



Disruption in the automotive industry Implementing advanced analytics

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Foreword

I am pleased to share with you this report on the opportunities for using advanced analytics in the automotive industry, and the strategies and investments required to become an insight-driven organisation.

The automotive industry, and in particular the original equipment manufacturer (OEM), is under increasing pressure from alternatively-fuelled vehicles, disruptive technology, increased competition and changing consumer behaviour that are transforming the automotive landscape.

OEMs struggle for growth and many fight hard to maintain market share and profitability. The speed and scale of social, political and technological change make it difficult to stay relevant to consumers and competitive in the market. As a result, OEMs are being forced to re-examine their entire business models, invest heavily in technology and refine their operations.

Automotive companies are relying increasingly on analytics to improve efficiency and profitability, and deliver competitive advantage. Across the entire automotive value chain, the use of advanced analytics to make sense of data, drive insights and automate decision making is adding value in terms of driving operating margin, revenue growth and asset efficiency.

Without existing capabilities in place and previous successes to look back on, some OEMs struggle to exploit the potential of advanced analytics. However, we believe that strategic planning and smart investments can overcome barriers to their use.

To support a business case for advanced analytics, this report argues the need for use case identification and prioritisation, based on clearly defined challenges with tangible business outcomes. This report identifies over 30 such use cases, exploring three in detail. One identifies potential annual savings for OEMs of £150 million to £200 million through the use of AI to reduce warranty claims.

I hope you find this report insightful and thought-provoking, and welcome your comments.



Mike Woodward
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Executive summary

There has been a step-change in analytics capabilities over the last decade. In addition to descriptive analytics, commonly used for business intelligence and reporting of what has happened in the past, we are now seeing the emergence of advanced analytics in the form of diagnostic (explaining what happened in the past), predictive (what will happen in the future) and prescriptive analytics (finding the best course of action), which allow businesses to increase the scope of their data analysis and improve decision making.

The use of AI and advanced analytics has the potential to transform the automotive industry. In an era of unprecedented change, it can be used as a tool to drive operating margin, revenue growth and asset efficiency, and enable OEMs to remain competitive.

To build a sustainable capability, it is advisable to start by creating pilots or 'minimum viable products' with business questions that share the following characteristics:

High perceived business value

- aligns to and supports corporate goals and objectives
- clear articulation of the value driver(s): Revenue growth, operating margin, asset efficiency or market expectations.

Low risk to complete

- executive sponsorship
- data availability
- a clear performance benchmark.

In this report, we identify three high-value use cases that are based on clearly defined challenges with tangible business outcomes. For each use case, we identify the business challenge and the value it can create, and the analytical approach needed to build and effectively deploy the solution.

Organisations throughout the automotive industry are looking at how best to invest in and exploit these opportunities. But investment is no guarantee of success. An OEM should create an environment where talent can thrive and build its analytics capability around five dimensions: strategy, people, process, data and technology. To fully exploit the opportunity, organisations should first consider strategy – that is, what business questions and challenges do you need to focus on and why?

Finally, this report identifies key factors in delivering a successful project and suggests viable next steps for organisations regardless of their existing analytics capabilities.

In this report, we identify three high-value use cases that are based on clearly defined challenges with tangible business outcomes.

Analytics explained

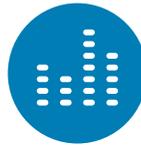
The rapid move towards connected, autonomous, shared and electric (CASE) strategies throughout the automotive industry is creating a dynamic set of challenges for original equipment manufacturers (OEMs) and their suppliers. In order to stay relevant to consumers and competitive in the market, OEMs are being forced to re-examine their business models and identify new strategies for growth, make long-term investments in technology, and refine their operations. In the light of such major change, automotive companies are relying increasingly on advanced analytics.

The ability of OEMs to use analytics is made possible by the continuous stream of data generated within the industry. New data is being created every day – an individual vehicle creates and shares data on geolocation, performance, driver behaviour, and biometrics, and technology associated with the internet of things (IoT) provides continuous feedback from equipment on the factory floor.

However, OEMs making investment in analytics need to understand the breadth and depth of solutions available to them. After all, not all analytics are equal – there is a big difference in the value of knowledge generated from historical sales data compared to the information derived from real time telematics.

With this in mind, analytics can be divided into two groups: business intelligence and advanced analytics.

- **Business intelligence (BI)** is an umbrella term for the applications, infrastructure, tools and best practices that enable access to and analysis of data to improve and optimise decisions and performance. The analysis is usually **descriptive** in nature.
- **Advanced analytics** is the semi-autonomous or autonomous analysis of data or content using advanced techniques and tools. There are three types: diagnostic, predictive and prescriptive analytics.



