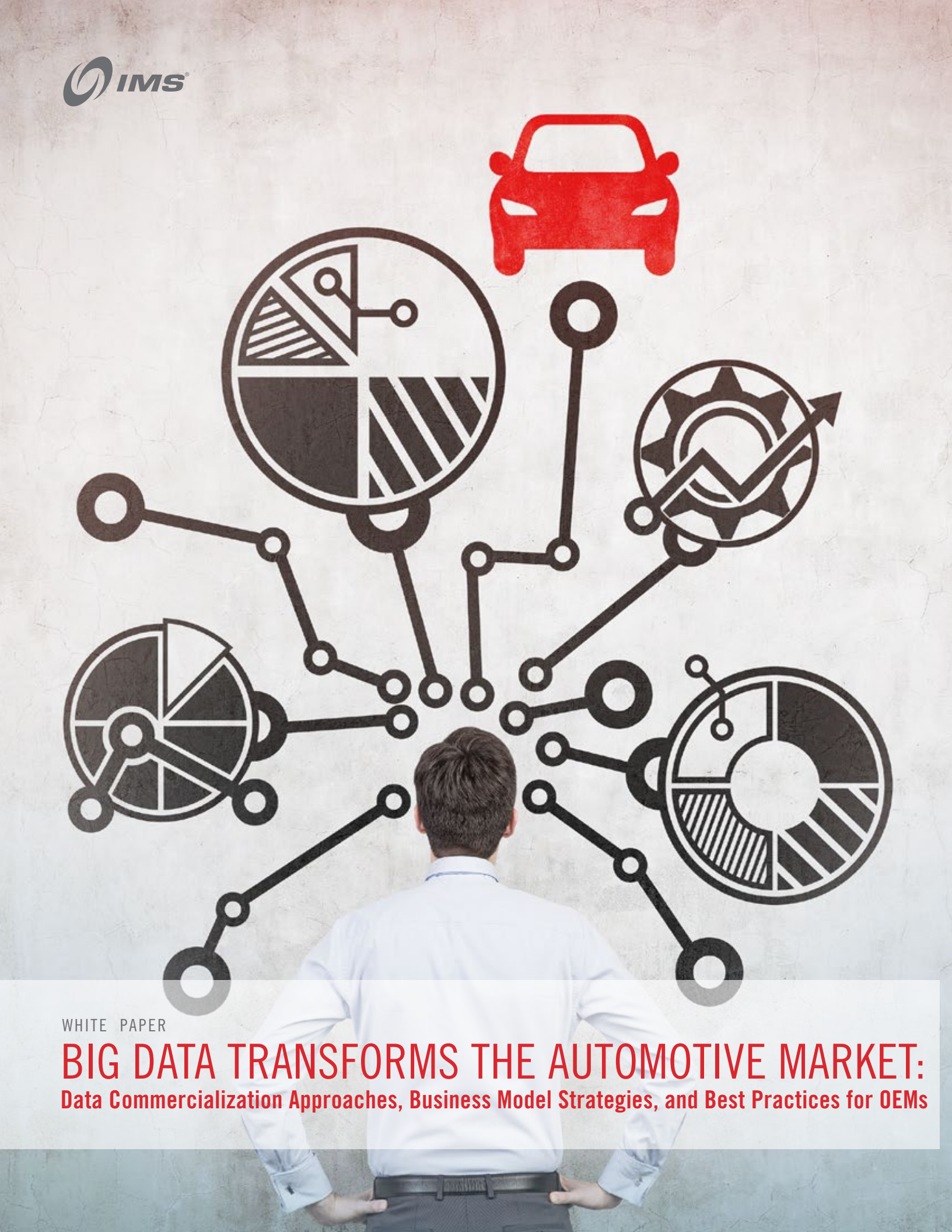

WHITE PAPER

BIG DATA TRANSFORMS THE AUTOMOTIVE MARKET:

Data Commercialization Approaches, Business Model Strategies, and Best Practices for OEMs

Executive Summary

Original Equipment Manufacturers (OEMs) in the automotive field have struggled for years to create revenue streams sufficient to offset the costs of implementing connected car technologies. Initial attempts to recoup these costs—primarily through subscription services—failed to meet the acid test with car buyers. Most demonstrated their indifference by dropping services after free trials ended.

