Fraunhofer
IML

FRAUNHOFER-INSTITUTE FOR MATERIALFLOW AND LOGISTICS IML

ACES - A REVOLUTION FOR RISK MANAGEMENT IN THE AUTOMOTIVE INDUSTRY?

WHITEPAPER

ACES – A REVOLUTION FOR RISK MANAGEMENT IN THE AUTOMOTIVE INDUSTRY?

Initial approaches for utilizing and enriching corporate data for managing supplier-related risks

AUTHORS
Felix Schreckenberg, Fraunhofer IML
Marco Motta, Fraunhofer IML
Saskia Sardesai, Fraunhofer IML
Philipp Klink, Fraunhofer IML
Josef Kamphues, Fraunhofer IML

CONTACT
Fraunhofer-Institute for
Materialflow and Logistics IML
Joseph-von-Fraunhofer-Str. 2–4
44227 Dortmund

INSTITUTE MANAGEMENT
Prof. Dr.-Ing. Uwe Clausen
Prof. Dr. Michael Henke
Prof. Dr. Michael ten Hompel

26. August, 2021

COVER, ILLUSTRATIONS, LAYOUT AND TYPESETTINGS
Sabrina Peters, Fraunhofer IML

DOI
10.24406/iml-n-639070

ACES – A REVOLUTION FOR RISK MANAGEMENT IN THE AUTOMOTIVE INDUSTRY?

MANAGEMENT SUMMARY

Automotive industry products are undergoing a dramatic transformation into self-driving, connected and digitalized vehicles powered by alternative drive technologies, particularly electric ones. In addition, shared mobility has given rise to new business models in which products are not used solely by the buyer's friends and family. All these changes are captured by the acronym "ACES", which stands for autonomous driving, connectivity, electrification and shared mobility.

The developments induced by ACES will change not only the nature and appearance of road traffic but also the premises on which the automotive industry operates, particularly for OEMs and their suppliers. Tomorrow's mobility solutions will still have to be manufactured; however, the production supply chain will change. The growing digitalization and electrification of motor vehicles will require new and different suppliers who will occupy an entirely different position within the supplier market than established automotive suppliers. The changes will affect not just OEMs or their first- and second-tier suppliers. The industry's transformation will trickle all the way down to the raw materials markets. For example, competition for rare earths has intensified since these materials are needed not only for many ACES innovations but also by manufacturers in industries such as consumer electronics.

In this environment, supply chain risk management is particularly important. Strategy risks and issues have to be addressed before awarding contracts to existing suppliers or establishing new, potentially unknown suppliers for ACES-related components and technologies. This demands new approaches to qualitative and quantitative risk identification, analysis and evaluation. Operating risks have to be managed better, too.

For example, OEMs have to compete with other industries for components, particularly for those needed to digitalize and electrify the products. It should be noted that competing sectors such as consumer electronics sometimes buy much larger volumes of components from suppliers than the automotive industry does. As a result, responses to risks that affect multiple sectors may not have the same effect as they would in established supplier networks that only serve the automotive industry.

This whitepaper aims to take an initial look at these aspects of risk management as ACES trends continue to unfold. It draws on interviews with automotive industry experts and scholars as well as an initial industry analysis of the supplier market conducted by Dun & Bradstreet. In addition to touching on theoretical risk management approaches, the whitepaper highlights the implications of ACES trends for the automotive industry and particularly for OEMs and identifies new supplier risks emanating from these trends. It also presents initial data-supported information from the industry analysis. The industry analysis provides an initial glimpse into the changing supplier industry as well as the changes that took place between 2010 and 2020. In addition, it shows that the supplier market began differentiating during this period, with some suppliers specializing in technologies relevant to ACES trends.

This whitepaper was written in cooperation with Dun & Bradstreet and is intended to help investigate the impacts of ACES trends on risk management within the automotive industry and to serve as a starting point for future investigations that rely on industry expertise.

WHITEPAPER

ACES – A REVOLUTION FOR RISK MANAGEMENT IN THE AUTOMOTIVE INDUSTRY?

CONTENTS

MOTIVATION

Today, the automotive supply chain is struggling with shrinking margins and increasing investments. However, these are necessary to remain competitive. [1] Furthermore, there are trends that are currently having a lasting impact on the automotive industry: The transformation-inducing developments around the acronym ACES. These include autonomous driving, digital connectivity between driver and vehicle, electrification of powertrains, and shared mobility. [2] This means that cars are becoming environmentally friendly and less equipped with combustion engines. Moreover, they are becoming more and more connected as well as autonomous in their driving ability and can be shared with other people.

These trends are already noticeable today. Worldwide, the demand for driver assistance systems is rising. In Europe, China and the U.S., the market volume of these systems, and that of autonomous driving functions, is expected to increase more than triple between 2020 and 2030 to as much as EUR 270.2 billion. [3] The Situation in automotive connectivity, which is also expected to grow continually, can be found in a similar way. [4] In addition, the number of electric cars worldwide has grown to 10.9 million electric cars in 2020 (up 3 million year-on-year), making the global electric car count 50 times larger than it was in 2012. [5] Furthermore, in Germany, for example, steady growth is showing in the number of car-sharing vehicles, which represent a part of shared mobility. [6]

Experts from the automotive industry see the politically desired electrification of the automotive market as a driver of these trends. However, environmentally driven goals are also seen as triggers for the electrification of traffic, which are related to ACES trends such as autonomous driving and the increasing percentage of software in automobiles.

THE TRANSFORMATION OF THE AUTOMOTIVE INDUSTRY

The move to electric motors will **reduce the number of components** needed. For example, electric drive systems do not need the drivetrain or related components such as the starter, petrol tank or exhaust system. While a conventional drivetrain has thousands of components, an electric vehicle only has several hundred and thus a fraction of the total components. Certain suppliers specializing in internal combustion engines are expected to have difficulties with the likely decline in revenues or will face **fiercer competition within the supplier market.** [7]

Original equipment manufacturers (OEMs) have changed their outsourcing activities, too. OEMs are adding less value in the context of internal combustion technology since they are increasingly developing in-house expertise for generating value with electronic drivetrain parts and components. [8]

In short, competition between established automotive suppliers and fast-growing, highly innovative tech companies is threatening to intensify in the supplier market. [9] ACES trends are also expected to produce lasting changes within supply chain structures. For example, there will likely be more collaborations due to the **asymmetry in ACES knowledge** between automotive and tech companies. As a result, OEMs will work with only one partner starting in the design phase, rendering proving procurement strategies (e.g. dual or multi sourcing) largely moot and making OEMs more dependent on individual suppliers. [10]

THE ACES TRENDS BRING NEW RISKS OF THEIR OWN

One prime example of ACES-driven risks relates to how **semiconductors are supplied to the automotive industry**. Semiconductors are needed to integrate ACES technologies in vehicles. Vehicle assembly lines all over the world recently had to shut down due to a semiconductor shortage. Even suppliers who incorporate semiconductors into larger components faced considerable production difficulties. [11] The shortage thus affected OEMs directly and indirectly through their suppliers. Semiconductor shortages within the automotive industry occur repeatedly due to competition with other industries such as consumer or telecommunications electronics. The silicon sub-supplier is usually booked up by the other sectors and cannot meet the automotive industry's demand for semiconductors. [11] These new risks have made **supply chain risk management (SCRM)** an even more critical discipline of supply chain management (SCM).

