

2019

BIH AUTOMOTIVE INDUSTRY ASSESSMENT:
**TRENDS, CHALLENGES
AND OPPORTUNITIES**

FINAL REPORT





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Sarajevo



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INTRODUCTION



Metal processing sector in Bosnia and Herzegovina (BiH), along with base metal production, has traditionally been country's strongest and the most significant industry and export-oriented sector, accounting for more than 30% of total exports. As a sub-sector, BiH automotive industry with over 60 companies and more than 11,000 employees, has experienced development in recent years, with estimated volume of export amounting to 90% of the overall production. According to the relevant global studies, the automotive industry world-wide is going through significant changes caused by new technology-driven trends and business models that will have far-reaching consequences for the entire industry. The four megatrends will shape up the future automotive industry: electrified vehicles, autonomous vehicles, shared economy and connected vehicles with regular updates. These changes will have important effect on BiH companies too.

Inspired by the new trends and significance of the automotive industry for the country's economy, the United Nations Development Programme (UNDP) has commissioned the "2019 BiH Automotive Industry Assessment: Trends, Challenges and Opportunities" study with the main purpose of providing a structured overview of the following topics:

1. Future trends in the automotive industry with far-reaching consequences for the entire industry and corresponding value chains;
2. Regional automotive industry, along with connections and synergies with the region and global automotive market;
3. BiH automotive industry, with general overview of BiH companies and their characteristics;
4. Carving out the BiH industry's share in the future automotive industry, with impact analysis of the global trends on BiH automotive companies, identification of major threats and growth opportunities for BiH automotive industry, along with recommended exploitation and mitigation strategies.

The key messages from this study are intended for both local institutions and private sector to anticipate and pre-empt the short and mid-term effects to the BiH automotive industry.

The study has been implemented under the auspices of the Economic Governance for Growth (EGG) project, which is primarily funded by the Government of Norway and implemented by the United Nations Development Programme (UNDP) in BiH. It has been designed in close collaboration with the key national partners, namely the Foreign Trade Chamber of Bosnia and Herzegovina, Chamber of Economy of the Federation of Bosnia and Herzegovina, Chamber of Commerce and Industry of Republic of Srpska and private sector.

1

EXECUTIVE SUMMARY



1.1. MEGATRENDS

Global automotive market offers a wide range of new ideas and trends almost on a daily basis. This report presents 4 global trends (megatrends) that were selected among many new ideas and trends that are introduced on market every day. These four megatrends are unique because they will see rapid development in the years to come and they pertain, to a large extent, to a completely new, innovative and advanced technology which can shape the future of the automotive market:

1. ELECTRIFIED VEHICLES (EV)

In the world where people are facing serious climate changes caused by very high CO2 emissions, most of the governments and organizations are pushing for reduction of CO2 emissions in all areas of life. The transport/mobility sector responded through rapid development of technology and products based on Electrified Vehicles. Currently, it is one of the most developed technologies that allow reduction of CO2 emissions.

2. AUTONOMOUS VEHICLES

Due to rapid technology improvements and the positive influence from the market regulators – who, in many cases, intended to liberalise the regulations in the area of autonomous driving, the vehicles that are currently being manufactured are becoming increasingly independent from the driver. Most of the systems are designed to provide on-road support of the driver and still need a human driver to operate, but this status is going to change very soon. At present, the whole market is focusing on further development of error-free technology that will allow delivery of fully autonomous vehicles.

3. SHARED ECONOMY

Shared economy is a global trend inseparably connected with “Generation Y” (people born between 1980 and 1995). This generation will be the driver of profound changes in the automotive industry in the upcoming years. Their demand for more sustainable and convenient services, supported by the online platforms, has changed traditional economic model into a new one, based on the cost efficiency and sharing rather than owning – called “Shared Economy”.

Car sharing became very popular mostly among young people, who live in large urban agglomerations and usually do not need to own the vehicle as the fastest and the smartest way for them to commute in the city centre is public transport.

4. CONNECTED VEHICLES WITH REGULAR UPDATES

Modern vehicles are built by OEMs as a large platform for advanced solutions of Internet of Things (IoT). The average user expects a modern car to be fully connected to internet, to send additional information to a chosen dealership and to remain compatible with the newest models of smartphones. The connected vehicles are changing the automotive market as they are providing additional features to their users.

1.2 INTRODUCTION TO AUTOMOTIVE VALUE CHAIN

The traditional model of automotive value chain was based on the assumption that automakers were responsible for vehicle design and assembling the vehicles. To achieve this goal, every automaker had a number of suppliers who were originally divided into tiers (Tier 1 – Tier 3). This clear and simple division of roles through the automotive value chain is no longer aligned with the modern market requirements.

Tier 1 - suppliers are responsible for delivering the vehicle's components directly to the automaker.

Tier 2 - suppliers manufacture the simple parts that will be used to manufacture the components delivered by Tier 1 suppliers.

Tier 3 - suppliers are responsible for providing the raw materials.

Systems Integrator - company responsible for designing and integrating components into the larger modules, which are delivered directly to the automaker's assembly plants

Global Standardiser - company which is capable to set the global standard regarding the component or system level.

Component Specialist - manufacturer of specific component or subsystem dedicated to the current type of vehicle.
Raw material supplier - company which supplies the raw materials to automaker or its suppliers.

To fit into the new reality and redefine the role of the suppliers in their business, the automakers started redesigning the automotive value chain. The new division of the roles has placed more responsibility onto suppliers in terms of design and engineering of the components/systems and managing supplies required to manufacture these components.

	SYSTEMS INTEGRATOR	GLOBAL STANDARDISER	COMPONENT SPECIALIST	RAW MATERIAL SUPPLIER
FOCUS	Company which assembles the whole module or system	Company that sets a standard for a component on a global basis	Company that designs and manufactures a component tailored to a vehicle	Supplies the raw materials to the automaker or suppliers
MARKET PRESENCE	Global	Global	Global for 1st tier Regional or Local for 2nd /3rd tier	Local Regional Global
TYPE OF COMPONENTS	Interiors, Doors, Chassis	Tires, ABS System, ECU	Stampings, Engine Components	Steel, Aluminium, Polymer

Such a transformation of the value chain structure also suggests the need for restructuring on the suppliers' side. Being an integrator or standardiser in such a process requires delivery of a wide range of high-complexity products and services. At this level it is also crucial to be an international company with global presence to be able to meet the automaker's requirements at every location across the world where the assembly plant is placed. Only the strong market players are able to do that and can afford to do that.

1.3. NEW TECHNOLOGIES ON THE AUTOMOTIVE MARKET

LIDAR

LiDAR (Light Imaging, Detection and Ranging) is a technology whose concept is similar to RADAR, but instead of continuous radio waves, it uses the visible pulsed laser light to detect the distance to surrounding objects. Owing to LiDAR, autonomous vehicles can create a 3D view of environment and receive the information about the distance to other objects. LiDAR is a part of Advanced Driver Assistance System (ADAS). Combined with classic radar and vision systems, LiDAR provides the most accurate and detailed information about environment. Although the LiDAR systems saw rapid development over the past few years - from the heavy mechanical spinning objects to a whole family of solid-state microchips - a lot of work remains to be done before this project can be delivered to final customers. The global standardisation of those components would bring a considerable relief to everyone, but currently it is too soon for Global Standardisers to address it.

HIGH DENSITY BATTERIES

Electric vehicle batteries should meet some general requirements set before the engineers and potential customers:

- ▶ **High Capacity** – the power storage is supposed to be as high as possible.
- ▶ **Weight** – the ratio that we are looking for is approx. 1 kWh/1 kg.
- ▶ **High Voltage** – to release the large amount of energy in a controlled manner without overheating.
- ▶ **Short charging time** – the shorter the better.
- ▶ **Improved safety** – safe for usage and possibly non-flammable.

At present, we have two potential competitors of (alternatives to) Li-ion batteries:

- ▶ **Solid state** – the liquid electrolyte is being replaced by solid compound which also allows for ion to transfer.
- ▶ **Fluoride-ion** – the battery can safely operate at higher temperatures without overheating and allows reaching energy densities up to 10 times higher than the limits of Li-ion batteries.

No matter what type of battery eventually wins the market and replaces the Li-ion batteries, the global demand for battery packs for EVs or PHEVs/HEVs will grow rapidly in the next few years and there will certainly be an immense potential to provide such products on the market.

1.4. REGIONAL OVERVIEW

Automotive industry in the region of Western Balkans has had a long tradition dating back to the time of the common state of the mentioned countries (plus Slovenia), known as former Yugoslavia. Former Yugoslavia used to have its own production of passenger, transport, freight and special-purpose (military) vehicles. The roots of automotive industry in the region can be traced to Germany, Italy and France. Over the course of 20th century, regional automotive industry was fully integrated in terms of a planned development of all of its segments, including local suppliers of parts and components. After the breakup of Yugoslavia in 1992, automotive industry saw significant decline, due to Balkan wars, disruption of internal and external market connections, privatisation and transformation to market economy. Since 2005, regional automotive industry

has been of the path of slow recovery, gradually gaining its strength and increasing its share in the economies of Bosnia-Herzegovina, Croatia, Macedonia and Serbia. Today, some worldwide famous brands operate in the region, such as Fiat in Kragujevac, Serbia, and Rimac Automobili in Sveta Nedelja, Croatia, as worldwide vehicle manufacturers. In addition, international producers of parts and components for automotive industry made a significant number of acquisitions of domestic companies.

1.5. CONNECTIONS TO COMPANIES IN EUROPEAN REGION AND GLOBAL AUTOMOTIVE MARKET

The existing regional connections and synergies between enterprises in automotive (parts and components) suppliers' value chain are still rather weak. The producers mainly import raw materials, process it, and export the automotive industry products. A typical process in the companies within automotive suppliers' value chain involves:

- ▶ **Import of production inputs from abroad or purchase from local traders**
- ▶ **Technical preparations based on specifications provided mainly by foreign buyers**
- ▶ **Internal processing of supplied materials (cutting, bending, milling, grinding, welding, surface protection, quality control...)**
- ▶ **Outsourcing certain processing segments (e.g. surface treatment) to other local companies, but with key production/processing functions being kept within the company**
- ▶ **Quality control, storage and packaging operations, direct delivery of goods to buyers, with rare engagement of sales intermediaries**

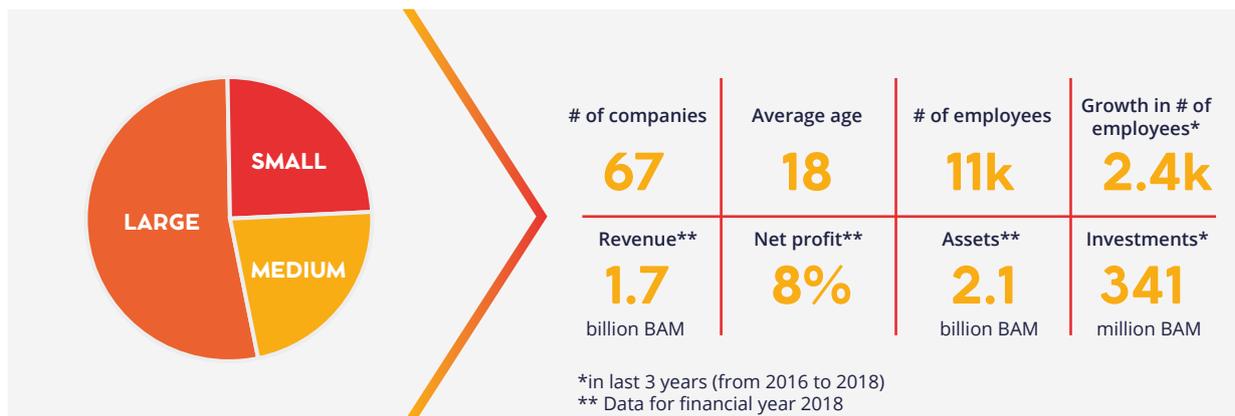
The region has local raw material producers, but their products are rarely used in production of parts and components for automotive industry, primarily because the quality of products is insufficient to meet the high requirements of automotive industry. Nevertheless, regional automotive industry is fully dependent on foreign, mostly European, vehicle producers and Tier 1 suppliers. Very few BiH and regional enterprises participate in all product development phases throughout their cooperation with buyers. Most enterprises perform processing in line with their parent companies' specifications, or specifications provided by their buyers, whether they are intermediaries or global automakers. Cooperation between regional companies represents a great potential and future development opportunity, although at the moment it is rather poor.