Diagnostic analytics examines data or content to answer the question “Why did it happen?” Examples of techniques are drill-down, data discovery, data mining and correlations.



Predictive analytics generally makes a claim about future events: “What will happen?” Predictive analytics is based on assumptions about past trends continuing into the future. Techniques include statistical modelling, machine learning, regression and classification.



Prescriptive analytics examines data or content to answer the question “What should be done?” Techniques of analysis include simulation, complex event processing, recommendation engines, heuristics and machine learning.

Advanced analytics offers OEMs many ways to improve their operations, develop new offerings, and provide better customer service at a lower cost.

In the business world, both BI and advanced analytics use data to inform decisions, which in turn influence actions. As shown in Figure 1, the development of prescriptive analytics in the form of AI has reduced the need for human intervention between data and action, speeding up the decision-making process and eliminating the potential for error.

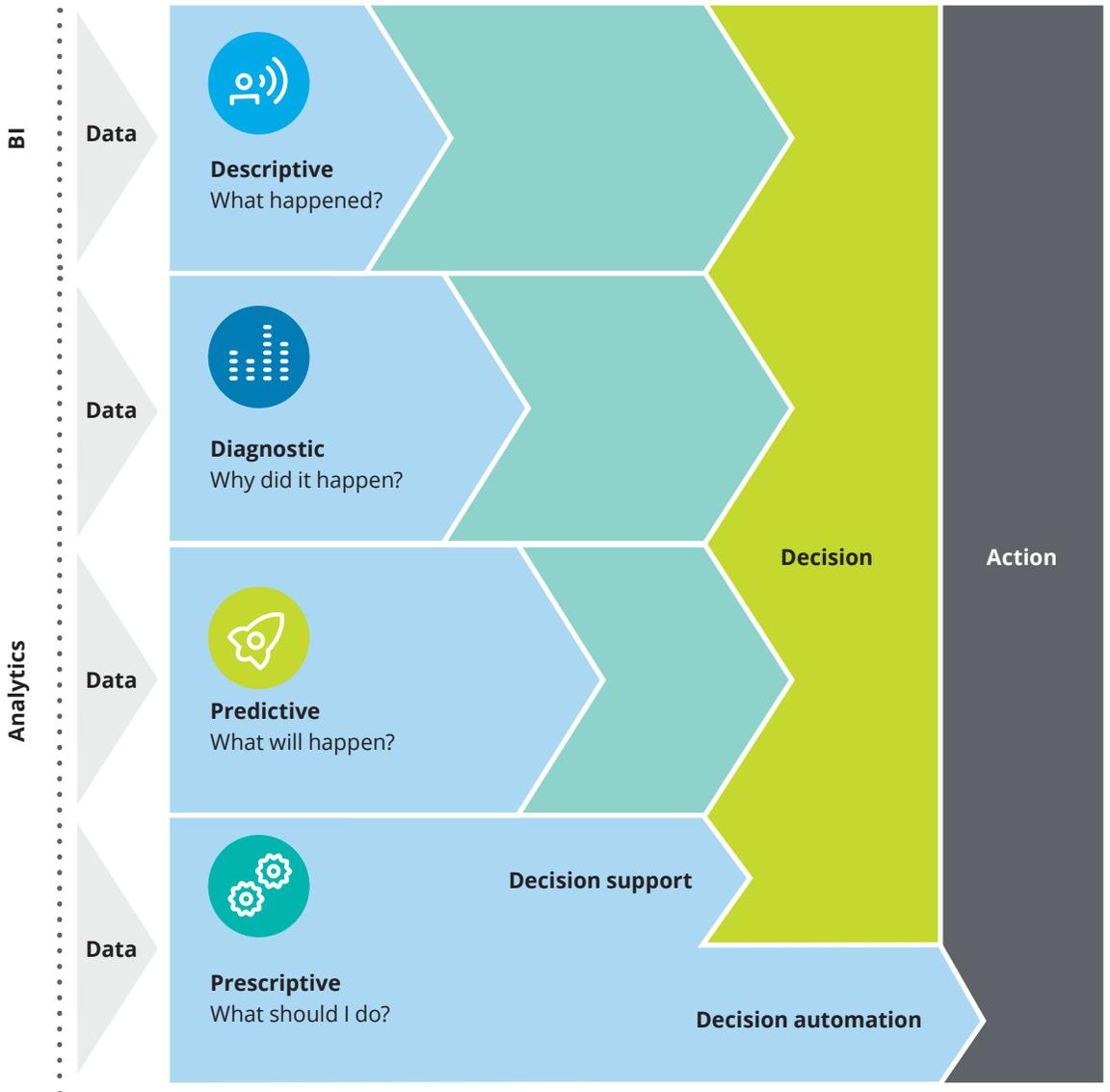
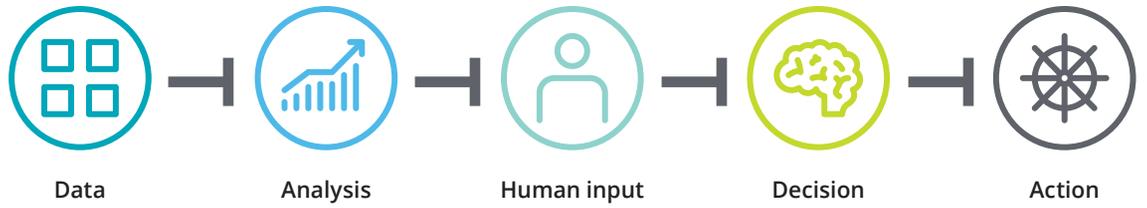
Used in the right way, descriptive, diagnostic, predictive and prescriptive analysis can all be used by businesses to drive better decision-making. However, the ability of prescriptive analytics to reduce the time required to take action by offering decision support, or even automate decision-making for example in customer service and or marketing communications, makes it an incredibly powerful tool for businesses.