> "The risks used to be less digital."
>
> *Sabine Kindhammer, Purchasing Strategy and Supplier Network, BMW Group*

Automotive industry players have employed various strategies to address the risks arising within the automotive supply chain. While a **reactive strategy** involves taking action after a risk has occurred, a **proactive strategy** aims to identify and assess risks before they happen in order to prepare contingency plans and thus prevent considerable losses. [12] Researchers have recognized the need for **proactive SCRM**, particularly in the automotive industry. [13]

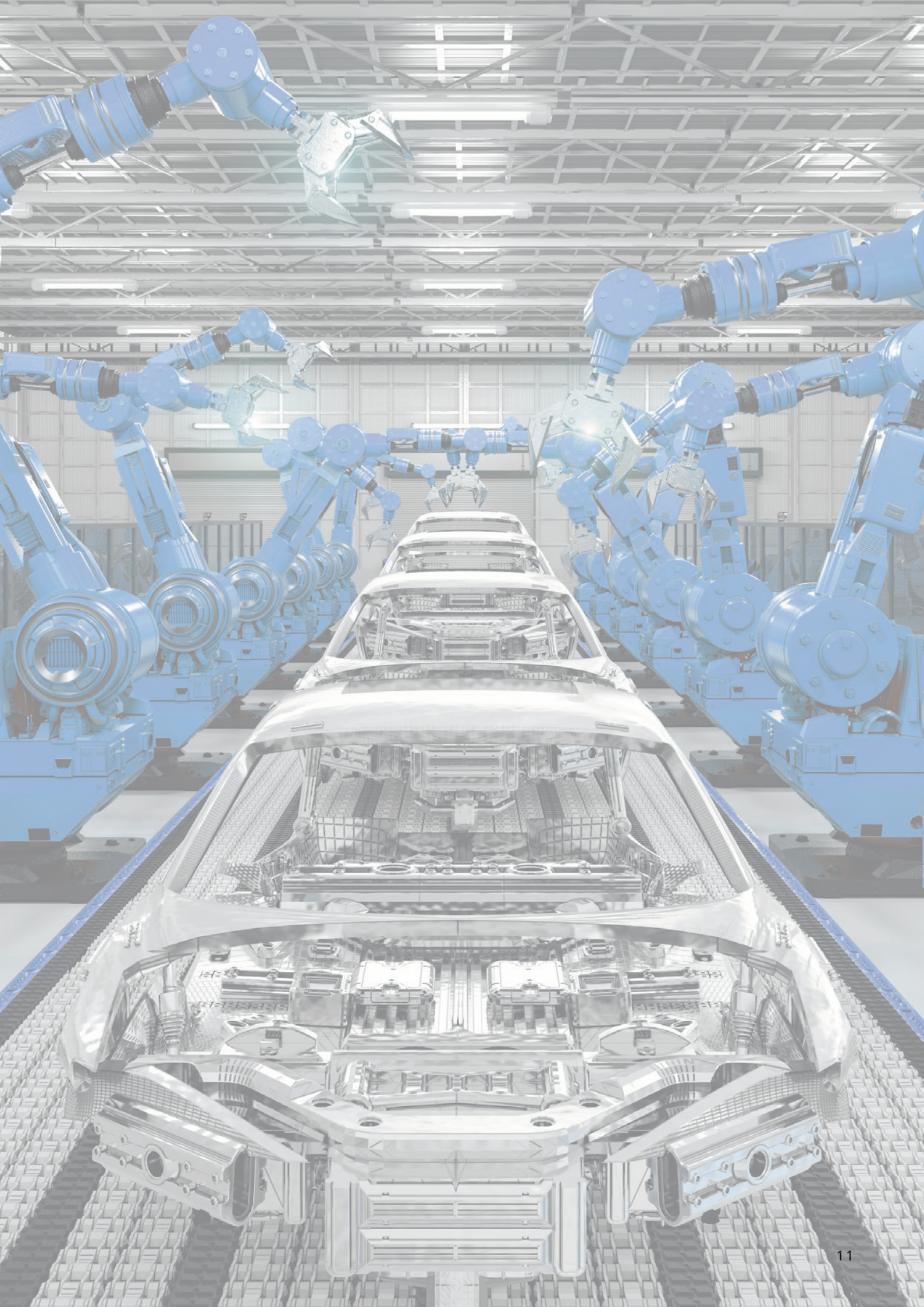
CAUTION! WEAK POINTS IN TODAY'S SUPPLY CHAIN RISK MANAGEMENT

To execute a proactive risk strategy, companies have to be able to accurately predict the probability of occurrence and the potential damage caused by the risks. [12] On the other hand, an empirical study showed that **information-sharing among supply chain members** improves their understanding of the risks as well as the impact of these risks on the supply chain. [14] **By sharing** relevant data **throughout the supply chain for specific purposes**, participating companies could gain the ability to respond more quickly to changing conditions within the supply chain and recognize and manage risks. [15/16] They can then employ proactive risk management along the entire supply chain based on risk-related data and information in order to increase security of supply, including in connection with the ACES trends [14].

However, some questions remain unanswered: What will the supplier market do in the transitional period between conventional and electric drivetrains? Are there signs of new diversification driven by ACES? How does this affect risks within the supply chain?

Next, this whitepaper consolidates information on the four big trends hitting the automotive industry – summarized as 'ACES' – and on SCRM. It also identifies weaknesses in how OEMs are currently approaching risk management. By presenting the impacts of ACES on the supply chain, it identifies additional supplier-related risks.

The information required for this analysis is extracted from interviews conducted with experts from the automotive and supplier industry and from the academic and research communities. Information about the impact on the automotive supply chain is also culled from analyses based on data from Dun & Bradstreet's worldwide database, which contains more than 400 million company entries and information on companies, their corporate ties and basic financials.



THE FOUR BIG TRENDS IN THE AUTOMOTIVE INDUSTRY

As described in the introduction, the automotive industry is currently grappling with the four big trends covered by the acronym "ACES". The four ACES technologies have evolved at different paces but are closely intertwined [17] and are described in more detail below and in Figure 1.

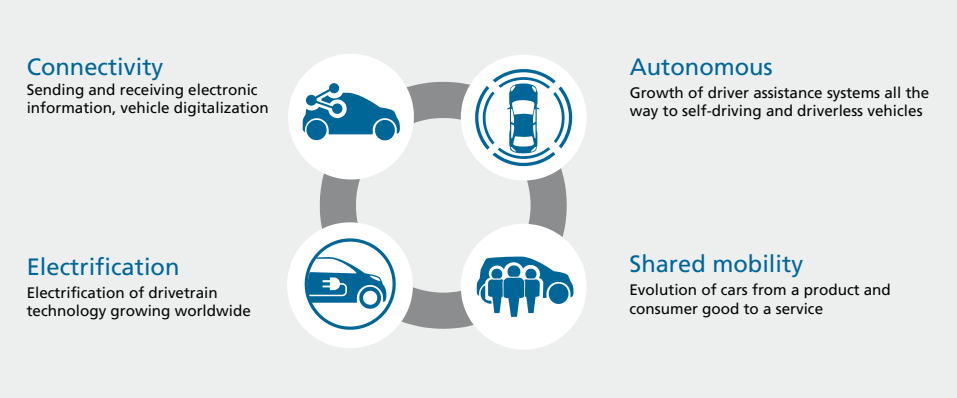


Figure 1: ACES technologies (own figure)

Vehicles are called **autonomous** if they can operate without a driver and can drive themselves. The automobiles entering the market today are generally semi-autonomous but require a human driver to be present. Level 5 vehicles are intended to eliminate all human attention at the wheel. [18] Driver assistance systems and particularly autonomous driving functions are growing; the global market value of $80.2 billion in 2020 is forecast to grow to $270.2 billion by 2030. [3]

The **connectivity** trend refers to connecting automobiles to networks so that they can send and receive electronic messages and information. Connectivity also includes the ability to push data and software updates to a vehicle from the cloud. [18] The growth in automotive connectivity is driven by factors such as urbanization as well as demographic change as digital natives are taking the wheel. [8] Growth in automotive connectivity should be fairly consistent. In 2020, the share of connected cars stood at 32% in the US, 26% in the EU and 16% in China but is forecast to increase to 97% in the US, 93% in the EU and 72% in China by 2035. [4]

Drivetrain **electrification** is a trend with environmental and political implications. Electric vehicles with adequate batteries are the ideal choice for autonomous driving, which requires tremendous amounts of energy for sensors and processors. [18] The number of electric vehicles grew to 10.9 million worldwide in 2020 – an increase of 3 million over the previous year. The global stock of electric vehicles is thus 50 times larger than it was in 2012. [5] If the forecasts are borne out, newly registered electric vehicles will continue to expand their global market share. The market share was only approx. 5% in Germany in 2020 but is expected to grow to 28% by 2030.