1.6. OVERVIEW OF BIH AUTOMOTIVE COMPANIES

Under the scope of the project, a comprehensive database of BiH automotive companies with 67 entries was compiled (Annex 1). The mapping database includes information on all companies (complete or partial) operating in the automotive sector across BiH, as well as information on the potential newcomers to the industry. It comprises the following data relevant for the research: **general information about the company, technological background, supply chain & market position, technological competencies, quality standards and financial information.**

The data was collected through business intelligence data and expanded additionally through informed input of the experts. Out of 67 companies included in the database, 12 were selected and interviewed by automotive experts (Annex 2). Selection was based on economic power, significance in the value chain and relevance for BiH automotive industry.

STRUCTURE OF AUTOMOTIVE COMPANIES PER SIZE



COMPANY CATEGORIES AND THEIR CHARACTERISTICS

In the process of developing this report, we conducted analysis of 67 enterprises representing the BiH automotive sector. The analysis shows that the majority of analysed companies belong to 'component specialists' category. Only one company can be classified as a raw material supplier, whereas the other one may be regarded as a global standardiser. Moreover, the analysis indicates that almost all BiH automotive companies produce the parts and components for global European standardisers. The majority of automotive companies (43) operate in machine processing sub-sector, whereas 11 enterprises pursue specialised production (border areas in terms of technologies, materials and products – e.g. plastic fibres, ceramics, filters and rubber). Four companies provide ICT and design services for the automotive industry, while 5 produce electro-components for conventional vehicles. The remaining enterprises process textile and plastics for automotive industry.

1.7. IMPACT OF AUTOMOTIVE TRENDS ON BIH AUTOMOTIVE COMPANIES AND THEIR PREPAREDNESS FOR FUTURE CHALLENGES

All the mentioned new trends will certainly influence the future business operations of assessed automotive companies. The companies are aware they will need to adjust in time. In terms of a possible level of influence the new trends may have on BiH automotive companies, the companies can be classified into 3 categories:

- ▶ companies whose production programs are not directly threatened by new trends
- ▶ companies that are, to some extent, threatened by new industry developments, and
- ▶ companies whose production programs may be exposed to the foreseen changes.

However, BiH companies covered by the survey believe that anticipated changes may not arrive so soon. The changes impacting the automotive market will be gradually introduced into the industry, leaving sufficient time for adjustment. BiH automotive companies are aware both of the chances and opportunities brought by the new technology and market trends and of the challenges and threats should they miss the chance to adjust.

CHALLENGES AND OPPORTUNITIES FOR GROWTH OF BIH AUTOMOTIVE COMPANIES

Depending on the characteristics of their production programs, BiH automotive producers may face different challenges. Some of them will need to invest significant efforts to adjust and improve, in order to be able to cope with new trends, while many feel their position is not threatened and rather perceive it as an opportunity for growth. The surveyed companies have singled out their most significant advantages and disadvantages, as presented in the Table 1.

Table 1. Key advantages and disadvantages of the surveyed companies

ADVANTAGES

- Still relatively inexpensive workforce
- Favourable geographic position (close to EU)
- Wide range of production facilities and expertise
- Quick response, production and delivery
- Flexibility in production
- Tradition in industrial production, European habits and technologies
- Honouring contracts and agreements

DISADVANTAGES

- Weak skills and workforce drain
- Lack of quality standards
- Weaker technology compared to competitors
- Poor infrastructure
- Political and economic instability in BiH
- Poor country image
- Weak position in negotiations (with big players)
- Low investment and development budgets



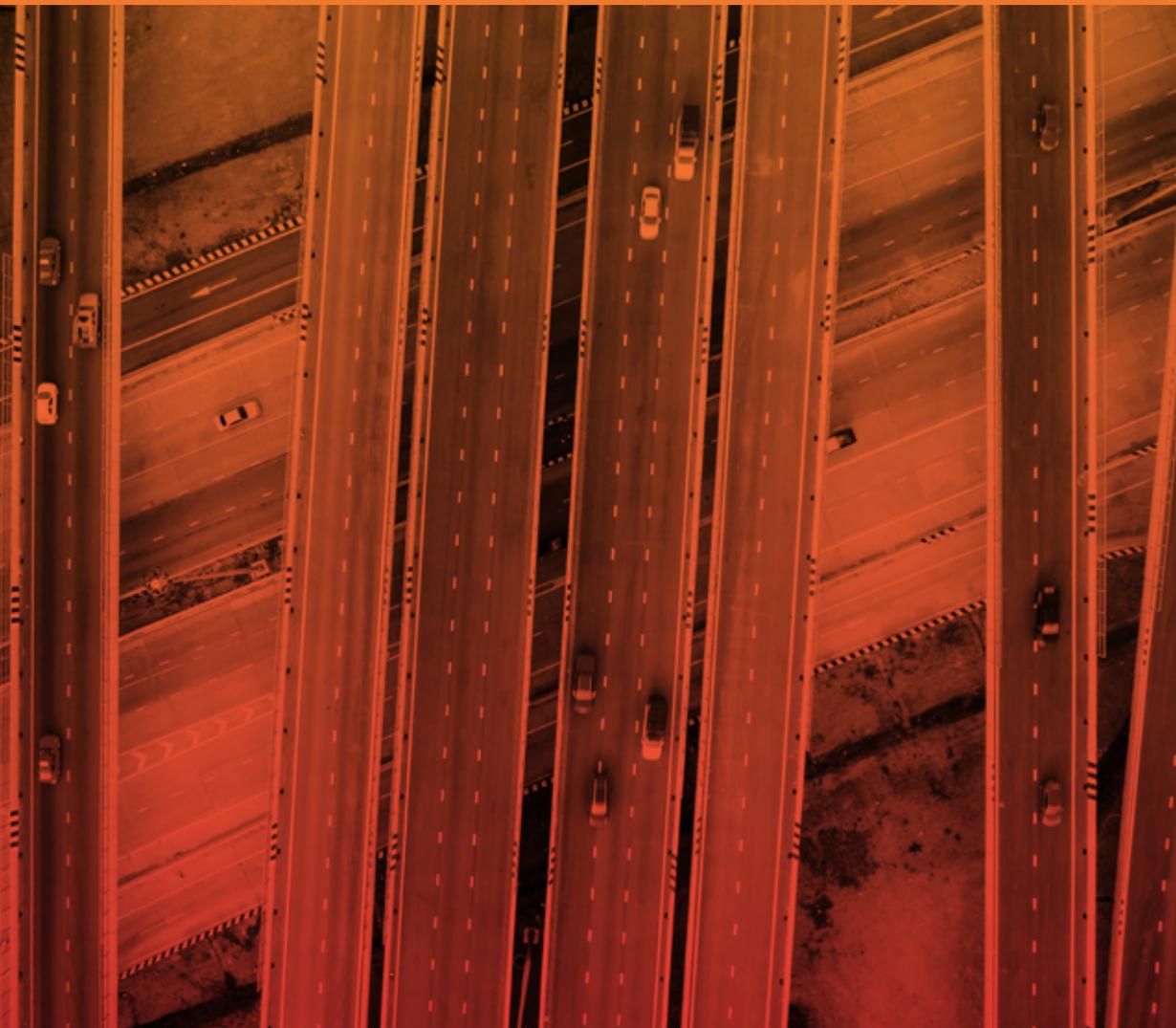
Table 2. Actions recommended depending on the readiness for new trends

COMPANY CHARACTERISTICS	POSSIBLE GROWTH ACTIONS		
	Short-term	Mid-term	Long-term
Companies not exposed to new trends (producers of wheel components, ball bearings, aluminium housings and parts, plastic components, parts of cooling and fluid systems, etc.)	<ul style="list-style-type: none"> • Introduction of the latest technologies • Strengthen cooperation with existing buyers 	<ul style="list-style-type: none"> • Digitalization of production and all other business processes 	<ul style="list-style-type: none"> • Monitor long-term changes in the industry and take appropriate measures to undergo timely adjustment • Develop own R&D facilities and / or establish cooperation with R&D facilities
Companies partially exposed to new trends (producers of components for freight and special vehicles and engines)	<ul style="list-style-type: none"> • Development of plans and strategies to gradually upgrade production in order to fully face new trends • Expansion of buyers' base 	<ul style="list-style-type: none"> • Introduction of new technologies in line with new trends • Digitalisation of production and all processes • Undertaking actions to strengthen market position in the value chain 	<ul style="list-style-type: none"> • Focusing special attention on monitoring industry changes & trends • Introduction of own product development facilities or establishing cooperation with relevant facilities
Companies fully exposed to new trends (producers of parts for ICE engines, exhaust systems, fuel filters, transmission systems, etc.)	<ul style="list-style-type: none"> • Prompt development of investment plans in line with new trends, with possible introduction of significant changes (new technologies, new products) • Launching introduction of new technologies and new products 	<ul style="list-style-type: none"> • Expansion of technological base for introduction of additional new products • Establishing closer cooperation with existing and new buyers • Digitalisation of production and all other business processes 	<ul style="list-style-type: none"> • Introduction of own product development facilities or establishing cooperation with relevant facilities • Developing new products with the highest possible added value
Companies planning to leave automotive sector and produce for other markets and industries	<ul style="list-style-type: none"> • Taking immediate actions to establish connections with new buyers in different new sectors • Development and implementation of plans & strategies allowing to transfer to different markets and products 	<ul style="list-style-type: none"> • Strengthening market position in the new market segments • Upgrading existing technological base in line with requirements of new markets 	<ul style="list-style-type: none"> • Increasing the level of finalisation of production • Developing new products with the highest possible added value
Common actions relevant for all automotive companies regardless of their readiness to face new trends	<ul style="list-style-type: none"> • Joint participation at trade fairs • Visiting other companies to exchange best practices on organisation of production, business processes, etc. 	<ul style="list-style-type: none"> • Introduction of QS, particularly IATF 	<ul style="list-style-type: none"> • Cooperation with educational institutions, R&D institutions and ICT companies

BiH automotive industry will be impacted by the new trends in a similar way to other countries, not only in the region but also in the rest of Europe. Several new trends have developed on a worldwide automotive market that will simultaneously bring significant changes to the global automotive industry.