Laying the foundations

Getting the basics right can have a major impact on an organisation. Whilst there are significant opportunities in advanced forms of analytics, our experience tells us that many organisations face challenges in producing trusted, automated and targeted BI. Investment in BI can lead to saved time and more efficient decision-making, whilst also building the foundational skills and capability required for more advanced use cases.

Advanced analytics offer OEMs many ways to improve their operations, develop new offerings, and provide better customer service at a lower cost. As such, it can potentially strengthen an organisation's competitive advantage in the marketplace. In the next section, we explore how advanced analytics is being put to use across the automotive value chain.

Figure 1. The four analytics capabilities



Source: adapted from Gartner (2017)¹

Opportunities for analytics in automotive

Below are 31 examples of advanced analytics applications that automotive companies are prioritising, with examples from across the entire value chain grouped by the primary form of advanced analytics that are in use.

Key: where in the value chain does this use case sit?

 Strategy & R&D

 Supply chain

 Production

 Distribution

 Retail

 Sales & marketing

 Aftersales

1 Performance management
 Monitor aftersales performance across channels (e.g. body shop, workshop) to diagnose and improve performance

2 Stock loss / scrap analytics
 Understand impact of stock loss and scrap on total delivered cost to make the appropriate cost reduction plan per part

3 Pack loss monitoring
 Track every pack movement in order to investigate and reduce pack losses

4 Countermeasure tracking
 Monitor the status of countermeasures to ensure quality issues are being addressed effectively and on time

5 Network management
 Monitor dealer network performance to inform investment and intervention decisions and improve overall network health

6 Product concept intelligence
 Capture customer feedback on new concepts to inform design of next generation vehicles

7 Purchase management tool
 Capture, manage and track purchase performance and forecasts to identify cost reduction opportunities

8 Vehicle design trends
 Analyse market trends by segment to identify opportunities to differentiate next generation vehicles

9 Brand health tracker
 Track customer opinion over time to ensure overall brand health

10 Satisfaction diagnostics
 Monitor the drivers of customer satisfaction in order to pull the right levers to improve customer relationships

11 Vehicle health check
 Monitor customer vehicle service and claims history to target customer-relationship management activity (e.g. future or on-site service recommendations)

12 Residual value
 Gain visibility of and monitor residual value across the market

13 Incentive ROI calculator
 Predict impact of incentive spend on sales volume to inform investment and drive demand

14 Market opportunity modeller
 Predict potential performance of new and existing dealerships to locate opportunities in the market



Descriptive



Predictive



Prescriptive

15 Portfolio optimisation
 Predict uptake of options and accessories on new vehicle sales to optimise pricing / portfolio mix

16 Quality AI
 Use self-learning techniques on high-lead innovative data sources to predict emerging quality concerns, their root cause and appropriate countermeasures

17 Supply chain management
 Predict and manage against the impact of macro-economic and geographic incidents

18 Demand management
 Predict the impact of macro-economic and geographic incidents on customer demand to improve plant flexibility

19 Post-launch quality analytics
 Identify the root-cause of in-market quality issues with social media analytics to reduce their reoccurrence in future models