Similar trends can be observed across Europe and in the US and China. In fact, the market in which electric vehicles are expected to occupy the largest share (38%) is China. [19] The growth will be achieved by improving electric vehicle range, for example. This is why OEMs and battery manufacturers have focused much of their technological efforts on developing better batteries. New technologies will likely unlock more long-term value after 2025. In addition, battery costs will fall steadily due to new materials and processes and larger production runs. [8]

Shared mobility refers to the trend of sharing means of transportation (e.g. ridesharing). Studies suggest that the rate of car ownership among young people is declining. [18] Shared vehicles are projected to account for approximately 4% of global passenger kilometres in 2025. By 2035, up to 18% of global passenger kilometres will be covered in shared vehicles. [20] Transport expenses for individual mobility services such as car sharing, car hires and ride hailing are expected to rise 95% in Germany, 114% in the US and 358% in China over 2015 levels by 2040. [8] The shared mobility community is growing fast in countries such as China, as evidenced by the growing market size of car sharing services, which amounted to ¥0.36 billion in 2017 and is estimated to reach ¥19.05 billion in 2020. [21]

EXCURSUS: OEM RISKS AND OPPORTUNITIES FROM ACES

To what extent will ACES result in changes and implications for OEMs other than changes to their supplier structures and supply chains? All trend areas generally present foreseeable risks and opportunities. The **growing connectivity and autonomy of vehicles** should be viewed as a huge opportunity. It generates **large volumes of data** that can be used and processed in order to obtain insights (on user behaviour, etc.). [22] The corresponding risk, however, is **data protection**, which is both strictly regulated and widely debated. [23] Autonomous driving also presents the **problem of liability shifting** along the supply chain since riders cannot be held liable for the vehicle's driving mistakes. [24]

One factor favouring drivetrain electrification is that many governments have supported electric mobility through purchase incentives [25] and emission limits [26]. Will that present a risk when the government support disappears? Shared mobility also presents OEMs with challenges: Instead of producing one car for one customer, they have to manufacture vehicles for a large number of different drivers. The car is viewed more as a service than a product. While model cycles are shorter since the sharing market – i.e. the buyer – establishes new models more quickly, the total number of vehicles is declining. [27] In addition, vehicles and their interiors have to be adapted to new usage patterns. [28] As discussed earlier, the trends will do more than just change road traffic and OEM business models; they will transform automotive supply chains. These shifts will increase supply chain sensitivity, driving uncertainty and raising the importance of supply chain risk management. [29]

Before exploring the impact of ACES trends on the supply chain and OEM-supplier relationships, it is necessary to present information about supply chain risk management and the main risk types evaluated in this whitepaper.


SPEED
75
Km
Ai

SUPPLY CHAIN RISK MANAGEMENT

Supply chain risk management (SCRM) considers risks that occur in a supply chain and represents a sub-discipline of supply chain management (SCM). It combines strategies, measures, information and processes in order to identify and assess risks within a supply chain and thus generate a solid foundation for future decisions. [30] Unlike risk management within individual enterprises, risk management for a supply chain that spans multiple networks is characterized by interactions within the risk analysis process as well as delayed long-term negative supply chain consequences of a risk event. [31]

WHAT TYPES OF RISKS EXIST?

Put briefly, **supply chain risks** can be viewed as a **disturbance or disruption with a quantifiable probability of occurrence** that affects the entire supply chain instead of just a single company. [32]

As shown in Figure 2, risks may arise in the supply chain environment (e.g. weather-related risks) and within the company (e.g. process and management risks). Cyber and sustainability risks play a role, as do supplier and customer risks within the supply chain. While customer risks mainly depend on demand, supplier risks generally present supply risks to the sourcing company. Particular attention must be paid to the sales-procurement interfaces when addressing risks within an automotive supply chain. [33]

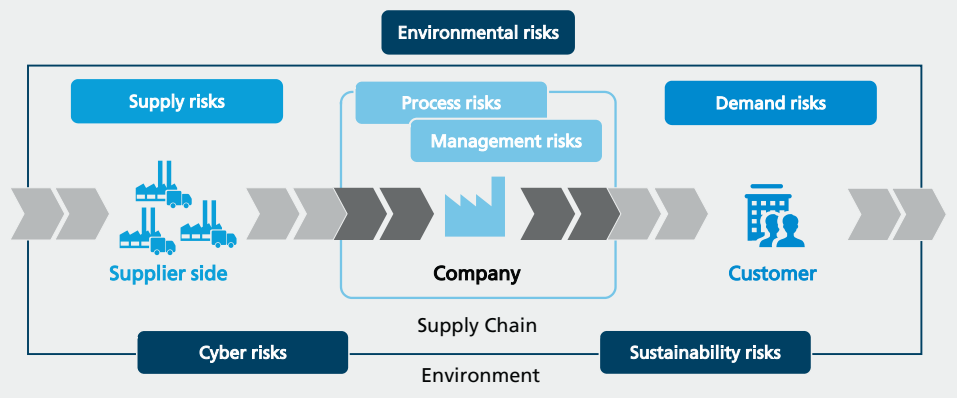


Figure 2: Supply chain risks (based on [34])

The supply risks targeted by this whitepaper that occur upstream in the supply chain may be **strategic** or **operational**. While operational risks focus on the threat to short- to medium-term objectives, strategic risks affect long-range goals and should therefore be viewed as a threat to the entire company. [35]

The automotive supply chain is exposed to a wide variety of **supplier-related risks**. Supply risk sources include an inability to handle demand fluctuations, non-competitive prices, a failure to meet product or quality requirements and technological product changes that cause suppliers to fall behind industry standards. [36, 37]

Operational supply chain risks include risks caused by equipment failures or human error. However, risks may also be triggered by impediments to operations or other external events. [38] For example, operational risks covered by this whitepaper include downtime risks due to missing components and/or materials as well as obstacles within the supply processes.

Strategic supply chain risks that may occur on the supplier side of the relationship include increased dependence on a member of the supply chain or the loss of knowledge to suppliers or other competitors. [39] The incompatibility of buyer (i.e. OEM) and supplier strategies also counts as a strategic procurement risk. Associated risks primarily relate to the suppliers' strategy or market practices and are triggered by events such as the supplier realigning its strategy or changing owners. The worst-case scenario is a supplier becoming a competitor. Another possible risk is the divergence of the buyer's and supplier's technological roadmaps. This can cause the supplier to fall behind technologically and be viewed by the OEM as a strategic risk. In addition to strategic supplier risks, which OEMs can influence by treating the supplier fairly or unfairly, there are also risks that arise when the OEM does not account for a large enough share of the supplier's revenues.In this case, the supplier may not devote enough attention to the buyer and thus not treat it as a high-priority customer during a shortage. [40]

The next section considers what the general supply chain risk management process should look like and how to identify and manage strategic upstream risks.

SCRM APPROACHES AND METHODS

According to ISO 31000, the risk management process breaks down into three phase that build on each other: establishing the context, risk assessment and risk treatment. [41] The resulting cycle is illustrated in Figure 3.