Some trends will be visible only in automotive market of BiH, while others will have a broader impact on other industries as well. Based on the findings of this research, the footprint of global automotive industry in BiH as well as generally in the region is not very strong. Currently, there is a large representation of Tier 3 suppliers working on raw materials. But the industry is changing swiftly and it can be felt in the current BiH market. The companies in BiH are mostly medium and small size, but in the upcoming times this will be their biggest advantage. Small and medium size companies are strong enough to provide components in the quantities and of quality expected by their customers, but still possess great flexibility. They are able to adjust to the changes in the scope of production or materials in a relatively short period of time. The international car manufactures, with their infrastructure spread all across the world, are struggling to be as agile and flexible to the extent expected by the new generation of customers. That is why they are in desperate need to find reliable suppliers able to deliver required components and adjust to the rapid changes and customer expectations coming from the automotive market. This is a huge opportunity for a country like BiH and its local market.

2 DESCRIPTION OF THE METHODOLOGY



The first step in developing “Automotive Industry Assessment: Trends, Challenges and Opportunities” report was identification of general global trends in automotive industry and their implications on the supply chains. Trends were assessed, reviewed and forecasted, identifying challenges and opportunities for growth in a short, mid and long term period. In parallel, we have mapped the impact of new trends on the BiH automotive sector representatives (companies) in short and mid time perspective. This provided an overview of the current automotive industry in the country and the region. Finally, opportunities and challenges for growth of the BiH automotive industry were defined.

In order to collect and validate data, desk research was conducted and several meetings with key market players were held. The following section presents the methodology for assessment of domestic automotive industry.

2.1. METHODOLOGICAL APPROACH TO ASSESSMENT OF DOMESTIC AUTOMOTIVE INDUSTRY

Data on automotive industry was collected through desk research, questionnaires and interviews with representatives of global and local markets. In addition to business intelligence data, all available reports and previous assessments were analysed in order to assess domestic market. Moreover, data on local companies and automotive industry were collected from reports and datasets received from the chambers¹. Additionally, online questionnaire was developed to collect the data that are not publicly available, but are relevant for the assessment of the industry.

Under the scope of the assessment, a comprehensive database of BiH automotive companies with 67 entries was compiled. First step included identification of companies operating in automotive sector and development of the relevant database of BiH automotive companies. The database includes information on all companies (complete or partial) operating in the automotive sector at the territory of BiH, as well as information on the potential newcomers to the industry. After the mapping phase, additional questionnaire was prepared to facilitate data collection through the structured interviews. Out of 67 companies included in the database, 12 were selected and interviewed by automotive experts. The selection was based on the economic power, significance in the value chain and importance for BiH automotive industry. These estimates were made based on the number of employees, revenues, technological competencies and complexity of production. An overview of interviewed companies is provided in Annex 2, as well as the questionnaire used in the interviews (Annex 3).

The interviews with the owners, directors and key technical or sales managers were conducted between May 21 and May 29, 2019, each taking approximately 2 hours. This step was aimed to gather the data on BiH automotive suppliers’ perception of the new technological trends in specific areas (technology, workforce, value chain position, vision and cooperation, marketing). Based on the information collected, experts developed report on companies’ readiness for new technological trends. The findings were presented and verified, with the participation of 8 companies from BiH automotive sector.

Full process of data collection and development of report is presented in the Figure 1.

Figure 1. Data collection process phases and report preparation



¹ Foreign trade Chamber of Bosnia and Herzegovina, Chamber of Economy of the Federation of Bosnia and Herzegovina and Chamber of Commerce and Industry of Republic of Srpska

3 FUTURE TRENDS IN THE AUTOMOTIVE INDUSTRY



3.1. AUTOMOTIVE MARKET GLOBAL TREND ANALYSIS

The global automotive market offers a wide range of new ideas and trends almost on a daily basis. Most of them are just “fads” and sooner or later will fade away. Others are country specific trends caused by the current regulatory situation on the market. Only a few of them have global range and pertain to most of the markets (developed and developing) and, more importantly, also have an impact on automotive value chain. We have decided to select 4 that are unique in our opinion. The uniqueness of these four megatrends is that they meet all requirements mentioned above and have one more feature – they will see rapid development in the upcoming years and are related to a completely new, innovative and advanced technology which can shape the future of automotive market. In the following paragraphs we would like to present these megatrends and view it from different perspectives to allow a full understanding of the impact they will have on the automotive value chain.

3.1.1 TREND #1 – ELECTRIFIED VEHICLES

3.1.1.1 DESCRIPTION

The carbon footprint has developed into a serious global problem today. Most of the governments and nationwide organisations are pushing for reduction of CO₂ emission in all areas – from manufacturing to everyday life. Due to the fact, which is undoubtedly proven, that climate changes, felt increasingly on a global scale, are caused directly by human activity, the current struggle with CO₂ reduction is becoming the most pressing issue. According to the research performed by the European Environment Agency:

- ▶ Transport sector accounts for nearly 30% of a total CO₂ emissions
- ▶ Out of this, 72% of emissions are directly generated by on-road transport.

Obviously, from global perspective, the transport and personal mobility are one of the key factors that account for CO₂ emissions, especially when we consider that this area is not controlled and monitored at the same level across particular countries.

That is why, a couple years ago, the automotive manufacturers started to look for technologies that may help reduce CO₂ footprint of the vehicles. One of first and the most obvious steps was to try to find an alternative vehicle drivetrain which would be more user friendly than petrol or diesel engines. They first viewed technology which has been available on the market for almost 140 years (the first electric cars were available already 140 years ago). For many years this technology was not used given that the OEMs started mass development of combustion engines. Electric Vehicle development was closely connected with development of efficient batteries - that can store the high voltage power for a long time without memory effect, have large capacity but are small in size, and can be charged in time reasonable for an average user. Such technology became available at the turn of the century when Ni-MH batteries became widely accessible. But the real revolution arrived when the Ni-MH batteries started to be replaced by Li-Ion batteries that have twice as much density as Ni-MH batteries and can store twice that much power. That was the time when electric vehicles became widely available, easy to implement and all other alternative fuels and drivetrains – such as hydrogen and fuel cells were pushed aside. Of course, this technology too has its limitations, but Electric Vehicles (EV) have certainly been recognised as the most possible future for automotive industry.

Currently available technology is not sufficient to fully replace internal combustion engines on the market, but will certainly suffice to start considering an idea of Electric Vehicles as an everyday means of transportation for a considerable number of citizens – particularly those who live in urban areas. Most of the car manufacturers are committed to provide full electric models till the end of 2025. One of the largest car makers - Volkswagen Group - claims that their first

fully electrified models available for the masses (the basic version which is supposed to start below 30k EUR) will be delivered in 2020. Recently, BMW Group announced that till 2021 all the currently available segments of their vehicles will have a fully electric vehicle present. Knowing that the average car owner drives about 13 000 km per year, which is only 35 kilometres per day – this includes all the days in a year – we can easily conclude that nearly every electric vehicle available on the market will be able to run without charging for at least two days. Considering that most of the new office buildings, shopping centres etc. are now equipped with fast chargers at the car parks, this time could extend to even a week without charging at home.

3.1.1.2 GEOGRAPHIC COVERAGE

This trend is worldwide spread. Its coverage is closely connected with development of the charging infrastructure in countries and local regulations supporting use/purchase of electric vehicles. When observing the trend in global terms, it becomes rather obvious that such a trend is noticeable mostly in developed countries rather than in developing countries.

There are 3 key factors at play here. These factors are supposed to be present to allow further progress in the use of EVs:

1. Subsidies/incentives

As electric vehicles are considerably more expensive than the conventional vehicles and the use of electrical car usually requires an access to the personal charging point available at the place of living

2. Infrastructure

In order to have the number of EVs on the roads growing, the governments, possibly in cooperation with private companies, have to provide fast charging infrastructure available across the countries for such vehicles.

3. Environmental education

Awareness on the necessity of environmental protection is a characteristic of developed countries that have clear and efficient environmental protection and environmental education policies. The goal is to build awareness among the citizens.

As observed in European markets, the largest growth in the number of registered electric vehicles is connected with tax reliefs or direct support for electric vehicle buyers.

3.1.1.3 POTENTIAL DEVELOPMENT

Electric Vehicles are at a very beginning of its journey and future development is crucial. Due to regulations enacted lately by European Union concerning the strict penalties for CO2 emissions exceeding 95 g/km (average per sales), the OEMs will be motivated to develop the fleet of EVs as soon as possible to reduce the average emissions. Larger number of fully electric models (to achieve 0 emission level and decrease the average) will bring normalisation of the prices and further development of technology. Achieving the effect of scale will definitely help make certain models more affordable for the regular customers.

All the factors above are crucial for development of the EV market. The only possible limitation is that there may not be enough public charging points available for the newly purchased electric vehicles, or the charging points will be concentrated in the city centres, with no presence in rural areas – which may prove to be discouraging for potential buyers living outside of the city centres. Some European countries (Norway, the Netherlands, Sweden, and UK) announced that registering new ICE vehicles will be strictly prohibited. The deadline ranges from 8 to even 21 years, but it is still a strong signal for OEM makers to implement electric model and pursue further development of technology in order to fulfil expectations of the customers who will soon not be able to register new ICE vehicles.

3.1.1.4 BUSINESS OUTLOOK

From the technical point of view, construction of EV requires considerably less components than in the case of internal combustion engine vehicles. The reduction is around 90% of the total number of parts required in case of ICE type of engine. Of course, reduction mostly includes the components connected with engine, fuel system and drivetrain rather than body, interior, suspension and steering system. Considering that the number of electric vehicles is going to grow rapidly in the following years, it heralds profound changes for the automotive supply chain. Not only most of the parts produced will no longer be needed, but even those that will be in high demand by the OEMs will fully differ from the ones that are actually being manufactured. Obviously, this will not happen overnight, but automotive suppliers should be prepared for such changes and start looking for possible new locations for new plants that will manufacture new components for the future vehicles.

3.1.2 TREND #2 – AUTONOMOUS VEHICLES

3.1.2.1. DESCRIPTION

- ▶ Due to technology development, the currently produced vehicles are becoming increasingly independent from the driver. Most of the systems are provided to improve safety and help driver avoid potentially dangerous situations or, in case of collision, minimise the outcome. However, most of them still need a human driver to operate and their purpose is only to support the driver on the road, not to fully control the vehicle. This situation is changing and the whole market is focused on providing fully autonomous vehicles. The vehicle which not only can drive by itself in defined use cases, but can also drive without a driver on board to any destination that may be required.
- ▶ This is a huge step forward for the automotive market - moving from the currently available vehicles with systems that support human driver and, in some specific cases, take over control of the vehicle, to autonomous vehicles that drive without support and are not monitored by the driver. It will open a whole new chapter in the area of personal/group transport and allow creating completely new additional services for users.
- ▶ The vehicles will no longer require a driver to take their users anywhere they want. The user base (people who will be able to use vehicles) will be expanded – ranging from persons who do not have a driving license to persons with disabilities that make it impossible for them to use the cars independently. These people, who are currently excluded from the possibility to drive themselves, are potential passengers in autonomous vehicles.
- ▶ One of the key beneficiaries of autonomous driving technology is on-road transport. This is the industry where a key element – driver – is also the weakest point in the value chain. People who work as truck drivers need to have regular rest breaks during their work days and their labour hours are strictly regulated by law – and usually stop at 11 working hours per every 24. Autonomous driving trucks would allow the number of on-road hours to reach almost 24/7. This is a significant improvement in the goods-shipping industry. Such technology would reduce delivery time, whereas the more precise driving would reduce fuel consumption and allow better utilisation of the truck by increasing its on-road time. According to PwC market experts, autonomous trucks will allow 5% to 30% reduction of transport costs. It means that one autonomous truck can save over 30 000 EUR per year and significantly improve road safety.