With consumers indicating a strong demand for connected car services, the challenge remains for OEMs to develop a business model that works effectively and justifies the manufacturing and operating expenses. There is a growing awareness among OEMs that the data captured during vehicle use—providing insights to both the driver behavior and the vehicle statu—represents a largely untapped asset. This potential asset only provides genuine value if vetted and analyzed to improve the customer experience, while providing useful, consensual intelligence to other parties. Accurate, captured data is important, but Big Data analytics applied to this data—collected over millions of miles of vehicle operation and multitudes of driver decisions—can open business opportunities and become a source of significant revenues. However, unless the scale of the revenues effectively offsets the costs of implementing the technology, it becomes a losing proposition for automakers.

The challenge of commercializing data captured during the lifespan of a vehicle's operation can be met with a comprehensive, multi-layered approach, but this takes a high degree of expertise and experience. In the interests of both the OEM and consumer, this approach must include provisions to protect user privacy, efficient data management processes, built-in data security mechanisms, and forward-looking engineering for the connected car. OEMs are only going to embrace data exchange programs with parties if certain considerations—outside of their core competencies—are skillfully handled. This paper discusses the key requirements that must be met to ensure Big Data provides a profitable avenue for automakers and a positive customer experience that helps sell cars. Complementary opportunities in other industry sectors are also highlighted.

1. The Scope of the Opportunity is Substantial

The potential of the connected car services market is enormous and, at the same time, end user expectations are extremely high. A survey by Telefonica[1] indicated that 80 percent of respondents expect a connected car to deliver an experience equal to the mobile device connectivity and communications they are accustomed to at home and at work.

In a Business Insider article, "The Connected Car Report: Forecasts, competing technologies, and leading manufacturers," John Greenough wrote[2]:

" Over the next five to 10 years, this Internet integration is expected to change the car ownership model, create a new platform for consumers to access content, lead to fully autonomous vehicles, and revolutionize the auto industry. The market position of the car today is similar to where the smartphone was in 2010—it has just taken off."

"The Connected Car Report: The Transformation of the Automobile," released by BI Intelligence in April 2016, strikes a bullish attitude about the market opportunity. Excerpts from this report indicate[3]:

> Over 380 million connected cars will be on the road by 2021. Automotive OEMs are accelerating their plans to connect the majority of vehicles that they sell, as they increasingly recognize the business opportunities in doing so.

> Consumers are adopting connected car technology at faster rates than expected.

> Technology companies will play a major role in the future of the automotive market.

According to McKinsey & Company, the combination of shared mobility, connectivity services, and feature upgrades could expand automotive revenue pools by approximately 30 percent, reaching USD 1.5 trillion by 2030[4].

Elements of Data Commercialization

For OEMs, commercializing the surging interest in the connected car requires gaining a better understanding of the shifting attitudes of the connected driver and discovering the best ways to conduct an outreach campaign to these drivers. It also requires selection of a trusted partner

1 Bzeih, Henry, Greg Ross, Nicholas Nollet, et al. 2014. "Connected Car Industry Report 2014." Telefonica. https://www.business-solutions.telefonica.com/download/2903.

2 Greenough, John. 2016. "The Connected Car Report: Forecasts, competing technologies, and leading manufacturers." Business Insider. http://www.businessinsider.com/connected-car-forecasts-top-manufacturers-leading-car-makers-2015-3.

3 Greenough, John. 2016. "The Transformation of the Automobile." Business Insider. http://www.businessinsider.com/intelligence/research-store?IR=T&utm_source=businessinsider&utm_medium=report_teaser&utm_term=report_teaser_store_text_link_connected-car-forecasts-top-manufacturers-leading-car-makers-2015-3&utm_content=report_store#!/The-Connected-Car-Report-The-Transformation-of-the-Automobile/p/47113866

4 Kaas, Hans-Werner, Detlev Mohr, Paul Gao, et al. 2016. "Automotive revolution—perspective towards 2030: How the convergence of disruptive technology-driven trends could transform the auto industry." McKinsey & Company. https://cdn.shopify.com/s/files/1/0196/5170/files/Auto_2030_report_Jan_2016-2.pdf?5911865906826854249

to handle the complexities of data collection and processing in a responsible manner. Finally, to obtain maximum value from data that is harvested and granted usage rights by end users, OEMs need a framework to create and offer services. An effective ecosystem must:

> Support data exchange

> Connect with complementary partners and services.