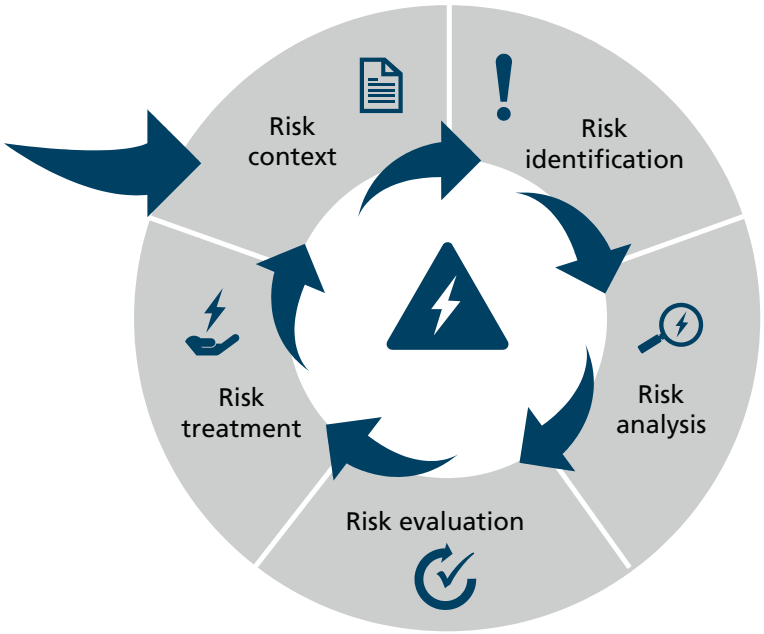


Figure 3: The risk management process (own figure)

Firstly, the **risk context** is established. [41] Also, internal and external boundary conditions are set and basic risk management decisions taken such as on trends that influence organizational objectives. [42]

Next comes the main phase in the risk management process: **risk assessment**, comprising risk identification, analysis and evaluation. [41] **Risk identification** systematically captures the company's relevant risks. This is a particularly important step since risks can only be assessed and managed if they have first been identified. Risk identification thus has a direct impact on process effectiveness. [43] If a company has no direct experience with relevant risks, it will have to identify them based on outside experience. This experience may come from competitors, supply chain partners or customers. Risks may also be identified by brainstorming, which renders implicit knowledge explicit. Key risk identification tools include risk checklists, risk workshops or conventional weighted sum analyses. [33] However, regular supplier scoring or financial information can also shed light on risks. [37]

Risk analysis involves analyzing risk causes and risk extent, which may be positive or negative. This step also aims to determine the probability of a risk event occurring. [41] VDA Volume 4 contains methods and approaches for analyzing risks in the automotive industry. It presents tools such as the fault tree analysis, failure mode and effect analysis (FMEA) and the SWOT analysis. [33]

Next, during **risk assessment,** risks are selected and prioritized based on the results of the previous steps. [42] Assessment can be quantitative or qualitative and involve procedures such as comparing the risk impact to the probability of the risk occurring. [44]

The next step is **risk treatment**, which defines how to handle identified and prioritized risks using defined strategies and measures. [42] The drivers of supplier risks and the cost and damages caused by supplier risks can be reduced in the course of managing strategic supply risks. [40]

Indicators can serve as tools for capturing potential risks at an early stage, acting as a kind of **early-warning system** that constantly monitors identified risk sources. One of the key qualitative indicators proposed in the literature is the observation of any changes in the supplier's responses to inquiries or suggestions for improvement. One possible quantitative indicator for monitoring strategic procurement risks is the percentage of total supplier revenue that is generated with the buyer. However, it is important to compare this number to other customers' percentages as well. [40]

As described earlier, supply chains now generate more data. That raises the question of how to best use the data for monitoring strategic supply risks. What quantitative indicators can be used for data-driven management of strategic risks? To what extent can reliable predictions be made of upcoming risks based on knowledge of a company's age, revenue levels or where its head office is domiciled? How are supply chain risks actually managed in the automotive industry apart from this theory? Experts in the automotive and supplier industry were surveyed in order to describe the above procedures and opportunities for improvement.

SCRM APPROACHES IN THE AUTOMOTIVE INDUSTRY NEED IMPROVEMENT

The interviews indicate that the frequent **lack of transparency** along the entire supply chain, especially toward n-tier suppliers, gets in the way of proactive risk management and makes it impossible to take early action to head off supplier-related disruptions.

> "We are still stopping at the first tier far too often instead of ensuring transparency across all n-tiers."
>
> *Sabine Kindhammer, Purchasing Strategy and Supplier Network, BMW Group*

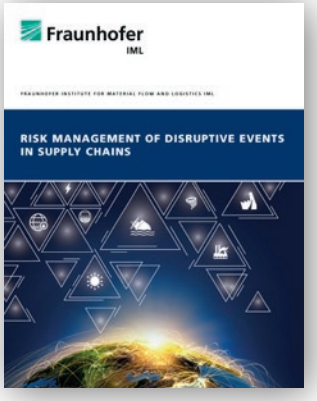
There are calls for new supply chain processes to be structured transparently and comprehensibly from the start. Changes in the suppliers' supply chain – whether in terms of composition or physical distance – must prompt an investigation into ways to enable early predictions of unusual incidents and measure the resilience of the modified supply chain. Answering these questions can clarify how to detect deviations within the supply chain early enough to solve the underlying problem more quickly and inexpensively.

Good supply chain process transparency is desired for products such as raw materials in order to achieve compliance and sustainability objectives. However, potential supplier insolvencies also have to be spotted early on in order to adapt the procurement processes.

One problem identified by experts in modern-day SCRM is the existence of legal barriers to full transparency. When OEMs purchase components all over the world, they may do business in countries with very different requirements for publishing financial and other information. It may be difficult to obtain reliable basic information about suppliers at short notice, especially in countries that do not require regular financial reporting.

To answer the question of whether ACES trends exacerbate this kind of shortcoming, the next section of this whitepaper looks at product structure changes and their impact on the supply chain and risk management.

Excursus: At this point, we would like to draw attention to other whitepapers published by the Fraunhofer Institute for Material Flow and Logistics that focus on supply chain risk management.



Kiebler L, Ebel D, Klink P, Sardesai S, Risk Management of Disruptive Events in Supply Chains; Dortmund; 2020

Klink P, Sardesai S, Gehring J, Görtz MD,
FAST RAMP-UP: Anlaufmanagement nach disruptiven pandemischen Ereignissen. Whitepaper im Rahmen des Forschungsprojekts "*Fast Ramp-Up*"; Dortmund; 2020

IMPACT OF ACES ON SUPPLY CHAIN RISKS IN THE AUTOMOTIVE INDUSTRY

In addition to the increasingly volatile economic environment, the automotive industry is undergoing a profound, inherent transformation process due to ACES-driven developments. We wanted to answer one largely overlooked question: How should the changing risk environment be handled in future? Since value generation has always been widely distributed along the automotive supply chain and ACES will likely bring change to the supplier industry as well, risk managers should also consider the **new requirements that supplier-side risk management has to meet.**

To gain an initial sense of what kind of action was needed, we combined **qualitative** and **quantitative** methods for the first time while preparing the whitepaper. After searching the literature for classification criteria for risk management (the findings are presented in previous chapters), we qualitatively "deepened" these theoretical insights by conducting **key question-based interviews with industry experts** from the automotive sector, consultancies and academia. The analysis considered both the OEM's situation and the suppliers' perspective with particular regard to the industry.

Data for assessing the situation is absolutely essential for future proactive risk management. "Conventional" risk management typically looks at the companies' financial figures. To quantitatively validate the interviewees' statements and determine the extent to which current data stocks support **risk management that is adapted to ACES challenges**, quantitative analyses of changes in automotive supplier networks were conducted **based on a large dataset** supplied by Dun & Bradstreet.

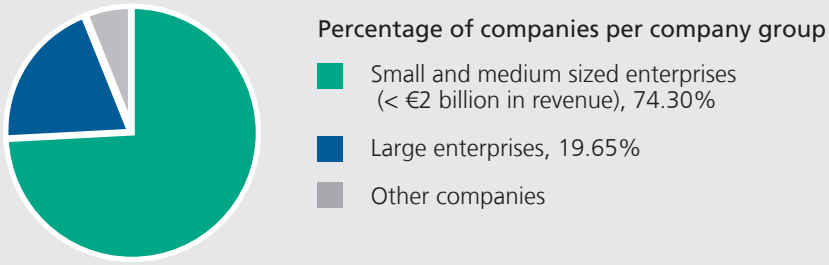
The quantitative analyses were run on a Dun & Bradstreet company data portfolio comprising **more than 400 million company entries**. A two-stage filtering process sifted through the data to obtain information on the world's largest and most important automotive suppliers as well as their subsidiaries and branch offices. Next, the selected company data for 2020 was compared with the same data points from 2010 in order to help determine the impact of developments such as ACES on the supplier industry. All told, 810 (in 2010) and 654 (in 2020) supplier groups, comprising more than a quarter million company data records, were compared with one another.