3.1.2.2. GEOGRAPHIC COVERAGE

Autonomous vehicles trend is global – therefore, most of the OEM's are currently working on controlled or full autonomy of their vehicles. However, for the time being, this trend is limited

to the selected countries (or even states, in the case of USA), where regulations on the use of autonomous vehicles (and implications regarding responsibility for potential damages) allow to use such vehicles on public roads. Without such regulations in place, even if we have fully autonomous vehicle ready for use, it will be impossible to drive it.

If we consider an overall potential for autonomous driving, the best prepared countries currently are²:

EUROPE	NORTH AMERICA	ASIA	OTHER
The Netherlands	USA	South Korea	UEA
Sweden	Canada	Singapore	New Zealand
The United Kingdom			
Germany			

More importantly, these countries allowed, either fully or partially, the use of autonomous vehicles on public roads, and their testing (with driver inside, ready to take over control). This is the milestone in autonomous vehicle projects where the vehicles undergo real-life testing on public roads.

Other countries are working on the solutions to allow autonomous vehicles to drive on public roads. Once the regulations are ready, more and more countries will process such solutions and the trend will become globally known.

The timeline for availability of self-driving cars on the market depends on the definition. Most of the automakers are making baby steps in this area by providing the autonomous vehicles gradually i.e. level by level (level of autonomy – from 0 to 5), and by adding additional systems or functions to the currently available models. So, it seems to somewhat vary from one brand to another, but 2025 is the furthest date set for fully autonomous vehicles (level 5). Ford announced lately that the first true self-driving vehicles will be available in 2021 (level 4) and will be available first through ride hailing programs. Toyota and Honda believe that their first autonomous vehicles (level 3) will be able to drive by themselves on the highways only and will be marketed in 2020/2021. The most surprising news came from Nissan who announced it is ready to release 10 different self-driving cars by 2020. These cars will be autonomous in urban conditions, but not driverless. The driverless models should appear in 2025. Volvo – the first company that promises to take full liability whenever one of its cars is in the autonomous mode – decided to announce it will release the car that can drive fully autonomously on the highways till 2021. BMW and Daimler want to present the fully autonomous vehicles (level 4 or level 5) in 2021.

3.1.2.3 POTENTIAL DEVELOPMENT

- ▶ Once potential legal and ethical issues are clarified, technical problems resolved, and the autonomous vehicles become the regular participants in road traffic, the reality of transportation will change dramatically. According to PwC Autofacts team, autonomous vehicles will account for over 40% of mileage driven in Europe in 2030. Implementation of fully autonomous vehicles on the roads will also change the way the cars are used by people. Potential users will transfer from car ownership to using the vehicle when needed. People will no longer be attached to one vehicle for a long period of time; instead they will use multiple

² KPMG, Autonomous Vehicles Readiness Index: Assessing countries’ openness and preparedness for autonomous vehicles, 2018

vehicles for short periods of transportation.

- ▶ This will also change an entire automotive supply chain. The future of autonomous driving belongs to the large fleets of vehicles that will be rented or shared by multiple users to meet their transportation needs. It means that the cars will not be intended for one person or a group of people, but for all users who may need them across the area. Currently, an average car spends approx. 95% of its potential usage time sitting in the car park while its active driving accounts for only 5% of total time. If the cars are shared and autonomous, the average mileage will increase as the vehicles will be used by multiple users. In the case or when the vehicles are used randomly from a larger pool for shorter periods of time, details like e.g.: body colour, upholstery or detailed equipment will no longer be important in the purchase process.

3.1.2.4 BUSINESS OUTLOOK

The technology used in autonomous vehicles is completely new on the automotive market and the type of parts used in production changes in line with the level of technology development. Certainly, the parts used in massive production of autonomous vehicle must be smaller and more compact than the ones used in the test phase. The key parts that will be needed in the first place include the whole range of sensors, radars, lidars and cameras that are necessary for autonomous driving. These parts must be considerably more integrated with each other and better built into the vehicle to integrate with vehicle's regular components.

If we look at the list of the most innovative companies in the world³, only one automotive company is ranked among the TOP 10 and – it is TESLA. The remaining TOP 10 places are mostly occupied by the companies connected with IT industry. Those companies such as Google, Amazon and Apple are currently one of the biggest players in the autonomous vehicles industry. With their budgets and exceptional skills of their engineers, they can afford to design, test and manufacture the elements needed for the car of the future. From that perspective, it is very obvious that the largest OEMs and technology companies may establish cooperation to build autonomous cars, where OEM will be responsible for delivery of “white label” vehicle and the technology company will use that platform to build the system which will allow autonomous driving and will maintain and secure it furthermore throughout the life cycle. In such a model, technology company will certainly ensure compatibility of the vehicle and built-in services connected with external products delivered by that company i.e. smartphones or shopping platforms

3.1.3. TREND #3 – SHARED ECONOMY

3.1.3.1 DESCRIPTION

Shared economy is a global trend inseparably connected with “Generation Y” (people born between 1980 and 1995). This generation will be the driver of profound changes in the automotive industry in the upcoming years. Their demand for more sustainable and convenient services, supported by online platforms has changed traditional economic model into a new one, based on the cost efficiency and sharing rather than owning – called “Shared Economy”.

In the automotive market this trend is being implemented through the car sharing – global phenomenon which allows millions of people across the world to share the vehicle when they need it and pay only for the time they use it. In general, automotive shared economy can be divided into 3 different concepts:

1. Ride hailing

The situation when you share a journey with other people who are driving in the same direction or willing to drive you to your destination. In exchange, you participate in the costs. In general terms, services such as Uber are also associated with ride hailing (at least as a general idea).

2. Car Sharing

Available in 2 forms – station-based and free/floating. Using the vehicles that are owned by the company and paying only for the time of usage. The idea is to return it to the dedicated stations (station-based model) or leave it on the parking space in the area covered by the supplier as service delivery area.

3. Private car sharing

Joining the platform which helps share your private car with other people for financial compensation, in the period when you do not use it. The issues that arise here are insurance policy and responsibility for potential damages – it is more popular in the countries when the legal system allows linking TPL insurance with a person, and not the vehicle.

Car sharing became very popular mostly among young people, who live in large urban agglomerations and usually do not need to own the vehicle, as the fastest and the smartest way for them to commute in the city centre is to use public transport. Generation Y finds it more appealing to have an option to use vehicles – when necessary and temporarily – available at almost every corner, and pay more per kilometre but only for the kilometres that actually driven, than the full-time car ownership. It is common for them to not recognise the car as a social status symbol, but more likely as a tool which transports them from point A to B. This is completely unlikely the Generation X people, who base social status on ownership of goods like i.e. cars, flats etc.

The way people use car sharing vehicles is changing the automotive market as well. With shared economy and no single party responsible for mileage, the decision criteria used when selecting a new corporate fleet will change.

It also changes the old model of manufacturing, configuration of vehicle, sales models and the way such vehicles are purchased. The car sharing market is more interested in purchasing a car as a service solution, rather than a regular car. This market is expected to provide additional services connected with vehicle purchase or termination of the usage/leasing period such as: additional transport of purchased vehicles to group stations, buy backs for vehicles that are no longer used/leased, with guaranteed residual value of such vehicles, providing vehicles with winter tyres etc. All these services should save work time for car sharing company or minimise the business risks these companies face. The emotions usually connected with purchasing cars, extra additional inventory or similar factors are no longer valid in case of car sharing companies. It prompts new approach to sales process at the NSC as well as dealership network level.

3.1.3.2 GEOGRAPHIC COVERAGE

Shared economy is known across the world in most of the countries. Car sharing services are mostly found in developed and developing countries – especially the ones with large urban areas and developed public transport services. The rural areas usually do not offer such services, unless there are large touristic attractions and in that case car sharing services may be useful for tourists.

3.1.3.3. POTENTIAL DEVELOPMENT

Shared Economy model has just started to earn our trust. Every day it makes people increasingly aware that shared solutions are not a fleeting phenomenon, but rather the future model which is here to stay and evolve. Co-sharing the assets is more cost-effective and flexible than any other known model. So, sooner or later, the car sharing companies will start to improve their services and specialise by offering personalised and dedicated services. Customers will be able to find the exact type of the vehicle they need and will be willing to pay extra money to easily share the bigger van, small city car, or maybe a 9-seat van which will carry a whole family during a trip. Also, this may enable emergence of the type of service where professionals will provide vehicles for

entrepreneurs who need more than a one size car to be more flexible in their business.

All this leads us to something that will profoundly change the automotive value chain – vehicles assembled specifically for car sharing purposes. At present, it is possible to order business-specific vehicles i.e. rental cars, or vehicles for specific groups i.e. police vehicles or government/ diplomatic limousines. Those vehicles have completely different specifications and additional equipment – not available in regular versions.

3.1.3.4 BUSINESS OUTLOOK

The growing popularity of sharing economy is forcing changes in automotive market. Large, high-rotating fleets are becoming increasingly important clients for OEMs. Due to the large volumes, specific needs of such clients (car sharing companies), and the fact they differ from the rest of client base when it comes to using such vehicles, it is convenient to provide a custom-made offer or even consider manufacturing special versions of vehicles. The car sharing companies are interested to purchase the vehicles with additional services that allow them to transfer part of business risk to other parties.

In the near future, many potential individual customers living in large urban agglomerations may forego the idea of purchasing the vehicle in favour of frequent use of car sharing mobility services. This may have a tremendous impact on market sales model and the dealership activity on the market.

On the other hand, many car sharing companies may become a problem. High rotation of vehicles and large volumes in the small area of business activity bring issues of keeping the residual value of vehicles that are no longer used / leased and potential demand for such vehicles in a long term. The vehicles offered by car sharing companies may be new, but they have high mileages, primarily due to intense usage.

3.1.4 TREND #4 – CONNECTED VEHICLES WITH REGULAR UPDATES

3.1.4.1. DESCRIPTION

Modern vehicles are much more different than a couple of years ago. The new trends result in changes not to the engine (under the hood) or an appearance of the car (design), but in the hidden elements like the electronics, which was not the case in the past. Just a few years ago, the most popular car amenity was a sat-nav system with large LCD touch screen and Bluetooth connection for mobile phone. At present, such set is not enough. Modern vehicles are built by OEMs as large platforms for advanced solutions of Internet of Things (IoT). The average user expects a modern car to be fully connected to internet, to send additional information to a chosen dealership and to remain compatible with the newest models of smartphones. The connected vehicles are changing the automotive market as they are providing additional features to their users. Currently, the car will download the live information about the traffic condition, car accidents on the road and will help you find a restaurant nearby or even book a table there. But this is only the beginning of what a Connected Car can do for its user. By using the built-in sensors, internet connection and in cooperation with smartphone, it can do many other things:

- ▶ Suggestions on using safer roads based on the number of accidents mapped in the navigation system
- ▶ Customised Insurance Premium based on the information on the driving style obtained by the built-in sensors and transferred to policy holder via internet
- ▶ Maintenance updates, safety improvement updates and vehicle condition reporting

- ▶ Maintenance costs, scope and time schedule based on the driving style and condition of the vehicle
- ▶ Online appointment booking at the dealership garage for requested maintenance
- ▶ Accident control and detection through the automatic system which sends out alerts for help and sends all information on the condition of the car in case of emergency
- ▶ Over the Air updates of the firmware and system patches – also new functionalities
- ▶ Replacement of the car keys by the smartphone which will allow control of the car and provide additional information on the range, status, charging level etc. to the user.
- ▶ Car2Car communication to exchange the information about the road traffic, speed and road conditions. As well as communication with road infrastructure such as traffic lights, highway gates etc.

