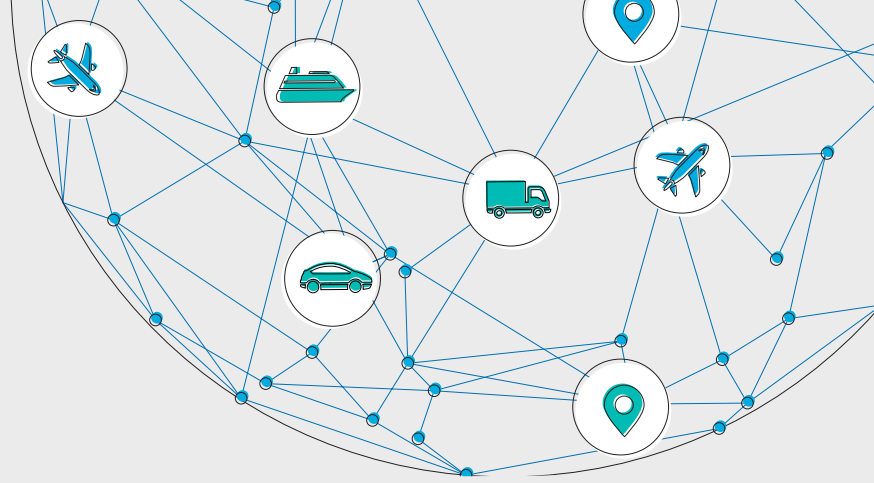




TRANSFORMING THE AUTOMOTIVE INDUSTRY SUPPLY CHAIN

For resilience, intelligence,
connectedness, and sustainability



EXECUTIVE SUMMARY

Automotive industry supply chain disruption reveals its strategic role and the need for change

Recent disruptions to the automotive industry and its environment are now leading to far-reaching changes throughout the supply chain, as well as to a better appreciation of its strategic importance. Relevant disruptions include:

- **Political and economic events** during and after the pandemic. These are forcing companies to undertake rapid supply chain evolution to increase flexibility and optimize risk management.
- **Rapid regulatory change.** A lack of visibility in the supply chain can hamper compliance with emerging ESG laws and guidelines.
- **New customer expectations** that add further complexity. For example, customers now expect an omnichannel purchasing experience – making new demands on outbound logistics – and, once they’re using the car, want to buy new features as a service.
- **Far-reaching changes to the automotive business** itself, such as new entrants and business models. Success with EVs and software-defined vehicles, for example, depends on forming the right supplier relationships.

These disruptors have led automotive companies to reappraise their whole approach to the supply chain, with a better appreciation of its strategic role. They know that a small event

somewhere in the supply chain can have a big impact on business growth and continuity, and that the right capabilities in this area can therefore confer a strategic competitive advantage.

However, most automotive companies today feel that they are not yet fully equipped to seize this advantage. Fewer than 20% of organizations across all industries currently consider themselves able to handle today’s supply chain challenges with consistent success¹, and our experience suggests that automotive companies fit this pattern.

Transforming the automotive supply chain

To deal effectively with disruptions and challenges, an automotive organization needs to increase the resilience and adaptiveness of its supply chain. By doing so, the business will ensure that it can tackle both current pressures and future “black swan” disruptions, safeguarding its long-term prospects.

Resilience depends, fundamentally, on using data to obtain visibility and intelligence right across the supply chain. In order to be able to correctly identify risks and build trust among the organizations in the downstream value chain, visibility must now extend to the Nth tier of the supplier ecosystem.

In addition, OEMs are realizing that they need to broaden their supply chain approach to provide resilience, intelligence, connectedness, and sustainability across every aspect of the end-to-end supply chain, from procurement to packaging management.

¹ [Capgemini Research Institute, 2022, “How greater intelligence could supercharge supply chains,” page 14](#)

It also makes sense to improve understanding of demand with a combination of demand sensing and inputs from various sources of demand information. Better intelligence about demand enables a more sophisticated approach to planning.

Enablers of supply chain resilience

Automotive companies have several levers that they can pull to increase visibility and resilience in the supply chain. For example:

In an ongoing evolution of the supplier ecosystem, leading companies are already considering whether they should be collaborating directly with suppliers on downstream tiers, especially semiconductor providers (or even setting up their own refineries for lithium). They are also reevaluating the number of suppliers they need in each area. Some are also moving to closer relationships with a smaller number of suppliers in strategic areas.

Orchestration of the supply chain is a top enabler of resilience. It requires a central governance structure for the industry, with rules, standards, and guidelines to be agreed first regionally and then across the whole industry. These will also apply to players from other industries such as textiles that participate in the automotive supply chain.

Data is key to providing visibility and hence achieving resilience. With today's technology, an extra layer of software can easily be introduced to

add intelligence to the organization through data-enabled decision-making. As well as implementing these approaches, companies also need to ensure that they have the right mindset to adopt them right across the organization, which may require a cultural change.

Technology – drawing on and combining both engineering and IT disciplines – is relevant to many aspects of this transformation. The combination of technological innovation and well-managed data can enable planning and modeling of unprecedented sophistication, and can provide undreamed-of levels of visibility. Some of the most exciting tools require integration of offers from newer providers such as hyperscalers and specialist data science solution vendors.

Talent has always been at the heart of an effective supply chain. The skillset now required is different, though, with advanced data science and decision support skills becoming essential. Skills gaps can be addressed through the usual methods of upskilling and recruitment, but imaginative new approaches are also likely to be needed in this highly competitive area.

Recommendations for increasing resilience now

Companies know they need to up their game in areas that strongly influence resilience. Steps that automakers can take now include the following.

Rethink planning. Adopting advanced approaches such as complex scenario planning makes it possible to forecast demand far more accurately, with integrated business planning to respond to change, and to continuously update suppliers so that they can adjust their own plans.

Embrace transparent collaboration. Consider whether closer supplier partnerships could increase resilience. Strengthen connections by promoting data sharing and mutual trust.

Get help with innovation. The right ecosystem of expert advisors on technology and engineering can help the company move forward at the right pace and with the right solutions.

Build a data-driven culture. This will ensure that new solutions are trusted by the business, and that the insights they generate are used to drive decisions and actions.

This approach will help automotive companies to build a resilient, connected, intelligent, and sustainable supply chain: one that will be a rich source of competitive advantage.

Figure 1: Five levers to transform the supply chain

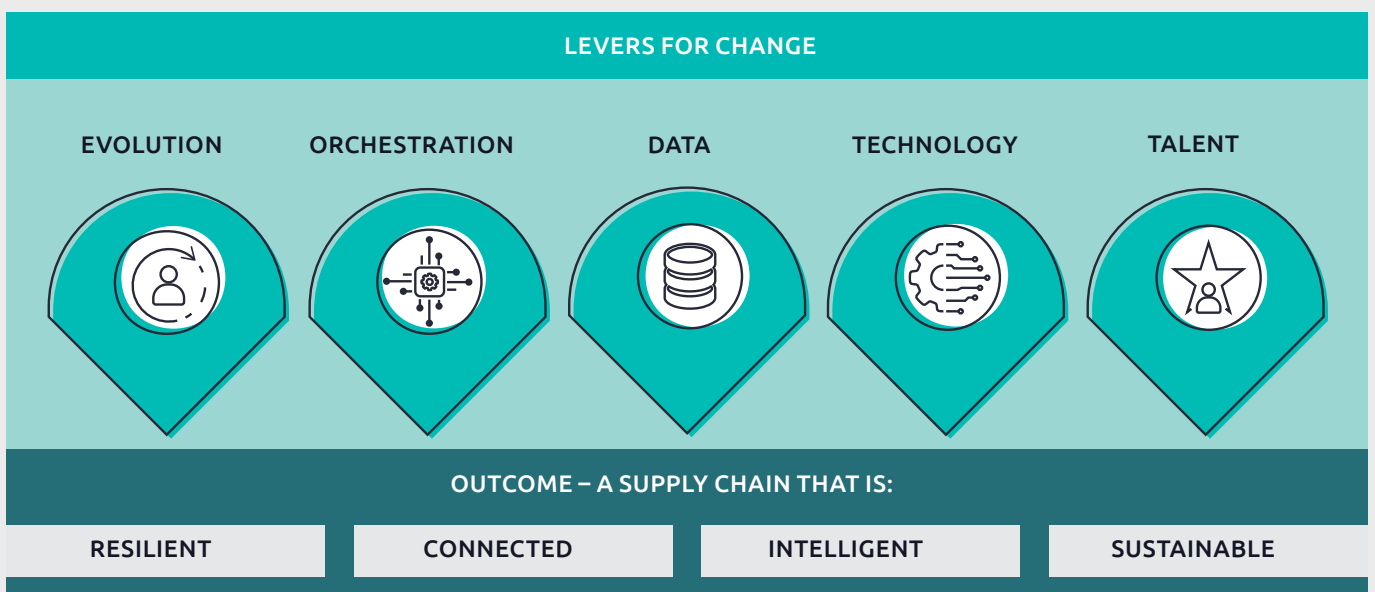
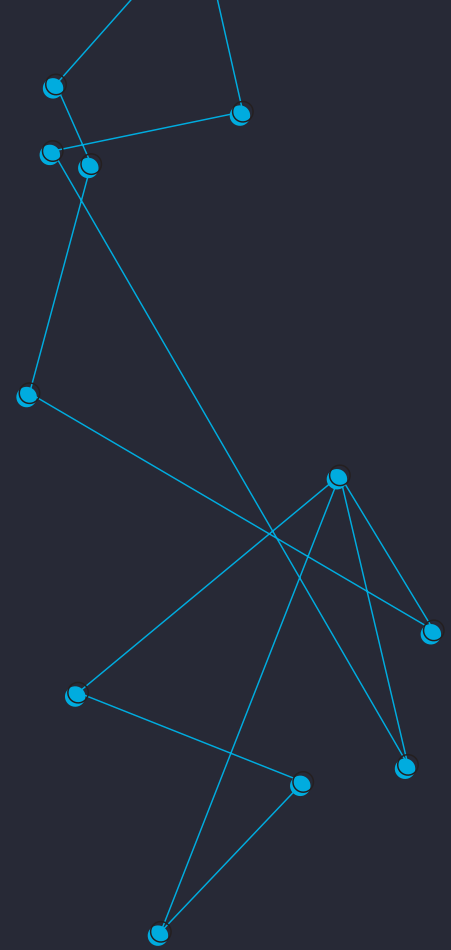


TABLE OF CONTENTS



INTRODUCTION: The need for supply chain resilience	5
SETTING THE SCENE: Supply chain challenges in the automotive industry	6
LEVER 1: Evolution	12
LEVER 2: Orchestration	14
LEVER 3: Data	16
LEVER 4: Technology	18
LEVER 5: Talent	22
THE FUTURE OF THE AUTOMOTIVE SUPPLY CHAIN: Recommendations	23



INTRODUCTION: THE NEED FOR SUPPLY CHAIN RESILIENCE

Current resilience levels fall short of automotive industry needs

Fewer than 20% of organizations currently consider themselves able to handle today's supply chain challenges with consistent success². That finding is particularly worrisome for the automotive industry. Recent disruptions have emphasized the strategic importance to the business of suppliers – not just in Tier 1 but at all levels – as well as of support partners such as third-party logistics companies (3PLs). Optimizing the supplier ecosystem, and the way it is managed, is clearly critical to a company's overall resilience.

