotive OEMs to foster and enable new business models and customer differentiation approaches for utilizing data as a "currency."

Although not limited to automotive, there is widespread awareness of the utility of the adoption of open source and collaboration technology to spur innovation and create value. Automotive OEMs and their suppliers are aware that the business model of the automotive industry is shifting from selling vehicles (i.e., hardware) to mobility and customer relationship services. This shift is happening quickly and the automotive industry, although rigid and resistant to change, has been investing in new approaches, relationships, and capabilities to add service-oriented value and customer differentiation.

The second factor impacting a push for data partnerships is MaaS. MaaS, which includes ride sharing/hailing, car sharing, and micromobility services (e.g., escooters and ebikes), has created a low-barrier alternative to vehicle ownership, as well as created new modalities for personal mobility and urban transportation. This market fosters new opportunities for traditional and nontraditional automotive suppliers seeking ways to engage customers by engaging with Smart Cities, cloud providers, and transportation networking companies (TNCs). Whether it be a commitment to develop a TNC-optimized vehicle or the deployment of their own end-to-end MaaS to the formation of creative partnerships and joint ventures (e.g., Daimler and BMW's combined mobility unit), OEMs are recognizing the need to understand how to add value to MaaS.

Building and delivering services and value based on automotive data sharing is not easy. Challenges exist in a variety of areas including just the idea of data standardization. For example, today, most vehicle data gathered remains proprietary and not something easily aggregated or understood. Also, parties looking to share data must have agreement and consent for the contractual conditions and license terms to be able to do so, which is still all but routine. Further, all parties must agree to and prove that they have the proper compliance strategy in-place to be able to manage the complex regulatory requirements for data gathering, storage, and usage. And when monetization is considered, all parties must agree on the appropriate value of each party's data to decide revenue share but also, more importantly, to provide the means for a simple, understood customer business model. Addressing these issues takes time, but the potential is there for OEMs and suppliers to spend the energy to try and solve them.

Associated Drivers

- Rising customer expectations: More convenience, customization, and control
- Sense, compute, act: Maximizing data value
- The platform economy: Competing at hyperscale

IT Impact

- The traditional automotive development approach requiring custom, proprietary, and closed software environments and ecosystems can no longer be sustained in a data-driven, service-oriented world where scale, interoperability, and interconnection are valued.
- Data management and monetization partnerships often span multiple organizations and functional areas of automotive manufacturers and suppliers.
- The use of data in a federated way across companies creates an escalated burden for all parties to ensure its security and privacy.

Guidance

- Align internally on where horizontal IT tools and open source technologies can be used to create a more flexible and open environment for future innovation. One key to increased success in a data-driven world is actively pursuing and tapping into an powerful open ecosystem.
- Obtain buy-in from the highest levels of management to ensure a clear pathway to pursue new products, services, and policies. It is not enough to have support from IT, as initiatives will likely span multiple organizations including procurement, marketing, sales, and engineering.
- Develop a holistic data management security policy and engage partners to implement best practices across software, processes, and documentation. This step will provide a secure foundation by which providers and suppliers can reliably grow the diverse ways to utilize data.

Prediction 3: By 2022, 75% of OEMs Will Employ Cross-Industry Digital Innovation Platforms to Aid Product Development, Supplier Collaboration, and Simplify Big Data Strategies, Resulting in a 10% Opex Improvement

The automotive industry of today cannot operate solely in a vacuum, and instead its future success is largely tied to interindustry collaboration. This trend that has been evolving for the five-plus years and will continue to evolve as more vehicles become connected and autonomous. Automotive manufacturers (OEMs) realize that platform-based collaboration, data management, analytics, and federation across their entire value chain, and beyond, is necessary to enable functional safety, security, quality, and monetization of connected and autonomous vehicles. Examples of this cross-industry ecosystem approach include:

- High tech and semiconductor: For simulation, AI platforms, data processing, and domain consolidation
- Energy: For electric vehicle (EV) charging networks, grid distribution, and powertrains
- Chemical: For material innovation, lightweighting, and ecofriendliness
- Retail: For sales, in-vehicle content and goods, and mobility as a service
- Telecommunications: For content creation, distribution, and proactive monitoring

This open platform, on-demand marketplace approach is critical for automotive OEMs to enable a wider aperture for innovation that can engage interindustry with partners and suppliers, as well as crowdsourcing with the end customer. And, this approach has been used within fast-moving consumer goods providers for decades with great success. These providers were the first to see the advantage of rapid, open collaboration with external stakeholders, and did so as a means to deal with a shortening product innovation cycle. A similar dynamic now exists in automotive, where interconnected new product development and introduction (NPDI) and time to market, value, operation, and time to customer are all important metrics to consider.

In recent IDC's 2019 Product and Service Innovation Survey, respondents indicated that their three top business priorities over the next 12-24 months were improving organizational excellence in manufacturing, improving the adaptability/flexibility of the supply chain, and improving the speed and success of product innovation. To achieve these goals, automotive manufacturers must adapt a technology platform that can support internal ecosystem domains for engineering, manufacturing, supply chain, and service, as well as support the diverse, multi-industry external domains of ecosystem of partners and suppliers. Engineering software providers need to evolve their offerings to support this cross-industry, multi-ecosystem approach. This means better supplier collaboration capability, a focus on cybersecurity, and providing complementary marketplaces for applications, data analytics, and digital twin operation. Examples of these marketplace-driven partnerships include Wejo and GM, Otonomo and Daimler, Telenav and Amazon, and HPE Pointnext in concert with Continental. Engineering software providers offer cloud-based innovation platforms and IoT platforms in support of this approach.