Many of the above-mentioned functionalities can be found in modern vehicles, especially premium brands. Tesla is a great example of a connected vehicle of future. Owing to the ingenious idea of Elon Musk, Tesla's vehicles can update themselves for new functionalities, and deliver their Clients additional user experience by adding the out-of-scope features to every Tesla's car around the world. This is exactly what a modern user wants, what she/he expects from automotive market. People have gotten used to having gadgets like smartphones, tablets or smart watches, with so many applications and new features, easily downloadable via internet. They expect the same thing from their connected cars – to be always online and be updated about new functions and improved quality of the older ones.



3.1.4.2. GEOGRAPHIC COVERAGE

The connected car trend is limited mostly to developed countries, as the connected vehicles are usually new, premium segment cars and require stable internet connection. Additionally, to support functionalities available via connected vehicle, external partners must provide services in the given country.

With further development of technology and the scale effect, the popularity of connected vehicle functionalities will also grow among the volume brands. Therefore, the number of countries as well as the number of brands that offer wider selection of services will increase.

3.1.4.3 POTENTIAL DEVELOPMENT

Customers have become somewhat “spoiled” with tech giants like Apple or Google who got them used to a high level usability of their smartphones or tablets, with almost unlimited potential for new functionalities. Therefore, the customers expect same thing from their vehicles. In the age

of autonomous driving where customers will have increasingly more free time during the driving, they will, in particular, expect new services that will improve the way cars are used.

The other part of this business includes tailor -made services based on the connectivity with the vehicle – for example - based on the Pay How You Drive model. The future of this business will be insurance premium services or maintenance plans adjusted to the real-life level of vehicle usage as people will expect more individual approach and focus on their needs.

3.1.4.4. BUSINESS OUTLOOK

Developing communication and infotainment software is the key to customer experience these days. Customer expectations regarding the usability of the built-in software will only grow and the large OEMs have limited capabilities to meet them. Automotive companies who are facing huge problems with innovation of their systems and challenges due to a strict demand from their customers to provide more and more functionalities in their vehicles or find the use for collected data, will need some support from smaller, technology-savvy IT companies. There is a large niche for small companies or start-ups where they can help develop and deliver the software for increasingly complicated vehicles. OEMs have large R&D budgets and are going to start using it soon to meet the upcoming expectations of their customers. This is a great opportunity for smaller companies with innovative products to attract the interest of large market players and help them win the market. Software design and development is not bound to geographic location and can be achieved anywhere in the world, and essentially requires no further investments. In addition, a significant part of the business is based on the new ideas and innovations that need to be tested and verified with market and aligned, as much as possible, with the real expectations of the Customers. The large companies such as OEMs are not able to respond to such a feedback as quickly as smaller, agile companies who can respond immediately and adapt their activities to the current market demands.

Additionally, some services available via connected car technology will need to be supported by external providers and this is also an opportunity for smaller companies.



3.2. INTRODUCTION TO AUTOMOTIVE VALUE CHAIN

The first and foremost thing that needs to be said about the global automotive market is that it is fully automakers driven. Automakers are the companies owning globally recognisable vehicle brands that we all drive.

- ▶ They have sufficient resources to fund R&D programs and search for new technologies or improvements to implement them in their new products.
- ▶ They also have financial resources to launch global marketing campaigns that can influence customers and direct their interest towards the key issues related to the future of automotive sector.

All automakers are international businesses that deliver their products in a large number of countries, sometimes completely different from each other. Decisions made in the automotive sector are based on multiple factors and variables that make this business much more complicated than any other industry.

- ▶ The automakers are under constant pressure from many sides.
- ▶ Customers' preferences and expectations determine the current trends in vehicle design and scope of functionalities.
- ▶ Vehicle performance and its technical features need to be aligned with the newest customers' expectations.
- ▶ On one hand, the governments amend, improve or bring new rules and regulations on safety, sales, distribution and environmental protection to which every manufacturer must adhere.
- ▶ On the other hand, every automaker must cope with the actions of its competitors, their market strategies and corporate targets.

All this above also has a huge impact on technology development process, design innovations and production process improvements.

With so much pressure and so many factors at play, automakers need to be very flexible and able to adapt to the rapidly changing environments. They need to hone their ability to respond to all the changes in above mentioned areas. To make it possible, automakers have to create a unique value chain which is, on one hand, robust and durable to ensure high volume flow and on the other hand agile enough to respond to the ever changing environment.

Value chain is defined as a full range of activities performed to bring the product from its conception to delivery. In case of simple products, the value chain starts with raw materials i.e. inputs used to make a product and further includes all other things added before the product is sold to the customer. At this level, the automotive value chain is much more complicated.

We have to bear in mind that vehicles are one of the most expensive items – after the houses, of course – purchased during the lifetime by the majority of customers. This is why the value that such a product brings has to be full and unique. To bring such a value to the customer, the supply chain must be individual and focused on delivering the highest value to the customers.

Traditional model of automotive value chains is based on the assumption that automakers are responsible for design and assembling of vehicles. To achieve this goal, every automaker has a number of suppliers who are originally divided into tiers:

TIER 1 Suppliers are responsible to deliver the vehicle components directly to the automaker

TIER 2 Suppliers manufacture simple parts which will be used to manufacture the components delivered by Tier 1 suppliers

TIER 3 Suppliers are responsible to provide the raw materials

This clear and simple division of the roles throughout the automotive value chain is no longer in line with the modern market requirements, modern approach to car manufacturing and technologies emerging due to the changes in customers preferences, as visible in megatrends. In addition, after many years of running the business in traditional way, the suppliers (especially Tier 1) evolved into large international companies, who have plants across the world, work for multiple automakers in parallel, and supply the aftermarket with spare parts as well.

The automakers started redesigning their automotive value chains, in order to adjust to the new reality and redefine the role of suppliers in their businesses. The new division of the roles has placed more responsibility on suppliers regarding design and engineering of the components/systems and management of the supplies required in manufacturing of the said components. The new roles⁴ can be described as:

1. Systems Integrator

Company responsible for design and integration of components into larger modules that are delivered directly into the automakers’ assembly plants.

2. Global Standardiser

Company able to set the global standards in terms of components or system levels. It can design, develop and manufacture complex systems that may be delivered directly to automaker or through the Systems Integrator.

3. Component Specialist

Manufacturer of specific component or subsystem intended for the present type of vehicle. It usually acts as supplier for the systems integrators and global standardiser.

4. Raw material supplier

Company which supplies raw materials to automaker or its suppliers.

Characteristics of automaker’s suppliers

	SYSTEMS INTEGRATOR	GLOBAL STANDARDISER	COMPONENT SPECIALIST	RAW MATERIAL SUPPLIER
FOCUS	Company which assembles the whole module or a system	Company that sets a standard for a component on a global basis	Company that designs and manufactures a component tailored for a vehicle	Supplies the raw materials to the automaker or suppliers
MARKET PRESENCE	Global	Global	Global for 1st tier Regional or Local for 2nd /3rd tier	Local Regional Global
TYPE OF COMPONENTS	Interiors, Doors, Chassis	Tires, ABS System, ECU	Stampings, Engine Components	Steel, Aluminium, Polymer

Source: F. Veloso, R. Kumar – The Automotive Supply Chain

Such a transformation of the value chain structure also suggests that suppliers need to undergo restructuring as well. Being an integrator or standardiser in such process requires delivering a wide scope of high complexity products and services. At this level, it is also crucial to be an international company with global presence to meet the automaker’s demands anywhere in the world where the assembly plants are located. Only the strong market players can do it and afford to do it.

On the other hand, it is also in line with the expectations of the automakers, as the general trend in the automotive sector is to reduce the number of direct suppliers to a minimum. It would reduce the costs of administration and increase the profitability of the cooperation for both sides. The automakers could offer their suppliers the opportunity to provide a wider scope of components at lower prices, whereas the suppliers will get a “bigger part of the cake” and, owing to a higher modularity of the components and global deliveries, reduce the unit production costs.

Very important factor in using the new model of business operations is the distance between the location where the company manufactures integrated/modular elements and the assembly plant. Automakers are reluctant to transport assembled vehicles or large vehicle modules for a

4 F. Veloso, R. Kumar – The Automotive Supply Chain

long distance. The cost of safe transportation of ready products is high, as well as the risk that the particular elements may be damaged. That is why automakers very often build their plants as close as possible to their largest markets, although building a plant and hiring thousands of employees at given location may not be the most cost-effective available option. When company becomes an integrator or standardiser, it is possible it will need to relocate at least a part of its business to place the factories closer to its largest clients.

3.3. INFLUENCE OF THE IDENTIFIED MEGATRENDS ON THE PARTICULAR ELEMENTS OF THE AUTOMOTIVE VALUE CHAIN

The purpose of the assessment was to evaluate the actual expected change of the automotive industry resulting from the mega trends, since not all the trends have direct impact on automotive industry.

To create a coherent methodology for measurement and assessment of an overall impact of the current phenomenon on the automotive value chain is important to select objective factors that describe it in a complex way. In order to have accurate results, the factors should define the real impact from the different angles and points of view.

In the process of developing the impact assessment methodology for automotive value chain, we selected the 5-degree scale – from 0 to 4, where 0 is the lowest grade and 4 is the highest grade. Due to the narrower grading scale, the grades i.e. scores are clear and accurate, which allows to describe the current phenomenon in the least complicated way.

The key 5 criteria will be subject to evaluation. These are the criteria that provide a full portrayal of the complexity of an impact on automotive industry and will allow assessing the real-life ramifications for industry leaders:

Additional Investments needed

The key factor in every industry is the level of investments required for various purposes: human capital, know-how, fixed assets, legal rights and technology implementation. All these various investments are the basic costs of changes born by an entrepreneur, and become the entry barrier for other market players. The investments are also the factor in break-even analyses which determines the profitability of production or service delivery.

New resources / suppliers to be identified

Using new resources (materials, supplies etc.) in manufacturing process is a major change for every company. The company directly involved in the use of new materials and supplies is exposed to many risks that need to be addressed, starting from assuring the quality of new materials and supplies quality obtained from the market to its properties and knowledge management issues. The same goes when identifying new suppliers – especially in the situation when new supplier needs to be found because of the implementation of a brand new technology on the market. In such a case, it is very common that new suppliers are identified in parallel industries, and often are not accustomed to business operations and specific requirements in automotive sector.

Changes in the manufactured assortment

Sometimes an automaker is required to provide additional products or services due to the impact of a global trend. This also signals the need for its suppliers to expand their product/service range - not only by adding, but also by replacing the assortment that is no longer needed. On one hand, there is an opportunity to expand the product portfolio and win the new clients, but on the other hand, it is always a challenge to withdraw existing products and design the new ones.