Leading automotive companies realize that there is a gap to be filled here. Already, they are systematically investing in suppliers at all levels, including in suppliers of raw materials for batteries and microchips. This contrasts with the historical position where their investment tended to focus on Tier 1 suppliers.

² [Capgemini Research Institute, 2022, "How greater intelligence could supercharge supply chains," page 14](#)

Organizations are already recognizing the strategic nature of the supply chain

Major OEMs are now recognizing that excellent supply chain management can provide them with a significant competitive advantage, and are therefore turning it into a strategic function with its own budget and board-level management. Those supply chain CXOs are exerting increasing influence over automotive organizations and emerging as future CEOs. Regulatory and policy changes globally, especially in the area of sustainability, are accelerating this shift.

The automotive supply chain now needs radical transformation

Progress is already being made, but automakers know that more revolutionary change is needed. It has become clear that minor disruptions anywhere in the supply chain can disastrously affect business growth and continuity. In addition, changes to the business environment are altering what is needed from the supply chain.

Companies are therefore starting to rethink the whole supply chain model.

They are breaking new ground here, though. It's clear what is needed – a supply chain that has end-to-end resilience, and is also connected (i.e. there's great internal and external real-time interaction and communication), intelligent (i.e. decisions at all levels are driven by up-to-date insights), and sustainable (i.e. able to meet the organization's ESG commitments and the expectations of external stakeholders in this area). But it's not so clear to companies how all that can be achieved within the right timescale.

A deep dive into the automotive supply chain

This report explains some of our current thinking on how the automotive supply chain must evolve to realize the potential strategic advantage that leadership in this area can bring. While our focus is on passenger cars, much of this thinking is equally relevant to commercial vehicles.



SETTING THE SCENE: SUPPLY CHAIN CHALLENGES IN THE AUTOMOTIVE INDUSTRY

Understanding the imperative for change

The supply chain has always been a high priority for the industry, but it's only now that its strategic role is fully being realized. This realization has been enhanced by recent supply chain challenges, which in turn have emerged from several disruptive factors.

These disruptions predominantly fit under four headings: political and economic events; rapid regulatory change; new customer expectations and their effect on outbound logistics; and changes to the automotive business itself.

Figure 2: Disruptions

POLITICAL AND
ECONOMIC EVENTS

RAPID REGULATORY
CHANGE

NEED FOR A
RESILIENT
SUPPLY CHAIN

NEW CUSTOMER
EXPECTATIONS AFFECTING
OUTBOUND LOGISTICS

CHANGES TO THE
AUTOMOTIVE BUSINESS

DISRUPTION 1: Political and economic events

Recent events such as the pandemic and the situation in Eastern Europe have shown just how indispensable the supply chain is to an automaker. The impact on the industry of chip shortages, for example, is still being

felt and will not quickly be forgotten in view of the lost sales that resulted.

More generally, many regions are seeing unprecedented political uncertainties. Coupled with economic instability, these are forcing companies to revisit their sourcing and manufacturing policies in order to minimize risk. As a result, supply chains are evolving fast and dynamically. Even

so, organizations face an existential challenge as they seek to maintain their competitive advantage in a highly unpredictable business environment. As an example, organizations have initiated mineral mining and refinery investments.



DISRUPTION 2: Rapid regulatory change

The regulatory climate is tightening, with contrasting approaches in different regions. In Europe, governments and bodies such as the European Commission are working intensively with NGOs and others to create laws and regulations to guide companies as to how they should run their supply chains from the ESG perspective. The US is probably as determined to tackle these issues but, as we'll discuss below, is taking a different approach. Other regions are at various stages of legislation and regulation in this area.

EU rules and guidelines affecting the supply chain include:

- The General Safety Regulation (GSR) aiming to reduce road accidents and injuries by fitting safety technologies to new vehicles. This is being extended to all new registrations in 2024, meaning that it will have a greater impact on product and feature design and on the parts ecosystem.
- The Corporate Sustainability Reporting Directive (CSRD).
- The Ecodesign for Sustainable Products Directive.

- The European Green Deal, a baseline from which many national initiatives have evolved.
- The General Data Protection Regulation (GDPR) – not new but still brings challenges, for example with respect to vehicle data.

Relevant legislation and regulation in the US includes:

- The CHIPS and Science Act aiming to stimulate local manufacturing of semiconductors, which will affect supplier strategy.
- Executive Order (EO) 14028 which is designed to improve cybersecurity.
- Inflation Reduction Act of 2022.

Different regions are approaching regulation in different ways. The European Commission is aiming to meet ESG objectives primarily through regulation. The US is emphasizing incentive-based models that encourage businesses to compete in putting forward the best ideas and so attract more capital. Developing nations such as India are also encouraging adoption of new ESG-compliant products through policy changes and new approaches to policy implementation.

OEMs and Tier 1s need ESG systems and enforcement-based approaches for ensuring compliance to ESG regulations. These are essential to ensuring that the supply chain is fully ESG-compliant, since ESG requirements apply to the whole end-to-end supplier ecosystem.

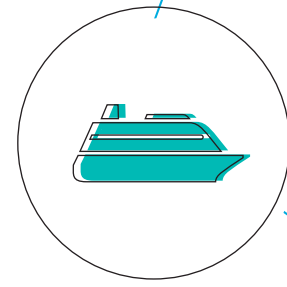
³ European Commission, Brussels, December 11 2019, "COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE EUROPEAN COUNCIL, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS: The European Green Deal"

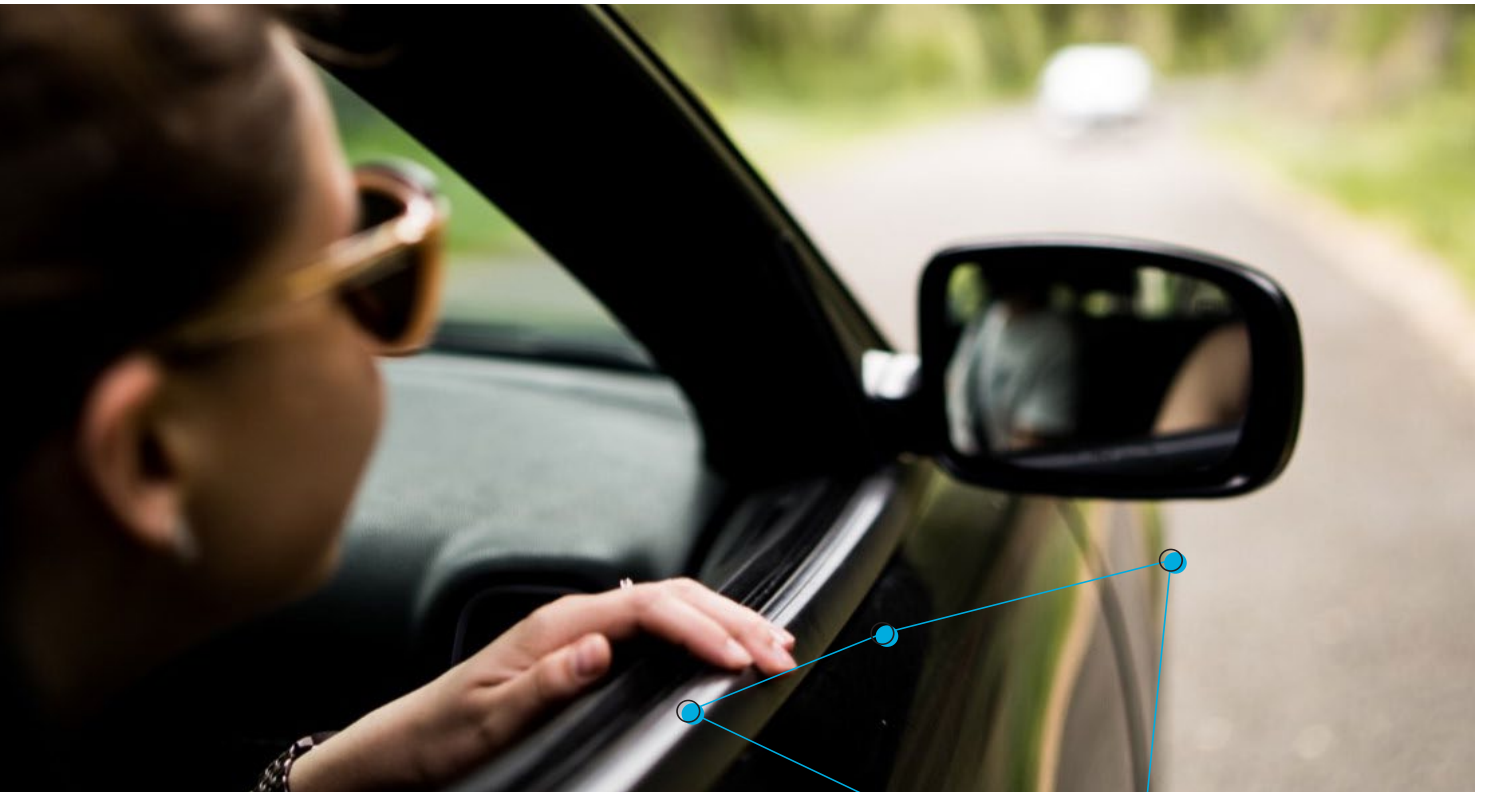
⁴ Federal Ministry of Labour and Social Affairs, Supply Chain Act, web page, accessed June 11 2023

⁵ Federal Office for Economic Affairs and Export Control, Supply Chain Act: Reporting Obligation, web page, accessed June 11 2023

Individual regulations pose their own challenges

Derived from the European Green Deal³, Germany's Supply Chain Due Diligence Act was initially applicable to companies with more than 3,000 employees but is soon to be extended to those with more than 1,000⁴. These companies will have to extend their scrutiny to suppliers further down the supply chain, including to suppliers with which they have no direct relationship. The Act is linked to reporting requirements from various German authorities such as the Federal Office for Economic Affairs and Export Control (BAFA)⁵.