Associated Drivers

- **The age of innovation:** Driving the future enterprise
- **Economies of intelligence:** AI, human, and organizational "learning" fuels asymmetrical advantage
- **The platform economy:** Competing at hyperscale

IT Impact

- Digitizing the experience and data from the vehicle including from design to service requires a special consideration to cybersecurity. This includes adopting the highest levels of encryption, authentication, and threat detection and response technologies to ensure trusted, controlled collaboration.
- Data collaboration approaches require the adoption of cloud-based solutions and tools to lower the barrier for ecosystem participation. Consider how to move product life-cycle management (PLM) tools and processes to the cloud while maintaining native design and data file repositories to mitigate compliance and IP theft concerns.
- Product life-cycle analytical tools that leverage AI and machine learning (ML) are required within an innovation platform to ensure greater levels of automation but also for enabling the

best next decision functionality during design, engineering, manufacturing, service, or vehicle operation.

Guidance

- Harden your cybersecurity approach with the latest technology and policies. Manufacturers need to mandate that partners and suppliers demonstrate compliance to your cybersecurity standards. Failure to develop and deliver on a security policy can lead to considerable direct and indirect financial and operational impacts.
- Leverage the public cloud for early stage design, ideation, innovation, and supply chain collaboration to expedite faster, more accurate product, feature, and service development.
- Empower your organization by adopting product life-cycle analytical tools that can be used in concert with digital twins of your supply chain and manufacturing processes, manufacturing assets, and products.

Prediction 4: By 2022, over 70% of Automotive OEMs Will Integrate Technologies Such as AI and IoT in New Vehicle Models to More Seamlessly Integrate Automation Systems and In-Vehicle Infotainment

The notion of an adaptable, interoperable, and intelligent system has been long envisioned to be the core of providing a highly customized, user-centric environment. As the connectivity technologies, bandwidth, and computing available for vehicles improve, OEMs will look for machine learning-driven systems that can understand consumer preferences and reduce friction while seamlessly being extended into the vehicle's infotainment experience.

In many industrialized markets, the amount of time a typical passenger spends driving has increased considerably creating more awareness as well as prioritization to choose a vehicle with a personal environment that they can closely relate with. IDC's research shows that automotive OEMs are looking for ways to integrate voice-enabled, smart assistant devices such as Amazon's Alexa or the Google Assistant to more easily bring the concept of hyperpersonalization and allows on-connectedness to their drive. Adopting these changes will allow for settings such as preferred cabin control settings (e.g., climate and seat positioning), entertainment options (e.g., radio and visual interface), along with other personal attributes and routines to be more automatic – customizing the vehicle to each driver. In addition, the in-built AR/VR-enabled dashboards ensure that the drivers are both attentive and familiar with the alerts. For instance, WayRay has designed a product that helps mapping the user environment and provides pop-up navigation alerts, which are quite intuitive and voice activated and require hands-free operations. Ford has been working on heads-up displays (HUDs) that provide directions right on the windscreens by consuming data from the traffic and user driving preferences.

The onset of 5G technologies will further increase the adoption while decreasing implementation costs and create a cognitive environment that seamlessly connects the various modules from home and office.

Associated Drivers

- **The age of innovation:** Driving the future enterprise
- **Intelligence everywhere:** AI's opportunity and implications
- **Rising customer expectations:** More convenience, customization, and control

IT Impact

- The large data sets needed to support the computing capabilities and diversified data sets to enable personalized insights will require the adoption and use of scalable, cloud (i.e., hyperscale) platforms.
- Multifactor data insights require the cooperation and integration of communications across vehicle systems, subsystems, and discrete sensors.
- The development of future personalization-based use cases will require 360-degree visibility of data across organizations spanning customer, product, and user data.

Guidance

- Partner with cloud platform providers to provide computation capabilities, hosting options, and tools to ease development efforts across the complete life cycle.
- Invest in technology infrastructure that improves the diversity of communications that your vehicle can access, as well as the richness of the visualization element.
- Engage and educate consumers on the value of an integrated, seamless vehicle experiences to drive adoption, revenue, and customer loyalty.

Prediction 5: By 2022, the Cost of Independently Developing Complex AV Systems Will Drive over 50% of OEMs to Acquire and/or Partner with Autonomous Vehicle Platform Providers to Reach Market

Over the past few years, billions of dollars have been invested in the research and development of autonomous vehicle (AV) systems. All aspects of the vehicle ecosystem and value chain are being reexamined as companies race to address the challenge of autonomous driving. Companies are working to improve and integrate sensors, processors, networking and other aspects of hardware, as well as developing the software and artificial intelligence necessary to autonomously navigate in a chaotic driving environment. As such, no one platform or approach has become a "standard," and multiple different methods will likely be valid. Further, multiple coalitions and partnerships have formed to more effectively address different challenges. The M&A environment and venture capital activity in the AV space has been robust over the past few years, as major automotive manufacturers, tier 1s, and well-funded start-ups look to gain competitive advantage.