> Provide the necessary mechanisms to unify disparate formats, communication protocols, data collection and transmission rates, and differing hardware conventions.

Obtaining Informed Driver Consent

At the heart of any effort to commercialize driver and automobile data is obtaining consent from each individual considering a program. The prevailing lore across the industry is that drivers shun the idea of providing information to other parties—whether insurers, OEMs, or government agencies. Statistical and anecdotal evidence, however, suggest that consent often depends on the terms being offered.

In surveys, drivers typically express reluctance to share data with a manufacturer or another organization unless there is a specific benefit to them. Shaping that benefit to something of reasonable value to the driver makes a considerable difference in consent rates. Assuring the driver in absolute terms that the data will only be used for specific purposes is also a primary consideration.

Millennials in particular are very comfortable with a quid pro quo approach to sharing data. They often download and use free or low-cost smartphone apps in exchange for access to a fair amount of personal data. Sometimes the benefit to the user seems almost negligible, for example, consenting to personal data access in exchange for a smartphone flashlight app (even though that capability is already built into many smartphones). Millennials should not be ignored by automakers. In 2010, they made up about 17 percent of new car sales and in 2015 that number has grown to 25 percent (which is now the fastest growing segment in the auto industry). Sharing data typically is not an issue with them.

Older, seasoned drivers typically require more direct benefits to provide consent. For example, a study referenced on Movimento shows that more than half of drivers are willing to share vehicle data with insurers to obtain better rates. Over 66% will share data to help improve future vehicle quality and design. Nearly half are willing to share data with manufacturers to gain a more individualized experience in their automobiles. Other quid pro quo areas currently indicate greater consumer reluctance, such as sharing data with advertisers for special offers (34%), but the increase in location-based advertising is expected to diminish this resistance over time.[5]

Gaining consent from drivers is not a given nor is it an automatic process; carmakers will need to earn this consent. By offering better experiences, special offers, or unique services that satisfy consumer wants or needs, the chances of obtaining informed consent rise accordingly. Encouraging drivers to exchange data on operations for free connected car services—over the life of the vehicle—can be a power inducement for them to take part in a program.

5 Neilsen, Rasmus. 2016. “Automakers Lead in Connected Car Privacy Policies, But Still Have a Way to Go.” Movimento. http://movimentogroup.com/blog/automakers-lead-in-connected-car-privacy-policies-but-still-have-a-way-to-go/.

2. Three Pillars for Successfully Commercializing Data Use

Given the market challenges so far in terms of establishing successful revenue streams to offset the expenses of providing connected car technology, OEMs are still hunting for a business model that will work—for customers, partners, and the OEMs themselves. Trends in the automotive industry point toward always-on data capture and distribution over the lifespan of a vehicle. Tesla has successfully integrated this approach into their brand, strengthening their tie to customers by focusing on personalized experiences. Over years, the company accumulates a wealth of data about each vehicle's operational history—from both a vehicle and driver behavior perspective.

The value of the services and intelligence that can be derived from this data is the key. Data plus analytics yields intelligence and that intelligence has tremendous value across many markets. The considerable challenges of profiting from connected car subscription services has troubled the industry since these services were first introduced. OEMs, however, can monetize the data collected in a variety of innovative ways—as long as they manage certain essential considerations well. The value of deep insights about the drivers of their vehicles is a bonus beyond the basic monetization of the data.

The data commercialization challenges faced by automakers typically involve three major pillars, all of which must be resolved as a part of an effective business model for providing connected car services.

Pillar 1: Data Management: Integrity, Security, and Privacy

Building a business model that involves the capture, validation, provisioning, and distribution of massive volumes of vehicle and driver information requires considerable expertise and a supporting infrastructure. Under the umbrella of data management, several specific areas of data handling must be addressed to meet the concerns of OEMs.