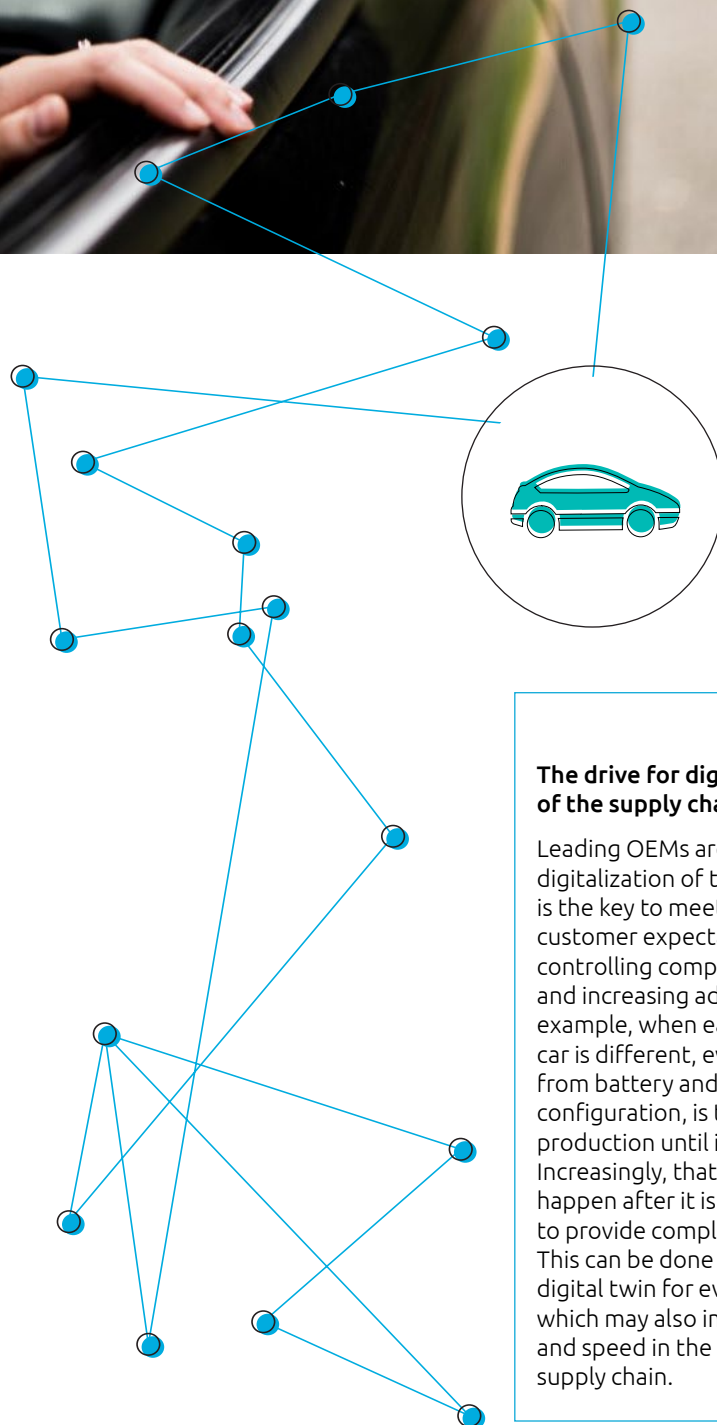


DISRUPTION 3: New customer expectations affecting outbound logistics

Customer expectations about the purchasing experience have changed rapidly in the past three years. The expected experience is evolving from simply buying vehicles from dealers to omnichannel, with a range of additional features around online configuration, dealer and agency models, and seamless integration of online and offline lead generation. This change is also transforming requirements around vehicle delivery and outbound logistics.

Automakers therefore need to create, and optimize, new and complex outbound logistics processes to satisfy the expectations around omnichannel experience. This requires advanced algorithms and sophisticated data management and modeling techniques for optimization purposes.

Forecasting, and sales and operations planning, are instrumental for resilience. Past forecasting models, based on just a few parameters, are being replaced by large data- and analytics-based models. Furthermore, the measurements used are evolving from a forecast-actual approach to data-based end-to-end KPIs.



The drive for digitalization of the supply chain

Leading OEMs are realizing that digitalization of the supply chain is the key to meeting changing customer expectations, while also controlling complexity and cost and increasing adaptability. For example, when each individual car is different, every feature, from battery and ECU numbers to configuration, is tracked through production until it is shipped. Increasingly, that tracking needs to happen after it is shipped as well, to provide complete traceability. This can be done by maintaining a digital twin for every vehicle sold, which may also improve efficiency and speed in the aftermarket supply chain.



DISRUPTION 4: The changing nature of the automotive business itself

Product landscape changes, such as the advent of EVs and software-defined vehicles, are modifying the character of the supply chain by altering what OEMs need from their suppliers and the nature of the collaboration. Microchips are becoming central and vehicles tend to use a smaller number of more specialized chips, implying closer relationships with a smaller group of suppliers in this field. These changes necessitate end-to-end availability of real-time data on demand, supply, and ESG parameters.

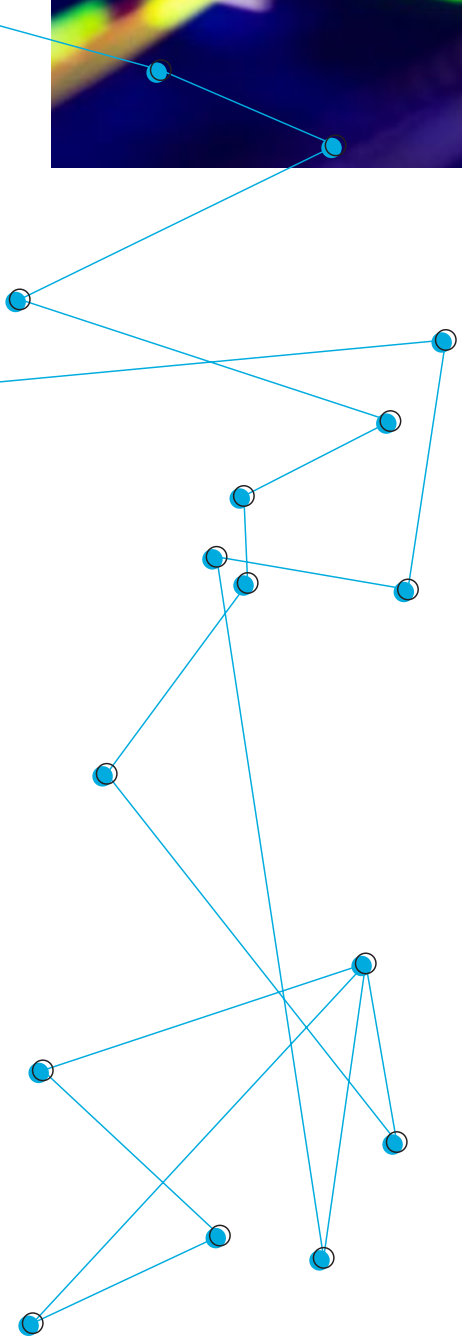
Automotive supply chain transformation is now paramount

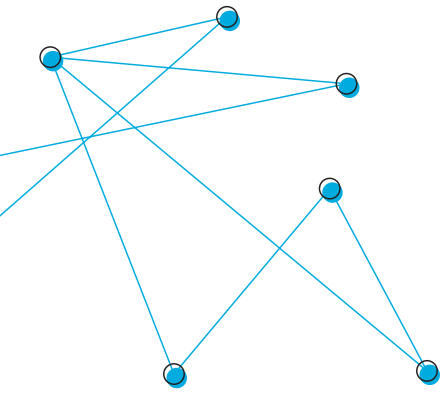
Building resilience to respond to these disruptions requires a paradigm shift in the whole supply chain. There are other reasons to transform the supply chain, too. For example, to cope better with macroeconomic pressures such as inflation, OEMs and suppliers need to optimize inventory and increase resilience and efficiency. (Inflation is a particular concern for small suppliers who may need to borrow more cash at higher rates.)

The journey to resilience has two key facets. The first is the development of an intelligent data layer providing visibility, decision support, and risk identification for complex scenarios. That visibility must extend to every aspect of the company's interests, and to every level of the supply chain, as well as to the demand side of the equation.

The second facet of the journey is acting on visibility. The support layer should enable scenario planning and responsiveness to dynamic decisions, and disruptions, across the supply chain.

As a result, the supply chain will be far more resilient, often able to deal with disruptions before they even arise using the latest data-derived intelligence; connectedness with internal and external stakeholders will become straightforward because everyone will have a shared view of what's happening, and it will also become easier to meet sustainability objectives by coordinating action to achieve objectives and address challenges along the end-to-end supply chain.





Why automotive supply chain transformation is so hard

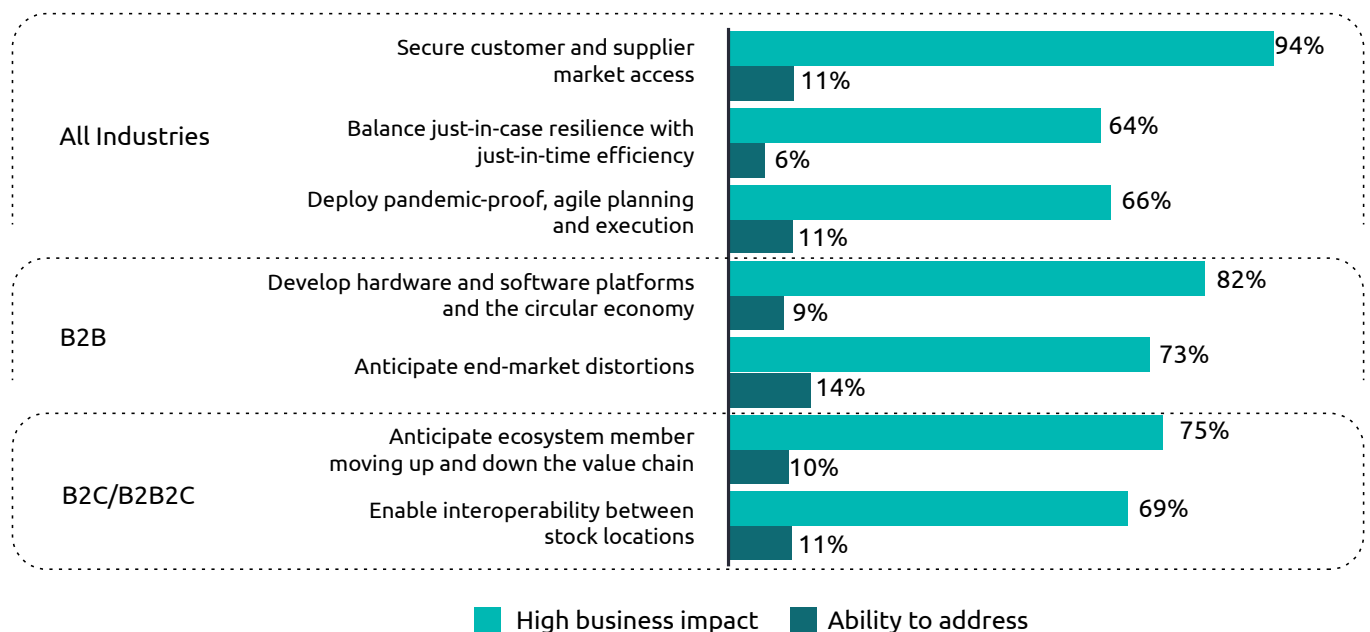
The automotive industry has one of the most complex supply chains of any sector, not least because it is interwoven with other industries such as chemicals, ferrous and non-ferrous metals, textiles, and so on. With so many different individual players naturally trying to safeguard their own interests and businesses, achieving the transformation to a resilient supply chain is extremely difficult.