One important concern is the quantitative analysis of the impact of ACES on the company portfolio. It swiftly revealed the limitations of the current industry codes, which were not granular enough to classify the changes and areas of specialization in portfolio companies' operations in enough detail to allow any inferences about the impact of ACES.

Composition of evaluated company portfolio, 2010-2020

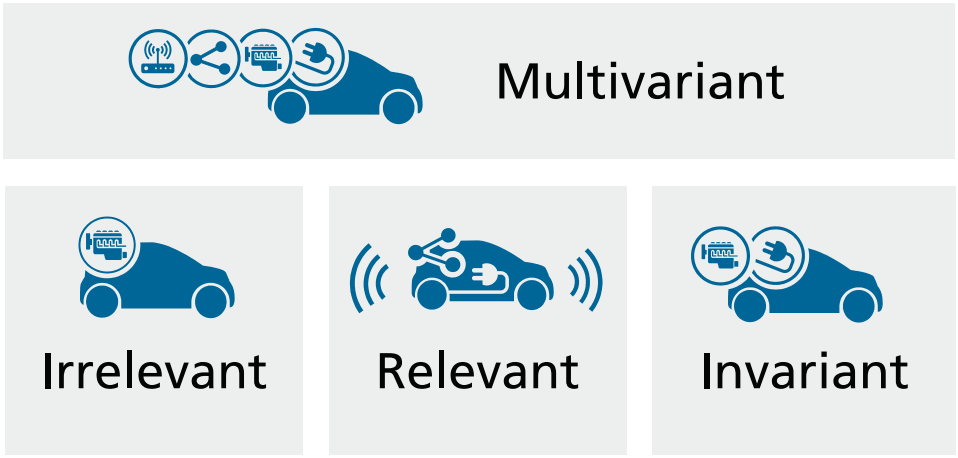
Large companies constitute only a small portion of the supplier industry (approx. 20%) but possess tremendous economic firepower. According to an analysis of their financials, they appear to be the most likely to meet OEMs' requirements. They grow profitably and inexorably, follow their customers' globalization lead and prove to be adaptable by entering new business fields. Small and medium-sized enterprises with revenues below €2 billion still constitute 74.3% of the analyzed company portfolio.

From the Dun & Bradstreet analyses [45]



To address these limitations, Dun & Bradstreet enriched the data using a **web crawling approach** before the analyses were conducted. The next step was to define German and English keywords that are typical of technologies, products and inputs for a particular aspect of ACES or for an internal combustion engine drivetrain. The portfolio companies' websites were automatically analyzed using a multi-tier system and the hits from this web crawling process were then incorporated into the company data.

Figure 4: Company categories in web crawling (own figure)



Keyword frequency and distribution on the various company websites yielded four company categories that characterized the company's relationship to ACES technologies. As Figure 4 shows, the company categories are:

- **Irrelevant**: Companies that largely focus on internal combustion technology and systems
- **Relevant**: Companies that primarily develop and produce technologies that are relevant to ACES trends
- **Invariant**: Companies that specialize in technologies and systems used in electric vehicles and in vehicles powered by internal combustion engines
- **Multivariant**: Companies that fit into the above categories equally well

This generated more detailed information about the portfolio suppliers' current product and service range. Expert interviews and quantitative analyses highlighted the key impacts of ACES on current supplier networks. They break down into four categories: "Composition of the supplier portfolio", "Evolution of companies in the current supplier portfolio", "New dependencies in the supplier portfolio" and "Geographic shifts within the supplier portfolio". These categories are presented below.

Seifert M. ACES - A revolution for risk management in the automotive industry? Results from a data analysis. Darmstadt: Dun & Bradstreet; 2021 (Dun & Bradstreet Insights).

COMPOSITION OF THE SUPPLIER PORTFOLIO: NEW TECHNOLOGIES – NEW SUPPLIERS?

One element of the ACES-driven transformation, drivetrain electrification, will gradually **replace the internal combustion engine** with alternative drivetrain technologies. The interviewed experts had observed changes in the supplier market that were driven by ACES trends. They noted that electrifying the drivetrain directly impacted the supplier structure.

> "The market will obviously change – maybe not everywhere since it's dependent on the components. Companies who have committed all their resources to internal combustion engines or were completely unaware of this will obviously encounter problems in future."
>
> *Tobias Liebelt, COO, Benteler Trading International*

It is worth remembering that multiple drivetrain systems will co-exist during a transitional period, which will likely expand the supplier portfolio and thus increase the **complexity of risk management in the supplier network**. However, drivetrain electrification is not the only factor affecting the supplier market. Autonomization, digitalization and connectivity will also increase the percentage of **electronic components** such as **controllers and sensors** in vehicles; the importance of software in vehicles will grow as well. The ACES trends will likely attract new players to the supplier market who may not necessarily hail from the automotive industry. These market changes will likely be driven by the components.

> "As the share of software in the vehicle grows, OEMs will have fewer hardware-based supplier relationships in future: whether in the classic parts business, which will be greatly reduced due to the number of parts in an electric motor versus an internal combustion engine, or in relatively standardized computer components that can perform a lot of actions at the software level."
>
> *After Sales IT Director, automotive industry*

On the other hand, supplier groups that focus exclusively on internal combustion engine technology will conceivably see their incoming orders decline. For example, iron foundries that specialize in casting engine blocks will have a **smaller sales market** due to drivetrain electrification. These highly specialized companies will probably be replaced by more diversified suppliers with broader portfolios. This is the reason behind the apparent consolidation of conventional automotive suppliers in the market.

Consolidation in the automotive supplier market, 2010-2020

Within the company portfolio, 11,254 subsidiaries and/or branch offices in 463 corporate groups have been sold and 15,902 closed over the past ten years. 12,146 have been established and 35,051 purchased. Only one third of today's companies existed 10 years ago. The analyzed data reveals regional trends. However, the growth markets are China and North America.

From the Dun & Bradstreet analyses [45]

The next important question about risk management in the supplier network concerns the process of observing "conventional" suppliers of internal combustion engine components transition to alternative drivetrain systems, as described in the next section.

EVOLUTION OF COMPANIES IN THE CURRENT SUPPLIER PORTFOLIO: NEW OR DIVERSIFIED PRODUCT PORTFOLIOS?

Suppliers have to update their product portfolios, especially as drivetrains become electrified and vehicles are digitalized. The discussions with industry experts indicate that the **change in the supplier portfolio** presents new challenges for sourcing and the associated risk management.

When a current supplier changes its product portfolio, its production operations for new ACES-related parts and components may initially be less robust than those in its established product segment. On the other hand, if the supplier does not change its product portfolio to accommodate ACES technologies, it might end up being unable to respond to market shifts in the medium term. OEMs who decide to source parts required for ACES from new suppliers, especially if they are completely new to the supplier market, have to do so without any reliable information. They lack established business relationships with proven escalation paths if a risk occurs. Nor can they employ established risk management methods such as financial statement analyses before selecting suppliers that are new start-ups or joint ventures.

"New joint ventures or start-ups use entirely new business models that we have to monitor very differently than before. For example, you can no longer estimate risk based on financial statement analyses. We need different approaches."

Risk management, automotive supplier

Findings from a web crawling analysis on the relevance of companies to ACES, 2020

The large enterprises in the web crawling analysis are represented more heavily in ACES technology development and specialization than the mid-market suppliers in the analysis.

Around 38% of selected large enterprises focus on ACES technologies; only 19% specialize in internal combustion engine technology. The remainder consists of large enterprises that fall into the multivariant (26%) and invariant (17%) categories and thus cover a wide technological range.

In contrast, only one fifth of the evaluated small and medium-sized enterprises specialize in ACES technologies. More SMEs (approx. 29%) have no connection to these technologies at all and are thus classified as irrelevant. In addition, approx. 38% can be categorized as invariant and approx. 14% as multivariant.