Level of innovations in implemented technology

Implementation of innovative technologies in automotive industry is very challenging and risky. Only the biggest suppliers can afford to take such a risk and provide completely new products/services. The innovative technologies are usually still in development phase and are not standardised for the automotive industry.

Increase in attractiveness/importance of the value chain element

When supplier introduces changes in product portfolio or invests in development of new technologies, it is perceived as more attractive by its clients. In some cases, impact is so specific that importance of the product which is offered is rising considerably. In such a case, importance of supplier who distributes such a product and can develop it in line with requirements is also rising.



3.3.1 TREND #1 – ELECTRIFIED VEHICLES

Electrification of vehicles became a real challenge for automotive suppliers. We are finally witnessing the times when the whole automotive market is taking direction towards electrification. It is not only passenger vehicles, but also LC, light trucks as well as the heavy truck manufacturer that are taking this direction. All automakers promised that, over the next couple of years, they will present at least one fully electric model and have all others in HEV/PHEV version – which also could be classified as an electric vehicle.

From the perspective of automotive suppliers, it means it is a high time that they start implementing changes in their business models. The biggest threat for automotive value chain, as we know, is this – if an automotive market moves towards electrified vehicles (BEV, HEV, and PHEV) and if fully electric cars become popular. It means that automakers will dramatically reduce their demand for a vast number of components from the current suppliers.

The systems like:

- ▶ Primary combustion engine with all accessories (turbo chargers, alternators, manifolds etc.),
- ▶ Transmissions, axles and drive shafts (the ones connected with ICE)
- ▶ Fuel system (injectors, high pressure pump, fuel tanks etc.)
- ▶ Cooling system and coolant-based heating system,
- ▶ Exhaust system (including catalytic converters, DPF filter, EGR valves, mufflers etc.)
- ▶ Power steering system

The above systems will not be required for electric vehicles – the same goes for 90% of the parts for combustion engines vehicles that are currently manufactured.

Some may argue that traditional cars will continue to be manufactured and that for many years we will not be able to replace all ICE vehicles with EVs. That is also true. But if the automotive market fully commits to and takes direction towards EVs, an entire R&D budgets will be reallocated and used for development of EV technologies, whereas ICE will be pushed aside. With the growing popularity of EVs, the ICE engines will slowly turned into something similar to power generators for electrical drivetrains – it will be required to reduce CO2 emissions of the

total vehicle production for which all automakers will be fined starting in 2021.

If the orders and commissions drop by two-digit numbers, in a very short period of time, it will spell bankruptcy for automotive suppliers, unless they change their business models and invest some funds to develop production of components that will be more in demand in the future.

The efficient, high voltage Li-ion or LTO (Lithium Titan Oxygen) batteries, as well as the batteries, thermal management systems are certainly the products that will see a growing market demand. The same may be applied to electric drivetrains – for BEV and PHEV models. Currently, the price of the battery is approx. 25% to 40% of the total value of the EV. It is needless to say that it will be critical for the automotive market to develop technologies that will allow to price to drop, and enable the market to attract wider range of customers. According to Deloitte's forecasts, demand for the batteries and electric drivetrains will grow between 700% - 1300% by 2025. This is a lifetime opportunity for the current systems integrators and global Standardisers - to take a part in this transformation and remain the key players on the market.

Unfortunately, this kind of production has an entry barrier which may be difficult to overcome without a strong partnership.

The production of Li-ion batteries requires resources that are rare – in particular cobalt – it is a raw material, but also a high necessity in the production of Li-ion batteries. It is quite a rare material – the vast majority (more than 50%) of available resources of cobalt are located in Africa – specifically in the Democratic Republic of Congo and Zambia. The second biggest resources are found in Oceania, which accounts for 24% of its share. The remaining resources are split between both Americas and Asia. At present, the largest cobalt manufacturers are China and India. This is not a coincidence – China is one of the largest manufacturers of EVs. In 2011, the government of China emphasised that EVs will become one of their strategic industries in the upcoming years and they did everything to become a global leader.

The first company that comes up with an alternative to China's source of cobalt chemicals will be able to take over the large share of Li-ion battery manufacturing. China still needs to import resources from Africa or Oceania. Therefore, placing of cobalt plants (cobalt is a waste in nickel/copper production process) in Bosnia and Herzegovina, being much closer to Africa and with direct access to the Mediterranean Sea, may be profitable for European automotive market and serve as a countermeasure when it comes to China. If we observe the countries with the highest net export of Li-ion batteries, we will find countries whose geographical location is far less favourable and whose access to resources is more difficult, such as: Indonesia, South Korea, Belgium, Tajikistan or Israel. There are many developing countries that may not have a high-end background, but owing to their good geographical position are able to pursue manufacturing: Tunisia, Montenegro or Mozambique.

The second entry barrier is reflected in the fact that technology required to deliver high quality, high density Li-ion batteries is still in development. This means that to remain competitive as producer of EV batteries, one need to have highly skilled and trained employees; however supply of such a workforce on the market is poor.

Other possibilities that are still open for potential players include the companies joining forces in battery production business. At present, some countries are pure lithium



manufacturing leaders. The new battery technologies are just around the corner. However, it is highly likely that batteries will continue to be lithium-based for the next ten years. The world will need lithium to manufacture the next-generation batteries and someone will have to provide it. On the other hand – the average life cycle of battery pack is about 8 years. After this period, something will have to be done with the used and disposed batteries – in terms of their safe recycling and possible refining. It is still very prospective business, and at present we do not have problem on a large scale, but if the EVs become more popular, this issue will become essential for the automakers as they will have an obligation to ensure environmentally friendly process of disposing the used batteries.

“ If we take a look at this from a different perspective – providing the batteries for EVs is only halfway to success. The global success of EVs relies very heavily on the wide availability of charging stations. People will be willing to invest in the EVs only if they have access to charging points at multiple locations, and this also includes locations outside of the large cities. That is why, sooner or later, the demand for charging stations will start to grow rapidly. ”

	Raw material supplier	Component Specialist	Global Standardizer	Systems Integrator
Impact level				
Impact timeframe	Long	Medium	Short	Medium

When it comes to the EVs, the impact on the automotive value chains is still in very early stage – visible at the level of raw material suppliers. Production of EVs requires different materials that are needed to build the systems or components. For example – the batteries – in case of ICE vehicles, there is no need to build a large and highly efficient battery, as traditional car battery is sufficient. But to build the battery for EV, you will require lithium, graphite and a lot of chemicals. The EV technology development is advancing so rapidly that components for every new model are made from the scratch. A lot of work lies before Component Specialists, Standardizers and Integrators – especially because of the low repeatability of the models, it is like every time they are building a completely new car.

EV production is an entirely new type of business in the current automotive industry. There are rather significant differences when it comes to the number of parts, types of materials or technology used in production. Certainly, production of EV-specific parts will entail additional investments at almost every level of value chain. The raw material suppliers will need to provide additional resources for battery production, body elements or electrical engines. This will require finding new suppliers or at least new sources of raw materials that are required for the EVs, but are not used for manufacturing of the ICE vehicle components. Component specialists will need to provide additional scope of parts that are strictly related to powertrain, battery packs and energy distribution. This will require dedicated production lines for the new components.

At present, most of the parts are not being manufactured; therefore most of the suppliers will need to expand the range of the components they offer, given the importance of EV's parts in total production. On the other hand, most of the components required for the EVs are not being manufactured or being manufactured on a small scale – intended for one model only. This means that over the next couple of years, in order to improve efficiency and provide additional value to the final product, global manufacturing standards will have to be set and, last but not least, companies will need to apply innovative approach in design of parts and technology. Those suppliers who are innovative and able to provide a wide range of adequately designed components, compatible with each other, will be a very precious asset for the automakers.

3.3.2 TREND #2 – AUTONOMOUS VEHICLES

From technical point of view, autonomous vehicles are completely standard vehicles; however they are equipped with technology that allows control of the vehicle during the self-driving. There are no limitations when it comes to the type of drivetrain or amenities, as currently, self-driving vehicles are also the ICE cars. Thus, from that perspective, this megatrend has no impact on the automotive value chain.

However, if we focus only the technology required to make the vehicle autonomous, we may find there are technologies that will surely become a part of value chain in the forthcoming years. Both software and hardware are still at the testing phase in majority of the companies. The exception is Tesla where software is being tested while the vehicle (Model S and X) is already available. Therefore, the hardware parts used for testing are more likely to be added in the vehicle without any design modifications and will be handmade and intended for test purposes only. But once the technology is developed and ready for a large-scale production, it will be required to build in additional sensors and devices and make them an integral part of the vehicle. That is also the time when components will become a part of the automotive value chain.

The new technologies needed for the vehicle to become autonomous are:

- ▶ **LiDAR**
Technology similar to radar, but instead of radio micro-waves, it uses condensed light flashes to detect obstacles around the vehicle. It helps create a 3D view of environment.
- ▶ **RADAR**
Self-driving vehicles need to have at least a couple of radars to analyse environment for potential threats.
- ▶ **Artificial Intelligence Computer**
The unit which controls all the vehicle systems, analyses the uploaded data and provides decisions based on the said data.

At present, this technology is not available in automotive value chain. Once it is in place, it will have certain impact on the value chain. Also, there are elements used in autonomous vehicles that are currently available in standard vehicles. The sensors used in the existing systems, such as cruise control or Lane Assist, can and will be used in a more advanced systems like autonomous driving.

The real game changer in development of autonomous vehicles is software, being the core part of the system. The software is needed to make the hardware collect and process data properly so that decisions can be made on the way of driving. This is critical for success and poses the biggest challenge for all suppliers. The technology for implementation of a large-scale manufacturing is almost ready, but the software is still in development. The biggest change in the automotive value chain will be that it will have to include new breed of suppliers who will be responsible solely for development of highly advanced software required to build a platform (vehicle). These suppliers will not be the large international companies like integrators or standardisers but most likely small/medium size companies and start-ups, and will be a part of joint venture with large automakers. Automakers need them to develop technology which is far beyond their capabilities. Small, agile companies, specialised in AI, deep learning and machine learning technology are the sort of partners the automakers are currently looking for. Such companies are agile and far more flexible than any of the automakers with their corporate strategies. These companies can be run from any place in the world and have a worldwide range. With support of automakers in the form of R&D budgets, these companies can develop technology adaptable to the automakers' vehicles. First company, who develops the software ready to control the vehicle, and proves it is safe to use in all conditions and on the road, will win this race and the main prize. Such technology will be a rare resource on the market – in the following years only few companies will be able to achieve that.

The entry barriers for the start-up company are minimal. The new design and prototyping technologies have made testing the new ideas more affordable than ever before. The automakers are closely monitoring the start-up market and are very keen to learn more about such ideas as they finally understood that the only way to start technological revolution in automotive market is to find a creative partner and build a strong partnership. In 2015, Ford opened Greenfield Labs institute in Silicon Valley CA. It is a centre which pursues smart vehicle research. Ford's intention was to have a direct connection with all of the start-ups and their ideas. Cooperation between „David and Goliath“ is now possible and can be achieved in every country.

	Raw material supplier	Component Specialist	Global Standardizer	Systems Integrator
Impact Level				
Impact Timeframe	Long	Medium	Short	Short

The autonomous vehicles are still in the test phase. However, it is rather obvious, even now, that the advent of autonomous vehicles will give a rise to the completely new technologies. Some of these technologies have never been used before in the automotive industry. These components will have the strongest impact on Standardisers, responsible for implementation of standards for new parts manufactured globally, and Integrators, who will be responsible for the synergy between components and failure-free life cycle.