Notable transactions in the automotive space include Intel's acquisition of Mobileye, Samsung's acquisition of Harman, GM's acquisition of Cruise, Continental's acquisition of Elektrobit and the LIDAR business from Advanced Scientific Concepts, Apple's acquisition of Drive.ai, and Uber's acquisition of Mighty AI.

A number of companies are working to create complete AI software stacks for AV, while others are creating complete hardware and software platforms. Manufacturers and suppliers continue to test, improve, and validate these various solutions through road testing and simulation. The pressure on manufacturers will only increase as commercial services leveraging vehicles with true, level 4 AV functionality begin to reach market in the near-term. This inflection point will be one key driving factor that forces manufacturers behind in AV development and testing to either acquire or partner with proven providers to reach market. IDC believes that by 2022, the complexity and cost of developing AV solutions will drive an increase in acquisitions or partnerships as manufacturers race to catch up.

Associated Drivers

- **The age of innovation:** Driving the future enterprise

- **Economies of intelligence:** AI, human, and organizational "learning" fuels asymmetrical advantage
- **Sense, compute, act:** Maximizing data value

IT Impact

- Automotive manufacturer and supplier organizations need a flexible way to test, validate, and implement multiple third-party AV platforms, sensors, and solutions for evaluation.
- AV platform and solutions require the ability to support real-time data analysis and updates including support for functions such as over-the-air (OTA) software and firmware updates, security monitoring, and incident tracking.
- Flexible business models will be needed to be able to maximize the addressable market for L4 robo-taxi vehicles.

Guidance

- Invest in technology platforms and approaches that enable a repeatable way to evaluate and benchmark different third-party components and solutions. These platforms must also provide ways to flexibly test across real-world, full simulation, and x-in-the loop scenarios.
- Consider the extensibility and scalability of a platform as a means to deliver brand and model differentiation, maximize code reuse, and create more manageable hardware and system purchasing opportunities.
- Support a diverse ecosystem of AV deployment, management, and monetization strategies. When AVs are deployed at scale, many new approaches will be considered to maximize a providers KPIs whether it be utilization, revenue, or even customer loyalty.

Prediction 6: Due to the Need to Personalize and Enhance the Customer Experience, by 2023, 65% of Automotive OEMs Will Design Using Real-Time Data, Increasing Revenue by 40% and Reducing Recalls by 25%

The ability to mass customize products is not a fleeting trend which manufacturers must address. Outside of the vehicle, consumers have so many options to satisfy their mobility and connectivity needs that its even filtering into automotive, where consumers are prioritizing automotive manufacturers that integrate these products and services into their vehicles. Meeting this new paradigm shift where consumers control the technology and feature narrative remains both a challenge and an opportunity for manufacturers and suppliers, and it enables them to build strategies focused on experiences rather than just product improvements and innovation.

User and vehicle behavior data can provide a wealth of insights to help drive the decisions manufacturers make with regard to design, engineering, and life-cycle services, as well as to create a closed-loop digital thread. This digital opportunity enabled by an increasingly connected vehicle and end-to-end service ecosystem provides many advantages over earlier systems that relied on retroactive often manual inputs (which may have had accuracy issues) taken from a service repair or customer service record.

The link between the end consumer and the automotive manufacturers is becoming more seamless, as a result of technologies such as increasing IoT deployment and tools like artificial intelligence and machine learning, which provides the capability to perform real-time, automatic analytics, and recommendations. But this access to information isn't a given just because we live in a connected world. In IDC's 2019 IoT Survey, only 16.5% of manufacturers indicated that they had the capability to

monitor passenger vehicle performance data such as fault management, fuel efficiency, or predictive maintenance, with 24.9% in the pilot stage.

To mass customize, automotive manufacturers must have deep insight into consumers and adapt agile, flexible product development approaches. This will help them keep up with competitors pursuing a similar strategy but, more importantly, will help delight, attract, and retain customers. Respondents of IDC Manufacturing Insights' 2019 Product and Service Innovation Survey indicated that better service planning and execution and product ideation and design (35.7% and 35.3%, respectively) were their two highest priority areas for applying AI and machine learning. Consumers will be willing to pay for products and services that align with the experiences they desire, and likewise, and manufacturers must be able to gather and process the data-driven insights to delight these customers.

Associated Drivers

- **The age of innovation:** Driving the future enterprise
- **Intelligence everywhere:** AI's opportunity and implications
- **Sense, compute, act:** Maximizing data value

IT Impact

- Data security will become ever more critical in a connected environment where vehicles have always-on access to a mobile network connection. These systems, from a software, hardware, and process perspective, must be monitored in real time to ensure security and compliance.
- The scale and volume of data created by vehicle sensors and users can introduce a lot of unwanted noise. This drives the need to adopt advanced analytical tools to ensure the ability to glean the right insights at the right time.
- Agile development tools and systems will be necessary to shorten the time to market of newer products, as well as to adjust to the latest information captured from failure or performance data.

Guidance

- Integrate disparate systems at the vehicle, dealer, supplier, and OEM levels to ensure data will freely flow to all appropriate stakeholders and at the appropriate times.
- Create an agile product development culture, which connects an ecosystem of suppliers and partners on a product innovation platform that can incorporate data and insights tied to the service life cycle. This will help ensure that the focus is correctly placed on designing products and services that support enhanced customer value.
- Educate dealers and suppliers on the importance of delivering value-added services to the consumer, as well as how tools and capabilities like AI and IoT can help more accurately anticipate and address customer needs.