From the Dun & Bradstreet analyses [45]

Large enterprises

- relevant, 38,1%
- multivariant, 26,19%
- irrelevant, 19,04%
- invariant, 16,67%

Small and medium sized enterprises

- relevant, 20%
- multivariant, 13,6%
- irrelevant, 28,8%
- invariant, 37,6%

It therefore follows that risk management plays a particularly important role, both when dealing with established suppliers and when adding new suppliers to the portfolio in the industry transfer process. It is also safe to assume that comprehensive quality and availability management is enormously important for the short-term management of operational risks: New suppliers who underestimate or are not yet unfamiliar with the dynamics and demands of the automotive industry may exhibit **delivery delays** and/or **quality problems** since their planning, production and delivery processes are less mature than those seen in established supplier relationships.

However, even existing suppliers may present start-up risks such as **decreased process stability or quality, transport and storage risks** when they branch out into new business segments with new technologies.

> "Take electronics components: They have totally different transport and storage needs than, say, drivetrain elements made out of aluminium or any other metal. They demand special transport and storage processes that incorporate specific mandatory requirements such as temperature and humidity monitoring."
>
> *Tobias Liebelt, COO, Benteler Trading International*

At the same time, paradigm shifts in product development and management – such as different methodologies and team compositions – have to be taken into account. These risk aspects are not specific to the supplier market; OEMs themselves also venture into new technological territory and may thus become a "source of risk" to suppliers if, say, their call-off volumes fluctuate or their processes are not yet completely stable.

NEW DEPENDENCIES IN THE SUPPLIER PORTFOLIO: IMPORTANCE OF OEMS WITH NEW TECHNOLOGIES?

The **technological transformation** is changing the supplier market. The new suppliers possess **different knowledge**, are positioned differently and employ different **business and collaboration models**. One change seen at OEMs that was also described in the interviews is the development of partnerships with software development companies in particular.

The **resulting connection with development companies** is different from that seen with suppliers who manufacture physical parts. OEMs who partner with one company and lack knowledge about software and other aspects of digitalization may end up in an **inverted version of the classic supplier-OEM relationship**. OEMs could become dependent on this type of supplier; software developers, for example, serve customers from other industries as well. However, OEMs are also attempting to develop independent solutions in order to avoid becoming dependent on these partners. That also allows them to maintain some flexibility with regard to their own product.

In addition, ACES-driven developments, especially vehicle digitalization, require the same expertise and components as those used in industries such as consumer electronics. OEMs are thus **competing directly with other industries** that have no immediate ties to the automotive industry.

That means OEMs will have to battle tech companies as well as other OEMs for Materials such as the semiconductors mentioned in the introduction.

> "Semiconductors are a prime example: The automotive industry is not always the top priority for these suppliers. That is why we have to generate enough volume to change that attitude in future."
>
> *Financial control, OEM*

New supplier market for ACES technologies

Regardless of the above developments, a new supplier market for ACES technologies appears to be evolving alongside the established players. Firstly, other high-profile companies are entering this market from other segments. Secondly, a host of new highly local or regional mid-market companies are being established and making a name for themselves, including several with little financial firepower of their own.

From the Dun & Bradstreet analyses [45]

GEOGRAPHIC SHIFTS WITHIN THE SUPPLIER PORTFOLIO: NEW REGIONAL SUPPLIER CLUSTERS?

There has also been a **general geographic shift within the supplier market**. Much of this shift has been precipitated by ACES technologies since many semiconductor products are now sourced in Asia.

As described above, automobiles are evolving into digital, technology-driven products that require constant updates. New competencies are needed in order to provide customers with these regularly updated digital products. As competencies have become **geographically concentrated in certain key regions**, there has been a regional and substantive shift in competencies and associated experts. In this context, adequate risk management requires appropriate in-house knowledge and avoidance of excessive regional dependencies with regard to expertise and production capacity.

Examples of regional clusters include batteries from Korea, electric motors from China and rare earth metals that all modern technologies require.

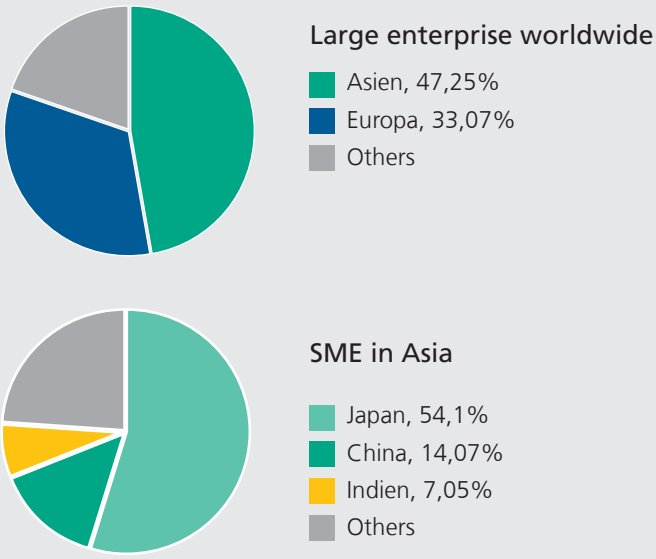
Geographic distribution of automotive suppliers, particularly in Asia, 2020

Almost half of the current large enterprises analyzed in the portfolio are domiciled in an Asian country. European / German companies, in contrast, make up only around one third of the total.

Some (approx. 42%) of the large Asian enterprises are regionally focused on Asian markets. That number shoots up to 62% for small and medium-sized enterprises.

The most common locations for Asian SMEs are Japan (54.1%), China (14.1%) and India (7.1%). The fastest-growing companies are located in China.

From the Dun & Bradstreet analyses [45]



It should be noted in this context that there are strategic supplier-related risks due to dependencies on these **geographic monopolies** as well as operational risks from a material shortage or a loss of suppliers. Conditions are even more difficult for the latter group due to the extended supply chains and long logistics lead times.

RISK MANAGEMENT IN THE AUTOMOTIVE INDUSTRY'S SUPPLIER NETWORK – WILL ACES EXACERBATE THE SIGNIFICANCE OF CURRENT WEAK POINTS?

Even without the impact of ACES on risk management, one of the main risk management challenges is to obtain **transparency into the n-tier supply chain**, i.e. the upstream suppliers all the way up the supply chain to the raw material supplier. This is only intensified by the ACES-driven risk management of supply chains. Often, little is known about upstream suppliers at lower tiers; the interviewees noted that the situation is even worse with some parts, particularly with electronics components.

> "New technologies mean less transparency. For example, we have very little solid information on where transistors and other microchip inputs are procured. This shortens the electromobility supply chain that we can monitor with a reasonable amount of effort."
>
> *Financial control, OEM*

This is where better **information about upstream suppliers** could support **proactive risk management** since risk event responses will likely take longer due to suppliers doing business with a wide variety of industries:

Automotive companies are not the only customers for these suppliers, nor are they the largest. Many of the interviewed experts suggested a **legal or contractual solution to this problem**; however, it would necessarily be limited to the OEM's direct business partner.

In addition to this requirement, which pre-existed ACES, many interviewees brought up **supplier sustainability requirements** in connection with the ACES trends. One factor driving ACES and drivetrain electrification in particular is the desire among consumers and politicians for more sustainable road vehicles. This desire comes with the challenge of understanding and guaranteeing sustainability along the entire supply chain.

> "It's senseless to produce a sustainable electric vehicle while violently contradicting sustainability principles throughout the supply chain."
> *Sabine Kindhammer, Purchasing Strategy and Supplier Network, BMW Group*

ACES-driven developments have focused the spotlight on **data protection**. Current innovations are assumed to generate an ever-expanding stock of data that will have to be properly protected. However, the innovations themselves also have to be protected since they constitute intellectual property.

CONCLUSION AND OUTLOOK

"Mobility of the future will have to be produced." [46] Even with all the industry **changes wrought by ACES**, manufacturing will be an essential and indispensable prerequisite for **future mobility**. In future decades, automobile production managers will be occupied with analyzing the process and orchestration of value generation in global supply networks.

