

Vision automotive production

VDA 6000, Version 1.0, Berlin, January 2021

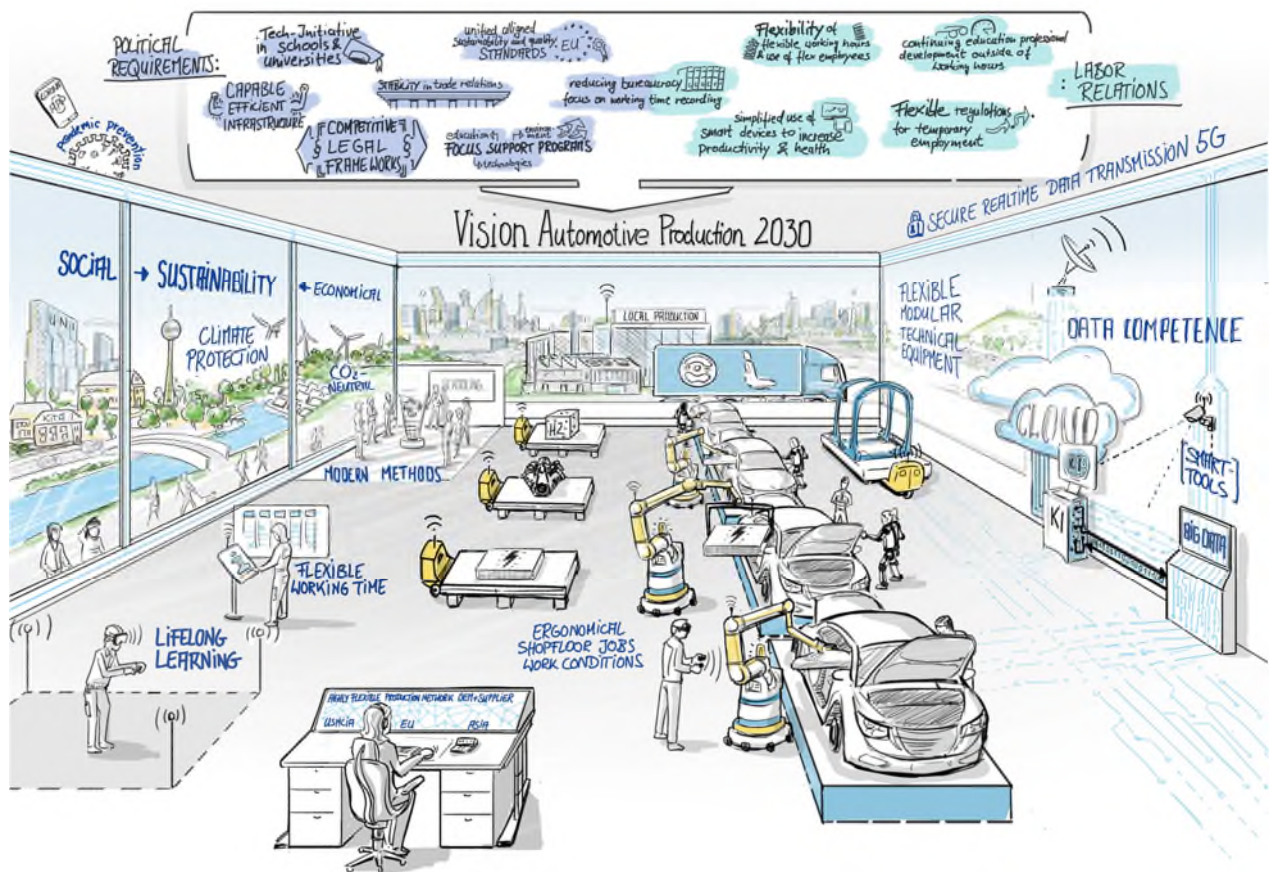


Table of contents

Summary / Executive summary	4
1 The German automotive industry in the face of global competition	5
1.1 Theses on automotive production of the future: Vision 2030.....	5
1.2 Dimensions of success in automobile production	6
1.2.1 Production network and flexibility	6
1.2.2 Employees and flexibility.....	6
1.2.3 Data, production systems and cybersecurity	7
1.2.4 Ecological and social sustainability.....	7
1.2.5 Pandemic prevention.....	7
1.3 Outlook.....	8
2 Production network and flexibility.....	9
2.1 Target vision production network 2030.....	9
2.2 Solutions to achieve the vision.....	10
2.2.1 Localisation.....	10
2.2.2 Joint operations network with suppliers	11
2.2.3 Flexibility within the factory.....	11
2.3 Summary	13
2.3.1 Changes to companies.....	13
2.3.2 Requirements for policymakers and trade unions.....	13
3 Employees and flexibility	15
3.1 Expectations of the workforce on companies.....	15
3.2 Requirements for the workforce and education system.....	16
3.3 Summary	17
3.3.1 Requirements for companies.....	17
3.3.2 Requirements for policymakers and trade unions.....	17
4 Data, production systems and cybersecurity	18
4.1 Data transfer in cross-company networks	18
4.2 Consideration of the production site	18
4.3 Summary	21
4.3.1 Requirements for companies.....	21
4.3.2 Requirements for policymakers and trade unions.....	21
5 Ecological and social sustainability	22
5.1 Ecological sustainability Decarbonisation in manufacturing.....	22
5.1.1 Scope and target for 2030.....	23
5.2 Ecological sustainability Focus on other emissions and resources	24
5.2.1 Other emissions.....	24

5.2.2	Resources	24
5.3	Social sustainability.....	24
5.4	Summary	25
5.4.1	Requirements for companies.....	25
5.4.2	Requirements for policymakers and trade unions.....	26
6	Pandemic prevention	27
6.1	Fields of action	27
6.2	Pandemic plan as a phase model.....	27
6.2.1	Crisis management	28
6.2.2	Work and health protection.....	28
6.2.3	Internal/external communication	29
6.2.4	Presence at the workplace.....	29
6.2.5	Travelling and mobility	29
6.2.6	Personnel management	29
6.2.7	IT support.....	29
6.3	Summary	30
6.3.1	Requirements for companies.....	30
6.3.2	Requirements for policymakers and trade unions.....	30
	Contact person in the VDA.....	31

Summary / Executive summary

The study at hand on “Vision Automotive Production” is based on experiences, assessments and internal developments in VDA member companies. This document serves to classify the topic in the overall context of automobile production and shows the potential for both VDA member companies and their partners in the supply chain.

Our German automotive industry has been the key industry in Germany for decades with more than 800,000 employees, contributes significantly to the gross domestic product and is one of the main reasons why the production location “Made in Germany” represents perfection and quality worldwide. However, developments towards alternative drive trains and connectivity are currently leading to a radical change in the industry. New players have emerged in the global automotive industry, to which significant parts of the value-added chain, often in other countries and business locations, are migrating. In addition, volatility in global trade policy and the economic recession as a result of the current pandemic present us with far-reaching challenges.

In order to continue to survive in global competition and to secure the national employment rate in Germany in the long term, action is required from all actors involved, i.e. companies, employees, employee representatives and policymakers. The VDA therefore developed the “Target vision in automotive production” for the year 2030. The target vision with the associated requirements, which are necessary for Germany as a business location to achieve the target vision, is defined along five dimensions of success, so that we can remain the leading automotive industry worldwide and continue to stand for perfection on four wheels:

1. **Production network and flexibility:** Due to the volatile trade policy, production will be independent in the three core markets in the future, with a large number of plants being able to manufacture different drive trains and a diversified product mix. This leads to a higher complexity in the plants, to which the industry responds with a flexible production network, made possible through modularisation, standardisation and a joint operations network with suppliers. The legislators promote this through a liberal industrial policy.
2. **Employees and flexibility:** With the new players in the industry, there is a global “war for talents”, i.e. German companies will remain attractive employers through appropriate measures. This also includes the two-stage qualification of employees: Policymakers create framework conditions in the training sector in which affinity and knowledge in the MINT and digital field are provided, and the industry ensures training and further education for the workforce.
3. **Data, production systems and cybersecurity:** The management of companies and their global supply chains are efficiently data-driven. The industry establishes the necessary standards for this, which is possible through corresponding laws and regulations.
4. **Ecological and social sustainability:** The German automotive industry will manufacture automobiles that are socially and ecologically sustainable in operation and manufacture. To this end, the industry is working on initiatives on raw materials and human rights, while policymakers promote existing and initiates new funding programmes.
5. **Pandemic prevention:** With an overarching prevention concept, the industry will respond to pandemics at an early stage, contain the spread and minimise the effects on operations and the global supply chain. Social partners facilitate the necessary flexibility and policymakers develop uniform (transnational) regulations on hygiene measures, travel restrictions, movement of goods etc.

1 The German automotive industry in the face of global competition

We as the German automotive industry have a strong position in the world market and are known for high quality and reliable vehicles and components. The companies owe their excellent position in the world market to a strong position in their home country. Many important production and development locations are currently in Germany. Local production and the associated value added are the decisive factors for the high national employment rate; with 800,000 employees, the German automotive sector is a key national industry.

However, the share of sales in Germany usually only accounts for part of its overall business. The vehicles and components produced, as well as development services, find customers all over the world and have to assert themselves against global competition.

The shift to alternative drive forms and networked vehicles poses major challenges for the German automotive industry and changes the dynamics of global competition. Many new, agile and innovative players have emerged who develop new technologies and vehicle ideas and compete for customers. Value added in the industry is becoming increasingly global and is shifting partly away from Germany. An advisory body to the federal government has made a forecast that, for example, 410,000 jobs will be lost in Germany in the automotive industry due to electromobility alone (source: Süddeutsche Zeitung, consulted on 03.11.2020).

We recognise a need to catch up so that we will continue to be one of the leading automotive industries in a changing mobile world and survive in global competition. This is the only way we can secure jobs in Germany in the long term. All those involved – management, employees, employee representatives and policymakers – are called upon to pull together to achieve this goal.

