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Big data and analytics in the automotive industry

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Analytics in the automotive industry

Improving forecasts, operations, and performance through the evaluation of large and complex quantities of data

The automotive industry continues to face a growing number of challenges and pressures. Cost pressure, competition, globalization, market shifts, and volatility are all increasing. At the same time, big data and analytics today offer previously unthinkable possibilities for tackling these pressures and many other challenges automakers face.

With increasingly better possibilities of data analysis, predictive analytics is developing into a powerful tool allowing for an enormous boost in forecasting efficiency as well as operations and performance. The challenge, however, lies in automakers' ability to make sense of giant quantities of readily available knowledge and experience data. The sheer volume of data, simply put, has made it difficult to evaluate in a way that informs strategic decision-making. Analytics allows this information to be merged regardless if the information is "machine-readable" datasets or unstructured data such as videos, sound recordings, or texts. Done right — the results are impressive.

In production, for example, analyzing historical data, parameters and combinations of parameters can be identified to determine whether something is okay or not. This can be used in the instances of recalls, allowing automakers to determine or even predict the time of when a potential product recall may take place. It never occurs in the first place because the decisive parameters are re-introduced to the target corridor in a timely manner. This approach and process can also be applied to customers, suppliers, and other stakeholders in the automotive ecosystem. A recent study with Deloitte discusses the importance of data as a highly effective source of performance parts.

From the masses of customer data, automakers can determine what models, accessories, or services particular customer segments are interested in. This allows for individualized and tailor-made offers and incentives that can boost sales. Via the Internet, social media, and increasingly interconnected vehicles, manufacturers also obtain an ever-increasing flood of customer data that allows analyses with increasing precision. Thanks to analytics, supply chain data can also reveal which links in a chain could weaken — thereby allowing for proactive and timely countermeasures ideally before a dangerous problem manifests itself.

The author: **Craig Giffi** is a vice chairman and leads the Automotive practice for Deloitte LLP in the United States.

Incredible innovations within the transportation sector are being driven by the growing recognition that cars, once synonymous with freedom and ease of mobility, have become a victim of their own success. In cities around the world, congestion is undermining mobility, imposing huge costs not just on commuters or people out to run a simple errand but on society as a whole. Data analytics, technology and innovation, coupled with new transportation capacity, can help reduce global gridlock for real-time traffic management and incident response.

Analytics is a powerful tool. However, applying analytics effectively requires knowledge and experience beyond statistics, operations, or information technology. Analytics done right requires a comprehensive set of capabilities that intersect and integrate with multiple functions and skill teams across an enterprise.

With that as the backdrop, our global team of automotive specialists have authored this collection of articles with the hopes of sharing what possibilities analytics offers your company and what you should consider when considering an analytics-driven initiative.

We welcome your feedback and stand ready to meet with you to discuss these perspectives, our experience, and potential impacts to your organization. Contact information for all the authors is provided at the end of this publication.

Featured articles

The evolution of decision-making requires a new style of management

Analytics: The relevant knowledge has to be filtered out of masses of data

Big data is the new oil. The next step in the evolution of innovation and productivity. It is a management revolution. Statements like these have made their way to the forefront, and there is today hardly an organization that is not aware of the opportunities analytics affords. The hype is understandable. Think of how regularly we experience scientific successes, new business models, and social changes that have resulted from big data analysis. Amazon, for example, recommends books based on algorithms. Match.com suggests partners based on character profile matching algorithms. And with "House of Cards," Netflix has produced a successful TV series — all based on behavioral principles.

This collection of articles consists of impressive forward-thinking opportunities of analytics for automakers. Forecasts of sales fallbacks on the basis of customer data; an individual combination of marketing campaigns and price strategies; and an improvement of customer loyalty using analysis of targeted customer behavior are all examples of topics covered by our team of automotive specialists.

Before tackling those very timely and relevant topics, however, we must first remove some of the "magic" that is often associated with analytics. In reality, analytics is nothing new. In its most basic form, analytics is people making decisions based on information and their knowledge. In essence, knowledge is the processing of relevant information, and information consists of condensed data. These "hindsight analytics" principles have been applied for centuries, dating back to the invention of bookkeeping. But what about analytics and forecasting the future? Although not as mature as hindsight analytics, predictive analytics is also nothing new — dating back to the 1950s and the introduction of credit scores and ratings.

The author: **Nicolai Andersen** is a partner and the head of innovation at Deloitte Germany.

More data — more knowledge

It is an exaggeration to say that there has been a revolution in decision making, in view of the current times, evolution is a more appropriate definition. What is revolutionary is the quantity of data being processed today, and therefore the quantity of information that can be produced. Three developments are of decisive importance:

- **More detailed data:** Technological advancements allow greater volumes of data to be processed and transmitted.

- **More types of data:** Specific methods allow for the processing of more unstructured data (such as texts and videos).

- **More data sources:** External data (such as weather and social media) can easily be combined with internal data sources. This extra data leads to additional analysis, and in theory, to an extra breadth of knowledge.

However, it is unclear which of this extra knowledge should actually be used to support decision-making and how to filter through it. Not all the extra information, made possible by extra data, is needed. When looking for a needle in a haystack, one does not necessarily find more needles if one heaps more hay onto the stack. Therefore, the usefulness of an analytics initiative must be determined prior to the investment. Will decisions have better support? Will they receive faster support? Will new and additional decisions be supported? How important are the decisions for the company?

Linkage is important

In our view, the increasing significance of analytics initiatives is causing major change within the enterprise, for example:

- **Collapse of borders between silos:** Companies that possess functional silos cannot exploit the potential of analytics. Because the combination of already existing data frequently leads to the most significant findings, analytical initiatives should be implemented and permanently steered across all segments.

- **Spread of the culture of innovation:** The new capabilities of analytics require a corporate readiness to test initiatives. Specialist segments that traditionally display little innovation are also becoming increasingly flexible and future-focused as a result of having to handle data.

- **Merger of skills:** When neither the statistical model, the algorithm, nor the data source of an analysis are understood, serious faults in decision-making can occur. Therefore managers with skill profiles, that are capable to bridge the gap from business issues into statistical models and/or technical solutions, are becoming increasingly important.

- **Taking care of the ecosystem:** Analytics initiatives can be so multi-layered that there can be inefficiencies in developing all the necessary competencies in a single enterprise. Therefore it is becoming increasingly important to create an equally multi-layered network of external partners (specialized start-ups, research institutes, data providers, etc.) which will process the analytics initiatives as an overall ecosystem.

- **Increasing sensibility:** Responsible handling of data has become more important. In all areas, companies will have to develop a sensibility to not just the legal, but also the ethical and social implications of an analytics initiative.

In this way, the already advanced evolution of decision-making is leading to an evolution of the style of management.

Managing the flood of data properly
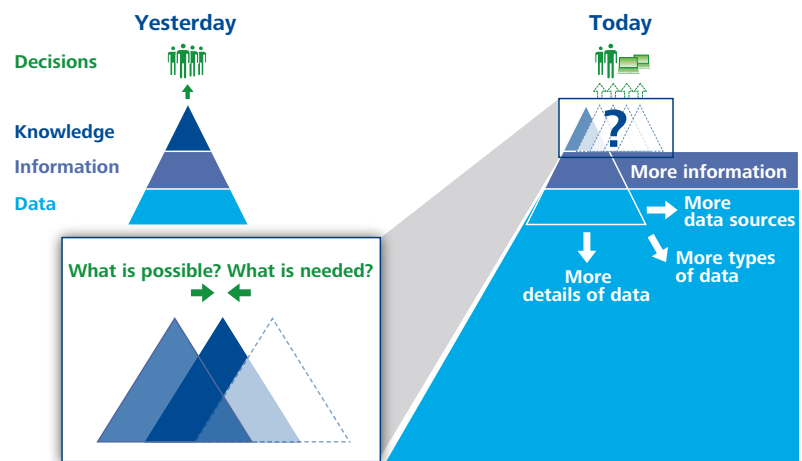
The mass of usable data is increasing just like the number of data sources and the types of data. It must be determined which of these are really needed for better decisions.