In the next sections of this report, we outline five levers that companies can pull to overcome complexity and increase resilience in the supply chain.



Figure 3: In all industries, supply chain performance falls short of requirements

Resilience trends - impact and preparedness



Source: Capgemini Research Institute, Intelligent Supply Chain Research, August–September 2022



LEVER 1: EVOLUTION

Build a resilient, connected, intelligent, and sustainable supply chain into the organization’s strategy

It’s often the “unknown unknowns” that really hurt. As well as coping with today’s pressures, businesses must prepare to deal with future “black swan” disruptions. Organizations should be able to leverage data and intelligence to anticipate risks, and respond to disruptions in an agile manner by choosing from a range of alternative plans to suit each scenario. In this way, and with the right logistics approach, it will be possible to limit losses from unforeseen events, and to safeguard the future of the business.

Supply chain resilience is an essential part of preparedness for today’s unpredictable business environment. In the post-pandemic era, levels of business in the automotive industry may well return to pre-pandemic levels, but with new challenges and the likelihood of similar supply disruptions. Therefore achieving resilience depends on making the organization,

including its supply chain, as agile and adaptable as possible, rather than simply reshaping it for current conditions – which would only be a short-term solution.

Achieving resilience requires action in several areas, including orchestration, data, technology, and talent – all of which are covered later in this report. Companies need to address all of these in parallel, since they are interdependent.

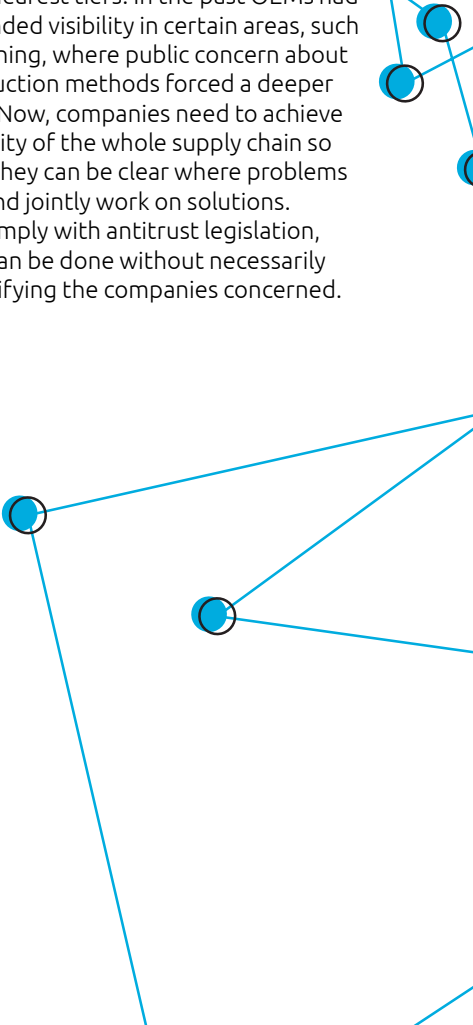
Automakers should recognize that the supply chain can bring strategic competitive advantage, and invest accordingly. It no longer makes sense to regard the supply chain as a purely operational aspect. It should be treated as part of the business’s game plan: a function in its own right which must be equipped to succeed and able to influence the overall direction. No wonder so many organizations are already tackling supply chain issues at board level.

Look further along the supply chain

Although OEMs tend to focus on their relationships with Tier 1 suppliers, resilience requires a wider focus because small specialist companies

can also play a critical part in the supply chain. These small and medium enterprises need to be managed in a different way from larger suppliers – for example, processes may need to be somewhat simplified without loss of rigor.

It’s important to oversee the entire supply chain and not just the one or two nearest tiers. In the past OEMs had extended visibility in certain areas, such as mining, where public concern about production methods forced a deeper dive. Now, companies need to achieve visibility of the whole supply chain so that they can be clear where problems are and jointly work on solutions. To comply with antitrust legislation, this can be done without necessarily identifying the companies concerned.



Manufacturing KPIs and parameters such as cost and quality are already being extended beyond their traditional scope of the OEM and Tier 1 to provide visibility of Tiers 2 and 3. However, it's now vital to extend visibility beyond Tier 3 in order to be able to correctly identify risks and build trust among the organizations in the downstream value chain.

Make supplier relationships more collaborative

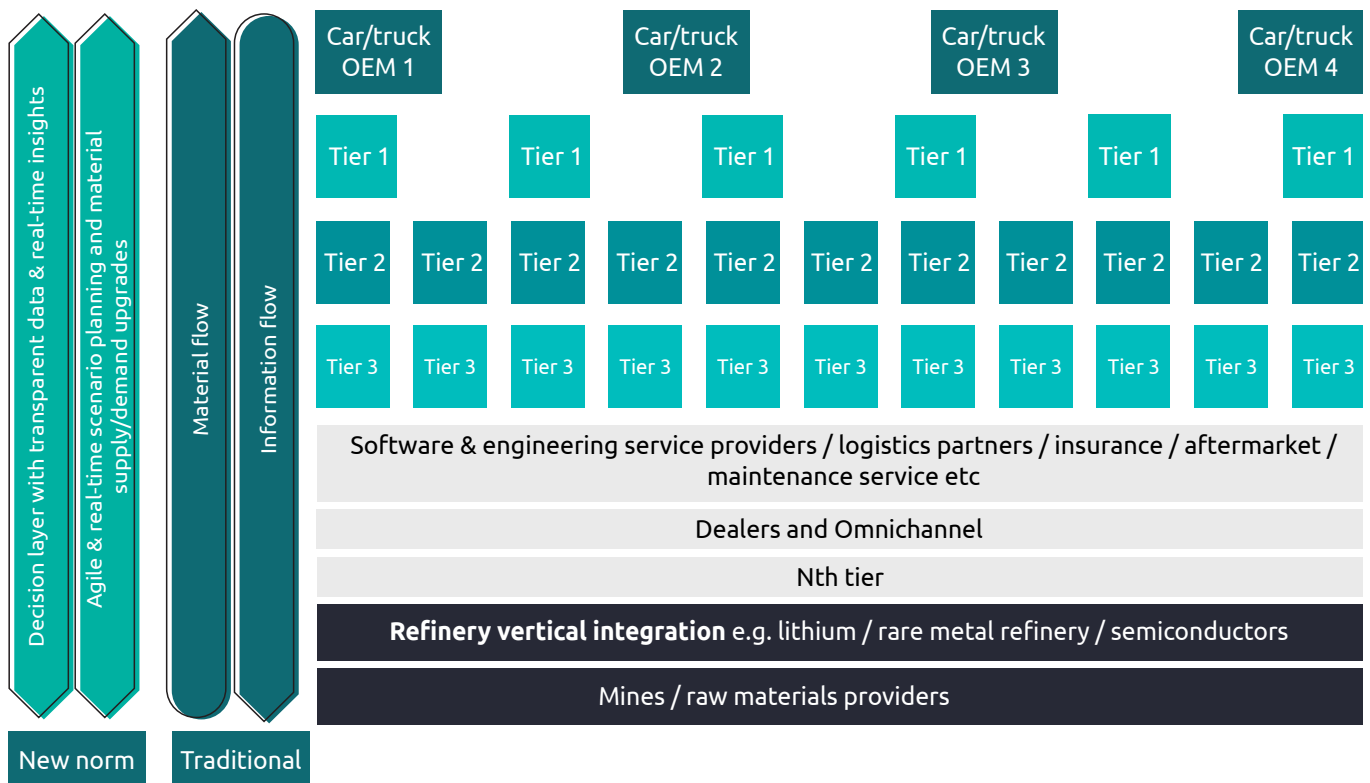
A more collaborative approach to the supply chain, with customers and suppliers developing products and

solving problems jointly for a win-win, might be more conducive to resilience than one where suppliers are expected to deliver to a contract and solve problems without bothering the customer. As a minimum, companies should consider a move toward more strategic sourcing – where each OEM has closer relationships with a smaller number of suppliers.

There are signs that this may already be starting to happen in Europe although the shift is hard to measure. For example, because of the criticality of electronics and microprocessors in software-defined vehicles – and in the light of the shortages that emerged during the pandemic – OEMs are

forging direct strategic connections with chip suppliers who they previously would have dealt with via Tier 1s. The OEMs hope that this will enhance their ability to react swiftly to changes in demand. (Alternative possibilities here include that of an OEM creating their own production facilities for raw materials – for example, lithium refineries.)

Figure 4: Vertical integration for supply chain resilience



Tighter collaboration also depends on high levels of trust between the parties, along with industry-standard approaches to measuring and communicating key parameters (which Catena-X is trying to achieve⁶).

Design products and plants with supply chain resilience in mind

Software is taking over some of the functionality of hardware (including chips) in software-defined vehicles. The platform approach, where

vehicles across a range all use identical hardware that is customized using software, is the logical conclusion of this trend. This, along with the closer strategic ties between chip manufacturers and OEMs, should help to simplify supply chains, and therefore increase resilience. This simplification could be accelerated by the fact that OEMs are also working to reduce the number of different chips needed in each vehicle.

Plants can be designed so that they can switch from one product to another to respond to changes in demand. For

example, one OEM has an assembly line that can switch from conventional vehicles to EVs and back. Especially if the suppliers are equally flexible, this can be a valuable contributor to resilience.

⁶Catena-X, Standards in the Catena-X data ecosystem, web page, accessed June 11 2023



LEVER 2: ORCHESTRATION

A central governance structure for the industry – and beyond – is essential for the orchestration of a resilient supply chain

If everyone is playing their own tune – with different ways of managing and using data, for example – there can be no harmony and therefore no resilience. Before resilience can be achieved, it is necessary to agree a framework of shared rules, standards, and guidelines, first regionally and then across the whole industry. These guidelines also need to be designed to apply to players from other industries

who participate in the industry's complex supply chain.

Such rules, standards, and guidelines do not exist yet, but organizations such as Catena-X are taking the first steps toward them.