20 Downtime diagnostics
 Predict downtime of production processes in order to reduce defects and improve operational efficiency

21 CO2 simulation tool
 Simulate emissions from future sales to find the right balance between improving profit and meeting regulatory requirements

22 Vehicle loading optimisation
 Identify the optimal outbound scheduling based on customer demand to improve on time delivery and cost efficiency

23 Pack optimisation
 Understand optimum ratio of pack to part to reduce stock volume and thereby total delivered cost

24 Truck fill optimisation
 Identify the optimal inbound truck fill mix (e.g. suppliers, parts) based on customer demand to improve on time delivery

25 Customer journey optimiser
 Track customers through their journey to address bottlenecks, ensure consistent experience, and improve conversion rates

26 Transport optimisation
 Identify the optimal transport route and mode based on potential disruption to improve on time delivery and cost efficiency

27 Inventory optimisation
 Predict and manage against the impact of macro-economic and geographic incidents

28 Offer personalisation
 Know more about potential customers to personalise their retail experience (e.g. incentive, financial scheme, options), increasing conversion rates and customer value

29 Inventory diagnostics
 Monitor bill of materials requirements in order to minimise inventory volume and optimise fit point placement

30 Marketing ROI calculator
 Identify the optimal used car / trade-in offer for customers that maximises chances of upsell and minimises margin erosion

31 Used car pricing tool
 Identify the optimal used car / trade-in offer for customers that maximises chances of upsell and minimises margin erosion



Analytics in action

We have identified three high impact and relatively low-complexity real-world use cases that demonstrate the ability of diagnostic, predictive and prescriptive analytics to make an impact in the automotive industry.

Use case one

Improving ROI from marketing spend to improve sales volume and margin



Descriptive



Predictive



Sales and marketing

Competition in the automotive industry is fiercer than ever. As well as traditional rivals, OEMs now find themselves competing against a large number of new entrants such as mobility start-ups and large technology companies among others. As a result, growing or retaining brand value is an increasing challenge. Given the importance of brand equity, OEMs can gain an advantage if they are able to manage their marketing spend (fixed and variable) effectively, optimise the allocation of spend and maximise ROI.

Marketing spend is a core item in an OEM's budget and it is not surprising that OEMs are looking to optimise this spend better.

In order to achieve an advantage over their competitors, OEMs are investing in analytics to help guide and support their marketing. OEMs investing in the tools, time and resources to ensure efficiency of marketing spend are realising a huge opportunity. For example, a one to two per cent reduction in marketing spend with no drop in ROI could have a £1.2 billion to £2.3 billion margin impact for global automotive OEMs.

How can analytics provide support?

A combination of descriptive and predictive analytics can be used to support an OEM's marketing activity and spend. In our experience, OEMs can implement descriptive analytics to achieve 'quick wins' which are easy to deliver and can help OEMs answer key business questions, such as:

- What models (and variants), regions and channels are in need of variable marketing support?
- How effective are each of the specific tactics and offers (such as trade-in deals) across each model, region and channel?
- Among models (and variants), regions and channels that share similar characteristics, where does the rate of variable marketing spend differ, and by how much?

With effective descriptive analytics in place, automotive companies can then implement predictive analytics to forecast demand given specific spending activity in a brand/market/channel and prescribe an optimal budget allocation across the whole system. This supports questions such as:

- What are the causal factors (other than elasticity) for predicting sales volume, given marketing spend?
- What is the optimal total marketing budget?
- What is the right mix of variable marketing expenditure and fixed marketing investment (by model, region and channel) that will drive the most profitable growth?

What is the impact?

Global marketing spend in the automotive sector was estimated to be around £115 billion in 2018, with growth of one to two per cent predicted over the next five years.² Variable marketing spend accounts for two thirds of total marketing spend (£80 billion) with the remainder allocated to fixed spending including digital channels. Allocating this spend to areas that will have the greatest ROI will have a measurable impact on sales performance and profitability.

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Use case two

Diagnosing root causes to reduce production downtime



Diagnostic



Predictive



Manufacturing

With their operations becoming increasingly complex, manufacturers can often suffer large amounts of downtime throughout their production lines due to breakdowns, defects and other holdups in the process. Due to the impact of downtime on overall operational efficiency, it is important to find ways of mitigating the problems and lessening the impact. A method commonly used by manufacturers is diagnostic analysis that looks back on historical downtime events in order to identify and analyse reoccurring issues.

However, there are problems with this approach. For example, sometimes historical downtime cannot be explained given the evidence available. A lack of sensors, missing data and complex processes combined with pressure to get operations functioning again can all result in a poor or non-existent diagnosis.