The evolution of the customer experience

Using analytics to enhance how automakers engage with consumers

With increasing customer reliance on social media and the Internet as a research and communication tool, car manufacturers today may want to rethink and evolve how they engage buyers throughout the sales and ownership cycles. Doing so is critical to automakers' ability to differentiate themselves amongst a growing and increasingly more competitive set of brands. As technology, especially consumer technology, revolutionizes the car buying and post-purchase service experience, automakers need to adapt and reconsider how to connect with on-the-go consumers that increasingly expect a personal and customized experience.
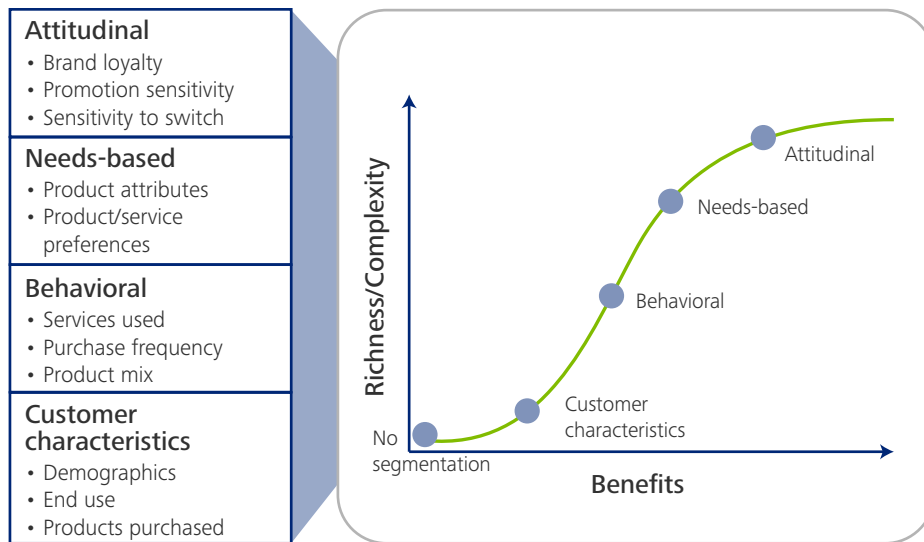

The author: **Ashwin Patil** is a director and leads the Analytics and Information Management practice for Deloitte Consulting's Manufacturing practice in the United States.

The primary stakeholders (operational, managerial, or executive) groups for customer data each have their unique set of questions.

Sales executives, for example, should consistently explore new ways to engage their core customers, and grow life time value from their existing customer base. When it comes to new business, sales executives should likely sharpen their focus on attracting new customers, which includes optimization of existing sales resources.

While similar, marketing executives ought to focus on understanding the value of various consumer segments (for example, by age, geographic location, income, etc.) and if they all provide the same value to the company's sales and growth objectives. Moreover, marketers are often challenged to define how the company and brand "speak" to the heart of customer wants and needs; how changes in price impact customers; how strategic targeting of customers can reduce marketing costs; and how optimization of incentive spend across the various sales channels can maximize sales volume and profitability.

For customer service executives, improving customer retention is a foundational objective, as is improving the customer experience across multiple channels. Doing so requires effective allocation of resources, and aligning those across channels and service requests, to ensure an improved customer service experience.

For automotive companies, analytics and information management can provide the means to tackle these complex challenges using quantitative techniques instead of qualitative assessments.

One real example is related to the recent discontinuation of automotive brands. When a brand is discontinued, historically, 90 percent of the customers that owned the brand are prone to defection. One major original equipment manufacturer (OEM) recognized this challenge and the potential loss of customers as it developed its strategy to shutter a major brand. The OEM understood that if it was going to be successful in shuttering the brand and not losing a significant number of customers, it had to develop a dual strategy of migration via brand and retention via service. Moreover the strategy had to be seamlessly implemented to maximize the impact on at-risk customers. The OEM leveraged analytics to acquire and retain their customer base and managed their growth targets with the brands that were retained. By leveraging data and analytical models to study brand propensity and consumer segments, they estimated 1 percent incremental sales would translate to about 20,000 additional units and were able to identify targeted offers based on variables analyzed across their call centers, warranty, and sales data to enhance their customer segments. Analytics helped the OEM protect their approximate 5.7 million customers that were at risk of defection. The annual uplift in revenue based on a 1 percent increase in acquisition rates through better analytics was estimated at $1.2 billion annually.

Figure 1: Customer segmentation maturity

| Attitudinal |
| • Brand loyalty |
| • Promotion sensitivity |
| • Sensitivity to switch |

| Needs-based |
| • Product attributes |
| • Product/service preferences |

| Behavioral |
| • Services used |
| • Purchase frequency |
| • Product mix |

| Customer characteristics |
| • Demographics |
| • End use |
| • Products purchased |

Moving up the data analytics maturity curve
Customer data integration is daunting because of the number of places it is stored, the level of detail that is available, and the complexity of the variables that surround customer data to make it usable. From customer relationship management (CRM) systems and call centers, to dealer management systems, to warranty and quality systems, to sales and marketing databases; the desire to understand the customer and create a single integrated view is key to the management of customer acquisition, retention, and lifetime profitability.

As automotive companies integrate customer data across the enterprise, they have the opportunity to drive a tremendous amount of richness and maturity. And the greater the richness of the dataset, the greater the insight and benefit potential of the customer data (Figure 1).

A critical step in making customer data useful is customer segmentation. Customer segmentation divides customers into groups that share similar attributes and can help address critical business issues. Customer segmentation identifies attributes such as motivating factors, interests, risk factors, behaviors, likes, dislikes, propensities, etc. This leads to the development of differentiated product offering

and value propositions for each customer segment. It also supports the creation of direct communication campaigns, database management of key forms of customer data and reporting, or the development of a customer relationship management strategy. Effective customer segmentation starts with the end in mind and requires careful research design to produce actionable insights.

One emerging trend driving customer segmentation is creating "household" segments instead of "individual customer" segments. This supports the notion of a connected micro-segment (or household) that is jointly responsible for decision-making. As one considers the interactions through a customer lifecycle an automaker has, the household evolves and iterates the lifecycle at different levels as teenagers grow up and adults grow older.

A household approach can influence the ultimate purchase decision for young consumers in the family. In fact, according to Deloitte's recent study of 23,000 consumers in 19 countries, family and friends top the list of sources of information that influence Gen Y consumers' (born 1977-1994) ultimate purchase decision — more so than dealerships, social media, and manufacturer websites.

These buying, retention, and influence behaviors, while complex, can be better understood and multiple household clusters can form household segments with similar characteristics.

Most effective segmentations are formed using a combination of two or more dimensions (Table 1).

Helping automakers understand their customers

Deloitte's project approach leverages deep customer insights and analytics experience to deliver actionable and relevant customer segmentation. We believe effective customer segmentation starts with the end in mind and requires careful research design to produce actionable insights. In our experience, the following guiding principles should likely be followed:

- Segments define a group with sufficiently similar needs and shopping behaviors that they require a common value proposition to win their business.
- Execution of value propositions against each segment should be measured on an ongoing basis to evaluate the effectiveness of the treatment and the segment itself.
- Segments should be actionable, allowing the company to identify customers and reach them with practical, demonstrated sales, service, and marketing actions.
- While multiple types of segmentations may exist in an organization, the segments within them must be clearly distinct and mutually exclusive; this usually demands that segments are derived using a statistical/mathematical technique.
- The attributes that are used to group customers together should be relatively stable such that the overall segmentation scheme can stand the test of time.
- However, segmentations should also be allowed to evolve over time as preferences and business needs change, allowing customers to migrate from segment to segment.
- Key stakeholders of the segmentation should be deeply involved early in its development to harness their business knowledge and to gain their buy-in.
- The final segmentation should be communicated to the relevant departments in such a way that it is well understood and usable for sales, marketing, and/or service operations.

While incorporating these principles into the day-to-day operations and long-term growth strategies may be complex, automakers who fail to take the time to consider how to use these ideas run the risk of missed opportunity.

Done right, the use of analytics to evolve the customer experience can lead to more effective marketing and customer engagement campaigns; can result in more targeted one-to-one offers; and can help automakers better understand the cost to serve by consumer segment — thereby enabling the design of more profitable marketing and customer service programs. Done wrong (or not at all), automakers risk missing opportunities to attract, engage, and retain loyal, life-long consumers.
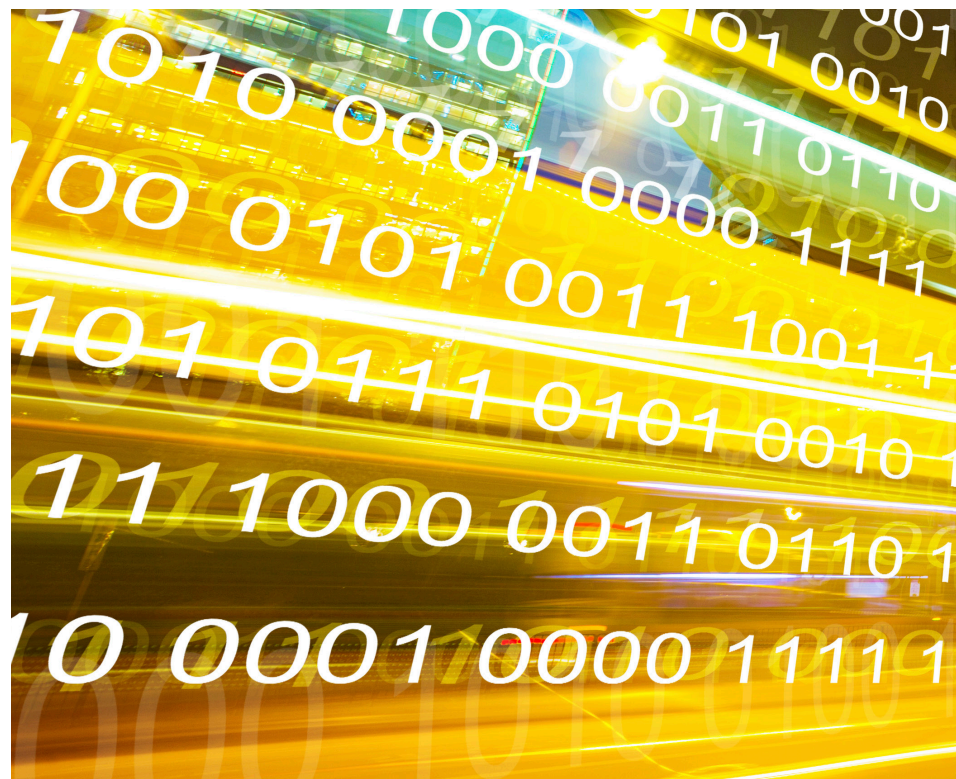
Table 1: Customer segmentation dimensions