Transparency

Every byte of data about a vehicle and the driver operating that vehicle must be subject to full transparency and consent. The driver must be consistently informed of what data is being collected, how it will be used, how long it will be stored, who else will have access to it, and what prerogative does the driver or vehicle owner have for terminating consent given for the use of this data. The most effective Big Data applications associated with automotive use assume an always-on model that can capture vehicle data throughout its cradle-to-grave lifecycle, whether it is in motion or parked, and includes a very wide range of parameters. The vehicle operator must give consent for the collection and use of every one of these parameters—from vehicle location to data capture of driver operations (speed, braking, the G-force of turns, and so on) to identifying the person behind the wheel at any given moment.

Privacy

Different jurisdictions around the world have varying levels of regulations and mandates in terms of an individual's data privacy. These laws and mandates can be complex and in some case overlap depending on the region and even the state. Data privacy is important both for legal and regulatory measures with which the OEM and any partners must comply, in addition to the basic business principle of respecting and protecting all information that relates to their customers. Failure to pay attention to data privacy could subject the OEM to fines or loss of their stature in the industry, as well as casting a dark shadow over the way that they are perceived by customers. When working through a service or intermediary that is handling data on behalf of an OEM,

the OEM must ensure that strong data privacy protections are included in any agreement and followed consistently.

Security

Ensuring secure data exchanges is integral to any data commercialization effort. Part of this involves monitoring and tracking where data is being sent, where it originates, and whether encryption is used consistently to secure data while in transit. Any areas in the data path that potentially allow intrusions or are vectors for abuse should be remediated to mitigate the risk. Risk has many different dimensions and security should always be implemented anywhere that a risk potential is identified. With rigorous, secure data protection mechanisms in place, hacking becomes a non-issue, rather than a concern for OEMs.

Required Vehicle Equipment

Many different mechanisms exist for capturing and transmitting vehicle and driver data. The hardware and software supporting this effort should be factored into the plan for commercializing data. The range of hardware and vehicle types supported introduces a layer of complexity. Of critical importance to any commercialization program is the capability of collecting, cleansing, normalizing, and unifying collected data so that irrespective of the OEM's hardware decision, the vehicle and driving information is delivered to each beneficiary in a uniform, usable format. Commercialization demands that the management of data across this spectrum of devices in a consistent, verifiable manner. To maximize the data value, this management should include the earliest devices in the market, all those operating today, and new devices as they are introduced (always maintaining backward compatibility).

Pillar 2: Sufficiency of the Data

For Big Data applications in the automotive sector to be successful, certain criteria must be met. Simply collecting and aggregating huge amounts of data, without being sufficiently selective or qualifying the nature of the data, is unlikely to lead to the kinds of useful insights that will identify patterns, reveal trends, and derive statistically significant results.

Going into a project involving automotive data, key questions should be resolved at the earliest stages of planning such as:

> Considering the full range of data being captured, what data points are most relevant?

> How much data is needed to drive the analytics and provide value?

> Over what time period should data be collected to ensure that the analytic results can be trusted with a high degree of confidence?

Partnering with an organization experienced at the collection and processing of vehicle and driving data can answer these questions and provide assurance that you will get results from the data consistent with the project objectives.

Pillar 3: Uses of the Data

At the point where the mechanisms are in place to capture the data, permissions have been granted for acceptable uses, the question arises: what can you do with this data? This is the area where innovation, imagination, and cross-industry cooperation converge—the point where new opportunities emerge and fresh services can be developed. At this stage, the value of the data depends on the kind of usage and the area of interest. For example, city and state

government organizations have an abiding interest in traffic control and safe vehicle road use. Emerging applications that track a vehicle's movements over specific roads or turnpikes can institute fair-use road charges to drivers traveling these roadways—based on actual data. Other data from vehicle locations can help reduce traffic congestion by intelligently manipulating traffic signals and automating passage through tollbooths.

Clearly, insurance companies are very interested in data revealing driver behavior patterns, vehicle safety features, vehicle maintenance, and driver lifestyle. This data has considerable value to them and arranging a data exchange will benefit the OEM, the insured party, and the insurer.

The OEM ecosystem also benefits from this data. Automotive service facilities with access to diagnostic and status data associated with a vehicle can use predictive analysis, incident logs, and historical data from similar vehicles to communicate with drivers about issues that require quick intervention or near-term attention. Other applications include understanding the driver's habits, preferences, and lifestyle to better match the vehicle's features, maintenance, and service programs to the owner's requirements.