It is not unreasonable to suppose that reductions in downtime might result in an increase in output capacity of between two and four per cent each year.

How can analytics provide support?

Diagnostic analysis is already commonly used in the industry to understand issues relating to factory/production downtime. However, the accuracy of this analysis can be improved and a combination of diagnostic and predictive analysis can lead to greater efficiencies.

It is important to understand what is causing the downtime and then implement measures to reduce the problem, and this can be done using diagnostic analysis. On a production line, downtime could arise from breakdowns, defects or holdups in areas such as:

- machinery, such as a car sling, conveyor belts or robotics
- measurements such as torque failure, pressures, temperatures
- model variants, components
- methods or materials used
- manual processes, shifts, staff members.

Data is typically available on all of these processes and technologies. Even older technology can have sensors retro-fitted to provide the required data for analysis. A diagnostic solution can be used to interrogate the data and identify drivers of downtime, production defects and production line inefficiencies.

Successful diagnostic solutions often begin with implementation in just one part of the production line. Identifying a simple but high value process, such as axle fitting, can create a success story that subsequently encourages scaling across similar processes along the production line and across other plants. This enables more learning to be obtained from larger data volumes and process configurations, before scaling on a wider basis.

Having identified the drivers of downtime, predictive analytics can predict downtime and defect generation, so that countermeasures can be actioned proactively rather than reactively.

What is the impact?

Ultimately, by diagnosing causes of production downtime manufacturers can reduce operating costs and increase production capacity by:

- reducing downtime of production line processes through identification of asset anomalies, process patterns, unusual events and predicting asset failure as well as defect generation
- reducing planned maintenance times by removing manual condition inspections and reducing the number of hours spent on both scheduled and unscheduled maintenance hours
- improving overall operational efficiency through generating actionable alerts.

It is not unreasonable to suppose that reductions in downtime might result in an increase in output capacity of between two and four per cent each year.

Use case three

Reducing warranty costs



Predictive



Prescriptive



Aftersales

With an abundance of choice across all classes of car, consumers are increasingly demanding. As a result, OEMs focus on build quality and the amount spent on after-sales warranty claims. We estimate that market-leading OEMs typically incur between one and two per cent of total annual revenue on warranty costs. This means that the total estimated cost of warranties for the ten largest OEMs globally (by revenue) is £13-25 billion worldwide.³ Improving the overall quality of vehicles that go to market not only improves brand perception but also directly impacts profits and the balance sheet by reducing the costs of warranty claims.

Warranty claims are the result of vehicles being delivered that exhibit quality to a lower standard than is expected by customers. Unfortunately for OEMs, quality issues are often the result of design or manufacturing processes and are rarely isolated to individual vehicles. As a result, when a new model is launched, it is crucially important to implement successful countermeasures to overcome 'sunk' quality concerns and issues. By reducing the time taken to identify and implement a successful countermeasure, fewer defective vehicles will be delivered, resulting in lower warranty costs.

Implementing advanced analytics can reduce warranty costs by 15 to 20 per cent. For a large OEM group, this could mean savings of up to £200 million per year.

How can analytics provide support?

The process used to identify problems and implement countermeasures is just as important as the countermeasures themselves. In order to identify the need for countermeasures and then optimise their implementation, OEMs are increasingly reliant on analytics.

Analytics can be used across three areas to improve delivery:



Categorisation

Using AI techniques to categorise quality concerns quickly and accurately.

Prioritisation

Using predictive analytics to create a prioritisation funnel for warranty claims.

Effectiveness

Using prescriptive analytics to manage existing countermeasures.

To make the most of prescriptive analytics capabilities to reduce warranty claims, manufacturers should make use of AI, and in particular machine learning and deep-learning neural networks.

Focus on categorisation

One way of reducing the time to identify and implement countermeasures is through 'concern categorisation'. Typically, OEMs receive unstructured text describing quality concerns, these are read by engineers and categorised accurately to enable effective prioritisation. Quality concerns may be in the form, for example, of a highly technically worded claim from a dealer technician or a quote from an owners' forum.

Each week large OEMs typically categorise and manage thousands of warranty claims. Giving an engineer responsibility for this is an inefficient use of their time and specialist skills. Making a categorisation of such claims can be improved through the implementation of AI tools. A predictive algorithm can be deployed to interpret and categorise words – a skill that is considered 'human'. Today, an AI-enabled solution can categorise concerns more accurately and faster than human engineers. This enables engineers to deploy successful countermeasures faster, which then frees up their time to focus on more business-critical work.