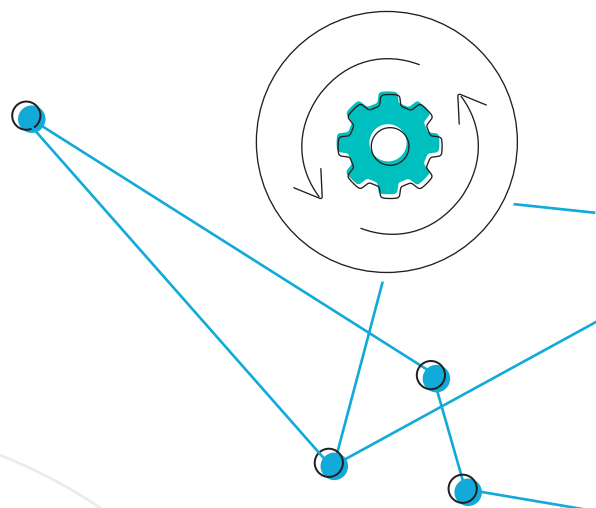
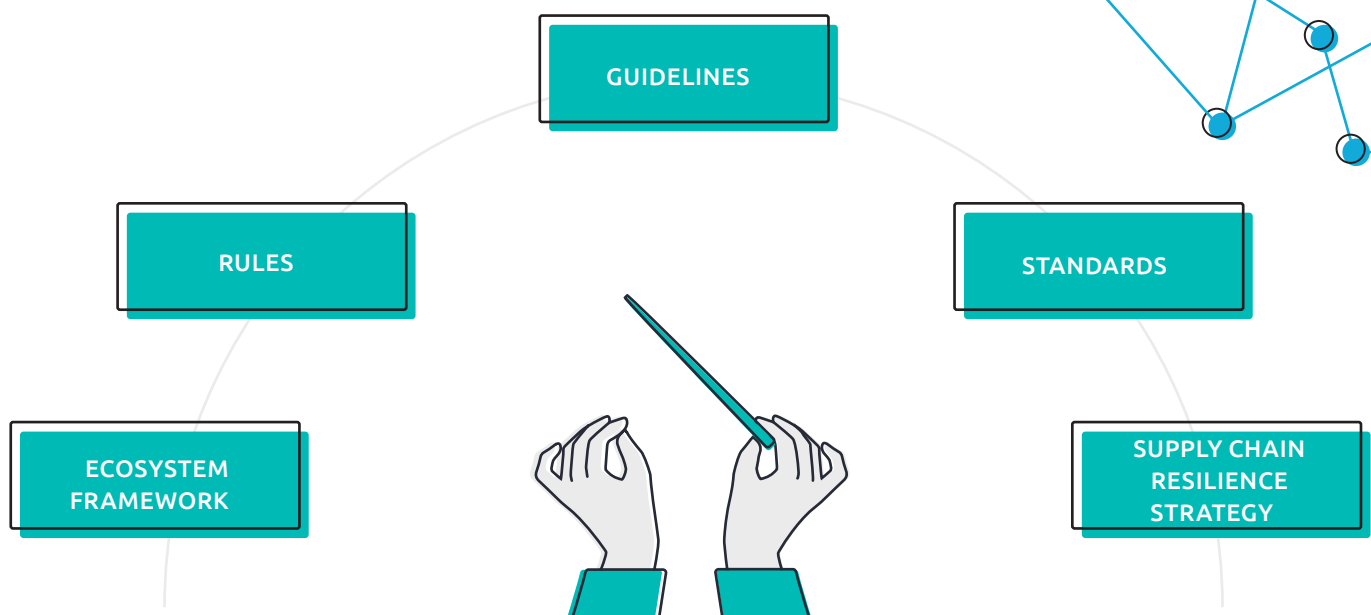


Figure 5: Orchestration can produce harmony and hence resilience

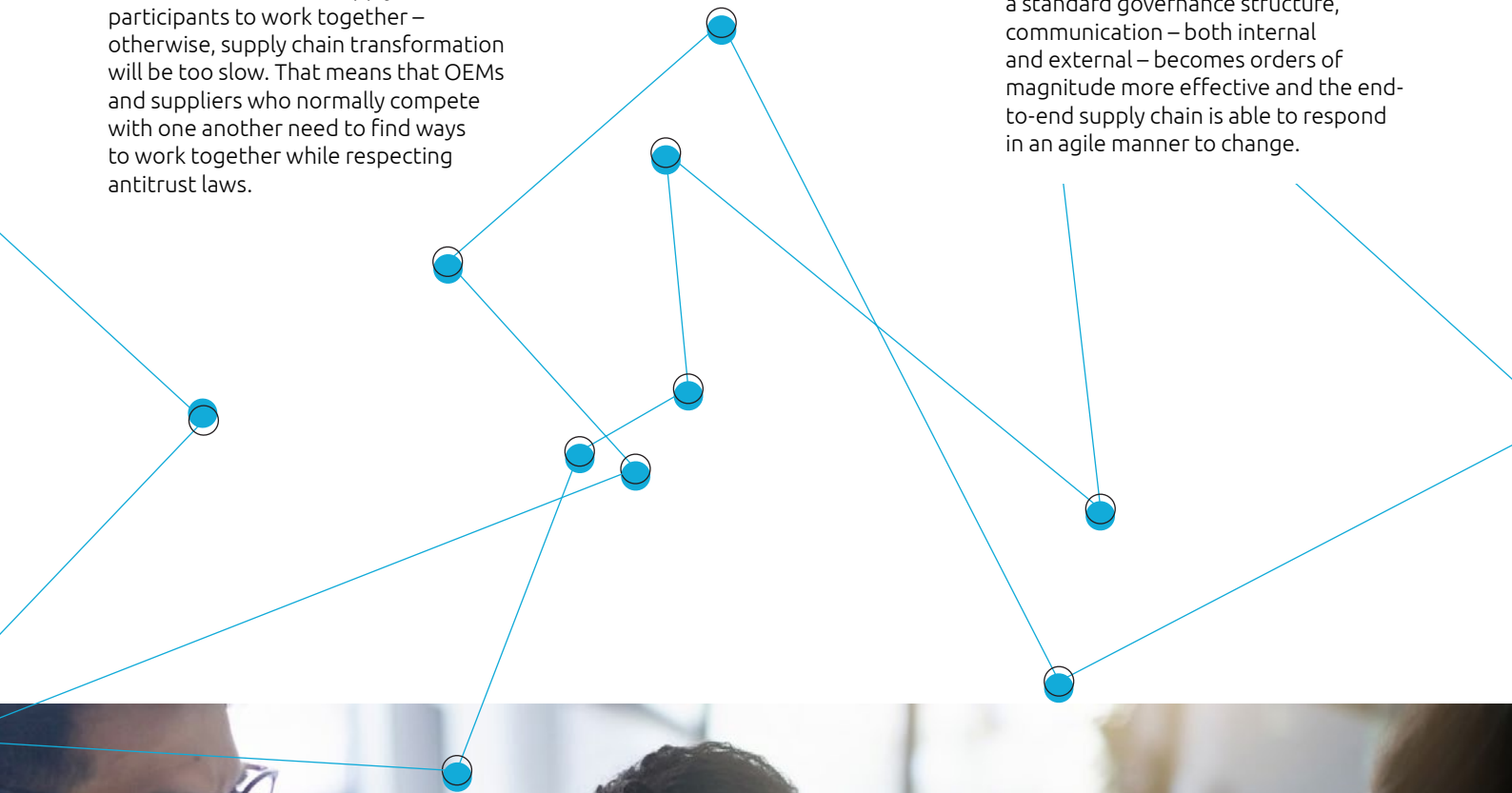


Intensive collaboration is needed to achieve a resilient and sustainable supply chain faster

In addition to standards, there must be commitment from supply chain participants to work together – otherwise, supply chain transformation will be too slow. That means that OEMs and suppliers who normally compete with one another need to find ways to work together while respecting antitrust laws.

Orchestration opens up the possibility of a connected supply chain

Once all stakeholders within the supply chain are collaborating around shared rules, standards, and guidelines within a standard governance structure, communication – both internal and external – becomes orders of magnitude more effective and the end-to-end supply chain is able to respond in an agile manner to change.





LEVER 3: DATA

Supply chain objectives mostly depend on the ability to leverage data

Whatever question we ask about the supply chain, the answer always seems to be better data exploitation to provide intelligence and decision support. The ability to collect and manage data, and to derive insights from it, is the #1 enabler for resilience and sustainability in the supply chain, as well as other goals.

Automakers know that making full use of data to create visibility of the supply chain would help them to ensure and demonstrate regulatory compliance; create better, earlier forecasts that can be used to plan production and inform suppliers, making the supply chain more resilient and stable; and build relationships of trust with suppliers, customers, regulators, and other stakeholders. This visibility paves the way for using data and analytics to predict and preempt risk, enabling complex, resilient behavior by the OEM, supplier, and dealer ecosystem.

But doing so is not always straightforward, given the volume and complexity of data with which they are dealing and the barriers that exist to data sharing, both internally and externally.

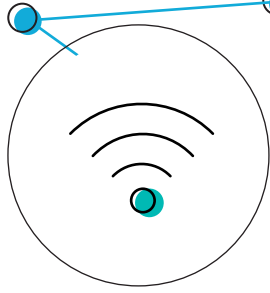
Siloed thinking is a challenge for data management and governance

Silos are still prevalent in the automotive industry and inhibit the sharing of data and hence its successful use in contexts like procurement and in- and outbound logistics. Closer collaboration along the supply chain depends on data sharing – but willingness to share data also depends to some extent on the closeness of collaboration, so this is a difficult conundrum to resolve.

Even within individual companies, data is not shared as freely as it should be. If procurement does not fully understand quality or delivery issues, it cannot engage effectively with suppliers.

Industry initiatives look set to improve data sharing

Data marketplaces, together with initiatives like Catena-X, should alleviate the problem of silos and pave the way for more collaboration around data. By helping to create visibility, such initiatives should also bridge any trust deficit between parties in the supply chain. Region-specific regulatory guidelines around ESG can also play a pivotal role in enhancing this data-sharing culture across the end-to-end supply chain.



Automakers need to act on internal data sharing too

Internally, companies must promote a collaborative, data-driven culture where functions such as procurement, R&D, and quality maintain a continuous dialogue. This will build a full picture of what customers really want and need. Senior management can lead this change by moving away from silo-specific KPIs and finding ways to incentivize everyone to see the bigger picture of organization-wide targets such as net zero, and work toward them.

In addition to the cultural change, success here depends on implementing an effective data platform together with strong governance and data management, to ensure that data is shareable and reliable. Industry initiatives to standardize data formats, while primarily aimed at facilitating sharing across company boundaries, may also streamline data sharing between internal functions.

Technical innovation to the rescue

Fortunately, it is easier than ever before to make the most of data. With today's technology, an extra layer of analytics- and intelligence-driven software can easily be introduced to support data-enabled decision-making for complex scenarios.