Dimension	Example attributes	When to use	Example
Demographic	Name/address Demographic data (e.g., age, income, marital status, children) Account type	Developing a customer census (e.g., how many customers are…) Customer interactions with brand/company/product are unknown	Baby Boomers Business customers
Lifestyle	Third-party lifestyle segments (e.g., PRISM, Equifax niche) Leisure activities Car ownership	Marketing a new product or service Developing a customer census Developing an external relationship with a related vendor	Young activities Golfers
Needs	Cost-benefit choice quantification Service level requirements	Key buying factors are not sufficiently differentiated Precision in attributes to tailor value propositions is needed	Availability buyer Relationship buyer Full-service buyer
Attitude	Brand preference Promotion sensitivity Sensitivity to switch	Assess unmet needs and frustrations Measure the brand premium Understanding the decision-making bias	Loyalists Convenience shoppers Cherry pickers
Value	Estimated customer value Customer cost to serve Customer Lifetime Value (CLV)	Where customer buying factors are clear and different between segments Making trade-offs between discounting and adding services	Strategic sourcers Price bottom feeders High luxury
Behavioral	Purchase frequency Product mix | Basket size Days since most recent purchase	Quick identification of need Simple sales force instructions Understanding switching behavior	Single, urban and upscale Young families Retirees seeking value

The separation of customers and possible purchasers into groups with similar characteristics and wishes makes it possible to produce tailor-made offers for various segments and thus address these customers more individually.

Customer behavior analytics: A game changer in automotive customer retention

A new customer strategy approach for automotive OEMs and beyond

With the quantity of data increasing multifold, big data analytics is often referred to in automotive OEM discussion, frequently with a sense of curiosity of what it represents. In the majority of occasions, the discussions miss the perspective that the data comprises the aggregated collective experience of the organization, which can guide future management decisions. Each customer interaction generates multiple data points which shed light on customers' behavior. With an ever-increasing number of customers, these data points run into the millions, complicating relationships in the data, thus uncovering valuable insights becomes increasingly challenging.

The authors: **Sharad Mohan Mishra** is a senior manager with Deloitte Japan and has experience in customer acquisition and retention strategy development and execution for global automotive OEMs.
Masanobu Kurihara is a manager with Deloitte Japan and has broad experience in cross-border business strategy planning and execution for global automotive OEMs.

Low customer retention is Achilles heel for leaders

The benefits of customer retention (CR) are clear. But, efforts in CR by the majority of automotive OEMs are low and often without any clear differentiation between competitors. In developing countries where automotive demand is heavily skewed toward first-time buyers, the focus on CR initiatives is even smaller. But over time, the market matures and the proportion of replacement buyers increases. At this stage, a solid CR operation becomes a lifeline, as is the case in developed economies presently. CR and sustainable growth are intrinsically linked and require sound strategic direction from the very start.

Conventional wisdom tells us that the cost of efforts to retain an existing customer is far less than acquiring a new one. As a result, the CR rate finds its place as a key business performance metric. But a focus on the retention rate is only half the story. To optimize CR efforts holistically, OEMs require an in-depth understanding of customers' behavior to define the most engaging customer experiences. As the data available today is vast and complex, OEMs need to expend more effort to uncover and convert valuable insights into retention-inducing strategies.

Analytics is not just mathematics

The meaning of analytics is often misconstrued as deriving insights by simply using mathematics and modeling. An appropriate analytics framework is critical to process data in such a way as to derive insights to serve its original purpose. Also, to gain actionable insights that are applicable to the real world, in-depth operational knowledge is vital.

At Deloitte, we drive value through our four wall breakthrough approach (see Figure 1), which makes analytics relevant to the real world and deliver more meaningful results.

Leveraging analytics to maximize CR

A customer's ownership journey is primarily divided into three stages: purchase, aftersales, and repurchase (Figure 2). Customers can leak out at any stage, depending on their experience. A detailed dissection of customer data at each touch point can provide valuable insights. For example, an analysis of the customer information database, at both OEMs and dealers, can reveal the inaccuracy or incompleteness of customer contact details. Combining this information with each customer's preference of contact methods can allow OEMs to identify possible causes of leakage and to design a strategic customer information management approach. Similarly, other aspects of retention such as engagement (driven by value chain services and products) and customer satisfaction (driven by experience) are required to be analyzed in totality to derive the overall possibility of retention.
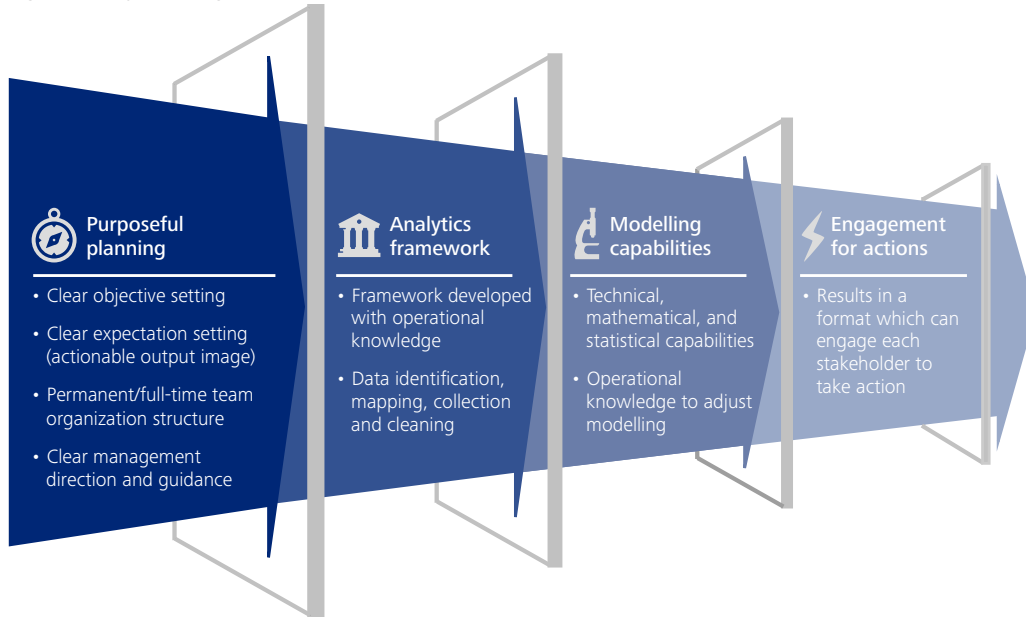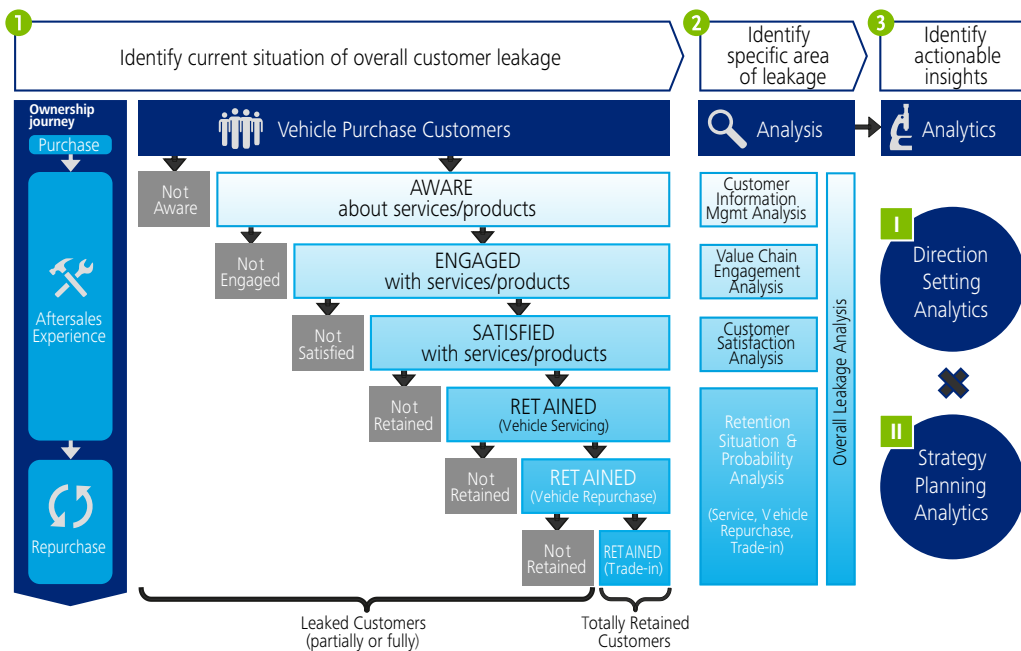
Figure 1: Key challenges