Vision statement

Our goal is for the German automotive industry to remain Germany's key industry in 2030. We already aspire to offer a high quality product range in all vehicle classes for all customer needs in ten years.

Mission statement

In order to achieve this goal, we will master the diverse challenges that arise by means of trade, legislative and demographic developments. At its core are the following fields of action: competition, value added, employees, digitalisation and sustainability, which we want to tackle in the next ten years together with our employees, policymakers, unions and associations.

1.1 Theses on automotive production of the future: Vision 2030

We have developed the following communitised theses:

1. In the future, **automobile production** will have to respond much **more flexibly** to individual **customer requests** and **fluctuations in volume**.
2. The **wage and ancillary costs** (energy, water, waste etc.) in Germany are **rising** faster than the prices for vehicles or the possible efficiency gains; thus, the **framework conditions** are **deteriorating** significantly.
3. In 2030, there will be a **diverse range of drive trains**. The total **volume related to individual products** will be **reduced** due to increased drive variance. This **increases complexity**.
4. In addition to the premium sector, a **sector for cheaper volume products** in Germany will also be offered. (High number of units, low variance). Volume and flexibility will be different depending on the class.
5. The **cooperation** between **OEM** (Original Equipment Manufacturer) and **suppliers** will shift. Suppliers become **system developers**, **system producers** and/or even **system integrators** on the production line. Stronger **system partnerships** between OEM and suppliers with the goal of **greater modularisation**. Different volumes can be processed within the plant by different companies.
6. A **joint operations network** between **OEMs** and **Tier 1** (first tier supplier: system supplier – designs, documents and develops components of the products of an OEM; last supplier in the chain to the OEM) in response to CO₂ requirements and increasing trade restrictions. **Industrial clusters** will gain in importance.

7. **Digitalisation increases** the **demands** on the skills of **employees** in the workforce classes close to production (including maintenance) and employee administration. **Training** and **lifelong qualifications** in this future issue are **decisive for competition**. The provision of a high-performance **digital infrastructure** by the federal and state governments is imperative.
8. **Development partnerships** between several **OEMs** and **plant construction firms** for the development of standardised automation solutions are becoming increasingly important.
9. The **more complex legal situation** and existing **works agreements** further increase the demands on production.

1.2 Dimensions of success in automobile production

The German automotive industry has a strong position in the world market, which the manufacturers and suppliers in this country have achieved through their constant innovative ability and the quality of their products. With regard to the labour market, industry in Germany is traditionally characterised by high employment figures at a very high wage level. The German automotive industry also employs a large number of people worldwide, especially in Europe. The established structures within the automotive industry are now changing. This happens at a time when companies are struggling with a difficult economic environment due to down markets and the Corona pandemic. It is forecast that sales levels will only recover slowly over the next few years. In addition to these difficult economic conditions and looking to the future, we find that the dimensions of success relating to the automobile as a product are changing due to technological transformation and the accompanying increasing global competition. These dimensions are summarised below and described in detail in Chapters 2-6.

1.2.1 Production network and flexibility

In the past, automobile production in Germany has been continuously optimised along the value-added chain. Many production steps are automated and the associated supply chain is very precisely tailored to production. This is also possible because the basic architecture of the vehicle with its drive train and engine has not fundamentally changed for decades. The emergence of alternative drive concepts in particular and new mobility concepts in general is changing the market. This poses major challenges for production. The demands on expertise in production, which make the automotive industry strong and distinguish it in Germany, are changing.

With regard to the global drive mix, it is to be expected that this will become increasingly differentiated in the future. In addition to classic petrol and diesel engines, hybrid and electric vehicles and, in the future, fuel cell vehicles will also be produced. The automotive industry in Germany covers the entire spectrum, and this diverse range of products must be able to be managed by production. While many global competitors have to face the same challenges, there are others who focus on a single technology and can reduce the complexity within their production. In the future, a changeable production network and more flexibility in the locations will be increasingly important for the German automotive industry in order to be able to map the volume development in each vehicle sector and make production competitive.

1.2.2 Employees and flexibility

Transformation in the automotive industry and the associated changes in the entire value-added chain have a major impact on employees. It changes how the vehicle of tomorrow is built. Production will become more flexible and digital. The same applies to indirect production sectors. A qualified and motivated workforce is an important key to successfully shaping changes in production. In order to successfully face transformation, employees must be willing to change. It is important to upskill employees with targeted training and further education to ensure that the necessary skills are available in the workforce.

In the global competition for the best talent and new qualified employees, the German automotive industry must remain an attractive employer in the future. As part of this competition, the German automotive industry is not only in global competition, but also increasingly with companies from other industries, e.g. the tech industry, who are making headway in the field of mobility. In order to create the conditions to meet the needs and requirements of employees, efforts need to be made within the company. The legislature must also create framework conditions so that companies in Germany can adapt faster and more flexibly to the requirements of their employees.

1.2.3 Data, production systems and cybersecurity

The digital transformation in automobile production describes the progressive digitalisation of work processes and networking of the production environment. As part of this development, analog working methods, practices, tools and production systems are continuously expanded, linked and digitally mapped through the use of software and sensors. This enables, among other things, an extensive collection and targeted evaluation of company-, product- and process-specific data that can be used to improve automobile production as a whole. Data form the basis for flexible production that can manufacture customer-specific products under the changed boundary conditions described above.

The development of digital change, which has been ongoing for a long time, has serious effects on work processes, such as planning and control, in production and in the entire value-added chain. The German automotive industry is called upon to create the necessary conditions for digital change in order to be well positioned in global competition. Since it is to be expected that the digital change will continue to gain in speed and importance, rapid action is required. This includes in particular the creation and further development of uniform standards in the production environment in the entire industry, network expansion and the creation of the appropriate infrastructure, the development of future-orientated digital skills and qualifications of employees as well as the safeguarding of data security and cybersecurity. In this process, it is important that all parties involved are willing to cooperate and solutions developed are practically and realistically viable.

1.2.4 Ecological and social sustainability

The question of ecological and social sustainability has long played an important role in the industry and continues to grow in importance. The reasons for this include dwindling resources and an increasingly pronounced environmental awareness on the part of both manufacturers and customers. Ensuring high workplace standards and employee rights is very important as part of social sustainability. The automotive industry is working on making its production increasingly sustainable. Manufacturers and suppliers assume their responsibility throughout the entire life cycle of the automobile, starting with the selection of materials, production in Germany and fuel-saving operation through to closing material cycles at the end of the life cycle. German automobile manufacturers have already achieved enormous success in conserving resources in production.

The great importance of ecological and social sustainability is also reflected in stricter legal requirements with which policymakers and society provide a framework for this development and create binding standards. It must be ensured here that these requirements and standards are adhered to by all actors, especially in light of cross-border value-added chains.

1.2.5 Pandemic prevention

The Corona pandemic broke out surprisingly in all regions of the world at the beginning of 2020. The entire automotive industry was faced with new and sometimes completely unexpected challenges. Different pandemic developments worldwide in terms of timing and intensity led to a partial disruption of global supply chains. The effects were felt in the entire global economy, with automobile production in some cases halting over a period of several weeks. The restart and regulated production under pandemic conditions, in particular to protect employees, were made more difficult by various factors. A large number of problems arose for which the companies first had to develop new solutions and ways of working together without the usual direct personal contact. Since all companies had to operate under similar conditions, no differentiation can be determined in global competition.

The consequences of the Corona pandemic are expected to have an impact for years to come, so companies and policymakers are equally challenged. In the companies, insights from dealing with the Corona pandemic contribute to the continuous improvement and further development of internal crisis management. There is also a demand for policymakers to create legal framework conditions that will help to overcome the crisis in the long term.

1.3 Outlook

We are committed to ensuring that the automotive industry will continue to be a central economic pillar of our country in the future and contribute to a strong industrial base in Germany. To do this, we have to be successful in competition – as a company and as a location. There are great challenges. It is all the more important to understand the organisational task as a joint task of companies, the state and society.

Achieving this goal requires a willingness to change. The German automotive industry advocates that all stakeholders in the affected companies and their environment are involved in the change process. To do this, they must be aware of the need for change that global competition requires. A cooperative collaboration, especially with social partners, is an important element in laying the foundation for dealing quickly, flexibly and sustainably with new technologies, processes and requirements and integrating them into operational processes, which are becoming more important due to global competition and new customer requests. As one of the largest employing industries in Germany, it is therefore important to initiate a discussion about the extent to which framework conditions can be created in Germany in order to secure competitiveness compared to global locations in the long term.

2 Production network and flexibility

Various global developments are currently increasing the demands on and complexity in the production networks of German automobile production and require greater flexibility in these.

Developments in global trade relationships are a key factor influencing our production networks, i.e. productions and supply chains. An important trend in global trade policy is the decline in multilateralism. While the liberalisation of trade relations has progressed multilaterally over decades, i.e. via the World Trade Organization (WTO), there has been a decline in multilateral trade agreements and an increase in bilateral and plurilateral trade agreements over the last 15 years. Another development, especially in the last third of the 2010s, with serious effects on our production networks is the trade conflict between leading industrial nations and the associated increase in protectionist measures. Both trends represent a challenge for existing production networks, as these are often based to a large extent on a liberal world trade order, i.e. low tariff (e.g. customs duties) and non-tariff trade barriers.

Another factor that affects and shapes our production networks and their target vision is the volatility in the markets. Important drivers for this volatility are often legislative requirements with far-reaching effects on customer behaviour. If, for example, governments make certain vehicle models, e.g. lower-emission models, more attractive for customers through directives, the demand for these models in that market often increases rapidly.