What is the impact?

By responding faster, manufacturers can reduce the size, scope, and cost of warranty claims. Speeding up the process for identifying problems can increase substantially the number of addressable vehicles on which an OEM can implement countermeasures. This is shown in Figure 2.

Based on our experience of working with OEMs, a conservative estimate of the savings that can be achieved by implementing advanced analytics are

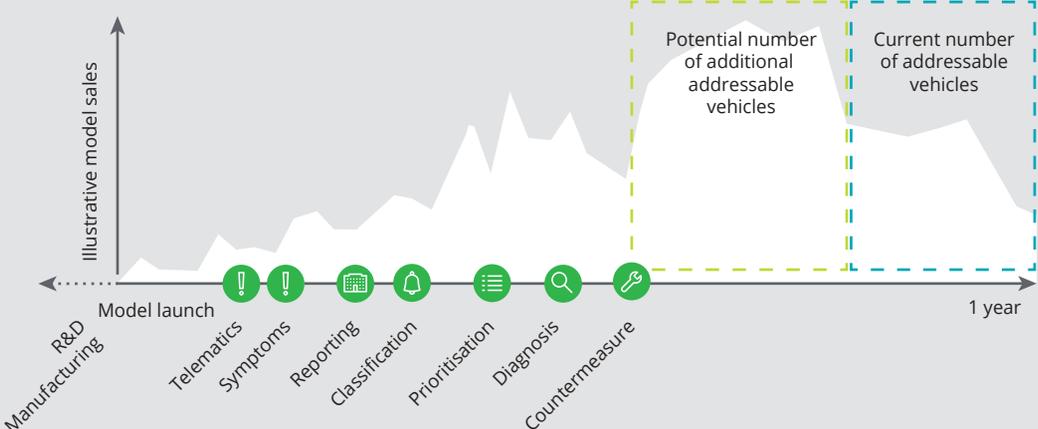
anything between 15 and 20 per cent of warranty costs. For a large OEM group with a revenue of £100bn, spending one per cent of revenue on warranty (£1 billion), this can mean a saving of £150 million to £200 million per year.

Implementing counter measures more effectively also has other benefits including the ability to save (and re-allocate), the time of highly skilled engineers and also prevent damage to brand reputation.

Figure 2. Number of addressable vehicles
Before implementation of advanced analytics



After implementation of advanced analytics



Source: adapted from Gartner (2017)

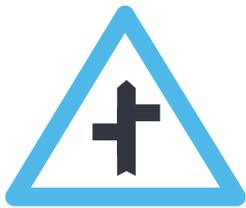
What makes a good analytics use case?

Choosing the right use case to implement in the first place is clearly important. To avoid over-complication, a good use case – that is worthy of investment – should exhibit the following characteristics:

- a clearly defined challenge with a desired business outcome (e.g. reduce annual warranty spend)
- a high and easily measured impact (operational and/or balance sheet)
- ease of implementation (given the available resources).

No two organisations or situations are the same, and there is a sliding scale of how robust assessments need to be, often determined by time, resource and budget constraints. When making the assessment, organisations may consider a set of criteria taking into account the relevance of the use case to overall business strategy and the potential impact on revenue growth, asset efficiency and operating margin (Figure 3).

Figure 3. Use case assessment criteria



Clearly defined challenge with a desired business outcome

Advanced analytics should not be seen as a solution in search of a problem. An organisation should not invest without clearly identifying challenges within their business and then exploring to find the most suitable solution. There is a wide range of tools, toolkits and approaches that can be used to analyse data. The challenges that present themselves are solution agnostic, and an OEM should not invest in technology that restricts the way it approaches projects.



Impact

Impact is measured primarily across the following areas – revenue growth, asset efficiency and operating margin, taking into account each of the drivers of performance in these areas. While some companies may consider one key performance indicator (KPI) when measuring value, another may come to a decision based on multiple KPIs.

For organisations that are able to provide strong senior leader sponsorship and existing technical expertise within the business, and that deal with a small number of data sources, identifying a business challenge and assessing impact can provide sufficient justification to start a project. However, for those organisations that are new to advanced analytics or are attempting a more complex project, they should also consider ease of implementation.

Ease of implementation

Ease of implementation refers to how much time and cost will be required to gather data, evaluate it, model it and deploy the model in 'business as usual' processes. We have identified five areas of complexity that should be considered when planning a project:

1. Data source complexity – What is the number of data sources to be joined? What is the data quality? What quantity of information will be involved, in terms of records and dimensions? Does any data need to be created, e.g. for supervised learning?