Emerging IoT Applications: Beyond uses envisioned for government organizations, vehicle service centers, and insurance companies, numerous opportunities exist—many still in the infancy stages of planning—for data that indicates consumer preferences, lifestyle matters, and daily routines. These opportunities often require a convergence of information from different sources, as is typical of emerging Internet of Things (IoT) applications.

The more related data points from various sources that can be pulled into the analytics, the more intelligence can be derived from the data. Automakers can capitalize on providing highly personalized services to prospective car owners. Some of these kinds of capabilities have already been introduced in the industry, generally as piecemeal programs. The full potential, however, will only be realized once a dynamic ecosystem is brought into the process to serve as a data exchange and conduit for different information sources.

Applying Analytics: The topic of analytics as applied to the connected car can lead in many different directions, including discussions of artificial intelligence, machine learning, and autonomous vehicle operations. In general, there are three different types of analytics that are applied to the data captured:

> **Descriptive analytics** apply to the moment-by-moment driving patterns and road behavior of all individuals who get behind the wheel of a particular vehicle. These patterns can be evaluated, linked to safe or risky behaviors, and combined with other data sources and vehicle information.

> **Predictive analytics** assess past patterns and driving behavior to make an informed judgment on the likelihood of various future possibilities. Some examples include where a driver is likely to drive on a given day, or the predicted risk of the driver given past behavior.

> **Prescriptive analytics** combines intelligence from both descriptive and predictive analytics and issues recommendations, guiding driver behavior to suit the situation based on past experiences. Examples include coaching guidance to specify where an individual should start slowing down to safely navigate a curve on the road or guidance to ensure the vehicle is being well maintained at a convenient location. By understanding a driver's regular behavior, prescriptive analytics can cause changes in that driver's behavior—to take an action outside of the normal routine (to the benefit of the OEM).

These three types of analytics can be used in complementary ways. For example, imagine that a trouble code appears during a drive. Predictive analytics can recognize that a driver normally travels between two places on a typical route and detects that a driver is on a different course. The driver is headed to a non-OEM dealership repair shop. The prescriptive analytics application can generate a service coupon for a nearby OEM repair facility, and provide directions to the dealership that can fix the problem immediately. In that case, the data can be used to identify the driver or the route they are likely to drive at that time on that day. Contextual data can then be used to persuade the driver to take a different course of action.

The leading edge of today's advances in connected car technology is all about imaginative uses of all three types of analytics and the integration of many different data sources harvested from IoT implementations that can sharpen and enrich decision making and improve the customer experience.

3. Business Models for Generating Connected Car Revenues

OEMs face numerous challenges in trying to implement a profitable strategy for vehicle connectivity and commercializing vehicle data, particularly because this entire area is essentially outside their range of experience. Commercialization of data requires both current data and historical data. In addition, not just data about the drivers of a particular OEM's vehicle, but also drivers of competitive vehicles. Effective data commercialization requires large volumes of demographically and geographically diverse data sources.

Ensuring high quality analytics results also requires collecting data from every generation of connected car hardware that each OEM has embedded. That data must be scrubbed and normalized to achieve the best results.

Before the data is even collected from the wide variety of OEM-embedded devices, the privacy rules of the government agencies at the federal and local levels must be acknowledged and met toensure compliance.

Once the authorized data is collected, scrubbed, and normalized, it is analyzed to the specific requirements of the given application. Few companies have this level of experience in the automotive space, and this kind of operation is beyond the capabilities of most OEMs.

An experienced technology service provider can resolve the issues involved in commercializing data for automakers. By providing a single integration point for commercializing the full range of data from a vehicle, the technology service provider can handle relationships with partners and other service providers and help establish a revenue stream that provides a reasonable return for the OEM.

Best Bets for Low-Risk Data Commercialization Benefits

Usage-Based Insurance (UBI) has become proven and it is becoming established in the marketplace. The accumulated knowledge and experience around UBI make it a low-risk starting point for data commercialization. Vehicle data captured for UBI applications has additional value to the insurance carriers that extends beyond this one application. As demonstrated by pilot projects and emerging programs, the true value of the data, through the insurance applications alone, can exceed the OEM's monthly connected vehicle operating

costs. The value of this data to the insurance industry can be divided into three categories: events, analytics services and basic data applications.