At present, autonomous vehicles and technology used to make them drive are one of the most advanced and innovative developments on the market. Thus, providing an ‘out of the box’ ideas and the brand new solutions poses an everyday struggle for the companies engaged in design and development process. The biggest challenge, in the case of autonomous vehicles, is to provide the parts that will be 100% compatible with the advanced software developed to allow autonomous driving. Those components, and the corresponding software, will be responsible for an on-road safety of the passengers – meaning they should be failure-free and reliable. The existing suppliers will have to implement new technology for component production, and learn how to integrate the systems in the vehicle with the software and high-speed computers responsible for environment recognition. This will be possible only through close cooperation of Systems Integrators and Global Standardisers, aimed to provide highly standardised, clear-cut production of highly integrated components, designed with the help of technology that underwent extensive testing (i.e. ADAS). This approach should be adopted by all component specialists to ensure that semi-components they provide, as an input for further manufacturing process, have comparable quality. This may require finding new service providers or suppliers, but will certainly not entail colossal investments, other than R&D budgets that are used at present.

3.3.3. TREND #3 – SHARED ECONOMY

Car sharing is the most mature among the four megatrends. In most developed countries, car sharing platforms have been available for a few years now, and people have gotten used to this kind of services. Its unique feature is that it is both country-specific and regional at the same time. Car-sharing varies, to some extent, from country to country, but seems to have common elements.

Shared Economy is considerably impacting the automotive value chain in a way that it reduces the sales volumes on every market. This occurs as certain number of individual customers abandons an idea of car-ownership and decides to use the car sharing services available in the places where they reside. Of course, not all potential customers abandon an idea of purchasing new vehicles – sometimes they give up an idea of buying the used car. If the country in question has excellent car sharing results, the transition from ownership to car sharing will be quite visible in

numbers. On the other hand, the vehicles in car sharing services are used more frequently than average cars, especially in the hands of individual customer. So, we can assume that the life-cycle of the car sharing vehicle is considerably shorter and that cars are replaced more often – which automatically increases the number of vehicles sold on the market. Car sharing is also changing what type of vehicles is sold. Typical car purchased by the car sharing company is different from the one purchased by an individual user. They differ not only in vehicle amenities, but also in price. Car sharing companies are treated as fleet clients and receive huge discounts on vehicles, which reduces the unit gross margin. So, at the end of the day, not only that the car sharing companies purchase only the cheaper versions of vehicles, but they also receive larger discounts, which decreases the profitability of the NSC and dealerships.

The automotive value chain will see the real change once the car sharing services reach a certain level. As mentioned before, car sharing companies select the vehicles based on their criteria that primarily include adequate profitability and business case, rather than equipment, vehicle amenities or performance. So, if the most common factors such as: additional equipment, engine size, performance or body type and colour are not considered in the purchase process, it is needless to factor them in when competing and propose an advanced solution. Purpose-built vehicles? What are those? Purpose-built vehicles are special versions of regular vehicles built specifically for Clients with special requirements.

In most cases, car sharing companies will have more or less the same requirements:

- ▶ **Engine**
Basic petrol version of the engine, as performance is not a factor, and petrol engines are less complicated than diesel.
- ▶ **Interior**
It can be simpler than the one in regular version car, but in ideal scenario it should be maintenance-friendly - easy to clean and considerably more stain-proof, even if it means that the fabric used in car sharing vehicle will be less colourful and less appealing aesthetically than the fabric in the regular version vehicle.
- ▶ **Wheels**
Basic size with all-season tires – to reduce the costs of tire changing.

Such a car, in simpler, dedicated version, may cost significantly less than the regular version, owing to the easier assembly and distribution process (as the colour, engine, equipment etc. will be fixed, these vehicles may available on stock, in case one of the car sharing companies needs to replace some cars), even 25% less than the regular version car.

It is easy to imagine that car sharing vehicles in the countries with large rural areas, or with high tourist traffic, may feature other differences – i.e. in terms of cargo space construction (to meet the needs of LCVs or pickups) or toughened suspension to allow tourists to visit off-road places. In order to deliver such products to the clients, company needs additional supplier located in the area with lower labour costs, and in the vicinity of large markets and large fleets of strong car sharing companies. The vehicles would be taken from the factory lines in their basic versions, without the upholstery finish, and transported to the separate plant where adjustments would be made in line with the requirements.

With the growing popularity of car sharing services, market demand for such vehicles will rise. Creating additional value chain for such vehicles would be reasonable if there is a potential for some cost- savings related to dedicated assembly process out of the assembly plant.

	Raw material supplier	Component Specialist	Global Standardizer	Systems Integrator
Impact Level				
Impact Timeframe	Long	Long	Medium	Medium

A decline in global car sales, as part of the growing popularity of the car sharing, will not directly impact the automotive value chain. Possible sales declines will lead to a drop in the number of purchase orders in all stages, but will not change the processes or components. The only thing that will influence the value chain is delivery of dedicated, car sharing versions of the vehicles. It is likely that the Standardisers and Systems Integrators will have to introduce additional line of service to manufacture the large volumes of vehicles that have different, non-standard specifications and are supposed to be considerably cheaper than the regular versions. Introduction of separate production line for less expensive versions of the vehicles will entail additional investments that will be primarily focused on supply and integration level. Introduction of additional product line requires an expansion of assortment and additional logistics processes optimised to avoid the increase of costs.

3.3.4. TREND #4 – CONNECTED VEHICLE

Connected vehicles show the strongest impact on the automotive value chain. Connected vehicles have not arrived yet, but when they do, additional step will need to be added in the value chain. This step will follow the assembling, but will come before delivery of product to the customer. The step is important because it will be fully manageable by the customer, where the customer will have an option to choose additional features available as a part of Connected Vehicle program, have it installed, and ready for use from the first day of usage. For this vision to come true, the new model must include additional actor– Systems Integrator responsible solely for the IoT services, and cooperation with external participants delivering and supporting additional services. There is significant room for standardisation of such services. The System Integrators will need to provide standardised, high- quality services across different markets.

Connected vehicle trend is not only about additional services provided by the automaker. It is also about how the car will communicate with the driver and passengers and in what situations it may be more useful. Technology development allows creating additional surfaces in the vehicle responsible for communication with the driver and intelligent components of the vehicle that take care of the driver and passengers. In the near future, all this additional equipment and connectivity solutions will be implemented in the vehicles available on the market. It will increase material costs to the extent where it will account for a significant part of the total price of a vehicle. For the first time in history, the leisure part of vehicle will have stronger impact on the price of an average vehicle than the drivetrain and the body. The automakers will pressure their suppliers to find a way to reduce these costs and make the product more affordable for an average customer.

	Raw material supplier	Component Specialist	Global Standardizer	Systems Integrator
Impact Level				
Impact Timeframe	Long	Long	Medium	Short

Connected vehicle revolution is one of a kind revolution that takes place mostly in the cloud infrastructure. Although an increasing number of vehicles will have to be equipped with connectivity modules and, most likely, even more LCD screens, the other changes will mostly take place outside of the vehicle. Connected vehicles will have direct impact only on the integrators. These companies will be responsible for integration of vehicle systems with the services available inside and outside the automaker's system integrity network. Additionally – these services will be delivered by multiple external companies and software developers that will be a part of global alliance.

In the case of connected vehicle services, additional investments will mostly be borne by additional service suppliers who will need to build the infrastructure around their product to make it scalable and available across the countries at the similar level. The more innovative services require the use of more advanced technology for its delivery, and this will entail the highest investment costs.

3.4. NEW TECHNOLOGIES IN THE AUTOMOTIVE MARKET

New technologies are introduced on automotive market every year. Some include completely new products or ideas, while others result from development of existing technologies. Some technologies allow delivery of a new type of final products in the market, and others transform the way existing products are manufactured. Other technologies are essentials the new tools required in manufacturing process. A good example of new technologies in manufacturing process is 3D printing. This technology is becoming increasingly popular, especially in industrial design, where 3D allow prototypes of future products to be easily built and adjusted in further iterations at a very low cost of manufacturing process. This technology is starting to be used in manufacturing of the body and plastic, metal or even glass construction elements for cars, boats, road infrastructure etc. It is important to remember that changing the scope or type of products manufactured, using standard technology (i.e. injection moulding), is very time consuming and expensive. In many cases, it requires replacement of the forms or even the purchase/rebuild of new machines. In case of 3D printing, it can be executed considerably faster and cheaper, as the 3D printers do not suffer from additional limitations such as shape, geometry, colour or texture, and in most cases it is about changing the project and material used.

For the purpose of this report, we selected technologies that will significantly impact an entire whole automotive industry in the forthcoming years and this influence will be visible across the world in the automotive supplier industry. Technologies that compete to make the final product affordable for mass production, and are focused on new product development, usually deal with the new methods of manufacturing, designing and assembling. To become new industry standards, these new technologies need to be cost-efficient. This is why, in this chapter, we focused on new technologies in the final product development that, in the will have a major impact on an entire market and on automotive suppliers' manufacturing processes in the upcoming years.

3.4.1 LIDAR

LiDAR is a brand new technology which will become a part of the automotive value chain once autonomous vehicles arrive at the market. LiDAR (Light Imaging, Detection and Ranging) is a technology whose concept is similar to RADAR, but instead of continuous radio waves, it uses the visible pulsed laser light to detect the distance to surrounding objects. Owing to LiDAR, autonomous vehicles can create a 3D view of environment and receive information about the distance to other objects. LiDAR is a part of Advanced Driver Assistance System (ADAS). Combined with the classic radar and vision systems, LiDAR provides the most accurate and detailed information about environment. LiDAR is based on the laser light technology. It sends the pulse laser light around the vehicle and measures the time it takes for reflected beam to return to the

sensors. With a known speed of light, it can calculate the distance to the object.

Essentially, two types of LiDARs are currently available:

▶ **Electro – mechanical**

The electro mechanical LiDARs are the one often visible on the top of autonomous vehicles spinning around and sending impulses. The main issue with implementation of this technology in autonomous vehicles is its size (as it needs to be installed on the top of the vehicle to “see” the environment) and the fact that it is assembled from many moving parts that may cause multiple problems and potential failures.

▶ **Solid state**

The solid-state LiDAR is built in the microchip. All the necessary systems are built in one small chip. It needs to be built in the vehicle at the front, at the back and on both sides of the vehicle as this type of LiDAR does not have any moving parts.

This technology is still in development phase. However, it appears currently that the solid-state version is definitely the future of the LiDAR in autonomous vehicles. This version is supposed to be easy to adapt to the vehicles. There is still a lot of work to do such as i.e. find the way to keep this crucial system failure-proof – as without it the vehicle is rendered immobile. On the other hand, LiDAR placed on the vehicle roof must be safe for people and environment, and there are still discussions on what range should LiDAR have.

Although the LiDAR systems saw rapid development over the past few years - from heavy mechanical spinning objects to a whole family of solid-state microchips - there is still remains a lot of work to be done before this project can be delivered to final customers. The global standardisation of these components would bring a considerable relief to everyone, but currently it is too early for Global Standardisers to pursue this. First of all, the final technology must be developed to provide the market with some sort of standardisation. This is required especially as at the very beginning there will be no ‘one size-fits all’ standard, but two or three standards. The Systems Integrators and its engineers need to address find a solution how to integrate the LiDAR, radar and vision systems to achieve the failure-proof solution at minimal price. ADAS module will be responsible for an overall recognition process – from detecting obstacles, movement analysis to signs/traffic lights recognition. If one of the components fails, the safety of the passengers may be threatened.