Ultimately, the steady increase in product variants also contributes to increasing complexity in our production networks. The increase in the number of product variants leads to a higher number of units in the product mix, which is why production is more flexible. In addition, changing customer demand and political requirements such as CO₂ fleet targets are currently leading to a diversification in the drive mix. This means that in addition to the classic petrol and diesel engines, hybrid and electric vehicles will be offered, and possibly also fuel cell vehicles in the future. The total number of vehicles produced will remain roughly unchanged or increase slightly, so there will primarily be changes in the proportions between the drive variants. Depending on the total number of vehicles produced and the percentage of the world market, the majority of our German OEMs will have few or no plants that can concentrate on one or a few types of drive. This increases the complexity per plant and thus also the necessary flexibility and changeability in automobile production enormously.

A flexible production system means that reserves are planned for defined modifications and fluctuations. The adaptable production system also describes our target vision, in which previously non-existent functional units can still be integrated. Various new products, derivatives and drive models can be quickly integrated into convertible production, for example through modularity in the systems.

Vision statement:

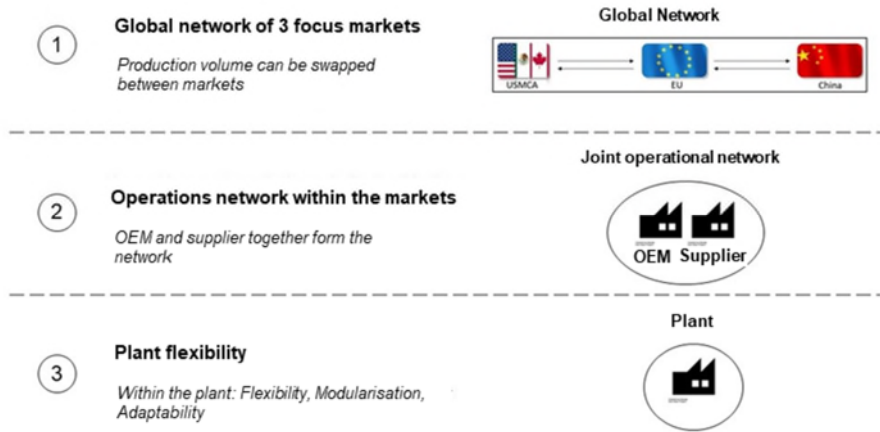
We, the German automotive industry, will respond to the current challenges – volatility in global trade policy and the increasing variance in the drive mix or product mix – with a highly flexible and changeable production system. With this flexible and adaptable production system, we can serve individual customer requirements quickly and efficiently. In this way, we will play a leading role in global competition.

Mission statement:

We will develop a flexible production system in order to be able to act efficiently and independently in large markets. Future production will respond flexibly to changes such as volume fluctuations, e.g. through reserves and adaptable operating times. The focal points of the production system of tomorrow are common networks between us OEMs and suppliers; we will work together integrally in planning and production within an operations group. In order to achieve these goals, efforts on the part of us, the OEMs, suppliers and associations as well as policymakers and trade unions are required.

2.1 Target vision production network 2030

The target vision with which we, the German automotive industry, ensure that we occupy a leading position despite the upcoming challenges is described on several levels (see target vision automotive production).



Vision automotive production 2030: Production network and flexibility

2.2 Solutions to achieve the vision

2.2.1 Localisation

In order to be able to respond to the challenges in global trade policy, our production networks are often designed in such a way that production can be carried out independently within the core markets EU, China and USMCA (United States-Mexico-Canada Agreement, formerly NAFTA). This near-market production also corresponds to the ecological goals of the corporations, as CO₂ footprints are reduced due to shorter supply chains.

The production and supply chain of various vehicles are currently carried out by some of our German OEMs across countries and economic areas. This is because due to the lower number of units in the luxury sector, it is currently not economical to localise the same architecture in different economic regions. For this reason, larger numbers of finished vehicles are now produced in one economic area and exported to other countries or economic areas for sale to end customers. Increasing trade barriers make this export more difficult and expensive. This is because the cornerstone of this production specification was the longstanding trend towards a multilateral liberal world trade order. However, due to the increasing volatility in global trade policy, this cornerstone is no longer so firmly anchored that our multi-billion dollar production networks are able to be based on it. In addition to these trade restrictions, various market demand scenarios call for a flexible allocation of vehicle volumes of the corresponding production series or architectures between the trading regions.

For a large number of our OEMs, the flexibility of production close to the market is essential. This is because the competitiveness of OEMs is no longer guaranteed when faced with increasing trade restrictions in the current allocation of series, derivatives and volumes. In the future, vehicles will be manufactured in the core markets of Europe, North America and China, where they will also be handed over to end customers. If necessary, this can also be done at short notice, i.e. derivatives and volumes can be quickly taken from one plant and transferred to another plant, e.g. in a different economic area. This near-market production thus promotes independence from (potential) increases in tariff (such as customs duties) or non-tariff trade barriers.

The flexibility that is guaranteed by the OEMs with production close to the market will also be reflected in the supplier network. For the above example, this means that if a derivative or volume is relocated from one production site to another production site in a different economic area at short notice, the supplier can purchase or manufacture the corresponding components in the respective new economic area and deliver them to the OEM in a tried and tested manner. This flexibility on the part of the supplier occurs without considerable additional financial expenditure for the OEM. This is possible for the supplier by achieving economies of scale through high numbers of units for the delivery of a series/several series, regardless of the economic area. If necessary, OEMs and suppliers agree upon joint production locations close to the market at an early stage.

2.2.2 Joint operations network with suppliers

Versatile factories are optimally complemented by a local operations network. The value-added chain is optimised with regard to a division of tasks between our OEMs and suppliers. OEMs and suppliers define a “sweet spot” for the value chain of automotive production: This sweet spot is the optimal extension of value added between (1) OEM production, (2) production at the supplier and (3) the supply chain. Often, the case will arise that the supplier takes over a portion of the volume so that the OEM can reduce the complexity. The tendering packages for the suppliers will contain roughly everything that is not part of the core business of the OEM. At the same time, it is possible in special cases for suppliers to take on larger parts of the value-added chain through system or development partnerships. This close cooperation is technically possible because we automotive manufacturers and suppliers use uniform and harmonised standards. Ideally, plants with specific part numbers for supplying an OEM at the supplier location are reduced to a minimum in order to ensure greater flexibility in the supplier network for fluctuating requirements at the OEMs. Together, this creates a win-win situation, both for the supplier and OEM.

In the manufacturing process, the supplier can also produce on the OEM's premises, i.e. together with them in a system. Depending on the production requirements, employees from OEMs, suppliers or external service providers can be deployed flexibly. High cycle time spreads can be avoided by using island production facilities away from the main line, and these can be passed on to the system supplier if required. It is also possible for the supplier for complex models to supply the main line with prefabricated components. This prefabrication can take place both inside the OEM's factory or outside the factory, e.g. in industrial clusters.

Suppliers are willing to settle (possibly at short notice) on the OEM's premises or close to the factory if this is logistically required for the cooperation. The legislature in Germany promotes these industrial parks through a liberal industrial policy, e.g. through short approval procedures. Social partners such as trade unions also contribute to the flexibility in the production networks and thus to the success of the German automotive industry, in which works agreements allow, for example, that both external and internal employees can work together in one area.

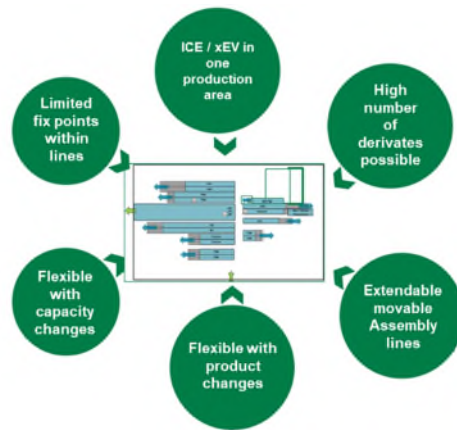
2.2.3 Flexibility within the factory

The aforementioned trend of diversifying the drive mix and the product mix will be reflected in the production plants in the future. Production systems can respond flexibly to changing volumes as well as to changing products and product requirements without having to completely redesign the production lines and without making substantial investments. A line will be flexible enough to map all drive forms: ICE (internal combustion engines), PHEV (battery-electric plug-in hybrids), EV (battery-electric vehicles) and, if applicable, fuel cell-powered vehicles.

The necessary flexibility accelerates the modularisation of the system technology as well as the reduction of the complexity in the products through increased common parts strategy for the products and derivatives, which can/should be manufactured on one line. Production is characterised by the formation of system modules, which in turn allow a high degree of standardisation across all vehicle classes.

Standardisation

A crucial way in which the flexibility is achieved in production networks is through the standardisation of production, assembly and manufacturing units. A reduction in complexity on the assembly line is necessary in order to be able to produce the variety of derivatives even more flexibly and efficiently. The goal is to be able to use the same line for a higher number of derivatives (see Item 2). For this purpose, fixed points are removed from the assembly lines in order to reduce the need for adjustment when changing types and integrations. Production lines and manufacturing and processing plants are equipped with the appropriate modularity so that they can be adapted to the respective products. At the same time, the assembly lines can easily be relocated or extended in order to be able to react flexibly and promptly to constantly changing depths of real net output ratio (production time).



Possibilities for increasing flexibility using the example of an assembly hall (source: Mercedes-Benz AG)



Flexible marriage – a new interpretation to a classic work step Fullflex Marriage in Factory 56 of Mercedes-Benz AG in Sindelfingen (source: Mercedes-Benz AG)

Daimler's Factory 56 in Sindelfingen is an example of such flexible production. The "flexible marriage" of Factory 56 makes it possible to flexibly couple both conventional combustion engines and electric drive trains on the same line. In just a few days, individual modules can be exchanged in order to be able to respond to new requirements.

Smart tools & digitalisation

The long-term vision for using all the possibilities of digitalisation is that of autonomous production, i.e. production that responds independently to changes and is self-adapting. This includes, for example, the use of artificial intelligence, cobots – collaborative robots that work together with the workers without protective devices – or (autonomous) driverless transport systems (AGVS). In order to survive in global competition, the constant improvement of automotive production in terms of cost efficiency and use of resources is essential. The continuous change process continues to have high priority. This means, for example, that camera systems document the production processes and evaluate the data with regard to potential for improvement. Targeted personal employee training and assistance is also made possible.