As illustrated in Figure 1, Event data tends to be random and infrequent, but it offers higher value to the insurers. Event data includes applications such as first notice of loss, accident scene management, and enhancements to the claims process.

Analytics Services involve the analysis of data and used by the insurer to understand the risk associated with the underwriting. These services are sometimes performed for a specific period, typically 6 to 12 months, and do not require the car to be connected for life. This type of analysis is not necessarily limited to identifying the low-risk driver. Insurers also insure risky drivers. The value of this kind of analysis is to provide the insurer with the necessary information to make an informed and profitable underwriting decision.

The final value category is related to Basic Data Applications. These applications often require the continuous collection of data. The data is used to detect fraud, create new insurance products, and provide discounts to drivers based on vehicle safety features, allowing insurers to compete using many of the advanced and emerging technologies available.

Creating Value from OEM Data

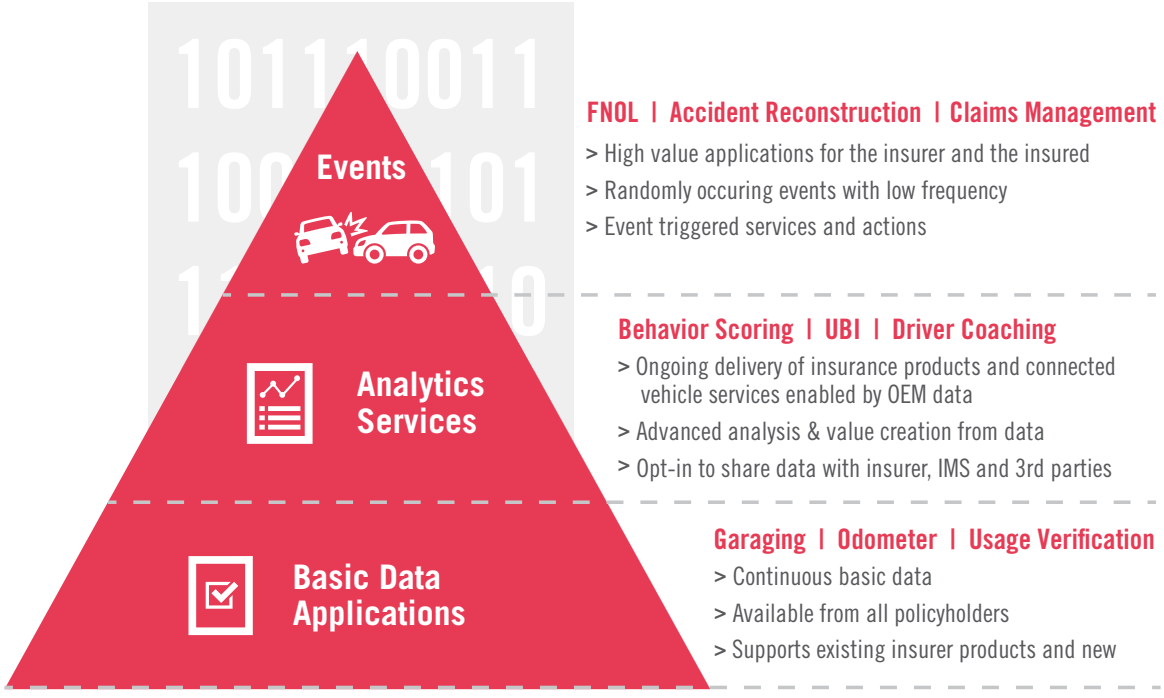

Figure 1. Creating Value from OEM Data

4. Long-Term Advantages of Harnessing Big Data

So far, this white paper has focused on the near-term applications for the data that minimizes risk for the automotive OEM and yields material benefits to the insurance industry. This data also has applications well beyond the insurance applications. There are a number of long-term

advantages of capitalizing on Big Data collected and analyzed from automotive operations, including:

> **Enhanced vehicle design**: Analysis of the data allows the automotive industry to have a better understanding of driver behavior, habits, and preferences—all of which will help improve the designs of future vehicles.