Prediction 7: By 2023, 60% of OEMs Will Begin Voluntarily Manufacturing V2X-Capable Vehicles Driven by the Cost, Technology, and Ecosystem Maturation of C-V2X and DSRC and Increased Regulatory Clarity

The original communication architecture for vehicle-to-everything (V2X) technology expected only a direct, short-range endpoint-to-endpoint exchange. This design, without intermediaries, helped minimize external requirements and subscriptions (i.e., no cellular/mobile network operators), supported very low latency, and maximized the impact for endpoints able to participate within the designated propagation distance (e.g., dedicated short-range communications (DSRC) at 5.9GHz and default transmitting power-supported communications up to 300m). In addition, V2X communications

were originally designed around a single communication protocol, dedicated short-range communications, also known as ITS-G5 in Europe. In 2016, however, a new, competing communication protocol emerged was developed by 3GPP, a key wireless telecommunications industry organizations and standards body, called cellular vehicle to everything (C-V2X).

At present, absent government regulation, neither DSRC nor C-V2X, has a clear pathway for global adoption. In these locations, automotive manufacturers, suppliers, Smart Cities, and road operators prefer to evaluate and trial V2X protocols, ecosystem technologies, and applications to understand its benefits. This includes BMW and Mercedes-Benz, which have expressed support for C-V2X and have publicly participated in testing, validation, and interoperability exercises. Some OEMs have gone further and have made voluntarily commitments to V2X deployments. This includes Toyota, which has deployed DSRC in more than 100,000 vehicles in Japan; GM, which deployed DSRC in its 2017 Cadillac CTS sedan and planned to embed DSRC into a new crossover vehicle in 2023; Volkswagen, which committed to deploying DSRC in its European vehicles starting in 2019; and Ford, which announced it would be installing C-V2X capabilities into most U.S. vehicles by 2022, as well as would deploy C-V2X in vehicles in Chinese beginning in 2021.

Market and regulatory indecision on the merits and timing for deployments have reduce the positive impacts of V2X. This has also facilitated the growth of dual-mode (C-V2X and DSRC) hardware being developed for the vehicle and at the roadside unit (RSU) in technology choice markets. Although, redundant and potentially inadequate in early generations, these hybrid solutions provide an insurance policy by reducing the need to expensively retrofit hardware should the protocol winds shift after procurement. It goes without saying that greater alignment between automotive manufacturers and regulatory bodies will reduce development and deployment costs, increase the uncertainty needed to reach sufficient unit scale and, most importantly, deliver upon the lifesaving and efficiency improving results promised by V2X. The industry is quickly approaching this nexus, and with additional momentum and time, the situation should become clearer.

Associated Drivers

- **The age of innovation:** Driving the future enterprise
- **Sense, compute, act:** Maximizing data value
- **The platform economy:** Competing at hyperscale

IT Impact

- V2X-capable vehicles will require onboard data processing capabilities to support the collection and analysis of messages, as well as to incorporate and execute safety applications.
- V2X protocols and technologies may differ for vehicles crossing jurisdictional borders (e.g., between EU states and Eastern Europe). Vehicles with a high likelihood of operating in these environments may a require a broader V2X capability and support approach.
- RSUs provide a critical piece of the V2X value chain. Close cooperation and coordination are needed across road operators, automotive manufacturers, and suppliers to ensure sufficient deployment scale and proper deployment timing.

Guidance

- Benchmark V2X technology provider platforms for onboard units (OBUs) and RSUs to ensure sufficient processing and storage headspace to be able to handle both near-term and long-term endpoint scale, as well as the development of new safety and convenience applications.

- Develop a V2X hardware strategy that reduces the impacts from an increasingly complex deployment environment. The up-front costs for additional futureproofing will likely prove less costly than a retrofit (and will help support a better customer experience).
- Facilitate discussions with V2X ecosystem participants to understand pain points, as well as to ensure buy-in. Develop tools and data sharing principles to ensure all parties are comfortable and tracking agreed to KPIs.

Prediction 8: By 2024, G8 Countries Will Mandate That SAE Level 4- and Level 5-Capable AVs Include a Human-Operated Backup Mode for Added Safety

When manufacturing new vehicles, simulation is already used as a method to validate its performance and behavior before being it is released to the public. This virtual approach is also key to its design to optimize cost and materials and to achieve maximum safety while minimizing the design timeline. For example, the evolving digital configuration of a vehicle is thoroughly tested and benchmarked in virtual crash test and physics-based simulation tools prior to being subjected to any regulatory physical crash tests. These simulations lower the cost barriers to introducing a vehicle into the conformance and ratings agency's physical tests, as well as allow for high-accuracy representations of the effect of small and large vehicle hardware and software changes.

However, as manufacturers prepare for the commercial availability of highly autonomous vehicles (i.e., SAE Levels 4 and 5 AVs), designing a clear and sufficient "physical" test to ensure the safety of the complex and mission-critical safety systems across all roadway scenarios is impossible. It is because of this that IDC believes that a physical test will never be able to accurately represent the permutations of the vehicle's safe interaction with other drivers, vehicles, vulnerable road users (VRUs), and roadway rules. Likewise for manufacturers looking to prove the safety and effectiveness of their AV platforms, it is not viable or realistic to physically drive the required hundreds of millions of miles or billions of miles needed to ensure its development vehicle can handle all driving corner or edge cases (e.g., extreme weather or roadway obstacles). Therefore, it is reasonable to assume that regulators, as well as manufacturers, will need to implement and utilize simulation as part of AV validation.