Purposeful planning
- Clear objective setting
- Clear expectation setting (actionable output image)
- Permanent/full-time team organization structure
- Clear management direction and guidance

Analytics framework
- Framework developed with operational knowledge
- Data identification, mapping, collection and cleaning

Modelling capabilities
- Technical, mathematical, and statistical capabilities
- Operational knowledge to adjust modelling

Engagement for actions
- Results in a format which can engage each stakeholder to take action

Figure 2: strategic customer retention framework and analytics

1 — Identify current situation of overall customer leakage

2 — Identify specific area of leakage

3 — Identify actionable insights

Ownership journey
- Purchase
- Aftersales Experience
- Repurchase

Vehicle Purchase Customers

Not Aware — AWARE about services/products

Not Engaged — ENGAGED with services/products

Not Satisfied — SATISFIED with services/products

Not Retained — RETAINED (Vehicle Servicing)

Not Retained — RETAINED (Vehicle Repurchase)

Not Retained — RETAINED (Trade-in)

Leaked Customers (partially or fully)

Totally Retained Customers

Analysis
- Customer Information Mgmt Analysis
- Value Chain Engagement Analysis
- Customer Satisfaction Analysis
- Retention Situation & Probability Analysis (Service, Vehicle Repurchase, Trade-in)

Overall Leakage Analysis

Analytics

I — Direction Setting Analytics

II — Strategy Planning Analytics

To retain customers and motivate them to make a fresh purchase, they must be satisfied at every type and every stage of contact with the brand. Analytics shows what needs to be done.

We divide analytics into two categories: Direction Setting and Strategy Planning — designed to derive actionable insights for CR enhancement in every customer leakage point (Figure 3).

Figure 3: Types of analytics
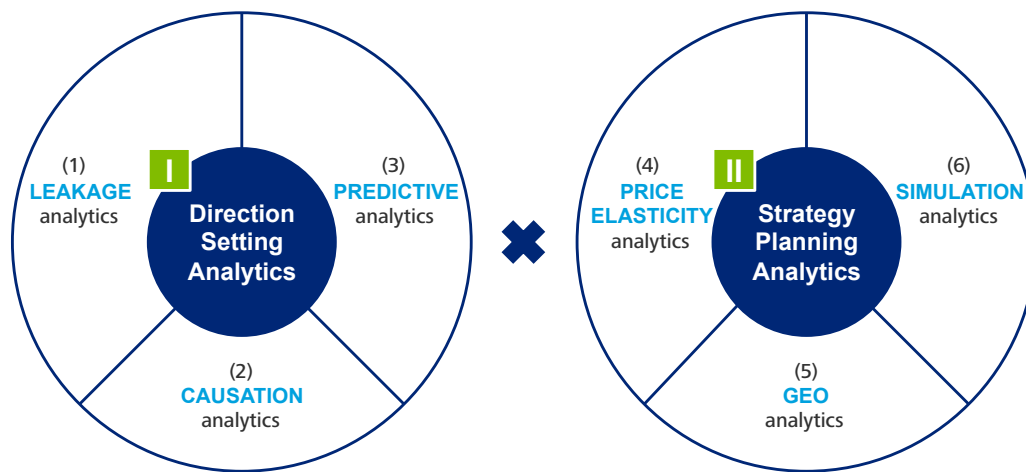
Direction Setting Analytics (DSA)

DSA aims to provide an in-depth understanding of the current situation, which can be utilized by OEMs to make concrete action plans. It has been categorized into three types of analytics: leakage, causation, and predictive.

Leakage analytics

The critical element in aftersales operations is understanding customer leakage from the perspective of *when*, *how much,* and *why*. While traditional analysis methods can provide an overall understanding of situation, it is difficult to derive concrete and specific actions to retain each customer segment. Leakage analytics aims to identify actual leakage patterns of various customers through the in-depth study of their individual behavior. This will lead to specific action plans for different customer segments. Such an exercise is almost impossible using traditional analysis methods alone, due to the complexity and size of the data.

Causation analytics

High leakage despite high customer satisfaction ratings is an ongoing conundrum for OEMs. Causation analytics identifies critical drivers for retention, which includes (but is not limited to) customer satisfaction. It provides a causation relationship between various factors/attributes

and customer retention. For example, it explains the impact of accident repair services on customer engagement, and ultimately on customer retention.

While this analytics is backed by mathematical modeling, its design hinges on operational insights to create actionable value.

Predictive analytics

The future can be staged by the threads of history and understanding of present. The historical data of each customer at all touch-points enables us to develop a model to define a predictive pattern that indicates how the individual will likely behave in the near future. For example, investigating the patterns of customer's aftersales behavior can help us draw insights on the expected behavior of customers in a certain ownership period. Likewise, it is also possible to estimate the probability of each customer purchasing certain items based on his/her given aftersales behavior. Predictive analytics can bring a paradigm shift in business planning to prepare for the immediate and long-term future (e.g., facility expansion, resource trainings, etc.).

Strategy Planning Analytics (SPA)

This aims to provide actionable insights for strategy planning. This analytics relates to the three most critical factors for CR (e.g., price, network, and value chain) through: price elasticity, geo mapping, and simulation.

Price elasticity analytics

Price elasticity analytics is an established methodology used to understand the optimal pricing range to realize the highest performance, whatever the target key performance indicators (KPIs) is (such as profit or revenue). However, application of price elasticity analytics in the CR field is uncommon to date. Price elasticity analytics of aftersales services can identify potential retention opportunities through different pricing strategies per ownership period, to optimize profit or revenue from the viewpoint of CR.

Geo mapping analytics

An effective network strategy is a result of carefully selecting macroeconomic and micro-level data, organized from a geographical perspective. This multi-dimensional data, combined with information on customer behavior, can enable dealerships to select appropriate network locations to enhance retention. Furthermore, incorporating historical data reveals high-level geo-economic trends and aftersales players' growth patterns, leading to the identification of suitable locations which translate to significant savings in time and manpower costs.

Simulation analytics

This is the final step in the action planning stage. Simulation analytics explains the business impact of CR initiatives in terms of dollars as well as number of customer retained. This is designed to engage all stakeholders to quickly simulate the impact of business actions on a simple and user-friendly visualization platform. With the continuous input of historical data, the accuracy of the tool output improves, leading to even more effective business planning insights.

Future of analytics in customer retention management

With the ever-increasing volume and variety of data, the significance of analytics in CR strategy will be the determining factor between players, with a far-reaching impact on the industry environment as a whole. While the arrival of connected technology in automotive is already seeing glimpse of what future has in offer, some advanced data analytics such as warranty analytics (automotive warranty accounts estimated $25 billion annually) should likely be utilized immediately to help reduce operation costs, while increasing customer satisfaction.

If OEMs are planning to build a leaner, more profitable, and data-driven business environment that chooses the right information for action planning, building in a solid analytics platform at each stage is certainly the way forward.

The question is how much are OEMs prepared?
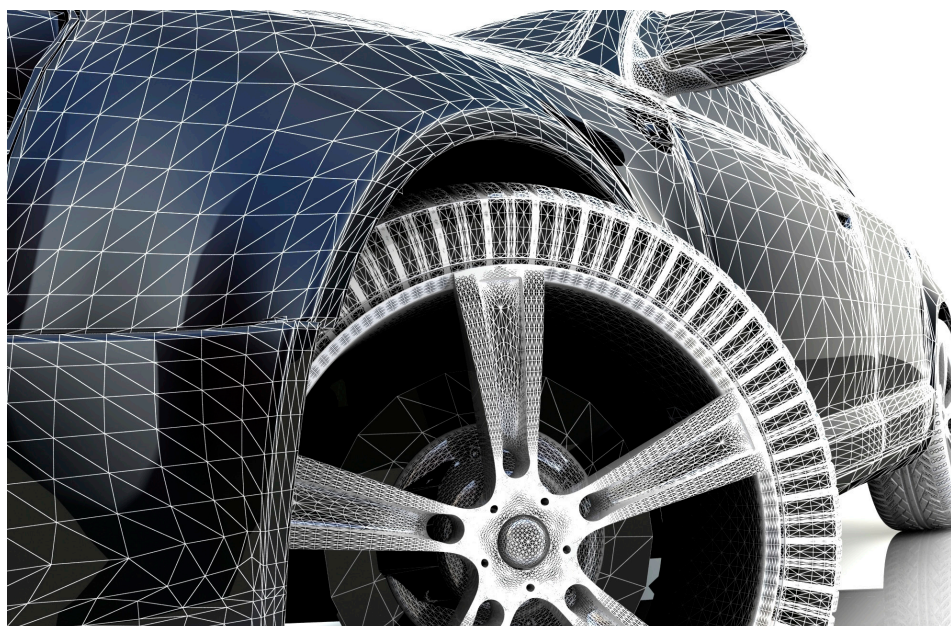
Marketing spend management through advanced analytics

Continuous analysis of the marketing mix permits an overview of cause and effect

Competition for consumers' attention is increasing among automakers. Today, there is not only competition among brands, but there is also increased competition with evolving transportation models that offset the need to actually own a vehicle. For OEMs, the importance of understanding current and potential customers' behaviors, desires, and preferences has never been more important. Those OEMs that are able to effectively manage their fixed and variable marketing spend and improve engagement have the opportunity to win with consumers that are interested in owning a vehicle, as well as those that love to drive yet see vehicles as costly and unaffordable. At stake for OEMs is improving marketing spend management to enable a reduction in fixed and variable marketing expenses. A 1 to 2 percent reduction in spend with the same or better yield could have a $1.5 billion to $3 billion margin impact for the global automotive OEMs.