> **Better customer experience:** Predicting the needs of drivers helps the OEM and its ecosystem anticipate and deliver better experiences and meet each driver's expectations.

> **Improved servicing processes:** The capture and analysis of service events—amplified by millions of on-road and service-bay data points—can lead to early fault detection, more efficient servicing procedures, and more effective inspection processes. Predictive analysis can help identify parts failures before they occur, avoiding vehicle breakdowns during trips.

> **Expanded aftermarket opportunities:** Combining location-based services with Big Data capture—using OEMs as the information conduit—can open a wide variety of aftermarket services. Through these aftermarket options, interested drivers could obtain entertainment tips and benefits, travel services, insurance discounts, maintenance reminders and offers, food service suggestions during travel, and more—all based on vehicle location. Big Data capture and analysis at this scope and scale requires an intermediary to aggregate, confirm, analyze, validate, and process the massive volumes of raw data in an efficient, secure way. This is one objective of the IMS Connected Vehicles Marketplace, discussed in the last section of this white paper. IMS Connected Vehicles Marketplace operates as an open platform to facilitate data exchange with marketplace participants.

5. Choosing the Right Technology Partner

The momentum behind connected car technology continues to grow. OEMs have a unique opportunity at this point to partner with a technology leader that can guide them through the morass of complexity surrounding Big Data applications and help build solutions that take advantage of the latest advances in this area.

Managing, validating, and distributing the data from a connected car is a demanding enterprise, one that requires specialized skills and expertise beyond the normal province of an OEM. Key capabilities to look for in a prospective technology partner to bridge the divide between automakers and insurance carriers include:

> Proven experience in both the automotive and insurance sectors

> Expertise and a demonstrated track record working with Big Data and advanced analytics in the context of automobile travel and insurance

> A background and experience in IoT technology, sensor data, and the legal, regulatory, and management issues surrounding data exchange within an IoT environment

> An established plan for designing, developing, and deploying solutions of significant complexity for capturing and commercializing data acquired from vehicles

Selecting a technology partner with these skills can help avoid the pitfalls and obstacles associated with commercializing data exchange.

6. The Role of IMS as a Valued Connected Car Technology Partner

IMS has deep expertise and proven experience with the essential technologies required to commercialize data for OEMs. The DriveSync® connected car platform developed by IMS for this purpose has successfully ingested and transformed data from multiple sources—including the unique data sets from each OEM—providing clean, consistent feeds of insights and generating value to multiple consumers of that data.

Partnering in the insurance sector is an excellent, low-risk way for OEMs to venture into the uses of Big Data to produce revenues. IMS is a market leader in this area with proven capabilities as a system integrator—for managing data from every conceivable vehicle type and data capture equipment. Because OEMs may change connected car hardware and software over the course of a model run, IMS stays current on these changes and adapts algorithms and data format conversions that correspond to the wide variety of OEM variations. IMS excels at the complex operations required to extract intelligence from vehicular data, including acquiring and scrubbing data from the embedded OEM devices, normalizing the data to fit a consistent format, and applying analytics to meet the unique requirements of the insurance carrier.

Over 11 years of insurance analytics experience encompassing 13 percent of the US insurance audience, IMS has acquired deep knowledge and considerable expertise in Big Data applications. IMS has over 500,000 connected vehicle activations annually, processes six billion data points each day, and has captured over 75 terabytes of data to date.

IMS's DriveSync connected car platform is flexible enough to manage both light data sets (as simple as odometer readings and distance driven), as well as dense, complicated data sets (such as second-by-second accelerometer readings and precise braking and turn data during the span of a trip). Being able to manage and deliver value across a whole spectrum of very lightweight and very dense data is important to ensuring that value will be provided to insurers, government agencies, and others.

7. About the IMS Connected Vehicle Services Marketplace

By establishing an open platform for the kinds of data exchanges that underlie automotive travel and personal lifestyle choices, IMS is enabling a connected vehicle services marketplace and collaboratively engaging with industry leaders, partners, and participants to help shape the advances in Big Data analytics and IoT applications. The creation of programs and initiatives around these supporting technologies will generate revenue opportunities that can bring value and business growth to all those involved with this exciting technology (see Figure 2).