However, even after AV validation tests and scenarios are agreed to (and there are industry-level efforts ongoing), there will be an additional challenge for regulators to solve, determining how safe is safe enough. This social question relates to a performance premium that will need to be applied to AVs (versus humans) to be able to reach an acceptable level of trust. Of course, the goal needs to focus on only allowing the safest AVs on roadways, but these vehicles will never be perfect as driving is inherently unpredictable and complex.

Understanding these constraints, it is thus highly likely that regulatory bodies won't have the consensus needed to develop these additional validation and performance policies for first-generation AVs in the next few years. This lack of clarity for AV providers will force them to utilize a human safety driver or operator as a redundant and fail-safe, as well as to limit the scope of initial deployments until regulators take action.

Associated Drivers

- The age of innovation: Driving the future enterprise
- Crisis of digital trust: Escalating threats mandate strategic responses
- Intelligence everywhere: AI's opportunity and implications

IT Impact

- AV providers need to prepare for a human operator control option, even within L4 and L5 deployment scenarios. This additional redundancy will be used for vehicle operation on public roads for testing and commercial use.
- Simulation tools, software, and methods need not only be as accurate as possible (potentially including voluntary industry certification) but also be incorporated into all AV testing and validation practices and processes to ensure continual use and documentation.
- Infrastructure is needed to build, test, and deploy new AV software versions as fast and cheap as possible. This will help drive provider competitive advantages, as well as differentiation.

Guidance

- Understand how tools and training can be utilized to maximize the effectiveness of the safety driver or operator. This can include the development of driver monitoring software to ensure attentiveness, as well as processes to loop these safety drivers into the testing of updated software and algorithms.
- Consider the capabilities of companies with demonstrated success, technological expertise, and a healthy ecosystem of partners as a means to augment or improve the effectiveness of your simulation approach.
- Organize testing and validation workflows by the criticality of their function. In addition, leverage hyperscalers and cloud providers as a way to maximize the use and distribution of data for scenario and model enhancement.

Prediction 9: By 2025, 60% of Global OEMs Will Partner with Utilities to Aid EV Battery Development, Energy Storage, Distribution, and Charging, Driving a 5% Further Increase to Expected Global EV Sales

Electric vehicle sales are beginning to seriously ramp upward, and automotive OEMs are taking notice – as are utilities and energy companies. Although overall EV sales still make up a small percentage (~2%) of overall vehicle sales, from 1H18 to 1H19, they grew 46% worldwide YoY – led by growth in China (66%), Europe (34%), and the United States (23%) according to EV-volumes.com. Much of the 2018 growth was attributed to the Tesla Model 3's introduction, which included a significant order backlog caused by initial production delays. Also influencing EV growth is the special financial and other incentives in Europe to encourage EV adoptions and CO2 reduction regulations including those that have been introduced in Europe and China. Although the rapid growth of the past year will likely temper, IDC sees that the combination of EV incentives along with the availability of a broader lineup of EV brands and models (i.e., battery electric [BEV] and plug-in hybrid electric vehicles [PHEV]) will reduce consumers inhibitions to consider electric. Equally influencing the growth of EVs are technology and scale improvements in batteries reducing the costs/kWh (and bringing greater cost parity to internal combustion vehicles), as well as early stage construction of networks of vehicle charging stations and pumps.

Utilities and energy companies see this shift to EVs as a major business opportunity. This includes enabling them to establish vehicle charging networks, as well as developing the tools and relationships to benefit from the management, distribution, and trading of energy through local electric grids. Growth of the share of EVs and PHEVs, for both personal ownership and mobility-as-a-service car sharing and ride sharing, will correspond to grid expansion across both rural and urban areas. As such, utilities and energy-producing companies will continue to refine their EV strategies by establishing partnerships with automotive manufacturers, as well as governments. Automotive manufacturers and their suppliers/partners are prioritizing EV investments, including charging infrastructure, tools, and

incentives, to ensure that vehicle owners consider electric. Boston Consulting Group estimates a $3 billion to $10 billion EV opportunity for utilities — large when you consider the expansive role that utilities could play with energy storage, distribution, and EV fueling.

It is still early, but cross-industry collaboration pilot projects are needed between automotive and energy companies to support this EV growth. Examples include French manufacturer Renault's partnership with a local utility in Madeira, Portugal, providing public officials EVs and helping manage an EV charging network of 40 stations; Volkswagen (VW) manufacturing its own EV batteries and planning to offer a home-powering service named Naturstrom; and Volvo recently invested in EV charging start-up FreeWire and, in September 2019, achieved 100% plug-in electric status for all of its models. On the energy front, Royal Dutch Shell, Chevron, and BP have all made considerable investments in EV charging and storage companies in the past two years. Indeed, EVs are inevitably driving the automotive and energy industries together, for a cleaner, more profitable future.

Associated Drivers

- **The age of innovation:** Driving the future enterprise
- **Rising customer expectations:** More convenience, customization, and control
- **Sense, compute, act:** Maximizing data value

IT Impact

- A digital innovation platform must be established that enables secure, scalable collaboration across a diverse team of internal and third-party automotive, energy, and electrical/grid stakeholders.
- Cloud-based platforms provide an environment to manage digital twins of vehicle fleets and energy grids to aid in the visualization and understanding of feature, service, and product innovations.
- Ensuring that current EV customers have a positive ownership experience is critical to growth of EV sales. Analytical tools that track battery performance and vehicle usage, as well as enable the communication of current energy storage and distribution availability, will contribute to that positive experience.