Dynamic market conditions and increased planning complexity are forcing OEMs to seek ways to apply fixed and variable marketing budgets in more targeted and efficient ways. If they don't, the impact can be costly relative to opportunity lost. But investing in the time, resources, and tools to get it right can also be expensive, and infinitely more complex — particularly when marketing costs are at the core of OEMs' budgeting and planning process and involves many different functions.

Additional factors also contribute to the complexities OEMs face in enhancing how they apply their marketing budgets. Externally, globalization is driving demand worldwide, but consumers in the U.S., China, India, Europe, Brazil, and markets all over the world respond differently to various tactics. Competition amongst OEMs is increasing as they fight for brand strength, segment share, and profitable growth. Dynamic market conditions have also dramatically increased the complexity of marketing and sales planning, arguably bringing to an end any sense of stability relative to long-term forecasts.

Internally, many automakers lack the analytical rigor and closed-loop mechanisms necessary to evaluate program effectiveness. Increased planning complexity due to portfolio extension, market variability, additional sales channels, and lack of price transparency are challenges. Reactive sales incentives are usually in response to inaccurate planning forecasts which impact brand strength, residual values, and margins. Additionally, establishing reliable and integrated price/volume and marketing planning and execution processes are becoming increasingly difficult.

The authors: **Kevin Mercadante** is a senior manager with the Strategy & Operations Practice at Deloitte United States (Consulting LLP). **Dr. Marco H. Hecker** is the managing partner for Deloitte Consulting's Automotive practice at Deloitte China.

These factors contribute to OEMs' needs to have a deeper understanding of markets and customers, which can then be factored into marketing spend management and decision-making more effectively.

Making the case for marketing analytics in automotive

Globally, variable marketing/incentives spend is estimated to surpass $124 billion in 2014, and is expected to increase 22 percent by 2020[1]. Advertising spend, meanwhile, is also forecasted to exceed $50 billion globally across all OEMs and media types[2]. And because fixed marketing investments (FMI) like advertising, and variable marketing expenses (VME) such as special financing and lease deals, are two key elements in the automotive demand generation system, we believe the ability of OEMs to get advertising and incentives right has a measurable impact not only on sales performance, but also profitability.

In our experience, marketing analytics can help automakers answer key business questions, including:

- What criteria are used to determine models and configurations in need of VME support?
- What inputs (in addition to elasticities) should be used to determine type and level of incentive programs by model and configuration?
- How should incentives be designed to reinforce other demand generation strategies for a given model?
- What steps should be taken to ensure that incentives are being applied to only those configurations that need them?
- How is program effectiveness measured (e.g., sales objectives, profit targets, return on investment, others)?

[1] IHS Inc. Automotive Data, 2014; "U.S. auto sales predicted to top 16 million in 2014 — with profits," AutomotiveNews.com, 2013.

[2] Advertising Age estimates 2014

- What is the right mix of VME and FMI in order to drive profitable growth?
- What closed-loop mechanisms and tools exist to modify advertising and incentive programs? How should the ROI for these programs be measured?

Helping automakers take control of their marketing spend

In our experience, the use of a consistent set of metrics to guide incentive program development can help OEMs improve strategic planning and increase return on VME spend (e.g., higher sales, lower spend per sale, etc.). And critical to the strategic planning and performance management processes is ongoing marketing mix analytics (MMX) that identify and measure incentive programs that drive growth more efficiently.

MMX is designed to quantify the contribution of marketing activities on sales and volumetric trends. This is accomplished by evaluating sales, marketing, and macro trends over time using statistical modeling methods. Over the long-term and when fully implemented, MMX can then also be used to power scenario-based marketing planning, portfolio budget allocation, performance forecasting, and media optimization.

As a result, OEMs are able to drive accountability through apples-to-apples comparisons of all marketing and media efforts through a standard set of consistently applied performance metrics. Moreover, MMX can help quantify the impact of macro-environmental factors (e.g., weather, economics, etc.) beyond marketing to apply "fair credit" to marketing and other factors impacting sales. OEMs also recognize the benefits derived from a rigorous, data-driven method that drives strategic and tactical guidance into performance management; provides a guide for integrated marketing plans; enables portfolio management; and informs causal forecasting.

Of these benefits, we see accountability as the most significant because it guides performance management efforts by clearly identifying what activities drive sales growth — primarily by attributing marketing impacts to sales and sales change, as well as by measuring effectiveness of marketing spending. Benefits are then enhanced when utilizing these insights to actively drive scenario based planning and business forecasting efforts.

For automakers considering MMX, it is important to align techniques with the business needs and available data. Techniques can range from a high-level strategic analysis that measures overall effectiveness of overall fixed and variable marketing, to more granular optimization by marketing activity and model/configuration, to regional and dealer-level approaches that yield regional and market-level insights.

The role of automotive marketers is evolving

The increased availability of "Big Data" and the analytics afforded to automotive executives should continue to fundamentally evolve the role of automotive marketers to look more and more like their counterparts in industries like retail, telecom, and banking. What will emerge are essentially four core roles for marketers to consider as the look to enhance their marketing strategies and spend through analytics. Those roles include serving as a champion of the customer experience; being a steward for growth and innovation; acting as an architect of marketing capabilities; and driving efficient marketing operations and investment. We have seen clients realize significant value in applying each of these roles using analytics.

In one example where a client applied all four roles, the company realized a 15 percent increase in customer retention and a 7 percent increase in customer satisfaction by using analytics to champion the customer experience. That same organization then also realized an annual growth rate of 650 percent through the company's enhanced ability to drive innovation as a result of the insights gained from analytics. Revenue, volume and sales increased 100 percent, 20 percent, and 62 percent, respectively. And, finally, using analytics to optimize operations, marketing ROI increased 15 percent while agency savings increased 20 percent.

These same results are more than achievable for automotive companies that work to adopt and apply the same principles.

What does the future hold?

Automakers are playing catch-up when it comes to using analytics to gain insight into their customers and into effective management of marketing budgets. Industries like retail and banking have been doing it for years. Done right, analytic insights for automotive advertising and incentives management should provide model level decision support at the national, regional, and dealer market planning levels. At the national level, for example, insights derived from analytics can inform automakers what incentive tactics (e.g., rebates, financing, trade-in, etc.) have been most effective and when. At the local level, analytics can inform automakers of the impact of incentives on a specific model in a specific geographic area, and even a specific store. Combined, these insights — enabled by dashboards and planning tools — can help continuously monitor performance and guide smart activation, helping OEMs better manage planning and allocation decisions for future marketing spend.

The good news is that automakers can take lessons learned from these efforts outside of the industry. However, OEMs need to accelerate the pace at which they explore analytics and the pace at which they develop and implement required tools and methodologies, particularly MMX. Realizing double-digit growth and at the same time optimizing massive marketing budgets will not be possible without investments in analytics and improving market and customer insight.

Cracking the code for global supply chain management

Using data analytics to manage risk and drive growth

Powerful forces perhaps never before been seen in the global automotive industry are having a profound impact on automakers' ability to effectively manage their supply chains. Globalizing operations to take advantage of high-growth markets, driving innovation strategies that seek to optimize the manufacturing process, and managing regulatory environments around the world are only a few of the forces that are exerting immense pressure on automakers' supply chain management capabilities. Get it right and OEMs and suppliers have tremendous opportunity to gain a competitive advantage and drive growth. Get it wrong and automakers can quickly find themselves in difficult scenarios ranging from parts shortages, to intense government scrutiny, to lost growth opportunity.

The good news is that in the midst of these intense forces and complex challenges, vast quantities of data are being stockpiled that can help automakers crack the code on managing global supply chain risk. And as a result of recent product recalls, natural disasters, and supply chain shortages, many are now starting to take a closer look at the data they have at their fingertips to try and mitigate similar supply chain risks in the future. However, are automakers going far enough in their efforts?