2. Analytical complexity – Are there just a few computations involved? How many models need to be built? Are complex algorithms, such as a deep learning model, needed to achieve effective results?

3. Sponsor complexity – What support exists from the business already? How many stakeholders are involved? Is the optimal solution a cross-functional one?

4. Regulatory/legal complexity – Are there any legal or regulatory considerations to take into account, for example the worldwide harmonised light vehicle test procedure (WLTP)?

5. Implementation complexity – Are resources readily available to implement? How difficult will this be to integrate into business as usual? How many users are intended to interact with the solution? Is extensive documentation and training required?

If a company has identified multiple challenges in their business then prioritisation of use cases becomes necessary. Those companies that have looked in depth at impact and ease of implementation for a number of use cases can use a standard implementation matrix to identify transformational projects and quick wins. However, all companies need to realise that prioritisation is never as simple as choosing the most impactful use cases and investing in them. For example, it is important to understand how many use cases can be tackled given the resources available in the business in the short, medium and long term.

Whilst transformational use cases are attractive, it can be more important for many organisations to prove the value of analytics in the short term. Even for companies with the financial capacity to invest in multiple projects, early success can help generate executive support for implementing actions derived from analysis, and can encourage investment of resources in larger and more costly projects in the future. With this in mind, each use case should be quick to implement and, most importantly, value should be realised quickly.

All companies need to realise that prioritisation is never as simple as choosing the most impactful use cases and investing in them.

Becoming an insight-driven organisation



Strategy



People



Process



Data



Technology

Having identified a business challenge that requires an advanced analytics solution, there are several stages that an organisation needs to undergo before value is realised. Instead of focussing on a specific tool or technique, such as AI or machine learning, an organisation needs to build its analytics capability around five dimensions: **strategy, people, process, data and technology**. To get the most from analytics, organisations should consider strategy, people and process first before making investments in data and technology.

Among these five dimensions for creating an IDO, the 'people' elements often represent the greatest stumbling blocks to building sustainable analytics capabilities. Organisations that have focused on attracting data scientists, building high-end technology infrastructures and transforming their big data will soon realise that this does not guarantee success. Building analytics capabilities with no thought as to how it will be championed within the business can lead to excellent solutions being undermined by a lack of support for implementation.

Successful IDOs accelerate their analytics capability-building through the development of proof of concepts or projects that solve a business issue and deliver measurable impact. To deliver ROI on analytics pilots/use cases that have been identified and championed, organisations need to invest beyond data and technology to build a highly functional analytics team capable of running and scaling the project.

When it comes to the people dimension of analytics, four areas can accelerate the development of sustainable analytics capabilities, as follows.

Talent

Organisations will not be able to source all the talent they need internally. Instead, they should consider building an ecosystem of internal teams and external partners to fast track returns and avoid years of investment.

Operating model

Make the best use of scarce analytics talent. At early stages of maturity, either concentrate talent into a centre of excellence (COE), or empower the most advanced pocket of talent to lead and champion the use of analytics.



Leadership

It is essential to pick transformation-savvy executive sponsors who are influencers capable of leading by example, and who come from key functions in the business that drive growth and profitability.

Culture

Be strategically bold by demonstrating a willingness to challenge business norms, and be tactically bold by devising practical use cases rather than conducting scientific experiments.



Delivering success

The use of advanced analytics and AI in particular, has the potential to transform the automotive industry, driving operating margin, revenue growth and asset efficiency, whilst also spearheading the move to alternative technologies and autonomous vehicles. But the decision to become an IDO should be well-considered and grounded in reasonable expectations. While there are no hard and fast rules, some high-level guidelines can be of help to organisations as they consider how to develop their analytics plans.

First, it is vital to create pilots or proofs of concept for projects with potentially high business value. This means identifying business challenges, recognising where and how advanced analytics can help provide a solution and defining measurable outcomes. Once a use case is identified, it is important to analyse the likely impact, weighing that against the complexity of the project.