The interviews conducted with industry and academic experts showed that risk management is more relevant than ever in the **currently volatile environment of sales and procurement markets**. Transparency was mentioned time and again separately from the changes sweeping through the industry. It is urgently needed, too, as highlighted by Dun & Bradstreet's initial **quantitative analyses** of data from a **selected portfolio of automotive suppliers**. These still relatively superficial analyses were powerful enough to reveal a **differentiation process** without even assessing the resulting risk exposure and the associated future viability of the companies. However, **this evaluation of future risk exposure**, along with knowledge about the supply chain members and the companies upstream from the first and second tier suppliers, is exactly what risk managers will need in future.

As the ACES trends accelerate, risk management should be thoroughly and rigorously divided into strategic and operational risk management and embedded in a **learning risk management cycle** in which lessons learned are incorporated into future risk management measures through a long-term feedback loop. The supplier market will welcome new players that OEMs do not know and that are not yet familiar with the specific characteristics of the automotive industry.

In this case, the **first challenge** may be to **evaluate the strategic risks**. The internal combustion engine will play an unshakeable role in the years ahead; however, other drivetrain technologies will appear on the roads as well. To facilitate this shift, OEMs will have to find the right partners to roll out technologies such as drivetrain electrification. This will likely broaden the supplier base, at least temporarily, and bring in new players to act as suppliers. In other words, **risk management will become more complex**, at least temporarily, and should be **proactively** prepared for that to happen.

New data sources are also needed in order to enrich the risk management process and develop specific classifications, as shown in Figure 5. This allows appropriate portfolio analyses to be conducted. The authors view this as an **industry-wide challenge** that still requires some basic work to be done. Collaboration can help by pooling the experiences of multiple players in order to drive the development of a sound foundation for forward-looking risk management and appropriate database requirements.

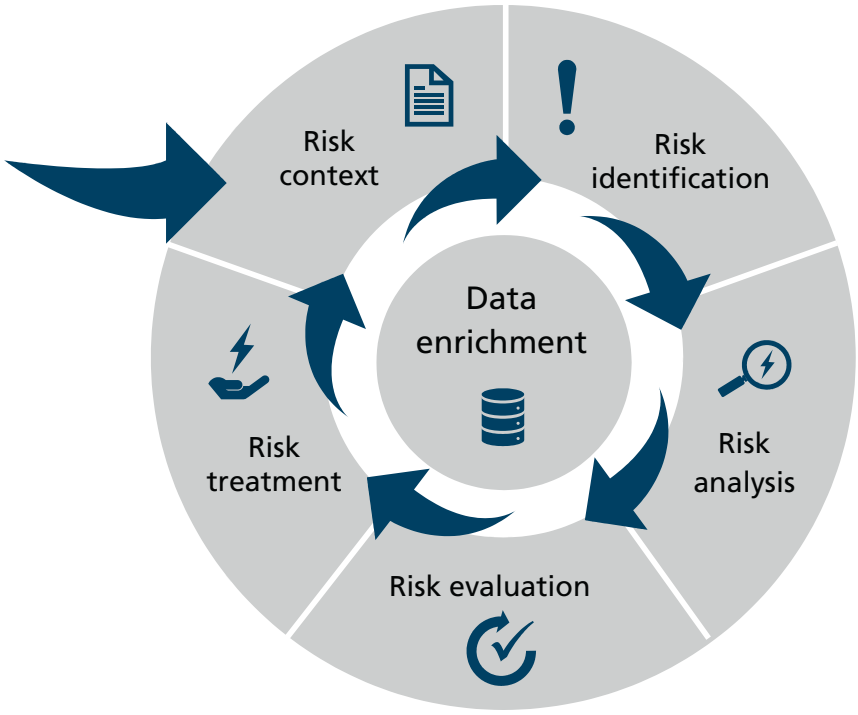


Figure 5: Supporting the risk management process through data enrichment (own figure)

BIBLIOGRAPHY

1. Kuhnert F, Stürmer C, Koster A. eascy - Die fünf Dimensionen der Transformation der Automobilindustrie; 2017 [Stand: 05.01.2021]. Verfügbar unter: https://www.pwc.de/de/automobilindustrie/pwc_automotive_eascy-studie.pdf.
2. Kortus-Schultes D. Konvergenz der Ökosysteme. In: Proff H, Hrsg. Mobilität in Zeiten der Veränderung: Technische und betriebswirtschaftliche Aspekte. Wiesbaden: Springer Fachmedien; 2019. S. 93–107.
3. Kords M. Prognose des weltweiten Marktvolumens von Fahrassistenzsystemen bis 2030; 2020 [Stand: 10.03.2021]. Verfügbar unter: https://de.statista.com/statistik/daten/studie/468552/umfrage/marktvolumen-von-autonomen-fahrfunktionen/.
4. Kords M. Prognostizierter Anteil von connected cars in Regionen weltweit bis 2035; 2020 [Stand: 10.03.2021]. Verfügbar unter: https://de.statista.com/statistik/daten/studie/757547/umfrage/prognostizierter-absatz-von-vernetzten-automobilen-in-regionen-weltweit/.
5. Kords M. Bestandsentwicklung von Elektroautos weltweit bis 2020; 2021 [Stand: 10.03.2021]. Verfügbar unter: https://de.statista.com/statistik/daten/studie/168350/umfrage/bestandsentwicklung-von-elektrofahrzeugen/.
6. Bundesverband CarSharing. Anzahl der Carsharing-Fahrzeuge in Deutschland von 2011 bis 2021; 2021 [Stand: 25.03.2021]. Verfügbar unter: https://carsharing.de/sites/default/files/uploads/datenblatt_carsharing_in_deutschland_stand_01.01.2021.pdf.
7. Henner W. Elektroautos brauchen weniger Teile – was heißt das für die Arbeitsplätze?; 2019 [Stand: 26.03.2021]. Verfügbar unter: https://www.aktiv-online.de/news/elektroautos-brauchen-weniger-teile-was-heisst-das-fuer-die-arbeitsplaetze-3486.
8. Gaffner A, Berking J. FAST 2030 - Future Automotive Industry Structure until 2030: The impact of current trends on value creation and their implications; 2018.
9. Hofstätter T, Krawina M, Mühlreiter B, Pöhler S, Tschiesner A. Reimagining the auto industry´s future: It´s now or never; 2020 [Stand: 15.02.2021]. Verfügbar unter: https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/reimagining-the-auto-industrys-future-its-now-or-never.
10. Burkacky O, Deichmann J, Stein JP. Automotive software and electronics 2030: Mapping the sector´s future landscape; 2019 [Stand: 26.04.2021]. Verfügbar unter: https://www.mckinsey.com/~/media/McKinsey/Industries/Automotive%20and%20Assembly/Our%20Insights/Mapping%20the%20automotive%20software%20and%20electronics%20landscape%20through%202030/Automotive-software-and-electronics-2030-final.pdf.