A recent Deloitte study of automotive supplier executives conducted with the Original Equipment Suppliers Association (OESA) suggests not. While approximately two-thirds (67 percent) of the supplier respondents said their organizations have an explicit focus on managing risk, many indicated that risk management was more informal and placed a higher emphasis on situations and circumstances that have been identified as critical.

And when asked to identify those critical risk areas, those same suppliers identified the regulatory environment (the complexity of requirements to meet rules related to emissions, healthcare reform, fuel type/economy/mileage, geographical standards, etc.); scale (globalization and consolidation to capture new markets and improve profit margins); and product development (introducing new product lines using innovative manufacturing processes to meet consumer demand) as their top three areas of concern.

These findings begin to identify a potential paradox in how automakers are addressing supply chain risk. While risk management is important, it is being approached

The author: **Siddharth Patil** is head of the Analytics and Information Management practice for the Production segment at Deloitte United States (Deloitte Consulting LLP).

and managed in a way that is siloed and situational. Yet the areas identified by some automakers as the most concerning areas of risk all require strategic forethought and long-term planning if they are to be successful in both mitigating supply chain risk and managing risk for reward.

So how do automakers develop supply chains that are more resilient to risk? And, how can better management of big data through advanced analytics help automakers create effective supply chain risk methods that protect against and proactively sense risk?

Developing risk-resilient supply chains

Before delving into the characteristics of what defines a risk-resilient supply chain and what exceptional supply chain risk management processes look like, it's important to understand why automakers continue to see significant disruptions and surprises. In our experience, there are three contributing factors.

First, many companies are falling short in defining the strategic direction, governance, and oversight responsibilities of their organizations' supply chain risk management efforts. In many organizations ownership is unclear, visibility is often siloed and limited, executives and boards fail to provide proper oversight and strategic direction, and employees often lack the understanding and experience to deal with complex risk-related issues.

Second, visibility outside of the organization into Tier 2 and below suppliers is frequently limited.

And third, communication and reporting lacks connectivity across all key stakeholders in the supply chain, thereby negatively impacting constituents' ability to identify potential risks early on and limiting the ability to proactively

Advanced supply chain analytics is more than applying "old math" to existing problems. Instead, it applies new techniques and methods to ever-expanding data sets.

manage risk. The lack of communication tools are another factor — tools that not only link key stakeholders, but also to make sense of relevant data.

Deloitte's global Automotive practice has helped OEMs and suppliers worldwide tackle these challenges by helping develop approaches and methodologies that result in risk-resilient supply chains. In our experience, building resiliency requires a holistic and proactive approach that allows automakers to quickly pinpoint critical vulnerabilities.

Moreover, the best risk-resilient supply chain management programs also have capabilities that allow automakers to prioritize risks based on intensity, vulnerability, and node criticality, as well as aggregate and correlate key risks in a manner that allows management to quantify baseline exposure level.

Defining costs and benefits of potential resilience strategies that can enable the development of business cases for the best course of action is another critical characteristic of effective supply chain risk management, as is developing means to monitor supply chain resilience and manage emerging risks and vulnerabilities.

How can advanced supply chain analytics help?
Advanced supply chain analytics represents an operational shift away from management models built on responding to data. Emerging capabilities in this area introduces a proactive management model, equipping automakers with the ability to continually sense and respond as the industry changes around them. Moreover, advanced supply chain analytics can help automakers analyze increasingly larger sets of data using proven analytical and mathematical techniques, including regression analysis, stochastic modeling, and linear and non-linear optimization.

These methods and tools can allow automakers to identify patterns and correlations that may have been missed in the past, further enabling OEMs and suppliers to look at the business and the broader supply chain in new, previously unimagined ways.

Advanced supply chain analytics is increasingly providing opportunities for the global automotive industry to move from historical point-in-time snapshots to real-time data access that pushes analysis and visibility to stakeholders within an organization and across the supply chain. The concept of centralized data warehouses or one-off databases will likely become anomalous in a few short years.

One thing is certain, however, advanced analytics supply chain will likely increase by orders of magnitude as the number of individual data elements and records also increases. Focus will shift from internal cross-functional sharing of data to greater coordination and shared understanding of the data flows across value chain partners. Individual silos with the supply chain, suppliers, procurement, operations, sales, the customer and consumer will be torn down. Instead a single, broader supply chain will emerge — one that is better connected and more prepared to sense, react, and proactively manage supply chain risk.

The cost of status quo
For automakers, staying the course and keeping the status quo is not an option as supply chain complexity will continue to increase risk to OEMs and suppliers. In fact, a recent Deloitte survey of Chief Procurement Officers (CPOs) revealed that more than half (57 percent) felt supply chain risk had increased over the last 12 months due to natural and man-made disasters, and elongated value chains. Moreover, 45 percent identified risk associated with supply assurance as one area where risk has increased over the last year, partially driven by their views of higher risk stemming from increased levels of low-cost country sourcing and outsourcing.

For most automakers, the financial implications of supply chain disruptions, missed launch targets and ongoing operational inefficiencies are significant.

Based on our research, OEMs lost about $1 billion in shareholder value due to supply chain disruptions, and OEMs will continue to incur 2 to 2.5 percent in lost revenue as a result of warranty expense and untold customer dissatisfaction.

More troubling, however, is the fact that supply chain risk issues will flow deeper into the sub-tiers of the supply chain, where our research shows quality and excess inventory charges will continue to be the most significant drivers of supply chain risk and financial losses.

In our experience, those automakers that are able to effectively manage risk across multiple tiers of the supply chain will gain a competitive advantage and be better able to drive growth. Core to achieving those objectives is leveraging the vast amount of data automakers have available and applying advanced supply chain analytics to both mitigate supply chain risk and manage risk for reward.

Predictive quality analytics may help identify problems before they occur

Quality leadership is becoming more important for manufacturers in terms of cost and brand image

A quality management team within an automaker moves within a challenging sphere of tension between customer satisfaction and cost control. The good news is that predictive quality analytics capabilities available today allow quality issues to be detected and resolved very early on, thereby facilitating improved abilities for quality management teams to manage against both customer satisfaction and cost control concerns.

Innovation, variety, and increasing product complexity increase the potential for faulty products to be released into the market. In fact, a recent survey conducted by Deloitte Consulting LLP in the U.S. and OESA of North American automotive supplier executives revealed that 60 percent believe that the introduction of innovative products and new technologies significantly increases the potential for product recalls in the future. Increased use of modular building box systems and similar parts that suit multiple production lines also dramatically increases the overall risk in the event of a recall. On the customer side, aggressive sales initiatives often reduce profit margin, putting extra pressure on warranty costs (while also increasing customer demands and pressure from the competition).

In this ecosystem, not only are the winners and losers in the race for quality quickly identified through ratings and tests, the exchange of customer experiences shared via social networks also has the potential to affect, positively or negatively, the customers' ultimate purchasing decisions.

Given these dynamics on both the customer and cost side and what's at stake, it's understandable why quality leadership is a declared objective of many automakers. And because quality is so critical, automakers must be able to detect potential quality issues early on if they are to take a competitive advantage.

Forecasting recall responses

The good news for automakers is that predictive quality analytics offers a solution. Mature analytics systems can today process large quantities of data and offer various analysis methods, thus identifying potential faults in advance and providing opportunities to develop suitable counteractive repairs. For example, forecast models can help to identify the likelihood of a product recall within

The author: **Frank Siemes** is a director of Strategy & Operations at Deloitte Germany (Consulting GmbH), responsible for quality management and sales.

a specific timeframe. They can also predict the effect of certain demographic customer characteristics and associated customer behaviors in response to a recall.

Depending on the parameters flowing into the model, defects occurring immediately after purchase can be detected, as well as defects that might result in a warranty claim later on in the purchasing cycle. Analytics models also help identify part defects among suppliers in advance. With these possibilities of analysis, predictive quality analytics is particularly useful in the development of prototypes, supply chain optimization, and recall management.

The great significance of quality management among automakers is illustrated by recent product recalls. Increasing regulation is exacerbating the situation, and thanks to modern communication, such as social media channels, news of a recall spreads around the world in minutes. These factors increase the impact of automotive recalls. Apart from the high costs, automakers also pay a premium in the form of damage to their brand's reputation. As a result, it should be no surprise that leading manufacturers are investing large sums in recall management and applying analytics solutions in particular to protect their brand image.

Typically, the application of this principle begins with recording and evaluating the status quo. What databases are available and in what quality? How is the recall management process completed and how does the exchange of information work? This information allows manufacturers to analyze how advanced current recall management processes are compared to industry best practices. The next step consists of the formulation of an

analytics pilot in which the first models are produced and improved in an interactive analysis process. The methods and techniques that have proved themselves are then incorporated and utilized in the final analytics solution.

Combined evaluation techniques

A typical predictive quality analytics platform is constructed in several stages. On the data level, diverse data sources are consolidated and form the basis of evaluations. The analytics level allows various evaluation techniques such as text analyses, event time evaluations, or poisson regressions.