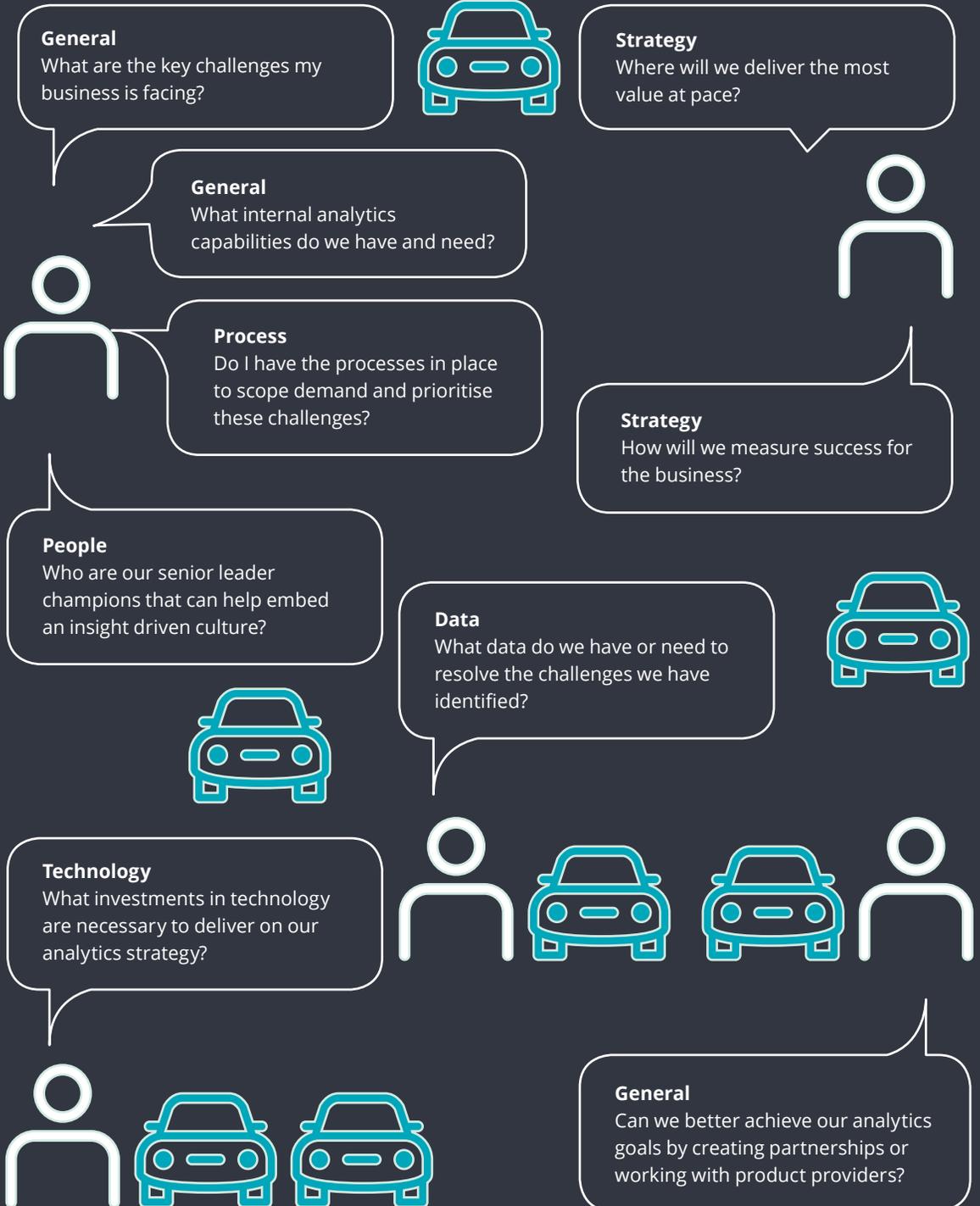
Having identified and prioritised use cases, an organisation can then conduct an internal audit of its existing capabilities to understand where it can use its existing strengths and capabilities. The aim should be to form internal teams dedicated to big data and analytics with a support structure in place, to help deliver and champion insights at the most senior levels of the organisation. Once the foundations are in place, an organisation can then invest in data and technology that has the capacity to deliver their objectives.

While there are no hard and fast rules, some high-level guidelines can be of help to organisations as they consider how to develop their analytics plans.



Key questions for business leaders

In order to deliver success, there are several key questions business leaders should be asking themselves:



Endnotes

1. The four analytics capabilities, Gartner, 2017. See also: https://www.gartner.com/binaries/content/assets/events/keywords/catalyst/catus8/2017_planning_guide_for_data_analytics.pdf
2. Global marketing spend, Adage, 2017 and Zenith Media, 2018. see also: <https://adage.com/article/deloitte-digital/automotive-marketing-shifting-gears-a-slowing-market/310392> and <https://www.zenithmedia.com/wp-content/uploads/2019/03/Automotive-adspend-forecasts-2019-executive-summary.pdf>
3. Global revenue of the top 10 OEMs, Statista, 2017. See also: <https://www.statista.com/statistics/232958/revenue-of-the-leading-car-manufacturers-worldwide/>

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