Guidance

- Reduce the initial friction between automotive and energy engineers working by mandating executive-driven training and enablement (i.e., executive buy-in), implementing in-person and web collaboration tools, and prioritizing data sharing.
- Transition your platforms to a cloud-based infrastructure to enable faster design reviews and validation, greater EV fleet and grid operation transparency, and increased scalability and flexibility for continued improvements.
- Leverage a mission control approach to provide real-time visibility and action-oriented decision making for EV performance management.

Prediction 10: By 2025, 10% of Levels 2 and 3 Autonomous Vehicles Will Incorporate Enhanced Heads-Up Displays to Improve Driver Safety, Awareness, and Productivity by 20%

The U.S. National Highway Traffic Safety Administration (NHTSA) has shown that 90%+ of serious accidents have a root cause or were contributed by driver error. This high level of correlation between serious accidents and the role the driver plays is one of the key reasons that automotive manufacturers and suppliers are developing and testing autonomous systems. But the timeline to

deploy only fully autonomous (i.e., SAE Levels 4 and 5) vehicles at scale on roadways will likely take 20+ years. As a result, the industry continues to pursue additional pathways for increased safety through automation, based on conditional autonomy (SAE Levels 1, 2, and 3). These conditional autonomy approaches may require the driver to always be in control (Levels 1 and 2) or be ready to take over driving control with little notice (Level 3.)

This transition from machine to human, referred to the human-machine interface (HMI) challenge, can be abrupt in either Level 2 or 3 systems, as studies have shown that humans tend not to retain full attentiveness when they are asked to supervise a robot. As a result, automotive manufacturers and suppliers are building in active driver monitoring technology into the vehicle to be able to measure and alert the driver of a potential distracted or waning state. These systems may measure the driver's hand position on the steering wheel and/or the driver's eye gaze and head position to determine whether or not the driver is able to take physical control (hands), as well as remained attentive of road details (eyes). And if not in compliance, the system provides warnings (e.g., lights, sounds, haptic feedback) to remind the driver of the improper behavior. But these monitoring approaches are not likely enough to ensure that a driver has the proper roadway context to be able to take control of the vehicle and safely navigate through the challenging, disengaging inducing driving scenario.

One such technology that may be able to complement driver monitoring and increase the safety and effectiveness of these handoffs are enhanced HUDs. These displays are able to project notifications, warnings, and other key vehicle and roadway features onto the dashboard directly where a driver would need to see them. Further, by utilizing edge processing and machine learning, the system should be able to fine-tune what is projected for each driver to reduce unwanted noise and focus only information is needed. Unfortunately challenges with projection and field of view have made these technologies difficult to develop and manufacture, as well as expensive to procure. IDC would expect that these systems would likely phase in beginning with higher margin, premium vehicles (i.e., likely Level 3 capable) and would only be deployed down market (i.e., Level 2/2+ vehicles) when costs support it.

Associated Drivers

- **Economies of intelligence:** AI, human, and organizational "learning" fuels asymmetrical advantage
- **Rising customer expectations:** More convenience, customization, and control
- **Sense, compute, act:** Maximizing data value

IT Impact

- The benefit from complementing driver monitoring with an enhanced HUD will only be known after careful analysis of driver behavior after a requested takeover or disengagement.
- Enhanced HUDs require system-level notifications that bring together vehicle intelligence including across perception, planning, and ADAS systems.
- Machine learning algorithms will need to be applied to responses and feedback from all active driver monitoring systems train and fine-tune the HUD notifications for drivers.

Guidance

- Study the behavior and risk profiles of drivers utilizing commercial Levels 2 and 3 systems without an enhanced HUD during human system takeovers and disengagements to see if there is a need for a HUD. Utilize this data in combination with HUD data to determine if there is a measurable increase in driver effectiveness, safety, or customer satisfaction.

- Develop a strategy to understand the level of data integration and processing needed to make use of an enhanced heads-up display, as a system without usable data will not be of much benefit.
- Create a data sharing framework and model to further personalize driver monitoring and HUD technology. The efficacy of these solutions will increase as the driver's behavior and routines are understood and an appropriate response or notification can be displayed/enacted.

ADVICE FOR TECHNOLOGY BUYERS

Companies looking to invest or partner to enter the next-generation ecosystem need to evaluate the challenges, dynamics, and growth opportunities to understand where best to target. IDC summarizes the following 2020 guidance for connected vehicle ecosystem participants that are focused on maximizing the impact of their investment:

- **Mobile edge computing for vehicle use cases:** Automotive manufacturers and suppliers need to align on both acceptable and ideal requirements for critical connected vehicle use cases for critical services and functions. If not sure, collaborate with other ecosystem members for additional perspective, guidance, or to develop benchmarks.
- **Data management and monetization partnerships:** Automotive manufacturers should obtain buy-in from the highest levels of management to ensure a clear pathway to pursue new products, services, and policies. It is not enough to have support from IT, as initiatives will likely span procurement, marketing, sales, and engineering.
- **Data cybersecurity approaches:** Automotive manufacturers must harden their cybersecurity approach with the latest technology and policies including mandating that partners and suppliers demonstrate compliance to your cybersecurity standards. Failure to develop and deliver on a security policy can lead to considerable direct and indirect financial impacts.
- **Testing and validation of AV systems:** Automotive manufacturers and suppliers must invest in technology platforms and approaches that enable a repeatable way to evaluate and benchmark different third-party components and solutions. These platforms must also provide ways to flexibly test across real world, full simulation, and x-in-the loop scenarios.
- **Integrating AI and IoT:** Automotive manufacturers and suppliers need to partner with cloud platform providers to provide computation capabilities, hosting options, and tools to ease development efforts across the complete product development and support life cycle.
- **Utilizing real-time data:** Automotive manufacturers should educate dealers and suppliers on the importance of delivering value-added services to the consumer, as well as how tools and capabilities like AI and IoT can help more accurately anticipate and address customer needs.
- **Voluntary V2X deployments:** Automotive manufacturers and suppliers need to develop a V2X hardware strategy that reduces the impacts from an increasingly complex deployment environment. The up-front costs for additional futureproofing will likely prove less costly than a more expensive retrofit (and will help support a better customer experience).
- **Utilizing simulation for AV validation and testing:** Automotive manufacturers and suppliers should prioritize the capabilities of companies with demonstrated success, technological expertise, and a healthy ecosystem of partners as a means to augment or improve the effectiveness of your simulation approach.
- **Positive EV ownership experiences:** Automotive manufacturers and suppliers should leverage a mission control approach to provide real-time visibility and take action on the management of EV and battery performance.

- **Creating an enhanced HUD:** Develop a strategy to understand the level of data integration and processing needed to make use of an enhanced HUD. This system will require usable, analyzed, and real-time data processed at the edge to derive insights for the driver.

EXTERNAL DRIVERS: DETAIL

The Age of Innovation: Driving the Future Enterprise

- **Description:** Digital transformation (DX) — the continuous process by which enterprises adapt to or drive disruptive changes in their operations, customers, and markets — is now being driven by multiplied innovation. Competition is powered by platforms and ecosystems where network effects and innovations feed off themselves. But the changes and innovations aren't accidental; they are driven by data, analytics, and learning, which feed and multiply more innovation. Data drives intelligence yielding insight and knowledge, allowing for action and creating value. Automation and machine learning revolutionize operations, providing major increases in productivity and efficiency. To compete, companies must balance digital and industrial competencies and master them at scale. Yet these efforts will not succeed without leadership and talent and the enterprises' ability to effect change.
- **Context:** With direct digital transformation investment spending of $5.5 trillion over the years 2018-2021, DX continues to be a central area of business leadership thinking. Industry leaders are transforming markets and reimagining the future through new business models and digitally enabled products and services. At the same time, companies that digitize their operating model may see a 40% increase in productivity. Purely digital opportunities aren't enough anymore. New opportunities will come increasingly from combining digital technology with physical assets. To succeed, digital natives need to adopt and transform the traditional world of industrialization and specialized assets. Industrial natives need to adopt and master digital technologies that could affect robustness, reliability, and safety.

Crisis of Digital Trust: Escalating Threats Mandate Strategic Responses

- **Description:** The new digital environment has significantly changed organizations' exposure to adversarial risk. Organized threat actors leverage AI to find and exploit new vulnerabilities. Ransomware, cybercrime, and nation state attacks are increasingly common events that cause significant business disruptions, high costs, and reputational damage. The first global cyberwar may be just over the horizon, bringing unknown havoc with it. In the face of daily incidents, many consumers, citizens, and partners have lost faith in technology, business, and government, creating a crisis of trust. Regulations, publicity, and fines increase risk aversion, while the positive correlation showing that higher levels of trust yield higher levels of GDP demand action. Protecting the security and privacy of digital assets and cultivating the ability to anticipate, identify, contain, measure, and address risks are critical to mitigating the crisis.
- **Context:** Bad decisions, poor leadership, complexity, and cybercrime result in breaches that have a significant impact on businesses and customers. New approaches such as zero trust and distributed integrity are proving themselves and blockchain shows promise to provide the "glue" for some digital trust issues. At the same time, quantum computing has the potential to redefine current security assumptions and practices. But, the crisis of trust goes beyond just security concerns. Social and other media are deepening trust inequities between informed and uninformed citizens, fueling discord within societies, while lack of trust between governments grows across them. AI shows promise in curating information, but there is little trust in whomever is managing the AI or the information.

Economies of Intelligence: AI, Human, and Organizational "Learning" Fuels Asymmetrical Advantage

- **Description:** Enterprise economies and the nature of competition have changed. While still important, economy of scale has been augmented with economies of scope and economies of learning. Now, leading companies are pursuing "economies of intelligence," the continual improvement, innovation, and variation based on leveraging data and AI technologies to identify and fulfill changing needs to enhance scale, scope, and customer engagement. This is changing the nature of intellectual property, whose value has shifted to where it's created rather than where it's realized and contributing to an asymmetrical accumulation of capital and innovation where an organization's capacity to learn has a distinct competitive advantage.
- **Context:** As enterprises scale their use of modern technologies for complete instrumentation, integration, and insight, they are able to expand their scope by offering a wider variety of experiences that demonstrate increasing value as the organization learns what is most desirable and efficient. This enables the learning organization to capture more knowledge and increase its asymmetrical accumulation of capital and innovation.