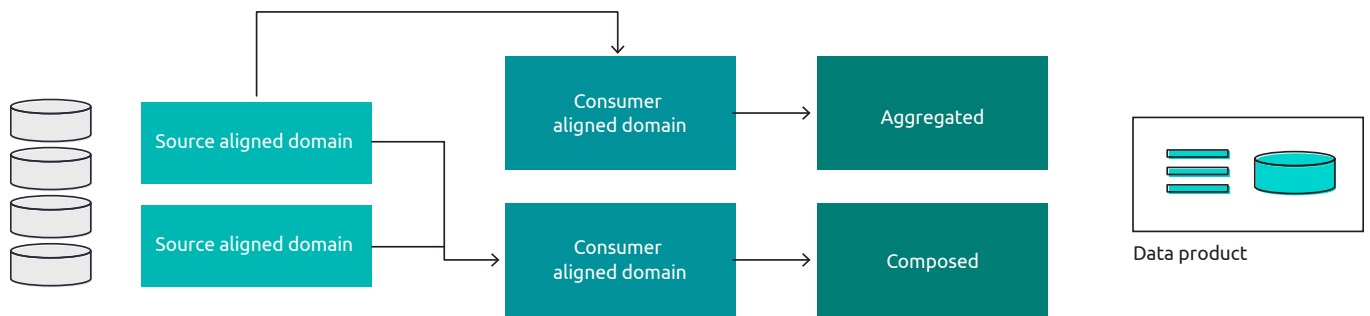
Pulling the necessary data together from disparate systems and platforms (such as an internal ERP system and a hyperscaler's cloud platform) can be complex, but these new approaches and tools make it easier.

For example, it is now possible to build a data "mesh" that combines data from multiple separate data lakes for analytic purposes without changing the existing data structures. This decentralized approach is far

less disruptive, time-consuming, and expensive than reorganizing the underlying data to bring it physically together.

This approach delivers insights that are much more powerful than those available from individual solutions such as an ERP system because they can potentially draw on all the organization's data platforms globally, and even those of its suppliers.

Figure 6: Data mesh



The result is increased transparency for consumers, regulators, and other stakeholders. For example, it becomes much easier to put together a picture of where a vehicle's components are coming from, together with the relevant carbon emissions and overall footprint.

Using data science to shift the business to a forward-looking focus

Current KPI-driven approaches encourage OEMs to look back at the past, but modern data science (including AI and NLP, for example) makes it realistic to predict the future using techniques such as data-enabled demand analysis, scenario planning, and risk assessment.

This shift will be a game-changer because it will make it possible to plan confidently and to align the supply chain to the plans, increasing resilience. Automakers should look for shortcuts to visibility: techniques that can facilitate data sharing without large-scale reorganization of the data.

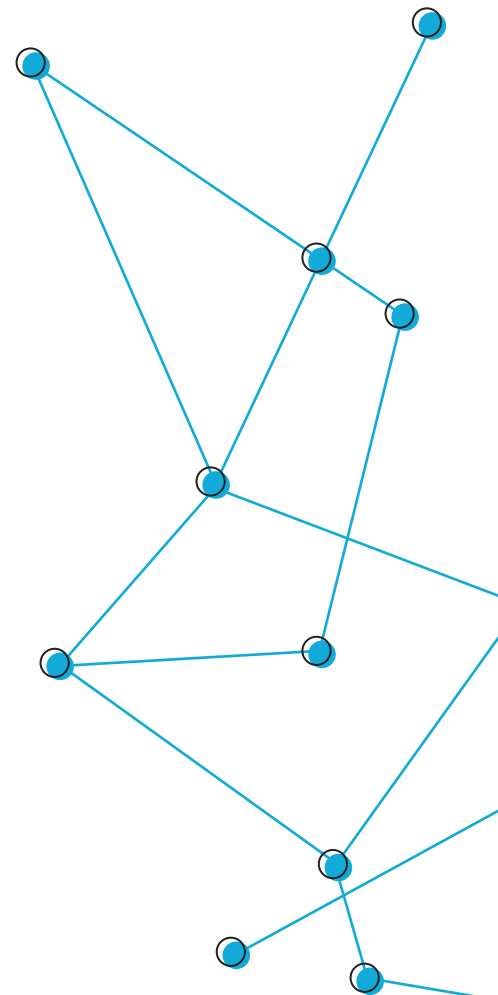
For newer data engineering concepts like the data mesh, it may be necessary

to partner with a professional advisor who already has experience of this approach.

The importance of identifying the real data requirements

When implementing data meshes and other new approaches, it's vital to be driven by the business case and the use cases, in order to maintain a focus on the data that is actually needed to create insight. This avoids the overhead of managing unnecessarily large data sets.

For example, with the periodic evaluation of suppliers, datasets tend to grow as new parameters are added – typically, new measurements around ESG will take their place alongside traditional ones relating to cost and delivery times. However, decision support tools work better if they are presented with only the data that enables a particular decision, rather than all of the data. Therefore, there should be mechanisms for selecting that data and setting aside the rest.





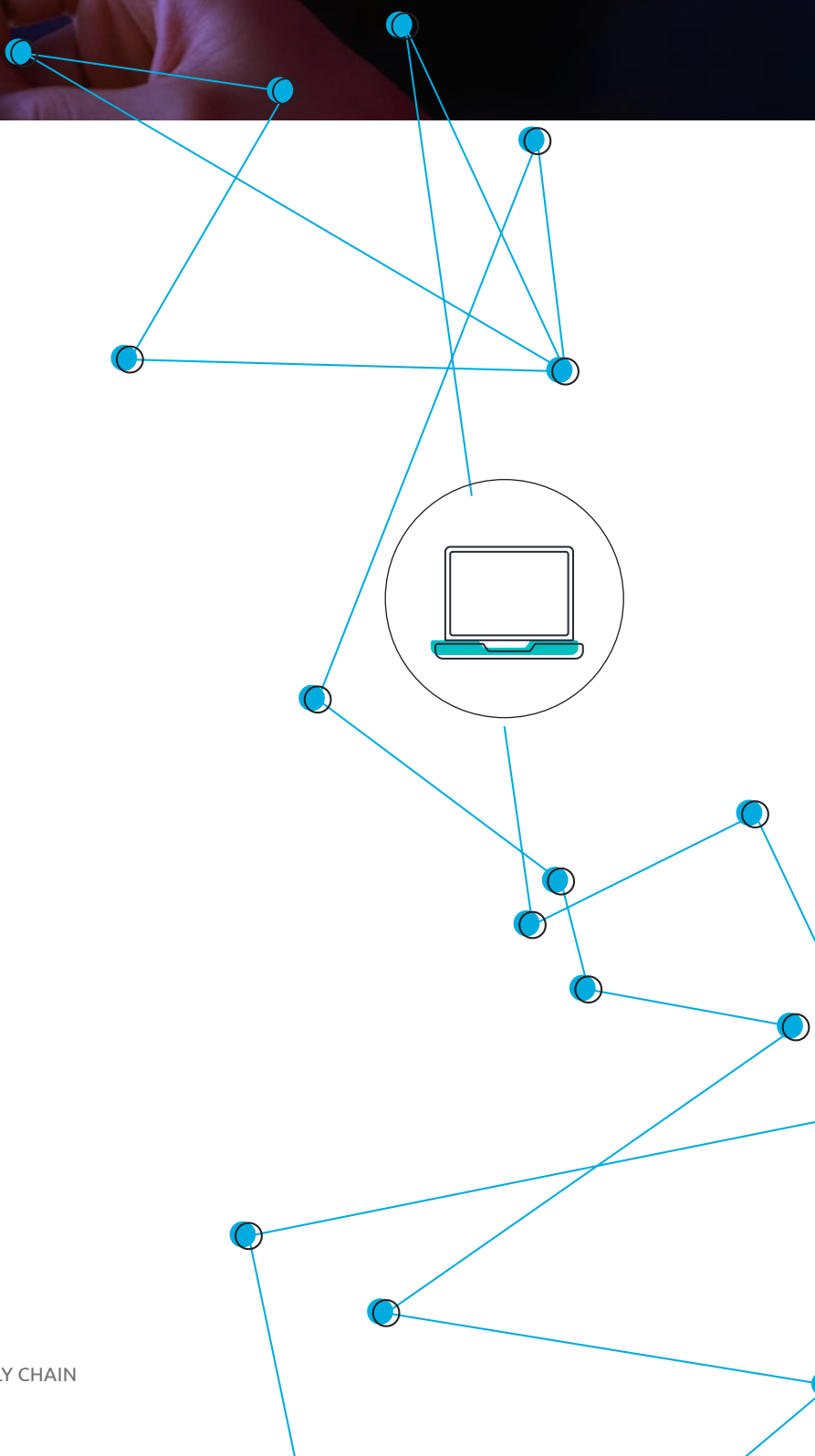
LEVER 4: TECHNOLOGY

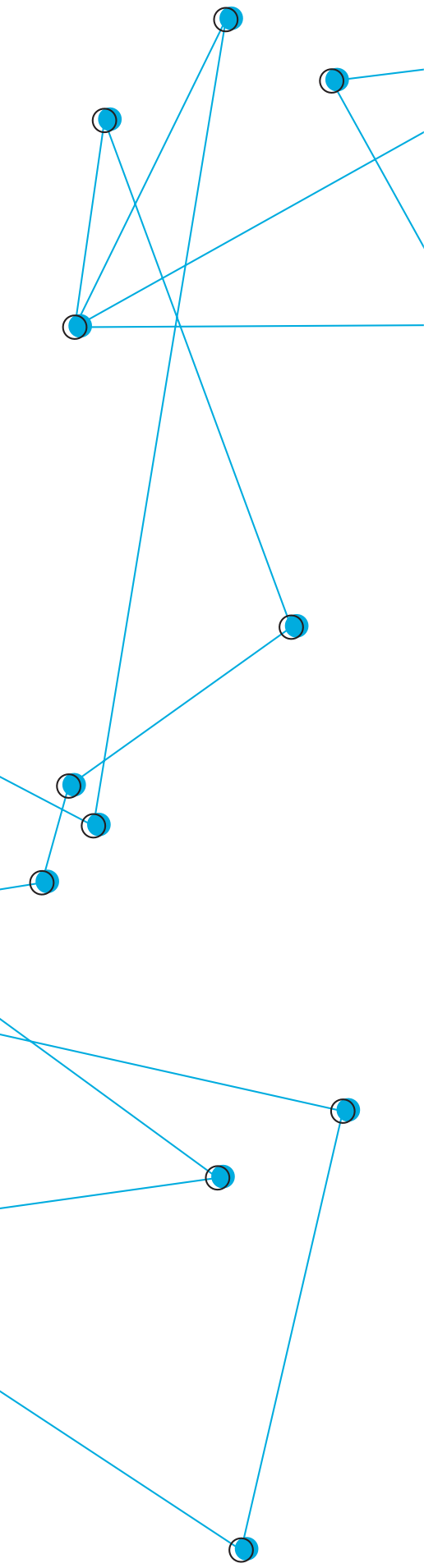
Engineering and IT are key to supply chain transformation

What brand-new possibilities do innovations in IT and engineering open up for the supply chain? Speeding up existing processes by orders of magnitude is just the start. One of the most important breakthroughs is that current analytics, applied to well-managed data, can enable fully informed decision-making at all levels, making the organization more responsive to change.