Text analyses process unstructured text data and forms words of similar meaning into clusters, allowing for quick identification of potential quality issues. Thus, a text analysis provides a clear picture of regularly recurring problems with quality. Event time analyses determine the expected "life" of a part. The system processes data on warrantees and translates them into graphs that show trends and departures from the normal expected life of a part.

In poisson regressions, too, data on warranties is analyzed. This processing technique shows the expected frequency of an event within a specific timeframe. For instance, how often a fault will occur with a certain part within the span of one year. A graphic representation in a U-chart can easily be read and displays critical deviations.

Here again, the models are able to integrate data sources on a broader level, and allow efficient data mining and user-friendly evaluations that, on the reporting level, can be converted to easily readable reports for end users and managers.

The above evaluation methods are only a few examples of the many possible techniques. Here, the "test phase" is used during an analytics pilot to determine which methods are to be applied to individual cases that are the most effective. The gradual introduction of evaluation, piloting and, finally, implementation will likely ensure that the right analysis methods are used and that they are continuously and suitably improved.

As in any new introduction, when implementing a predictive quality analytics system, it is necessary to pay

attention to the "buy in" process within the organization, while clearly communicating the advantages of the system. Moreover, the system user should have the opportunity to become connected with the analytics platform. Naturally, a system that functions flawlessly at the moment of its introduction and provides the expected results is a basic requirement for the implementation of any predictive analytics system. This can be guaranteed by gradual implementation and a test phase through an analytics pilot.

The most important features

The major features of a successful predictive quality analytics system are:

- **Data availability:** Internal data is gathered cross-functionally and made available to the users.

- **Data transparency:** The prevailing culture encourages a free exchange of information and data.

- **External data supplement internal data**, and are regularly updated and thus allow for more in-depth views.

- **Escalation mechanisms** are clearly defined in the event that data evaluations disclose potential quality issues.

- **Technologies and infrastructure** in the form of hardware and software support an efficient integration of data.

- **Visualization of information** helps identify the causes of potential problems with quality.

The introduction of such predictive quality analytics systems will dramatically alter recall management, leading to considerable increases in efficiencies, and result in massive savings in warranty costs. Once they have been detected, potential quality problems can be addressed early. Even a 1 percent reduction in the number of defects has a significant impact on warranty costs, in addition to intangible factors such as customer satisfaction and a better brand image.

What you don't know can hurt you

How automakers can enhance their recall readiness and management efforts

2014 was a record year for recalls with estimates topping 64 million vehicles in the U.S.[1]. 2015 has also already seen its fair share of recall announcements, demonstrating that the issue of product quality and recall management is not going away anytime soon — particularly as vehicle content becomes increasingly complex. As a result, automakers are under increased pressure to be quicker and more proactive in detecting and responding to product quality and safety issues. And — if a recall is required — regulators, customers, and other stakeholders are expecting automakers to more effectively manage the event. What do automakers need to do to meet their stakeholders' expectations? Where should they invest to develop predictive tools and processes that enhance proactive defect trend identification, recall readiness and management capabilities? Finally, are the tools and processes different for OEMs and suppliers?

The authors: **Neal Ganguli** is a director in Deloitte Consulting LLP's Strategy & Operations practice. He leads the automotive supply base and the Automotive Business Model Transformation group.
Rob Biskup is a director with Deloitte Advisory LLP and is among the leaders of Deloitte's Forensic Investigations group. Before joining Deloitte, he served as global head of compliance, assistant general counsel, and chief regulatory counsel for a major automotive company

In 2014, the automobile industry recalled a record 60+ million vehicles in the United States. One OEM reported spending more than $400 million dollars in warranty and recall expenses last year, which contributed to a near 40 percent decline in annual profit compared to the previous year. Moreover, researchers estimate that a major recall decreases an automaker's market share between 1.6 and 2.9 percent[2]. On the regulatory side, the National Highway Transportation Safety Administration (NHTSA) is implementing a new business intelligence platform to identify potential vehicle issues industry-wide, and is working to grow its staff of investigators. These are just a few indicators that clearly demonstrate that automakers are under a great deal of pressure from shareholders, regulators, and consumers to evolve their product quality, safety and recall management capabilities.

Developing the most effective tools and processes is often a complex endeavor that frequently differs for OEMs and suppliers. Despite these differences, however, our experience in helping OEMs and suppliers tackle this issue suggests that consistent elements of effective product quality, safety and recall management tools and processes must include capabilities that:

- Proactively identify, prioritize, and investigate potential product quality and safety issues
- Effectively manage product investigations and recalls
- Leverage data science and advanced analytics across the recall process
- Drive enhanced tracking and visibility
- Promote improved data management, governance, and communication

Moreover, these capabilities must be linked across multiple skill teams within an organization and, in the best scenarios, linked across multiple stakeholders within the automotive ecosystem (OEMs, dealer technicians, fleet operators, Tier 1 and sub-tier suppliers, etc.).

Leading capabilities must span the enterprise

In our experience, leading capabilities spanning process improvement, operational strategy, advanced analytics and visualization, and finance can enable automakers to better manage quality and safety issues and recalls. A four-part framework is foundational to ensuring leading capabilities are linked and that processes are consistently applied across the enterprise and broader ecosystem (Figure 1).

Organization and governance: Key elements include ensuring organizational alignment, controls and reviews, and cultural enhancements that can improve capabilities. Additional benefits include the establishment of recurring audit of recall management processes and performance; optimized resource deployment and planning; and the development of human asset management strategies for the recruitment, retention, engagement, and development of talent.

Data and information management: Establishes a centralized data repository for all relevant vehicle quality and safety data sources (unstructured and structured), field performance, warranty claims, repair and other data, from within and outside the OEM/Supplier companies, and enables automated reporting capability for vehicle investigation documentation and review. Effective data and information management also enables parts three and four of the framework by creating an operational data store that supports advanced analytics.
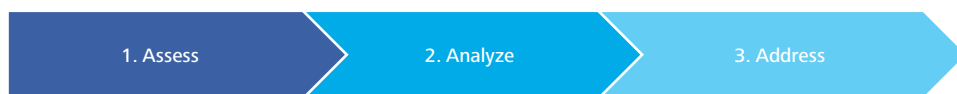
[1] "Cars recalled in U.S. reached 64 million in 2014, NHTSA says," Automotive News, February 12, 2015, http://www.autonews.com/article/20150212/OEM11/150219914/cars-recalled-in-u-s-reached-64-million-in-2014-nhtsa-says

[2] "The Liability of Good Reputation: A Study of Product Recalls in the U.S. Automobile Industry," ResearchGate, February 2006, http://www.researchgate.net/publication/262256809_The_Liability_of_Good_Reputation_A_Study_of_Product_Recalls_in_the_U.S._Automobile_Industry

Figure 1: Four-part quality, safety, and recall management framework

| 1. Organization and governance | 2. Data and information management | 3. Proactive sensing | 4. Visbility and tracking |

Figure 2: Key assessment areas

| 1. Assess | 2. Analyze | 3. Address |

Proactive sensing: Arguably the most important element of our four-framework, proactive sensing using advanced analytics is critical to anticipating and properly managing future recall events. With organizational and governance, and data and information management capabilities in place, proactive sensing enables early issue sensing and early defect trend identification. Risk scores can also be assigned to potential issues for workload prioritization and escalation, as well as provide consolidated, cross-correlated data to support issue monitoring, investigation and research, and determination of root cause.

Visibility and tracking: Effective visibility and tracking tools like Management Dashboards, advanced visualization techniques and so on, can enable the delivery of a consolidated, end-to-end view of all open and recently closed product issues, investigations, and field campaigns to track status, progress, and documentation. Tracking of process performance and resource loading via defined metrics and historical data trends is also enabled, in addition to a repeatable process that can provide competitive insights to identify issues related to shared suppliers, parts, and technologies across the automotive supply chain.

Start with a maturity assessment
Before implementing the recall management framework, we recommend automakers assess their own organizational processes and capabilities related to quality, safety and recall management in order to benchmark where they stand. The objectives of such an assessment include:

- Performing a review of processes and capabilities related to product investigations and recalls and benchmark against industry leading practices
- Identifying opportunities to strengthen the investigation and recall management process
- Recommending and strategizing process and capability improvements
- Piloting select capabilities to strengthen recall management practices

In our experience, the most effective approach to a comprehensive assessment covers three key areas (Figure 2).

Assess: Here we recommend automakers conduct recall management process reviews and stakeholder interviews. Automakers should also evaluate governance, controls, and communications processes, plot maturity on a lagging-to-leading spectrum, and document relevant rationale and observations.

Analyze: We recommend automakers plot an industry leading maturity across the full range of process elements on a lagging-leading spectrum and document best

A recent study conducted by Deloitte and the Automotive Industry Action Group reveals that OEMs and suppliers alike rank Problem Solving Capability and Loss of Experience, particularly as it relates to root cause analysis, among their top concerns and challenges in improving quality over the next five to 10 years. For more information on this study, visit www.deloitte.com/us/automotive.

practices, and then perform gap analysis to understand where there are process and capability gaps. Doing so allows OEMs and suppliers to identify and prioritize process and capability parameters to address.