"Smart tools" such as AR/VR glasses, smart glasses and online movement trackers are already increasingly being used – but predominantly where the affinity for digitalisation is particularly high and the legislative side sees significantly more potential than concerns, there are accordingly few legal hurdles to overcome. Part of the target vision of automobile production in 2030 is that German automobile production can also fall back on the latest technologies for process improvement – appropriate legislative framework conditions on the part of policymakers will make this possible.

In addition to pure hardware in production, digital data – so-called digital twins – will play a decisive role in the future. These digital twins are used in different places. One use case is the formation of a twin for every vehicle that leaves the factory. The twin saves all data on the vehicle (software status, configurations of the control units and much more). This ensures that the manufacturer can access all relevant information regarding the vehicle in order to be able to upload updates over the air.

Another use case of digital twins are the machines and plants of the production networks. Thanks to the digital twins of the plants, improvements/process optimisations can be implemented via updates and, if necessary, immediately transferred to systems of the same construction in other plants. Processes can thus be improved in a targeted manner and almost simultaneously in the network. The Mercedes-Benz Factory 56 in Sindelfingen shows the economic potential of such digital twins – as the magazine "Automobilproduktion" (October 2020 issue, page 30ff) describes: The various plants and the entire value-added chain are digitally networked via WiFi or 5G. This enables the group to respond early to deviations in production or supply chain through big data and predictive analytics. Additional efficiencies become possible and costs are reduced through increasing quality.

2.3 Summary

2.3.1 Changes to companies

- Early coordination of the operational networks between OEM and suppliers for the purpose of joint production close to the market is necessary. Flexibility in the OEM network is only beneficial if the supplier network is set up in a similarly flexible manner – see trade dispute/customs duties
- We VDA members are promoting standardisation/harmonisation in order to reduce costs and ensure a higher scope of reuse.
- In particular, standards for data design and data exchange have to be defined in order to be able to use uniform data structures across OEMs.
- Suppliers are required to be willing to invest and to develop expertise.

2.3.2 Requirements for policymakers and trade unions

- In order to be able to use upstream production volumes from the supplier directly at the point of value added of the end product, more flexible regulations for the use of external employees (PL: (personnel leasing; CWL: contract for work and labour) is needed in the value-added chain. For this purpose, the legislature is required to provide the appropriate framework. The labor law regulations allow suppliers and OEMs to work together in one system (site).
- Significant funding for sustainable technologies, e.g. in the context of digitalisation, is necessary on the part of policymakers.
- Short approval procedures are necessary for new construction projects.

- In the vicinity of industrial clusters, political support for housing construction and attractive infrastructure is necessary.
- In the context of works agreements, trade unions enable flexible working hours and the flexible use of PL.

3 Employees and flexibility

Transformation in the automotive industry is ubiquitous. In addition to the electrification of vehicles, digitalisation of the industry is also steadily increasing and is presenting the German automotive industry with major challenges. This concerns nothing less than the claim to remain the leading automotive nation. We are not only in competition with foreign competitors, but also have to deal with new competitors from the tech industry. A key to success is a qualified and motivated workforce that has the necessary tools for the new challenges.

In summary, it is about the war for talents – the talents who will continue to ensure that automobiles Made in Germany stand for perfection on four wheels!

Vision statement:

Our goal as the German automotive industry is to have a workforce in 2030 who has successfully completed a digital educational campaign and has the necessary skills to meet the innovation requirements of the leading German industry.

Mission statement:

In order to achieve this goal, we have to secure the acquisition of digital and electromobility-specific competencies as a cornerstone of training and further education. It is important to stimulate interest in MINT subjects as early as primary school and to challenge and encourage them in the further course of the educational career. For this purpose, the state, industry and interest groups have to equip the fields they are responsible for with the necessary infrastructure and to adapt the learning content.

3.1 Expectations of the workforce on companies

The appeal of the automotive industry for employees in the direct and indirect areas of production must be strengthened. Different measures are necessary for this in order to meet new employee needs. On the one hand, more flexible working hours in the direct area and the possibility of part-time in a shift system should be aimed for. This must be implemented in cooperation with the employee representatives. This would strengthen the compatibility of work and family (e.g. raising children, caregiving, bureaucratic affairs etc.). In this way, the currently prevailing discrepancy in working time models between direct and indirect personnel is adjusted and direct employees are valued more highly. For both direct and indirect employees, the direct measurability of their work performance in production creates a high pressure to perform, which in part has a negative effect on wellbeing. It is important to develop new approaches to counteract this. In addition, the automotive industry endeavours to reduce physical strain on employees in production. In order to achieve this goal, only ergonomic workplaces are set up and technical aids are made available. In order to continuously develop the ergonomics of workplaces, it is essential to give employees the opportunity to help shape their workplaces. The great importance of health protection becomes particularly clear in times of a pandemic. All necessary measures are taken to ensure the health of employees in the direct areas. In addition, extensive health management offers numerous preventive offers that enable employees to maintain their health over the long term.

The opportunity to develop further and thus gain a perspective is also an expectation that employees place on the company. The aim is to get to know other areas as well as new tasks. This also offers the opportunity to develop professionally and interdisciplinary and to take advantage of opportunities for advancement. The use of new media and the strengthening of work-integrated learning through digital applications such as AR and VR glasses are a means of making the further training of employees as efficient as possible and also highly attractive. Through the targeted use of these tools, the training period can be shortened and the possible area of application of the employees can be expanded in a short time. This creates a win-win situation in which both employee satisfaction increases as a result of greater variety and added value is created for the company through flexible deployment. In order to guarantee the times necessary for further education and training, it will be important in the future to work with employee representatives and legislators to find a solution that enables our employees to continue their education outside of regular working hours and the workplace.

In particular, managers in the direct area are confronted with the new expectations of the workforce. The necessary transformation is also changing demands on managers. The most important ability is correct thinking and effective action. This includes a consistent focus on results and priorities. Managers give employees tasks in which they can make the best possible use of their strengths, and their weaknesses do not affect the success of

their work. They create a robust climate of trust through their own integrity and fairness and by leading by example and being a role model. They think positively and treat people today with decency and appreciation.

3.2 Requirements for the workforce and education system

A two-stage strategy is needed to win the battle for qualified personnel. On the one hand, we as the automotive industry have to develop our workforce and, on the other hand, policymakers have to create the framework conditions in the field of education. Affinity and knowledge in the field of digitalisation must in the future be promoted and demanded from schoolchildren, trainees and university graduates – from primary school to leaving the education system. As the German automotive industry, we have to face the task of qualifying our workforce in accordance with digital and drive-specific challenges. Our goal is to use the transformation as an opportunity to maintain our top position in international comparison!

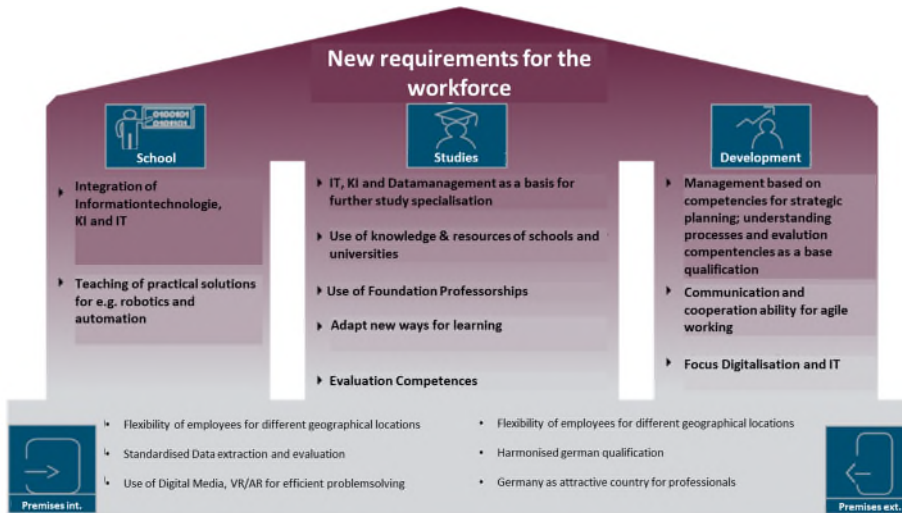
The German education system is based on three pillars. The first pillar is school education, the second pillar is vocational training and degree courses, and the third pillar is further education. An allocation of the responsibilities can be deduced from this categorisation. School education is the responsibility of the state or the state governments. In order to promote the skills in childhood and among young people that are necessary in later professional life, for example, as engineers or scientists/data scientists, good digital equipment in schools as well as the further development of teachers and learning content are required.

In the second pillar, there is an overlap of responsibilities. Particularly in the context of dual vocational training, it is important to create an interlinking of theoretical learning content in vocational schools and practical vocational training in companies. The trainees must be taught both technical and interdisciplinary skills, with the aim of achieving excellent assessment skills. This is necessary in order to be able to critically question and evaluate both the possible uses of digital applications and their results.

In university education, knowledge of information technology, data management and artificial intelligence must be established as basic content in the field of classic engineering training. With selective endowed professorships, the industry can make a decisive contribution to attracting the best scientists in the world. Furthermore, we call for the outstanding knowledge and equipment of universities to be made available for non-university further education, so that our employees without university education can also benefit from it. The universities must not be perceived as ivory towers, but rather as a place of independent science and the transfer of knowledge. In addition, cooperation between the automotive industry and science must be intensified, for example through public-private partnerships.