Some of the most transformative technology options come from newer providers such as hyperscalers and specialist data science solution vendors, so market knowledge is important. However, breakthroughs can also be achieved through ingenious use of existing tools.

Below we take a deep dive into automotive supply chain improvement via technology in three sample areas: radical new approaches to planning, increasing supply chain visibility, and optimizing outbound logistics.





EXAMPLE 1: Rethinking planning - a new paradigm

Better forecasts and integrated planning help suppliers and build trust

In the past, suppliers have often received forecasts from OEMs that were inaccurate, sometimes by a factor of 100%. Whether these inaccuracies were intentional (perhaps as a power maneuver) or accidental, some trust has been lost and suppliers often don't follow forecasts even when they are accurate.

A better approach to planning is needed, both to rebuild trust and because it makes the supply chain more resilient and sustainable for the reasons given earlier in this document.

Technology can assist with planning in many ways. For example, demand sensing via social media can be combined with more traditional demand forecasting methods based on dealer input to increase intelligence. In addition, after running the production plan, the OEM can be given modeling tools to help it instantly assess which of half a dozen suppliers has the plant available, and is cheapest/nearest bearing in mind the need for transportation. Decisions that have caused headaches in the past – such as whether to have parts delivered by air to alleviate a shortage – can become straightforward, because all the cost and environmental implications can be shown on a dashboard.

The aim should be continuous reassessment and refinement of scenario planning

Traditionally, planning happens periodically (typically monthly or weekly), and then the plan changes only in an emergency. But with the right modeling approach, it's possible to constantly reassess your production needs, realign, and update the information you share with suppliers.

This helps to reduce the disconnect that currently exists between production, sales, and suppliers, so that it becomes possible to give suppliers accurate information, offer customers the models that they want, and avoid holding excess inventory without compromising on resilience.

Automation enables more sophisticated integrated business planning

With the right tools, planning can be made much more sophisticated. For example, it becomes possible to:

- Create the plan interactively, with advance information and transparency into supplier activity right up to the Nth tier.
- Satisfy multiple objectives and constraints, using complex scenario planning with a clear definition of business objectives. Inventory, lead time, transportation time, cost at specific stages, and ESG should all be used as parameters for evaluation and decisions with respect to different scenarios.
- Allow decision-making to take account of a diverse set of variables. For example, the distance between production facilities and markets is a significant factor in cost and carbon footprint, and one that is more complex in the EV space given the geographical spread of the supply chain for battery raw materials.
- Help dealers improve their own planning. Providing tools and facilities to order more frequently – perhaps once a week or even every two days instead of every month or two months – would also help. Appropriate data and modeling techniques can help to optimize outbound logistics routes.



EXAMPLE 2: Obtaining supply chain visibility

Technology can be used to create visibility and intelligence around hitherto invisible aspects of the supply chain. New automated solutions are emerging to help with visibility and optimization in areas such as packaging, as well as the traditional focus, parts. These solutions provide many insights that could never be obtained through manual processes or spreadsheets, just because of the huge volume and complexity of the data.

The new solutions break down silos (both internal and external) and bring data together from all over the world. They process it into intelligence that provides a reliable basis for human decisions, as well as automating some

decision-making processes. For example, these solutions can:

- Provide multi-parameter track-and-trace for end-to-end logistics, both inbound and outbound.
- Include crisis management platforms to enable OEMs to predict and anticipate supply chain problems such as shortages of parts.
- Incorporate AI to interpret supply chain trends, make predictions, and proactively suggest risk mitigation based on data.

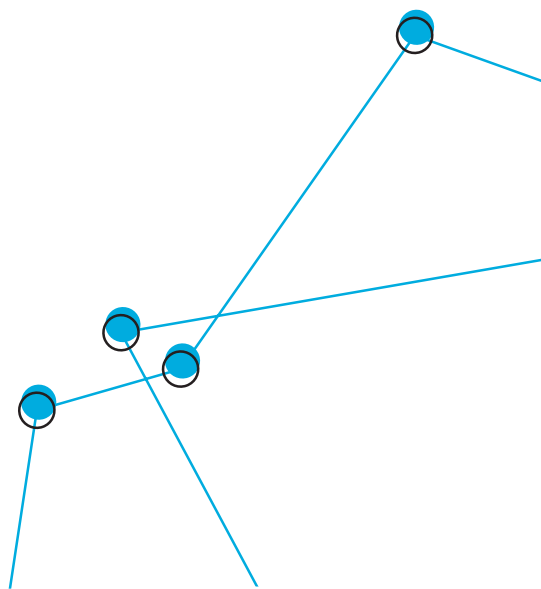
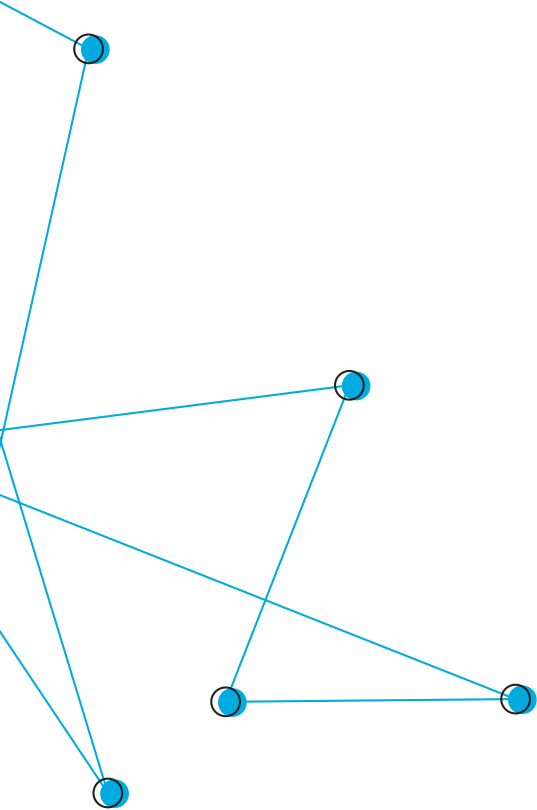


Figure 7: Six elements to address in improving visibility of the end-to-end supply chain

PURCHASING & PROCUREMENT	FLOW ENGINEERING	SUPPLIER MANAGEMENT
PACKAGING MANAGEMENT	ORDER MANAGEMENT	CRISIS MANAGEMENT



Use case example: extending supply chain visibility to cover packaging use

To meet sustainability goals, it is important to manage the packaging used for parts moving along the supply chain as effectively as the parts themselves. Technology solutions can be developed to help optimize all aspects of packaging: not just packaging design but also fill rates, flow architecture, logistics, and so on. Such a solution should reduce the use of transportation and packaging materials (including plastics and cardboard) and hence the overall carbon footprint of the business and of individual plants.

Optimizing the choice of packaging materials used to transport parts, and increasing their reuse, can deliver valuable cost savings and sustainability improvements. It becomes possible to track packaging in a similar way to parts, and to optimize the flows. For example, an organization can easily see where packaging elements are stuck in the supply chain for several days, so that decision-makers can investigate and get things moving again.

As with planning, complex modeling is integral to this type of solution. Data-derived insights can be used to determine, for example, when packaging should be reused by weighing up the savings against the cost and impact of returning or otherwise relocating a piece of packaging.

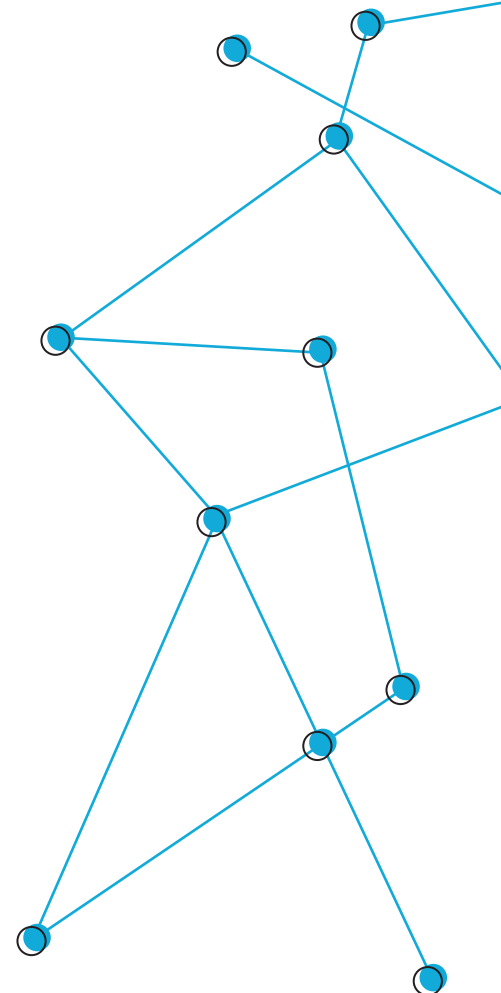
EXAMPLE 3:
Complex optimization of outbound logistics for omnichannel sales

With customers expecting an omnichannel buying experience, outbound logistics processes become an order of magnitude more complex. Optimizing these processes requires complex algorithms and sophisticated modeling techniques.

While the algorithms and techniques exist now, the computational demands may tax existing hardware platforms to their limits. Quantum technology could help in due course, because it looks set to offer unrivaled compute processing

of complex calculations at scale. OEMs need to stay aware of developments and keep refining their expectations about when quantum technology will overtake classical approaches in terms of performance and cost.

Although it is probably too early for most OEMs to do more than research and pilot quantum, it is definitely not too early to start developing an adoption roadmap. This way, it will be possible to gain a competitive advantage by acting fast when different aspects of quantum technology become viable for applications like this.





LEVER 5: TALENT

Supply chain management requires professional skills

Supply chain management is a demanding strategic and technical job whose importance has sometimes been underestimated. With current complexities, it is imperative that supply chain professionals have knowledge of data science, analytics, scenario planning, and financial decision-making.

Typically, supply chain management has been part of manufacturing, procurement, or even IT. Now, however, automotive boards are recognizing its significance. They are starting to make it a role in its own right, and to ensure it has both a budget and access to the skills it needs to carry out tasks such as scenario planning – whether these skills are internal or external.

Investing in supply chain management talent – and specifically the new skillsets required – will unquestionably save the business money and allow it to increase its revenues. The skills do not necessarily have to be internal, but may be found by engaging with expert advisors who are at the cutting edge of automotive industry supply chain management and the new disciplines it requires.

Supply chain transformation skills are scarce

Talent has always been at the heart of an effective supply chain. The skillset now required is different, though. Advanced data science and decision support skills, together with knowledge of AI, are likely to be needed to implement transformative solutions: for example, to replace the old spreadsheets and manual processes with radical new approaches to tasks such as production planning, discussed above.

As well as knowledge of the available tools, companies need people with the advanced analysis skills to formulate the requirement. And, of course, all of these skills are in short supply.