Intelligence Everywhere: AI's Opportunity and Implications

- **Description:** Accelerating progress in AI is impacting experiential engagement, business processes, strategies, and more – autonomously creating a significant portion of new innovations. But, as automation and augmentation increase, so do the ethical issues and opportunities for misuse, surveillance, invasions of privacy, and more. Many future applications will be developed by AI without human supervision. Beyond that, augmented humanity – the fusion of digital technologies and humans – for improved mobility, sensing, and cognition will become routine. There are justifiable concerns and issues around AI-enabled applications, bias, and transparency and the long-term impacts of these on workforce transitions and the essential elements of being human. Social pushback is demanding accountability and rights. Business and governments need to address the ethical and legal issues of AI to realize its opportunities.
- **Context:** AI innovation and application are being driven by massive investments in all kinds of industries. Hospitals are testing how AI can enhance care, school districts are looking at AI equipped cameras that can spot guns, and human resources departments are using AI to sift through job applications. Government agencies, including law enforcement, are looking for ways to harness this next technological revolution to meet their ends, while others are demanding accountability and an "algorithmic bill of rights." With industries investing aggressively in projects that utilize AI software, IDC forecasts AI systems will more than double from 2018 to 2022 to $79.2 billion with a compound annual growth rate (CAGR) of 38.0%.

Rising Customer Expectations: More Convenience, Customization, and Control

- **Description:** Customers accustomed to the personalization and ease of dealing with digital-native companies such as Google and Amazon now expect the same kind of service from every business in every industry. The changing expectations are most evident in the newest generations of customers, but all customers are demanding more convenience and personalization. At the same time, they want more control of what data is collected and how it is used. Intelligent customer agents will start to intermediate the relationship on the customer's behalf, taking more control from the vendor. Companies that systematically collect, measure,

and analyze data to create exceptional, personal, relevant, and compelling experiences can set themselves apart from their competitors.

- **Context:** With new customer expectations being set by thriving companies that disrupt markets, the previous levels of customer service are no longer good enough. New business, operational, and organizational models are required to meet continually growing consumer expectations. 38% of companies that are digital natives report that they are "almost constantly online" through their device of choice, the mobile phone, providing unparalleled access to behaviors and preferences, that they expect to be turned into customized engagement and experience. While there is also backlash, customers seem willing to relinquish some control over their data in exchange for a sufficiently engaging personalized experience.

Sense, Compute, Act: Maximizing Data Value

- **Description:** Today, data and intelligence represent a unique opportunity for creating unimaginable value. Real-time data from IoT, mobile devices, and other devices at the edge — combined with historical data, enterprise systems, and global information — continually sense an environment and put it into new contexts. By combining data with AI and machine learning, organizations are spreading intelligence from the core to the edge to turn data into action and action into value. Automation literally extends beyond decision making and optimization into life-and-death dependencies. Competitiveness is determined by how data is transformed into insight and knowledge to create high-value differentiators for products, customers, and markets and deliver meaningful, value-added learning, predictions, and actions that improve experiential engagement, industrial processes, enterprise decision making, and much more.
- **Context:** In this "data driving action" world, ensuring the veracity of the data and transforming data into insights become a strategic imperative. Sometimes called "decision-centric computing," the need to understand and utilize data goes beyond data integration and governance. What becomes essential is: first, to put data into context to provide meaning; next, to understand it in relationship to other data and events to gain knowledge; and finally, to add judgement and action to achieve the full potential of value realization.

The Platform Economy: Competing at Hyperscale

- **Description:** Understanding and provisioning the platforms that will sustain, advance, and scale business and operations are essential for every business. The platform is where the future of software, infrastructure, and connectivity will evolve and where edge will be accessed, integrated, and optimized. Mega platforms compete to own infrastructure, artificial intelligence, and development environments. Application-centric platforms look for the network effect to expand their reach. Industry-specific platforms harness multiplied innovation to build niche ecosystems. Capturing profits will be highly dependent on controlling or participating in the right platform. Every business must incorporate these new realities into its platform strategy.
- **Context:** Today, we are in a platform economy — one in which tools, capabilities, and frameworks based upon the power of information, cognitive computing, and ubiquitous access will frame and channel our economic, business, and social lives. Leading organizations are shifting to platform thinking to evolve their business models and manage their technology architecture. Platform thinking is a fundamental shift in business strategy, moving beyond product differentiation and pricing and toward ecosystem-based value creation. It is also a long-term, sustainable response to new realities in the DX economy, one in which organizations digitally transform themselves into digital-native enterprises.

LEARN MORE

Related Research

- *Critical External Drivers Shaping Global IT and Business Planning, 2020* (IDC #US45540519, October 2019)
- *The Current State of Electric Vehicles* (IDC #US45557719, October 2019)
- *Part III: Mobility as a Service, Public Transportation, and Autonomous Vehicles* (IDC #US45380519, July 2019)
- *2019 U.S. Consumer Connected and Automated Vehicle Survey, Part 2: Connected Vehicle Feature and Service Usage, Data Sharing, and Payments* (IDC #US45363019, July 2019)
- *2019 U.S. Consumer Connected and Automated Vehicle Survey, Part I: Vehicle Ownership, Usage, and Buying Preferences* (IDC #US45350619, July 2019)
- *IDC Market Glance: Next-Generation Automotive Strategies, 1Q19* (IDC #US44827119, February 2019)

About IDC

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