The field of further education is the responsibility of the automotive industry. On the path to qualifying our workforce, we conduct competence management for the strategic development of personnel. An increase in process understanding and the acquisition of assessment skills form a basic qualification. Here, too, the focus is on imparting digital competencies, practical IT skills and knowledge specific to e-mobility. In addition, the continuous increase in communication and cooperation skills is a focus in order to significantly increase the implementation speed of digital processes, for example in agile project teams. In order to pursue this path together with our workforce, we develop standards in the field of data acquisition and evaluation and use both VR and AR applications for efficient problem solving. To improve the flexibility of our specialists in terms of time and space, we need the support of the legislature. In order to be able to deploy our highly qualified employees in the future in accordance with their competencies, the possibility of more flexibility in working hours and deployment location is necessary – this applies to both direct and indirect employees. This requires adjustments to the Working Hours Act and to the works/collective bargaining agreements.

In order to combat the acute shortage of skilled workers in the MINT professions in the short term, it is essential for us as the German automotive industry that policymakers create framework conditions which make Germany an attractive immigration country for skilled workers and academics.



Requirements for the workforce

3.3 Summary

The previously described changing requirements of the workforce and companies as a result of the transformation can be divided into two areas of responsibility. The specific requirements are assigned below.

3.3.1 Requirements for companies

The requirements for companies essentially relate to the areas of appeal of the workplace and further training.

In order to increase the attractiveness of the workplaces in the direct and indirect areas and to successfully design the further training of the workforce, the following requirements must be met:

- Flexibility of working hours, both in shifts and in the home office
- Design of ergonomic workplaces
- Continuous professional and interdisciplinary development of employees
- Use of modern methods and media for induction and training
- Reliable executives with integrity
- Further development of the in-house educational institutions according to the new requirements

3.3.2 Requirements for policymakers and trade unions

The specific demands that we as the automotive industry make on policymakers, associations and unions include:

- Equipping all schools with a modern digital infrastructure
- Adjustments of teacher training towards greater use of digital learning formats
- Further development of the curricula in schools and universities according to the new requirements
 - Computer science and application of digital tools as compulsory subjects
 - Make technology such as robotics and automation tangible
- Alignment of education systems for the uniform integration of IT/digitalisation, for example through:
 - Standard A Levels (secondary school leaving examination), to simplify the change of residence within Germany
 - Same types of school
- Reduction of bureaucracy in timekeeping of working hours Adaptation of the regulations to the new home office culture
- Simplification of job rotation within the industry (automotive manufacturers and suppliers)
- Flexible regulations for temporary employment
- Allow in-company training outside of regular working hours

4 Data, production systems and cybersecurity

Digitalisation in automotive production is becoming increasingly important and has serious effects on the work processes of the OEM as well as the entire value-added chain. Production plants can record a variety of company and product-specific data, such as the plant status, the process, the product and the production order. At the same time, detailed data from the supply chain and the data required for quality control are made available. The correlation of this data opens up possibilities in the optimisation of the planning processes, the control of the production process, the production method as well as the product quality. Digital tools enable real-time-based data analysis, their visualisation and thus very fast decisions, even in a global environment.

In order to be able to take advantage of these opportunities to digitise production consistently and comprehensively and thus network it intelligently, the establishment of uniform standards, rapid network expansion and the safeguarding of data security and cybersecurity are necessary, among other things.

Vision statement:

Driven by data, we plan and control the entire value added chain in the German automotive industry within the OEM and across the entire supply chain.

Mission statement:

We have established globally applicable standards and their application. Data security against cyber attacks, which is important for an interaction, is guaranteed by established solutions. We have developed user-friendly and smart solutions, the introduction of which is manageable in terms of time and economically feasible.

4.1 Data transfer in cross-company networks

Value added in the automotive industry takes place via a complex network of different partners, starting with the raw material supplier to component and assembly suppliers as well as machine and service providers to the automotive manufacturer and its customers.

The efficient transfer, management, evaluation and use of all necessary data over the entire supply chain is the key to leveraging economic potential and the basis for optimal production control between suppliers and OEM. This requires a common understanding of the meaning of the data, but also the creation of appropriate standards and regulations.

Standardised data transfer as well as the assurance of traceability through the networking of components with the end products guarantee the required product quality. This approach needs to be expanded upon significantly. In order to achieve consistency, it is necessary to create transparency for all products and components with the relevant suppliers across the entire supply chain.

To this end, the expansion of bi-directional communication between the OEM and the supplier must be strengthened. Networking across the entire supply chain means that early forecasts can be used to respond to changes at short notice, and production capacities can be adjusted more quickly. This consistency becomes just as important with regard to cooperation with system suppliers.

Another aspect is ensuring a holistic quality control loop, which requires the consistency of quality and measurement data for defined, essential delivery parts. This can be parts and components, but also software. Data consistency plays an increasingly important role in compliance with legal requirements, especially in an approval-relevant or security-critical context.

4.2 Consideration of the production site

When focusing on a single production site, the following aspects are of central importance and will be addressed in more detail below.

Uniform standard across the entire internal value-added chain

The definition of uniform standards covers the entire area:

- Machine and plants and their integration into IT systems

- Key figures
- Understanding of processes and quality
- IT security

This fully includes the two levels of syntax and semantics (i.e. their meaning). This includes a common understanding of which data should be exchanged profitably for all those involved in the process, starting with the machines and systems and ending with the interaction between suppliers and OEMs. For machines and systems, the relevant process and machine data for each production technology is concerned. This data needs to be saved in an MES (manufacturing execution system) or big data system. OPC-UA and MQTT have established themselves as standards as an exchange format. The use of these standards must be described in detail. In this context, data from upstream production steps, for example from suppliers, must also be integrated. The solutions for quality and productivity improvement already mentioned in the previous section are used here. This guarantees continuous transparency of the manufacturing process and lays the foundation for its optimisation. Uniform standards now serve to overcome media and process gaps.

The definition of uniform standards also includes the connection between the digital factory and the real factory (key phrase: closed loop). Here, too, interaction between a wide variety of solutions from the individual manufacturers must be ensured (for example between systems for simulating line performance and an MES or between layout solutions and simulation solutions).

Uniform standards are also required to protect the machines, plants, systems and the entire infrastructure against cyber attacks. These attacks can be carried out internally but also externally. Standards concern a uniform understanding of the relevance of the topic and the definition of common requirements for the entire production and factory infrastructure.

The relevant key figures and their interpretation and calculation are of central importance for a uniform process understanding. This culminates in a common understanding of quality.

Comprehensive and secure real-time network expansion

The already heavy use of data will continue to increase in the future. Real-time transmission is required in order to use this data profitably. The term real time is understood as short transmission times for high data volumes. The requirements for this are different. It is therefore primarily a matter of providing the “right” data to the “right” addressee at the “right” speed.

A high-performance network infrastructure (e.g. in the form of a nationwide 5G network) is a prerequisite for using the large amounts of data. This allows IT systems to be more centralised (e.g. in a cloud), for example for centralised and holistic control of production. Internal standardisations can be implemented faster and more efficiently and thus cost advantages can be implemented, since a significantly smaller IT system landscape has to be set up and operated in the plants. Furthermore, rollouts can be implemented much faster.

Efficient networks are also of decisive importance for the increase in digital products (driverless transport systems – AGVs or driverless cars), for example for distributing new functionalities or correcting errors in the form of updates via the internet.

However, the isolated consideration of individual local plant networks (WiFi and LAN) is not sufficient here. To secure end-to-end processes, appropriate interoperability between the two must be ensured, including across plants. Otherwise, isolated solutions with associated inefficiencies arise, for example for the use of AGVs.

Such infrastructures are a prerequisite for smooth operation. This means that a high level of reliability, but also a defined service quality in the form of guaranteed transmission rates, is essential. When using them, the relevant IT security standards must be adhered to, which must be defined in advance.

A further requirement is to define internationally uniform network standards. A focus on Germany or Europe is by no means sufficient for international value-added networks.

The measures mentioned are important prerequisites for the construction and use of the digital twin or digital shadow.

Digital tools that are intuitive to use must be deployed

Digital tools are currently available in a variety of forms. The spectrum of such solutions is very complex and ranges from digital planning and simulation solutions to machine learning solutions. Regardless of their complexity, simple

and thus intuitive operation, combined with quick adaptation to the specific circumstances and framework conditions, must be viewed as a success-critical factor. It is important to avoid time-consuming programming. Modular approaches appear to represent promising approaches. This is already possible today with the intelligent programming of cobots and points in a practice-orientated direction. In this context, their device-independent and thus web-based availability is also important. In this way, complex local implementations can be avoided as far as possible, making them increasingly accepted.

In addition, solutions for self-optimisation and automated planning and monitoring of production are required. These tools actively support our employees in their daily work and make specific suggestions, but do not make any decisions on their own. This avoids liability concerns of such solutions. Self-learning, camera-based systems, for example, serve as the first step towards such intelligent or smart production. They independently recognise improvements in the production process. Thus, in this category, there are sometimes highly complex individual systems.

Other agents are solutions that support employees in administrative activities. These are agents from the field of industrial engineering, such as planning tools for machines and systems or solutions for organising employee attendance.

Remote access to machines and plants

As a consequence, the overall complexity in production increases considerably. The mastery of individual technologies is of central importance for their efficient use. Maintenance plays a pivotal role. Its range of tasks will expand significantly. Thus, the development of appropriate knowledge about digital technologies among the respective employees is a key criterion for success.

Due to the increasing complexity, machine and system builders must also be integrated, as these represent a corresponding expansion of value added. To do this, it is imperative to extend the standardisation of internal value added to machines and systems. This ensures standardised and secure remote access for external partners. However, remote access must also be established for internal employees across plants, for example for the use of smart devices (e.g. smart glasses). This ensures that complex maintenance activities can be conducted by globally available specialists – regardless of whether these specialists are internal or external.

A prerequisite for this is the definition of digital assets as a consistent extension of the machine and system description (physical asset), which is used to describe the machine and process parameters, including the corresponding access options.

Merging of digital and process competencies to implement practical applications

The digital transformation of processes is only sensible if they have been optimised in advance. Digitizing less optimised processes leads to a non-exhaustion of potential. Existing processes must not be converted 1:1 digitally (digitalisation), but rather be further developed according to Industry 4.0 in order to exhaust and make use of the additional potential (digital transformation).