11. Reimann A. Tausende Autos können nicht gebaut werden: Anhaltender Engpass bei Halbleitern; 2021 [Stand: 11.03.21]. Verfügbar unter: https://www.wiwo.de/unternehmen/auto/anhaltender-engpass-bei-halbleitern-tausende-autos-koennen-nicht-gebaut-werden/26787364.html.
12. Baryannis G, Validi S, Dani S, Antoniou G. Supply chain risk management and artificial intelligence: state of the art and future research directions. International Journal of Production Research 2019; 57(7):2179–202. doi: 10.1080/00207543.2018.1530476.
13. Henke M, Besl R. Risiken im Vorfeld erkennen: Supplier Risk Management in der Automobilindustrie; 2008 [Stand: 15.01.2021]. Verfügbar unter: https://beschaffung-aktuell.industrie.de/allgemein/risiken-im-vorfeld-erkennen/.
14. Christopher M, Lee H. Mitigating supply chain risk through improved confidence. International Journal of Physical Distribution & Logistics Management 2004; 34(5):388–96. doi: 10.1108/09600030410545436.
15. Schlüter F, Diedrich K, Güller M. Analyzing the Impact of Digitalization on Supply Chain Risk Management. Budapest; 2017.
16. Güller M, Koc E, Hegmanns T, Henke M, Noche B. A simulation-based decision support framework for real-time supply chain risk management. International Journal of Advanced Logistics 2015; 4(1):17–26. doi: 10.1080/2287108X.2015.1008948.
17. Adler MW, Peer S, Sinozic T. Autonomous, connected, electric shared vehicles (ACES) and public finance: An explorative analysis. Transportation Research Interdisciplinary Perspectives 2019; 2. doi: 10.1016/j.trip.2019.100038.
18. Eliot L. Fireworks About ACES As Key Acronym For The Future Of Mobility And Self-Driving Cars; 2019 [Stand: 16.03.2021]. Verfügbar unter: https://www.forbes.com/sites/lanceeliot/2019/07/04/fireworks-about-aces-as-key-acronym-for-the-future-of-mobility-and-self-driving-cars/?sh=42302319654e.
19. Kords M. Marktanteilsprognose von neu zugelassenen Elektro-PKW nach Regionen bis 2030; 2018 [Stand: 10.03.2021]. Verfügbar unter: https://de.statista.com/statistik/daten/studie/875231/umfrage/marktanteils-prognose-von-neu-zugelassenen-elektro-pkw-nach-regionen/.
20. Wong S. Global shared mobility: percentage of passenger miles 2025-2035; 2021 [Stand: 27.03.2021]. Verfügbar unter: https://www.statista.com/statistics/1016549/shared-mobility-percentage-of-global-passenger-miles/.
21. Wong S. Car sharing market size in China 2017-2020; 2020 [Stand: 27.03.2021]. Verfügbar unter: https://www.statista.com/statistics/992815/china-car-sharing-market-size/.

22. Hattrup-Silberberg M. Der ungenutzte Datenschatz: Durch Fahrdaten jährlich mehrere Hundert US-Doller Wertpotential pro Auto möglich; 2021 [Stand: 24.01.2021]. Verfügbar unter: https://www.mckinsey.de/news/presse/2021-01-10-car-data.
23. Christiane Köllner. Wenn das Auto Daten sammelt; 2020 [Stand: 26.04.2021]. Verfügbar unter: https://www.springerprofessional.de/car-to-x/datensicherheit/wenn-das-auto-daten-sammelt/18549120.
24. Bodungen B von, Hoffmann M. Autonomes Fahren – Haftungsverschiebung entlang der Supply Chain? NZV - Neue Zeitschrift fuer Verkehrsrecht 2016; 29(10) [Stand: 24.01.2021]. Verfügbar unter: https://trid.trb.org/view/1440878.
25. Bundesregierung. Kaufprämie für Elektroautos erhöht; 2021 [Stand: 24.01.2021]. Verfügbar unter: https://www.bundesregierung.de/breg-de/themen/energiewende/kaufpraemie-fuer-elektroautos-erhoeht-369482.
26. Europäische Kommission. EU-Mitgliedstaaten beschließen neue CO2-Grenzwerte für Autos - Deutschland -; NaN [Stand: 24.01.2021]. Verfügbar unter: https://ec.europa.eu/germany/news/20190415-co2-grenzwerte_de.
27. Kuhnert F, Stürmer C, Koster A. eascy - Die fünf Dimensionen der Transformation der Automobilindustrie; 2017 [Stand: 05.01.2021]. Verfügbar unter: https://www.pwc.de/de/automobilindustrie/pwc_automotive_eascy-studie.pdf.
28. Roeder D. Big Data im Carsharing: Was Betreiber aus den Daten lernen können; 2016 [Stand: 24.01.2021]. Verfügbar unter: https://t3n.de/news/big-data-carsharing-daten-690284/.
29. Mahnke A, Rohlfs T, Hrsg. Betriebliches Risikomanagement und Industrieversicherung. Wiesbaden: Springer Fachmedien Wiesbaden; 2020.
30. Wagner SM, Kemmerling R, Kersten W. Supply Chain Risikomanagement: Besonderheiten und Herausforderungen für kleine und mittlere Unternehmen. In: Engelhardt-Nowitzki C, Nowitzki O, Zsifkovits H, Hrsg. Supply Chain Network Management: Gestaltungskonzepte und Stand der praktischen Anwendung. Wiesbaden: Gabler Verlag; 2010. S. 97–116 (Gabler Research).
31. Shi D. A review of enterprise supply chain risk management. Journal of Systems Science and Systems Engineering 2004; 13(2):219–44. doi: 10.1007/s11518-006-0162-2.
32. Kersten Wolfgang. Schlussbericht zum Projekt „Supply Chain Risk Management Navigator". Hamburg: Technische Universität Hamburg; 2009.
33. Erler F. Downstream-Risiken in der automobilen Wertschöpfungskette: Instrument zur Risikobewältigung in der Kundenbeziehung von Automobilzulieferern [Dissertation]. Chemnitz: Technische Universität Chemnitz; 2014.
34. Christopher M, Peck H. Building the Resilient Supply Chain. The International Journal of Logistics Management 2004; 15(2):1–14.

35. Pfohl H-C, Aberle G. Risiko- und Chancenmanagement in der Supply Chain: Proaktiv - ganzheitlich - nachhaltig. Berlin: Schmidt; 2002. (Unternehmensführung und Logistik; Bd. 20).
36. Zsidisin GA, Ellram LM. An Agency Theory Investigation of Supply Risk Management. The Journal of Supply Chain Management 2003; 39(3):15–27.
37. Richard J. Strategisches Lieferantenmanagement: Leitfaden; 2017.
38. Huth M, Romeike F, Hrsg. Risikomanagement in der Logistik: Konzepte - Instrumente - Anwendungsbeispiele. 1. Auflage. Wiesbaden: Springer Gabler; 2016. Verfügbar unter: http://search.ebscohost.com/login.aspx?direct=true&scope=site&db=nlebk&AN=1066805.
39. Götze Uwe, Mikus Barbara. Der Prozess des Risikomanagements in Supply Chains. In: Vahrenkamp R, Hrsg. Risikomanagement in Supply Chains: Gefahren abwehren, Chancen nutzen, Erfolg generieren. Berlin: Erich Schmidt Verlag; 2007. S. 29–58.
40. Schiele H, Hoffmann P, Reichenbachs M. Strategische Beschaffungsrisiken: Versorgungsprobleme durch fehlenden Vorzugskundenstatus. Supply Chain Management 2011; (11):7–11.
41. International Organization for Standardization. Risikomanagement - Leitlinien (ISO 31000:2018). 2. Aufl. Berlin: Beuth Verlag; 2018 10.2018. Verfügbar unter: https://www.iso.org/obp/ui/#iso:std:iso:31000:ed-2:v1:en.
42. Schröder M. Strukturierte Verbesserung des Supply Chain Risikomanagements. Wiesbaden: Springer Gabler; 2019. (Supply Chain Management).
43. Kersten W, Schröder M, Singer C. Chancen und Risiken des demographischen Wandels – Eine Supply Chain-orientierte Perspektive. In: Müller E, Hrsg. Demographischer Wandel – Herausforderung für die Arbeits- und Betriebsorganisation der Zukunft: Schriftenreihe der Hochschulgruppe Arbeits-und Betriebsorganisation e.V. (HAB). Berlin: Gito-Verlag; 2012. S. 285–310.
44. Locker A, Grosse-Ruyken PT. Risiko-Management. In: Locker A, Grosse-Ruyken PT, Hrsg. Chefsache Finanzen in Einkauf und Supply Chain. Wiesbaden: Springer Fachmedien Wiesbaden; 2019. S. 231–67.
45. Seifert M. ACES - Eine Revolution auch für das Risikomanagement in der Automobilbranche? Resultate einer Datenanlyse. Darmstadt: Dun & Bradstreet; 2021 (Dun & Bradstreet Insights).
46. Putz M, Beyer U, Demmer A, Motta M, Biehl S, Hohwieler E et al. Mobilität der Zukunft - muss produziert werden: Positionspapier. Chemnitz: Fraunhofer-Allianz autoMOBILproduktion; 2019.