Creativity is needed to fill the talent gaps

Skills gaps can be addressed through the usual methods of upskilling and recruitment, but imaginative new approaches are likely to be needed in this highly competitive area. One option is collaboration with expert advisors, which can involve an element of skills transfer to the internal workforce. For technology skills, one option is the creation of a dedicated subsidiary – perhaps in partnership with a trusted tech company – as a “talent magnet.”



A wide range of skills are needed to make the most of data
Full use of data for supply chain optimization requires a broad portfolio of knowledge and skills, including strategy, engineering, technical and business processes, the varying regulations and legislation that apply in each region, the supplier ecosystem, and technology platforms and tools. Automakers need access to all these attributes.



THE FUTURE OF THE AUTOMOTIVE SUPPLY CHAIN: RECOMMENDATIONS

What automakers need from their supply chain can be summed up with four words: resilience, intelligence, connectedness, and sustainability. Those four words are quick to say but challenging to put into practice. To help, here are four steps that companies can take now to move them toward those goals.

1. **Rethink planning.**

Rather than a “one and done” approach to planning production at the start of each month or week, create an up-to-date planning process, based on data and insight, that gives you and your suppliers the most accurate picture of demand possible, and then continuously refines that picture. Dynamic scenario planning approaches are designed to do just that; they make it feasible to readjust plans in real time to meet current conditions. The information on which plans are based should include not just the usual forecasts from dealers, but also newer sources of intelligence such as demand sensing via social media. Also reevaluate your planning targets: Use data and multivariant scenario planning to evaluate multiple business performance parameters – including time, cost, inventory, and ESG parameters – and enable the right decisions to be made.

2. **Embrace transparent collaboration.**

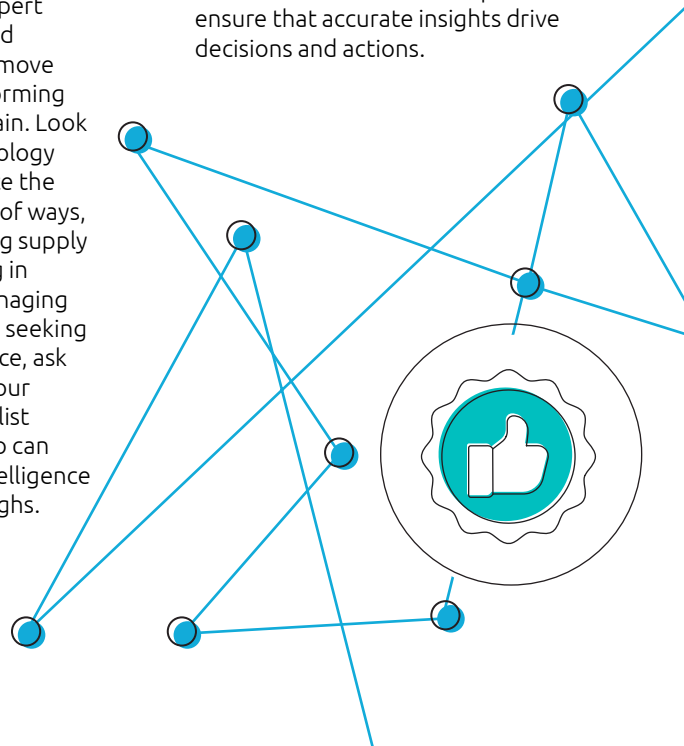
Consider whether closer supplier partnerships could increase resilience. Strengthen critical connections by promoting data sharing and mutual trust; it can be worth participating actively in industry initiatives designed to facilitate visibility. Reevaluate the number of suppliers you have in each area – would resilience be improved by having closer relationships with just a couple of suppliers? Also consider whether to collaborate directly with suppliers on lower tiers, such as semiconductor providers.

3. **Get help with innovation.**

The right ecosystem of expert advisors on technology and engineering can help you move forward fast when transforming the automotive supply chain. Look for consultants and technology experts who can accelerate the transformation in a range of ways, from creating or evaluating supply chain strategies to putting in place action plans and managing cultural change. As well as seeking their advice on best practice, ask them to help you create your own ecosystems of specialist technology providers, who can often provide advance intelligence of technology breakthroughs.

4. **Build a data-driven culture.**

Internal collaboration is also critical, since silos can undermine resilience and visibility. Move away from silo-specific KPIs and instead incentivize everyone to see the bigger picture of organization-wide targets such as net zero. Promote a data-driven culture where functions such as procurement, R&D, and quality maintain a continuous dialogue. This will build a full picture of what customers really want and need. Support cultural change by implementing an effective data platform together with strong governance and data management, to ensure that data is shareable and reliable. All this will help to ensure that accurate insights drive decisions and actions.





Conclusion:

How the automotive supply chain must evolve

The journey to a resilient, connected, intelligent, and sustainable supply chain requires a multi-faceted transformation, including the introduction of an intelligent data layer (integrating technology from hyperscalers and others) to provide visibility, decision support, and risk identification. This transformation will facilitate complex scenario planning and enable suppliers to respond effectively to dynamic decisions across the supply chain.

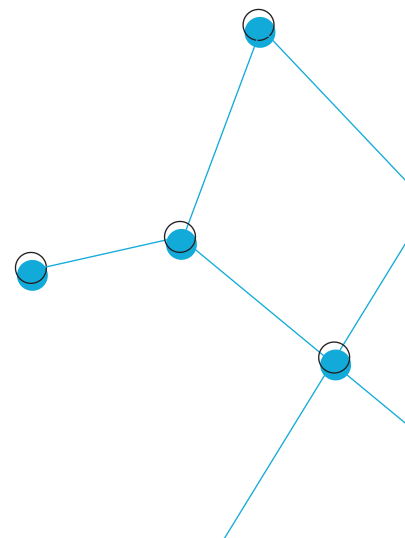
Capgemini's supply chain capabilities

Capgemini has deep experience in all aspects of **supply chain management in the automotive industry**, and also in other industries that are at the cutting edge of supply chain. We have also worked extensively with our automotive clients to optimize their decision-making to deal with recent and current disruptions. Relevant capabilities here include our combination of engineering and IT knowledge and experience, plus our ability to integrate IT and OT using APIs.

We are therefore ideally placed to help our clients transform their automotive supply chain to respond to current challenges, and are already engaged in doing so globally.

In addition, we undertake extensive research in this area. For example the Capgemini Research Institute recently published a report on [How greater intelligence could supercharge supply chains.](#)

- Automotive industry knowledge
- Global reach
- Familiarity with best practice across multiple industries
- Integrated IT and engineering knowhow
- Cross-cultural change management skills for the global environment



AUTHORS



Alexandre Audoin
EVP
Head of Global Automotive Industry



Roshan Batheri
Senior Director, Automotive Industry Leader NA
Offer Leader – Supply Chain Management – Automotive

EXPERTS

Jacques Bacry
EVP
Digital Continuity & Convergence Group Offer Leader

Mariam Belasfar
Sustainable Supply Chain and Packaging Engineering Team Manager, Caggemini Engineering

Anurag Bharadwaj
VP
Head, Automotive Industry Platform

Sven Dahlmeier
Senior Director, Intelligent Supply Chain, Automotive
Caggemini Invent

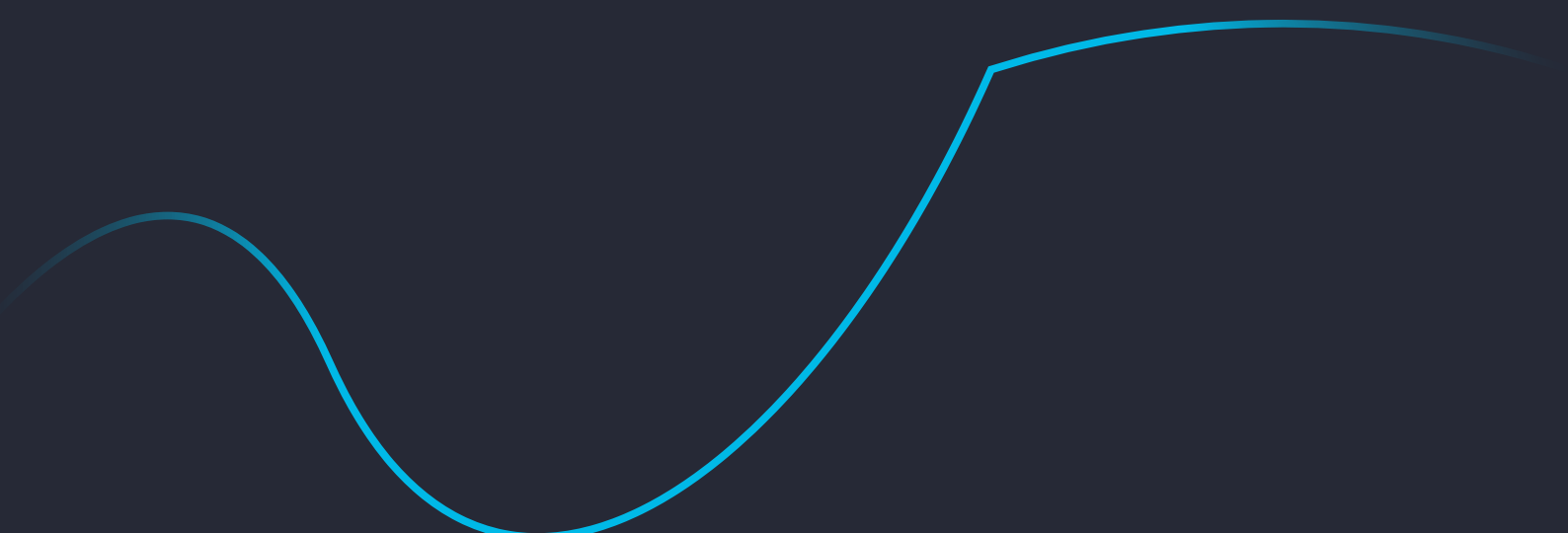
Milind Dumbre
Subject Matter Expert, Supply Chain, Caggemini India

Pascal Feillard
Senior Solution Director, Caggemini Engineering

Ruth Peters
Marketing Director
Global Automotive Industry

Maryem Sahnoun
Sustainability and Supply Chain Expert, Caggemini Engineering





About Capgemini

Capgemini is a global leader in partnering with companies to transform and manage their business by harnessing the power of technology. The Group is guided every day by its purpose of unleashing human energy through technology for an inclusive and sustainable future. It is a responsible and diverse organization of over 360,000 team members in more than 50 countries. With its strong 55-year heritage and deep industry expertise, Capgemini is trusted by its clients to address the entire breadth of their business needs, from strategy and design to operations, fueled by the fast evolving and innovative world of cloud, data, AI, connectivity, software, digital engineering, and platforms. The Group reported 2022 global revenues of €22 billion.

Get the Future You Want | www.capgemini.com