The Connected Vehicle Services Marketplace provides a centralized hub supporting the licensing of data sources. For example, data sources from a road usage charging program could be licensed

to an insurer offering commercial or personal lines UBI programs. This provides greater value to the end user, using data captured from a single source. Automakers have the opportunity to develop new programs and offerings with others in the ecosystem to capitalize on the value of consensual vehicle data and driver data.

Companies partnering with IMS can harness and exchange a vast array of data without dealing with the complexities of creating or maintaining the complex infrastructure that makes this possible.

To learn more or to become a partner in this IoT technology based marketplace, visit: http://www.intellimec.com/oem

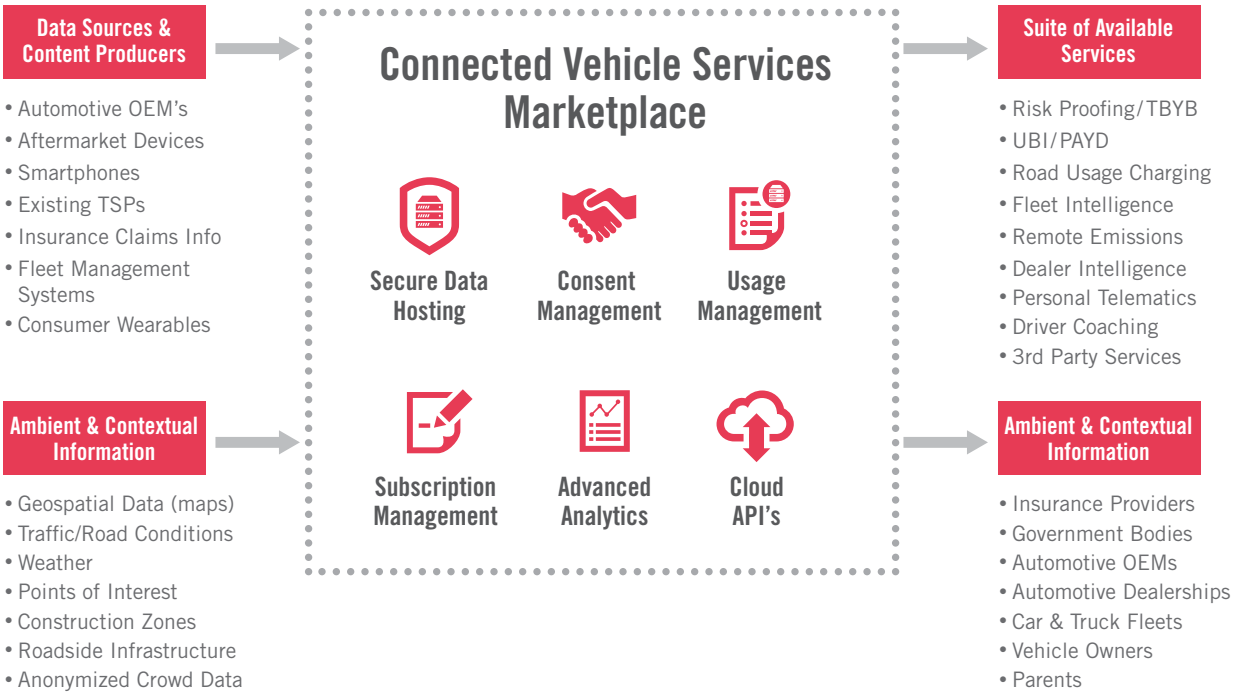

Figure 2. The Connected Vehicle Services Marketplace Includes Participants from Many Industry Sectors

8. About IMS

Intelligent Mechatronic Systems Inc. (IMS) is a leader in connected car technology that enables drivers to be safer, smarter, and greener. IMS is well positioned with the requisite knowledge and insight to work closely with OEMs and insurers around the world and has the direct experience and deep expertise to help craft strategies in support of connected car and telematics programs. IMS is prepared to assist OEMs and insurers with the necessary facts and figures to guide them through all stages of a successful program deployment.

For more information on how you can capitalize on Big Data and connected car technologies, or to explore the opportunities IMS offers, visit the OEM landing page; http://www.intellimec.com/ims-and-you/automotive-oem/