For this, it is essential that employees are qualified in the direct and indirect areas (as already mentioned for maintenance). Existing potential can only be leveraged if employees at all levels can use the new possibilities and systems accordingly. This is especially true for systems based on machine learning (ML). The use and thus the understanding of data will be essential for the economic success of our automotive industry in the future. In the future, decisions will need to be made in a data-driven manner. Efficient systems, starting with current dashboards through to the aforementioned ML-based systems, have to be understood by the employees in terms of content. This is the only way to achieve appropriate acceptance. This is supported by the active participation of the employees concerned in the selection and implementation of the solutions. Change management is therefore a key success factor, but it is also a cost and time driver. Here, it is necessary to define procedures and framework conditions as well as generic processes for its establishment.

As already mentioned, the systems used must be quickly adaptable to the operational conditions. Ideally, this is done using a plug-and-play approach, especially for standard problems such as the maintenance mentioned above. In addition, ML-based systems must have a high level of transparency about the mathematical models used and their restrictions. This is the only way to verify statements from such systems.

Best-practice solutions need to be exchanged between all those involved in the process in order to gain relevant experience throughout the automotive industry as quickly as possible.

The efficient merging of process and digital competence is of central importance. This is the only way to successfully achieve digital transformation.

Data protection and data security must be practicable

In order to sustainably secure Germany as a production location, a common understanding of digital transformation must be established across all social partners. This applies above all to the handling and use of smart devices and data. The high level of data protection within the EU must be expanded and developed accordingly so that these innovations can be used and are not blocked.

As in Chapter 3.2, digital applications such as AR/VR glasses, smart glasses and the associated (temporary) storage of data can be used to make the induction and further training of our employees efficient and, above all, attractive.

These tools are at least as important when it comes to optimising physical load and thus improving the health protection of employees. There are many possibilities here, for example in the ergonomic design of workplaces, both in production and in office workplaces.

4.3 Summary

The management of global production networks to increase productivity is becoming an ever greater challenge in times of volatile markets. The worldwide consistent use of data across the entire value-added chain is a key element of success.

4.3.1 Requirements for companies

For effective and comprehensive use of the data as well as data exchange, globally valid standards should ideally be defined and established. This requires the coordination of all those involved in the process. In particular, it must be taken into account that the regulations can be implemented cost-effectively and without great organisational effort.

Cyber-technical protection of the entire supply chain must also be ensured against unauthorised access and manipulation. The requirements must be defined for this. This concerns securing the communication channels between OEM and supplier as well as the cloud connections of the individual devices. It also includes the protection of the data on parts and components on the physical transport route (e.g. lorry transport).

4.3.2 Requirements for policymakers and trade unions

A key success factor when using data is its temporary and sometimes permanent storage. This requirement must be aligned with the current data protection guidelines and laws (e.g. GDPR) and extended to the operational requirements without forfeiting their advantages.

The legal aspects of standardisation must also be considered in this context. For example, who owns the data, who is liable for what, what duty of disclosure do owners and users of the data have, as well as how can intellectual property be protected in the future, which will be increasingly immaterial and in the form of data.

A common understanding with social partners and suitable legal framework conditions must be created for the use of smart devices and the associated (temporary) storage of data. Only in this way can these innovations be used effectively to support employees and also advance the German production sites in global competition.

Decisions in companies are data-driven on the basis of secure communication channels and in real time on the basis of established standards across the entire value-added chain as well as in the respective company. Smart tools that can be operated intuitively are used in a wide variety of forms.

5 Ecological and social sustainability

Our automotive industry is working on aligning production increasingly to the principles of sustainability. The aim is to secure economic, ecological and social goals vertically, i.e. across all stages of the value-added chain. The responsibility for sustainable economic activity should be shared between companies, policymakers and society. The German automotive industry is making its contribution here. Manufacturers and suppliers take their responsibility actively along the entire production and usage cycle of an automobile: from the selection of materials to production in Germany and fuel-saving operation to closing material cycles at the end of the life cycle. In the past two decades, German automotive manufacturers have achieved enormous success in conserving resources in production. Among other things, this reduced drinking water consumption by more than 60 per cent per vehicle produced. More than 80 per cent of production waste is recycled today. Solvent emissions from OEM painting have also decreased by 65 per cent since 1990. Today, they are at the lowest level in an international comparison.

Vision statement:

As the automotive industry, we not only want to manufacture automobiles that are sustainable in operation, but also in production.

Mission statement:

We work together with other associations and policymakers to set common goals in order to achieve sustainable production for our entire industry. We are guided by the Sustainable Development Goals (SDGs) of the United Nations, the Paris Climate Agreement and the Global Compact Initiative.

The companies involved in the automotive industry are securing sustainability as an integral part of their corporate strategy. They agree on ecological and social standards as specifications for the OEMs and all suppliers along the entire supply chain (analogous to ISO 16949). A standardisation of reporting analogous to the Harbor Report or Value Balancing Alliance must be checked (data acquisition, data quality, methodology, calculation basis, KPIs, monetisation etc.). The employees are aware of ecological and social sustainability (e.g. Go Green Initiative).

Ecological sustainability includes, among other things, the reduction of greenhouse gas emissions and pollutants as well as the sustainable use of resources such as energy and water, the reduction of waste or wastewater and the increase in the recycling of production waste. These topics contribute to the UN's 17 Sustainable Development Goals (17 SDGs; Sustainable Development Goals). However, there is a special focus on the topic of avoiding greenhouse gas emissions, especially CO₂.

CO₂ emissions are considered according to the following scope: Scope 1 – all direct, i.e. from sources within the borders; Scope 2 – the indirect emissions from electricity, steam, heating and cooling generated and purchased outside; Scope 3 – all other indirect emissions, including those from the manufacture, transport of purchased goods or the distribution and use of own products or the disposal of waste; emissions due to business travel are also included. Since there is a direct focus on production, processes in the context of Scope 3 are not considered here.

5.1 Ecological sustainability Decarbonisation in manufacturing

Our automotive industry accepts the challenge of climate protection. Our goal is CO₂-neutral mobility by 2050 at the latest – in conformity with the Paris Climate Agreement.

The companies involved in the production committee have undertaken to achieve the Paris climate targets for their locations by 2050. The companies are thus contributing to the EU Green Deal, which aims to achieve climate-neutral production in the EU in 2050.

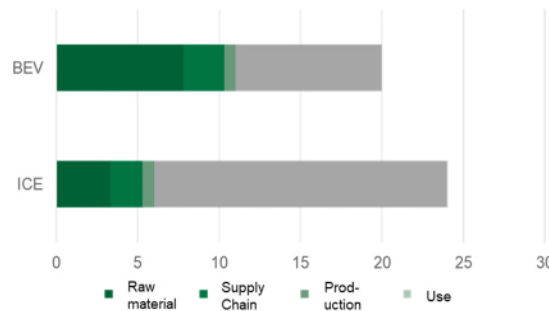
In addition to the social responsibility to reduce CO₂, the economic necessity is also important. More and more countries around the world are using a CO₂ price through emissions trading or direct taxation. This leads to increasing factor costs of fossil energy use and promotes energy efficiency and CO₂-free energy.

In order to achieve the common CO₂ emission targets for 2030, the first step is to reduce/avoid the energy consumption used. The second step is to substitute/convert fossil fuels with/to renewable energies. Individual companies also use compensation measures in order to achieve CO₂ neutrality earlier.

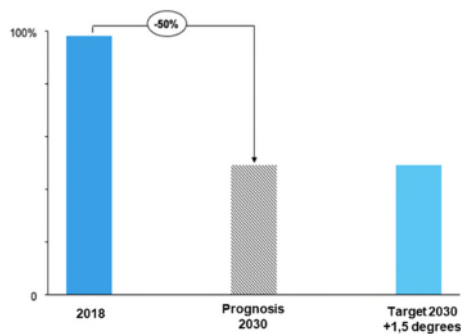
The way to achieve these goals is company-specific, but commonalities can be identified, which are described in more detail here.

5.1.1 Scope and target for 2030

Alternative drives reduce the total emissions CO₂e (CO₂ equivalents) in the life cycle of vehicles. Their introduction increases the percentage of emissions in production and less in the use of vehicles. This development makes climate-neutral production more relevant.



Life cycle balance in CO₂e using the example of a small car at 150,000 km (source: BMW Group)



Forecast CO₂ reduction in production by 2030 based on 2018

Based on the analysis of the companies involved (in the production committee), a joint CO₂ reduction in production of at least 50% is possible by 2030 (base year 2018). Compared to the criteria of the SBTi (Science Based Target Initiative), the companies involved would thus achieve the claim of a 1.5 ° scenario (Scope 1 and 2).

			Cost € / t CO ₂	Viability		
				2030	2050	
1	Reduction and avoidance	Energy efficiency	a) Heat Cycle	average - high	+	+
			b) Basic load reduction	low - average	+	+
			c) New painting techniques	average	+	+
2	Convert	Energy Production	a) cogeneration of heat and power	low	+	-
			b) photovoltaics on-site	average	+	+
			c) Geothermal energy	average	o	o
		Power from renewable energy	a) Proof of origin	low	+	-
			b) Power Purchase Agreement (PPA)	low	o / +	+
			a) Renewable Energy Certificate (REC)	high	o	+
3	Compensate		a) Protection projects	low - average	+	o
			b) forestation	niedrig	+	+
			c) Carbon Capture and Use (CCU)	average - high	-	o
			d) Carbon Capture Storage (CSS)	high	-	+

Overview of measures to reduce CO₂ in production

The overview of measures shows examples that will be implemented in stages for both the 2030 and 2050 reduction targets.