Address: Finally, we recommend devising appropriate strategies and actions for making improvements. Activities would include design of pilot solutions to address key gaps and do so in collaboration with business and IT, if applicable. In this phase, automakers should also consider defining broader enablement plans for enterprise-wide, organizational implementation of tested and proven pilot solutions.
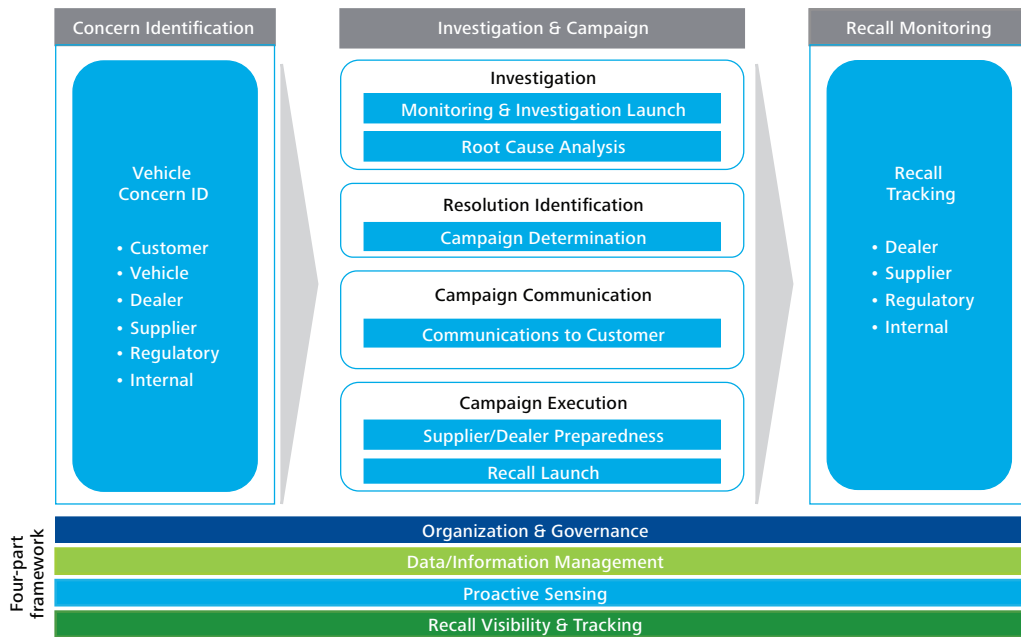
When complete, an assessment will help inform the development and implementation of a comprehensive recall management process that is founded on the four-part framework and engages a number of stakeholders across the automotive ecosystem (Figure 3).

Recall readiness and management differs for suppliers
A Deloitte Consulting LLP survey[3] of Original Equipment Supplier Association (OESA) members exploring the impact of recalls suggests a lack of recall readiness is also prevalent amongst some suppliers. According to the survey, 60 percent of respondents felt that the introduction of innovative products and technologies significantly increases the potential for recalls in the future. Moreover, 94 percent responding felt that new suppliers gaining entry to the industry, as a result of a new technology or product innovation, are not adequately prepared to respond to product recalls. When it comes to communicating across the value chain, only 9 percent felt the communications channels between Tier 1 and sub-tier suppliers are highly effective in

[3] Deloitte Survey, "Exploring the impact of recalls in the automotive industry, 2014.

Figure 3: Recall management process

Concern Identification	Investigation & Campaign	Recall Monitoring
Vehicle Concern ID • Customer • Vehicle • Dealer • Supplier • Regulatory • Internal	**Investigation** Monitoring & Investigation Launch Root Cause Analysis **Resolution Identification** Campaign Determination **Campaign Communication** Communications to Customer **Campaign Execution** Supplier/Dealer Preparedness Recall Launch	**Recall Tracking** • Dealer • Supplier • Regulatory • Internal

Four-part framework

| Organization & Governance |
| Data/Information Management |
| Proactive Sensing |
| Recall Visibility & Tracking |

preventing and/or earlier identifying recall situations, while 39 percent felt the channels of communication between OEMs and suppliers were ineffective to preventing and/or earlier identifying recall situations.

These are noteworthy numbers — particularly with leading edge technologies in vehicles changing dramatically (e.g., electronics, connectivity, and autonomous vehicles). According to one supplier responding to another survey conducted by Deloitte Consulting LLP and the Automotive Industry Action Group (AIAG), "Advances in technology are outpacing the tools we have to monitor and provide quality control testing in these relatively new areas. Product development will still be one of the main issues in 2020 due to the advances in technology and OEMs trying to 'keep the pace' when implementing innovations."

In our experience, an effective recall readiness and management framework for suppliers is slightly different than the OEM framework, yet does includes elements that still comprise operational discipline and readiness, governance and strategic risk management, and proactive sensing capabilities.

- **Operational discipline and readiness** — From an operational perspective, effective recall readiness and management tools and processes should enhance visibility across the sub-tier supply base. Design responsibilities throughout the product development ecosystem, such as in-production engineering changes, need to be clearly defined and documented, and should be supported by systems and processes that monitor manufacturing quality, optimize product launch sequencing, and trace parts application and performance data throughout their life cycle.

- **Governance and strategic risk management** — Taking a governance view, risk management involves senior executives driving capabilities to ensure readiness to prompt effective and timely decision making, and implementing processes proactively testing the system; such as, recall risk readiness workshops and third party audits.

Comprehensive risk management plans can also help mitigate financial and customer risk, support regulatory compliance, manage and monitor third-party contracting, and improve supplier and customer interaction. Through proactive development of an approach to strategic risk management, suppliers can also gain from the identification of risk exposures *before* events occur, as well as develop and test crisis management plans in advance.

- **Proactive sensing** — Today, many suppliers likely have processes and tools in place that support broader operations and risk management initiatives. Risk assessment and audit reports, such as balanced category scorecards, can help mitigate and proactively sense risk. However, in our experience many suppliers have limited proactive sensing capabilities. Moreover, it could be argued that any approach to recall readiness and management would fall short without all three pieces of the framework in place.

  Suppliers interested in implementing world-class recall readiness and management programs should ensure they include strong predictive analytics capabilities that allow for the aggregation, translation, and management of volumes of data. Doing so can help spot defects sooner, and cap earlier a supplier's potential financial exposure to field campaigns.

Conclusion

Our experience helping OEMs and suppliers tackle these important issues, along with the results of our research with OESA and AIAG, illustrate that one thing is certain — as vehicle complexity continues to increase, so does the potential for safety, and quality issues. Automakers should be asking themselves whether they are doing all they can *today* to proactively monitor for potential issues, establish rigorous processes and controls, and develop capabilities to effectively manage through recalls and other field campaigns that will remain an industry fact of life for the foreseeable future.

Contacts

Authors

Nicolai Andersen
Head of Innovation
Deloitte Germany
nandersen@deloitte.de

Ashwin Patil
Director
Analytics and Information Management Practice
Deloitte United States
(Deloitte Consulting LLP)
ashpatil@deloitte.com

Sharad Mohan Mishra
Senior Manager
Strategy and Operations
Deloitte Japan
sharmishra@tohmatsu.co.jp

Masanobu Kurihara
Manager
Strategy and Operations
Deloitte Japan
makurihara@tohmatsu.co.jp

Kevin Mercadante
Senior Manager
Deloitte United States
(Deloitte Consulting LLP)
kmercadante@deloitte.com

Dr. Marco H. Hecker
Automotive Consulting Leader
Deloitte China
mhecker@deloitte.com.cn

Siddharth Patil
Senior Manager
Deloitte United States
(Deloitte Consulting LLP)
sipatil@deloitte.com

Frank Siemes
Director
Deloitte Germany
fsiemes@deloitte.de

Neal Ganguli
Director
Strategy and Operations
Deloitte United States
(Deloitte Consulting LLP)
nganguli@deloitte.com

Rob Biskup
Director
Forensic Investigations
Deloitte United States
(Deloitte Advisory LLP)
rbiskup@deloitte.com

Automotive leadership

Craig A. Giffi
Vice Chairman & U.S. Automotive Industry Leader
Deloitte LLP
cgiffi@deloitte.com

Joe Vitale
Global Automotive Industry Leader
Deloitte Touche Tohmatsu Limited
jvitale@deloitte.com

Bruce Brown
U.S. Automotive and Off-Highway Consulting Leader
Deloitte Consulting LLP
brubrown@deloitte.com

Chuck Ciuni
U.S. Automotive Supplier Practice Leader
Deloitte Tax LLP
cciuni@deloitte.com

Jeff Glueck
Customer Experience Practice Leader
Deloitte Consulting LLP
jglueck@deloitte.com

Steve Schmith
U.S. Automotive Marketing Leader
Deloitte Services LP
sschmith@deloitte.com