5.2 Ecological sustainability Focus on other emissions and resources

5.2.1 Other emissions

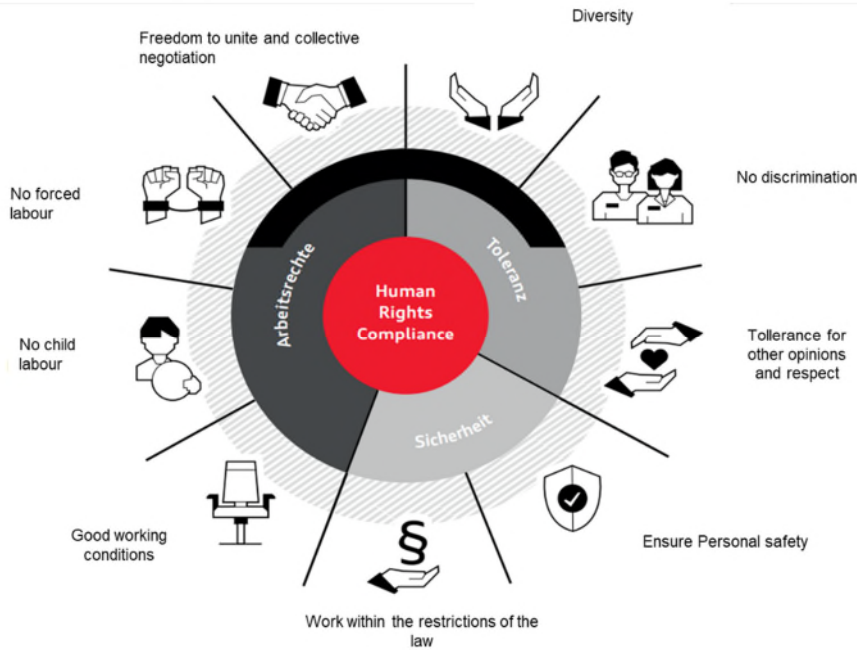
Our automotive industry strictly adheres to the regulations applicable in the respective countries on pollutants (e.g. NO_x, SO_x, VOC, PM etc.) and other emissions (e.g. noise). The VDA therefore advocates realistic, implementable emission limit values for emissions in Germany. Competitive disadvantages for the German automotive industry due to the tightening of emission limits compared to the European requirements must be avoided. This also applies as a whole to the technical instructions for keeping the air clean, which the Federal Environment Ministry intends to bring into alignment. The German industry does not consider a fundamental revision of the rules to be necessary; rather, adjustments to technical progress are sufficient.

5.2.2 Resources

- **Process:** Our automotive industry strictly adheres to the resource requirements in the respective countries. We are therefore committed to realistically implementable specifications. For example, we aim to avoid waste as much as possible and, where not possible, to achieve the highest possible recovery rate for the waste (reuse/recycling). The use of water and other media (compressed air/gas) should be reduced as much as possible.
- **Product/vehicle:** (e.g. steel, aluminium, rare earths, plastics etc.). Closed cycles and pure separation represent the greatest challenges with regard to the product-side reuse of resources. Here, the legislature is required to both promote projects for improvement and to create clear framework conditions. Especially for the batteries that are currently the focus, the VDA is working on a proposal for standardisation, both for production and reuse. Economically positive effects and the resulting battery cycles are to be expected from this. The material per kilowatt hour of a used battery from the automotive market can be reused in other markets for around 15% of its value as new. The lower SOC (state of charge) is often sufficient here. After that, a second reuse in the stationary area is conceivable.

5.3 Social sustainability

We understand social responsibility as the fundamental respect for human rights in accordance with the UN Guiding Principles on Business and Human Rights, the promotion of their employees in their development (see Chapter 3), the promotion of health and the reduction of stress in the workplace, the maintenance of uniformly high occupational safety standards worldwide, the promotion of diversity and social commitment.



Social sustainability (source: Audi AG)

As the German automotive industry, we promote a corporate culture that is shaped by the values of social sustainability.

The fundamental respect for human rights is the basis and influences cooperation in the entire automotive production. Managers live the values in the sense of role models; mutual respect, compliant behaviour and a speak-out culture are commonplace.

Education is also an elementary human right and the key to a sustainable society. In addition to lifelong learning, which was already discussed in Chapter 3.2, we offer our employees the opportunity to work independently. We take into account the needs of the employees in the different phases of their lives and create the freedom to combine family and work. This includes flexible working time models and the provision of childcare options, but also support when relatives need to be cared for.

Improving the physical and mental health of employees and minimising occupational accidents are the goals of holistic and globally applicable health management. To this end, the latest standards in ergonomics, safety technology and occupational medicine are used at all locations. The employees use individual prevention programmes and help to identify health risks at an early stage and to take countermeasures.

We focus on equal opportunities and strengthen cultural diversity. Our goal is a diverse and inclusive society. To this end, we develop programmes that promote young international talent and global employee rotation.

In addition, we are involved locally in the respective regions in order to further develop and strengthen them. As the German automotive industry, we stand up for the disadvantaged at all locations and initiate and support social projects.

Responsibility for people and the environment no longer ends at the factory gate, but should be secured across the entire supply chain.

5.4 Summary

5.4.1 Requirements for companies

In order to achieve the sustainability goals, the VDA will develop a common position for prioritising materials in the context of a project committee or a working group. A multi-mineral standard should be achieved. To this end, existing initiatives must be consolidated. Examples of initiatives would be the “Initiative for Responsible Mining

Assurance” (IRMA) and the Responsible Mining Index (RMI). Beyond the area of critical raw materials, the work of existing initiatives in business and human rights must be brought together. The goal is to standardise the core elements of human rights management. It is advantageous to focus on initiatives that are not only promoted by the automotive industry, but also in which other industry branches are involved and which are recognised by policymakers and NGOs.

5.4.2 Requirements for policymakers and trade unions

In order to achieve the CO₂ targets for 2030 and 2050, the following funding must be continued:

- Funding of measures for energy efficiency and CO₂ reduction for new investments and reinvestments continue to keep (simplify application)
- Funding of technology research for the next technological leap in energy-intensive materials and processes continue to keep (simplify application). For example, new possibilities for dryer heating in the paint shop process without natural gas.
- Expansion of renewable energies to meet the demand for regenerative energy for the industry
- Promotion of alternative heat generation in order to replace heat from natural gas in the long term (especially funding of 2nd generation biomass and biogas)

The following **new** funding is required to achieve the CO₂ targets for 2030 and 2050:

- Funding of technologies for storing electrical energy, so-called PtX technologies, in order to develop new ways in process technology (Power-to-X refers to various technologies for storing or otherwise using excess electricity):
 - **Market incentives for production and use across all sectors.**
We supported the initiative (by parts of) the federal government to largely exempt the electricity used to produce green hydrogen and synthetically produced gases from taxes, levies and surcharges, including an exemption from the EEG surcharge. We call for further measures so that hydrogen plays a more important role in the global decarbonisation of the heating market. A funding program for the industrial use of fuel cell technology would be desirable.
 - **Formulation of uniform sustainability and quality standards in Europe:**
We encourage the federal government to support European sustainability and quality standards (including for guarantees of origin for renewable electricity, synthetic gases and green hydrogen) to increase the European market opportunities for hydrogen, synthetic gases and PtX products.
- Funding for the power purchase agreement (PPA) e.g. simpler approval procedures and elimination of the Renewable Energy Act (EEG) surcharge (at least for the renewable energy generation plants)

With regard to the certification of suppliers (social sustainability), associations are calling for overlaps and parallel activities to be consolidated. The requirement of the legislature is a supply chain law at European level in order to avoid a heterogeneous landscape of national laws. In a similar way, uniform legislation for the zones USMCA, ASEAN (Association of Southeast Asian Nations) and China should be aimed for. The laws require a safe harbour regulation with clear criteria and a standard, which was formulated by the aforementioned multi-stakeholder initiative, which corresponds to the requirements of the legislator.

6 Pandemic prevention

In this chapter, pandemic prevention is detailed as an integral part of the target vision; a phase model is described and requirements for companies, policymakers and associations are deduced. This pandemic prevention is explained using the example of COVID-19 and may need to be adapted to the characteristics of a future pathogen. This procedure can in principle also be used for epidemics.

Vision statement:

The German automotive industry is operating in a new normal as a global network in order to prevent future pandemics and minimise their effects.

Mission statement:

With the help of a defined and comprehensive pandemic prevention concept, pandemics can be identified at an early stage, measures are prepared and the ability to respond if they occur is ensured. The prepared pandemic plans help to contain the spread and minimise the effects both internally and on the global supply chains. A coordinated phase model synchronises the measures to be taken in the global network.

6.1 Fields of action

With the Corona pandemic in 2020, the entire automotive industry was faced with new and in part completely unexpected challenges.

Worldwide, different pandemic courses of action – both in terms of time and intensity – caused a partial break in the global supply chains and thus also partially stopped automotive production. A restart and a regulated production mode under pandemic conditions were made more difficult by different state, federal and international legislations.

The following problems arose in the network:

- Pandemics have so far been an under-represented component of the company's risk management system, so that the response measures first had to be developed.
- In-house occupational health and safety was inadequately prepared for the pandemic, for example through prepared action plans, the provision of protective equipment or the establishment of pandemic-compliant workplaces.
- Communication on health threats was not prepared for an ad hoc response. Channels for awareness-raising work (beyond the usual cascade via executives) were not sufficiently set up.
- Regulations for presence at the workplace, mobile working and shift decoupling had not yet been prepared.
- Regulations on business-critical travel and mobility in the event of a pandemic (both for internal employees and business partners such as fitters and customer service employees) were not clear. This led to difficulties, for example, when commissioning or repairing systems.
- Concepts of flexibility and pandemic prevention measures for employees did not exist and were not regulated, e.g. in works agreements, working time models or hygiene concepts.
- The IT infrastructure was often inadequate for the extensive implementation of mobile work, also because in many companies, (needs-based) mobile work was not part of the standard.

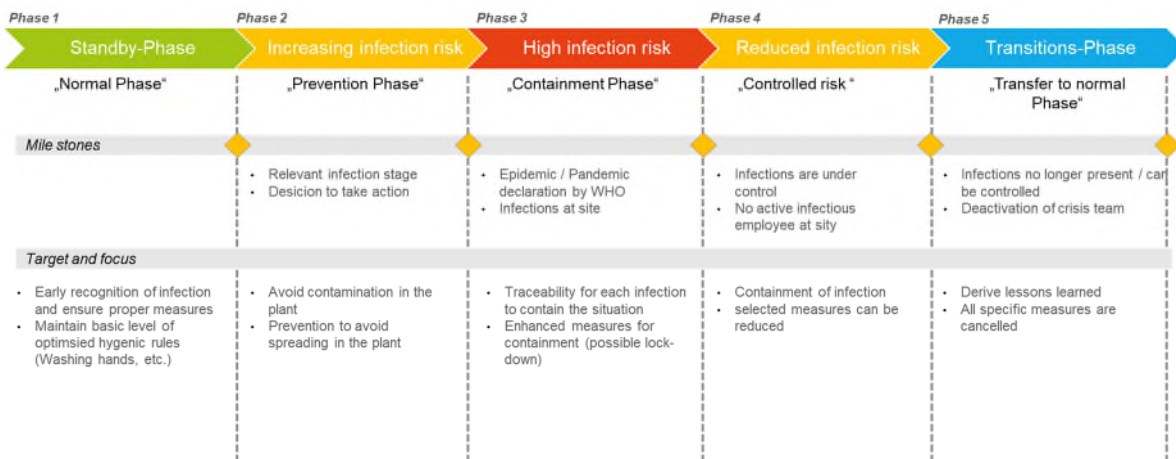
The missing or contradicting requirements at state, federal and international level for employee protection, such as the contradicting discussions about wearing mouth and nose protection, quarantine/guidelines on resuming travel, the implementation of pandemic-compatible workplaces and specifications for cleaning and disinfection, added to the difficulties for restarting production.

6.2 Pandemic plan as a phase model

The aim of the phase model is to identify the occurrence of infection in future pandemics at an early stage and to standardise the procedure in the automotive industry in order to protect employees from infection and to ensure continued operation.

The structure of the phase model follows the risk of infection. Phase 1 is called the standby phase. Phase 2 occurs as soon as a relevant occurrence of infection identified. Phase 3 pertains to the situation as soon as the pandemic has been declared. Phase 4 is able to control the occurrence of infection. Phase 5 describes the transition to a new normal state, which is sought after the pandemic has subsided.

The measures in the phase model are clustered into the following categories: crisis management, communication (internal and external), occupational health and safety, presence at the workplace, travel and mobility, personnel management and IT support.



Uniform phase model of pandemic prevention

6.2.1 Crisis management

Crisis management organisation is established under normal conditions (e.g. half-yearly meetings) and can be activated if necessary. There are regular crisis exercises as well as a regular check of the equipment and procedural regulations (pandemic plan). As the risk increases in Phase 2, the crisis management team is activated (central, regional, local), i.e. established as a special organisation with decision-making authority. In Phase 3, a regular situation assessment and further, pandemic-specific measures will be introduced (if necessary, ramp-down to shut-down as a maximum measure). Daily meetings of the crisis management team take place on the current situation. In Phase 4, crisis management is gradually transferred to line organisation, including a coordinated (re-)transfer of tasks. In Phase 5, the frequency of the meetings is significantly reduced. The focus of this phase is on documentation and data storage as well as on updating equipment requirements and procedural rules. The last step is to deactivate the crisis management team.

6.2.2 Work and health protection

Under normal conditions, the focus is on compliance with regular hygiene standards, such as hand-washing, sneezing and coughing etiquette etc. In addition, equipment is available for defined standard measures and fresh air supply or ventilation options; filtering options are provided if necessary. In Phase 2, the measures that have been developed for the pandemic will be implemented in stages. The focus is on avoiding the spread of infection (e.g. by reducing events, restricting catering/canteens and limiting travelling). In Phase 3, the restriction of physical personal contact is tightened (reduction of shift handovers or complete shift decoupling, group formation, special regulations for social areas, facilities, catering, canteens, passenger transport, company cars etc. In Phase 4, the measures (according to the step-by-step plan) will be relaxed in a targeted manner or restrictions will be withdrawn under certain conditions. In Phase 5, the restrictions are removed again and a new normal state is defined as lessons learned.

6.2.3 Internal/external communication

In Phase 1, electronic communication channels for direct contact with all employees and important business partners are also ensured outside of the company. In addition, the information networks for the health authorities and RKI are maintained in particular. From Phase 2, the crisis communication channels are activated internally and the workforce is regularly informed of the measures taken. The next potentially measures will also be communicated proactively at an early stage. Externally, networks will be activated. In the event of a pandemic (Phase 3), further crisis-specific networks and communication channels are checked, which are set up accordingly. A management report and the measures implemented are communicated internally on a regular basis. Crisis-specific communication is also maintained in Phase 4 before active communication of the completion of the measures in Phase 5 takes place.

6.2.4 Presence at the workplace

In Phase 1, preparations are made so that "rectification options" exist if necessary. In the direct area, this should be taken into account in the workplace layout and, if necessary, the use of cobots should also be prepared. In the indirect area, face-to-face and mobile work are possible; remote guidance is a well-practised model. Further preparatory measures for mobile working are initiated, for example company regulations, risk assessments, training courses and IT equipment including dial-in points. For all phases, special regulations can be introduced for risk groups. In Phase 2, the workplaces for direct employees will be rectified, and conversion as well as (preferably) distancing measures will be implemented. Measures are taken to also carry out production control (e.g. shop floor management) from a distance, e.g. digitally. The wearing of suitable protective equipment (e.g. mouth-nose protection) is introduced and the rotations at workplaces are reduced. For indirect employees, mobile working and, if necessary, rolling teams are introduced in this phase and intervals are set when they are present. In Phase 3, the measures from Phase 3 are implemented to the maximum and only the absolutely necessary employees are deployed at the workplace in the indirect area. In Phases 4 and 5, the measures at the workplace are gradually relaxed.

6.2.5 Travelling and mobility

In Phase 1, travel is possible in the context of the usual restrictions. As part of pandemic prevention, the infection situation is regularly screened (RKI, travel warnings etc.) and a step-by-step plan is developed for travel restrictions and the return of travellers and expats. In Phase 2, only essential trips are allowed with the appropriate approval. It should be noted that trips to risk areas according to the RKI classification are only permitted in an emergency. There is also a regular review of the infection rate and the situation of the health system in the various countries. All employees who work abroad are accounted for so that contact can be made. In Phase 3, travel restrictions are introduced (e.g. only systemically relevant, top management approval, justified exceptional cases, as far as officially possible). The return of employees and their families from abroad will also be initiated. In Phase 4, trips are gradually possible again, if absolutely necessary and with the appropriate approval. In the final Phase 5, all trips are possible again according to the usual restrictions.

6.2.6 Personnel management

As part of the cooperation with the employee representatives, measures requiring co-determination are coordinated in Phase 1 and, if necessary, regulated in works agreements (e.g. flexibility concepts, shift models, models for spatial rectification and regulations for company facilities such as canteens etc.). In addition, a procedure will be established on how the employee representatives can be integrated into the crisis management organisation from Phase 2 if required, and necessary measures can be coordinated with employee representatives at short notice.

6.2.7 IT support

In Phase 1, resources are reserved for a significant increase in remote work (e.g. bandwidths, dial-in nodes, server capacities, mobile devices). The ramp-up scenarios are available and regularly checked. In Phase 2, resources

are used to significantly increase remote work, and the development of crisis-specific reporting is supported or crisis-specific applications are introduced. In Phases 3 and 4, the specific shutdown measures are implemented, and in Phase 5, the measures undergo a review.

6.3 Summary

The phase model enables a coordinated and synchronised procedure in the supply chain of the automotive industry for future pandemic situations. The following lessons learned from the pandemic in 2020:

- Preparation of preventive and containment measures that can be implemented quickly according to the phase model
- Intensification of internal and external communication and use of the VDA as a platform
- Sufficient stockpiling of protective equipment and disinfectants
- Standardisation of specifications and procedures at state, federal and international level
- Better secured supply chains with regard to JIT forecasts for shutdown and restart of production
- Pandemic-friendly design of workplaces, e.g. also using cobots

6.3.1 Requirements for companies

Phase models must be set as a standard in internal work and kept up to date even after the pandemic has subsided.

6.3.2 Requirements for policymakers and trade unions

Uniform regulations and legislation are required here, for example on hygiene measures and travel restrictions. Differences in the regulations should be minimised so that no different measures are taken between the individual companies in the automotive industry (as well as outside of the industry). If quick decisions are required in the event of a pandemic, the regulations should have a certain degree of uniformity and sustainability/period of validity in order to create planning security.

Policymakers must increasingly coordinate their international agreements in order to achieve comparability in legislation, for example for lock-down criteria, regulations for the movement of goods etc. The exchange of experiences on lessons learned should also be strengthened.

Digital transformation is also a key factor in this context. The expansion of the IT infrastructure, especially in rural regions for mobile work, must be promoted accordingly.

There is an urgent need for action to increase flexibility in the drafting of works agreements, for example for flexible working time models, faster response times and shift decoupling.

The VDA acts as a functional link in coordination with the associations and as a point of contact for policymakers.

Contact person in the VDA

Management

Dr Joachim Damasky

joachim.damasky@vda.de

Head of Production and Logistics

Robert Cameron

robert.cameron@vda.de



Publisher Verband der Automobilindustrie e.V. (German Association of the Automotive Industry) (VDA)
Behrenstraße 35, 10117 Berlin
www.vda.de

Copyright Verband der Automobilindustrie e.V. (German Association of the Automotive Industry) (VDA)

Date of publication Version 1.0, January 2021