LiDAR technology has been well-known since the early 1960's. It was invented a few years after the radar. However, it was used mainly in NASA space projects (i.e. to detect the distance to the Moon) or for military purposes. Therefore, its use in automotive industry will be the first application of such technology for civilian purposes. Due to this, we may assume that it will have the strongest impact on the Standardisers and System Integrators. As LiDAR was never used in vehicles before, it is important to provide global standards for device manufacturing and properties. As mentioned above, LiDAR will be one of environment recognition devices and must work smoothly with vision cameras, radars and sensor. In order to achieve this, LiDAR technology must be integrated with all other systems.

High market demand for such devices will definitely require additional LiDAR technology suppliers. The current production of LiDAR devices is limited, but this will have to change immediately after the specifications for automotive LiDAR are set. The potential suppliers will need to adjust their production lines and make some investments to increase production volume.

LiDAR technology is certainly one of the most innovative technologies to be implemented in automotive industry. It is not every day you see technology that helps astronauts dock the space shuttles and station available in regular vehicles. The further integration with other components into ADAS will lead to the most advanced recognition tool ever used in vehicles. The company able to deliver this will most certainly see the rise of its importance in automotive value chain.

3.4.2 HIGH DENSITY BATTERIES

Electric vehicle batteries should meet some general requirements set before the engineers and potential customers:

1. High Capacity

The power storage is supposed to be as high as possible. It all depends on battery density and ability to store a large volume of energy.

2. Weight

Right now, the batteries are the heaviest part of the vehicle and it is becoming increasingly problematic in terms of expected range extension. The ratio that we are looking for is approx. 1 kWh/1 kg.

3. High Voltage

Possibility to release large amount of energy in a controlled manner without overheating.

4. Short charging time

The shorter the better.

5. Improved safety

The batteries should be safe for usage and in the event battery is damaged in accident, it needs to be safe for the driver and passengers and possibly non-flammable.

Ni-MH batteries were the first-generation electric vehicle batteries. They were expensive and provided enough power for PHEV/HEV vehicles. Unfortunately, Ni-MH batteries could store only about 30-80 Wh/kg. They were replaced by the second-generation batteries - Li-ion, that have been used until today. The main advantage of Li-ion batteries is that they have twice as much density as Ni-MH batteries allowing them to store twice that much energy with the same battery weight – approximately 200+ Wh/kg. Furthermore, Li-ion batteries do not have “memory effect” unlike their predecessors. The main disadvantages are the price of new energy source and high flammability of liquid component of the battery.

The Li-ion batteries were discovered in 1970's, but are still being used in BEV. Since early 1990's, when Li-ion technology was commercialised by Sony, no new, more advanced way of power storage had been discovered. The general concept has undergone no changes since then. The materials used to make cathode saw the only change as they were upgraded over the years to be able to store more energy. Today, we have reached the final stage of Li-ion technology and to extend the range of electric vehicles we will need to develop new type of battery to improve the capacity. EVs will be powered by Li-ion batteries for at least few more years, but after that things will need to change.

At present, we have two potential competitors of (alternatives to) Li-ion batteries:

1. Solid state

In modern Li-ion batteries, the ions move from negative electrode through liquid electrolyte to the positive electrode. In case of solid-state batteries, the liquid electrolyte is replaced with solid compound which allows the movement of ions. This technology makes it possible to manufacture high-voltage, high-capacity, denser and lighter batteries that may be a perfect solution for electric vehicles. In addition, solid-state batteries are non-flammable, unlike the modern Li-ion batteries.

2. Fluoride-ion

Honda presented the concept of these batteries in late 2018. Owing to fluoride electrolyte and new anodes and cathodes, the battery can safely operate at higher temperatures without overheating and allows reaching energy densities that exceed the limits of Li-ion batteries by 10 times. These batteries require materials that are easier to obtain and are more environmentally friendly unlike Li-ion batteries. This can contribute to considerable price reduction.

3. Next generation Li-ion batteries

Next generation Li-ion batteries are the batteries that continue to be based on the same metal lithium cathodes, but the second electrode, made from graphite in modern versions of Li-ion batteries, will be replaced with i.e. silicon dominant composite material or titan oxygen cathode. This improvement will result in 40% higher capacity, over 9 times faster charging and will extend the life cycle of the battery by 5 times. In this case, it is very important that all solutions include significant safety improvements regarding the overheating and mechanical damages to the battery – in both of the said cases existing Li-ion technology has not demonstrated particular efficiency. BMW and Daimler announced their interest in silicon battery technology.

Regardless of what type of battery eventually wins the market and replaces the Li-ion batteries, the global demand for battery packs for EVs or PHEVs/HEVs will grow rapidly in next few years and this will be an extraordinary opportunity for those interested to provide such products on the market.

	Raw material supplier	Component Specialist	Global Standardizer	Systems Integrator
Impact Level				

„Upgraded” versions of batteries will contribute immensely to the popularisation of electric vehicles on the market. It is likely that increasing number of people will choose EVs over ICE vehicles because of the battery range and improved charging time. The most profound changes in automotive value chain will be experienced by raw material suppliers and component specialists. To provide better batteries, the industry will require a lot of new resources like fluoride or titan. The existing suppliers will have to supply these resources; otherwise automakers will need to find new suppliers who are able to deliver sufficient quantities of raw materials to meet demand throughout the world.

Battery pack manufacturing which includes new types of battery cells will require further investments – mostly in know-how and technology implementation process. This will require new types of materials, and new methodologies of component manufacturing, but at least for the next couple of years, lithium-based batteries will minimise the costs of required investments and potential changes of the manufactured assortment. As it may be observed in case of NiMH

batteries, the older technologies will continue to be available on the market and used in the less demanding electric vehicles, so at least for the time being now, we will not be abandoning Li-ion batteries.

Battery pack suppliers will have an important place in the automotive value chain, not so much because of the changes in technology, but most certainly because of an increase in demand and importance of the element (battery pack).



4 OVERVIEW OF THE REGIONAL AUTOMOTIVE INDUSTRY



In this chapter, an outlook of BiH and the regional automotive industry will be presented. The geographic region to which BiH belongs includes a part of Balkan Peninsula (most often referred to as Western Balkans) with Croatia, Serbia, Montenegro and North Macedonia (Figure 2).

Figure 2. Region of Western Balkans



Automotive industry in the region of Western Balkans has had a long tradition dating back to the time of the common state of the above countries plus Slovenia, known as former Yugoslavia. Former Yugoslavia used to have its own production of passenger, transport, freight and special-purpose (military) vehicles. The roots of automotive industry in the region can be traced to Germany, Italy and France. Over the course of 20th century, regional automotive industry was fully integrated in terms of planned development of all of its segments, including local suppliers of parts and components. It may be noted that at the peak of its technological and technical development (in 1970s and 1980s), automotive industry of ex-Yugoslavia was on par with automotive industries of other European countries. After the breakup of Yugoslavia in 1992, automotive industry saw considerable decline, due to Balkan wars, disruption of internal and external market connections, privatisation and transformation to market economy. Since 2005, regional automotive industry has been on the path of slow recovery, gradually gaining its strength and increasing its share in the economies of Bosnia-Herzegovina, Croatia, Macedonia and Serbia. This growth has become increasingly visible in the last several years. The first steps involved production of parts and components for European automotive producers. Recovery did not go unnoticed and international companies start to invest in regional automotive industry. Today, some worldwide famous brands operate in the region, such as Fiat in Kragujevac, Serbia, and Rimac Automobili in Sveta Nedelja, Croatia, as worldwide vehicle manufacturers. In addition, many domestic companies were acquired by international producers of parts and components for automotive industry. These trends are followed by a number of newly founded local enterprises that cooperate with leading producers of auto parts and components.

The pages below present the key characteristics of automotive industry in the region, for each country.

4.1. REGIONAL AUTOMOTIVE MARKET

4.1.1 CROATIA

Automotive industry in Croatia is based on a long-term tradition of metal and plastics processing and engineering. Croatia has important educational facilities based on secondary and higher education that are relevant for technical occupations, knowledge and skills. Croatian automotive

industry may be observed from two angles: (1) new trends in automotive industry regarding electric vehicles and (2) production of parts and components for conventional and electric vehicles.

When it comes to the new automotive industry trends, Rimac Automobili (www.rimac-automobili.com) located in Croatia, manufactures luxury electric vehicles. Although this company does not manufacture in large series, it is very experienced and shares its technologies with brands like Porsche, Aston Martin and Jaguar. In addition to this company, it is important to mention company Dok-Ing (www.dok-ing.hr), which produces dedicated vehicles and city cars powered by electrical engines. When it comes to the conventional dedicated (military) vehicles it is worth mentioning company Djuro Djakovic (www.duro-dakovic.com).

Some 30 producers that operate in Croatia are involved in production of automotive industry parts and components. They supply large European automakers. Some of the most important Croatian manufacturers of parts and component are presented in Table 3.

Table 3. Producers of auto industry parts and components in Croatia⁵

COMPANY	PRODUCTS	LOCATION
Eloda	Plastic switches	Zagreb
Orešković B.K.	Starters	Zagreb
HSTec	Automation	Zadar
Yazaki	Wiring harness	Zagreb
Dok-ing	Electric car	Zagreb
Rimac Automobili	Electric car	Sveta Nedelja
Avl Ast	Consulting	Zagreb
Munja	Batteries	Zagreb
Saint Jean Industries	Aluminium parts	Slavonski Brod
El-set	Wiring harness	Zlatar Bistrica
Cimos	Turbocharger housings, brake parts, transmission parts	Buzet, Roč, Labin
Feroimpex	Bearings parts	Zagreb
Konig Metal	Parts for trucks	Pisarovina
Teh-Cut	Tools for plastic moulding and plasticity deformation	Zagreb
Wollsdorf	Sewing and pressed leather and textile parts	Varaždin
Selk (EPCOS OHG)	Electronic parts	Kutina
LHT Castings	Water pump housings, anti-vibration systems, brake systems	Benkovac
Gumiimpex GRP	Re-treaded tires and rubber parts	Varaždin
Croatia Protekt	Re-treaded tires	Garešnica
Starco	Steel wheels	Beli Manastir
Harburg Freudenberg	Hydraulics presses for automotive industry	Belišće
Monaris	Rubber products and parts	Gornja Stubica
Lipik Glass	Glass units	Lipik
Kostel promet	Car seats	Pregrada
Boxmark	Car seats	Trnovac Bartolovečki
Esco Fofonjka	Springs	Bjelovar
AD Plastik	Plastic parts	Solin

5 Croatian Bureau of Statistics, 2018

The automotive industry accounted for 4, 7% of total exports of Croatia in 2018. Some 90% of total exports in the industry are generated through export activities. The industry (production of motorised vehicles and transport means) employs 10.050 people. In 2018, an average gross salary in the industry was 1.088€.

4.1.2 MONTENEGRO

According to the available information, automotive industry is not a significant actor in the industrial production of Montenegro. However, Montenegrin aluminium industry has a potential to become an automotive industry supplier.

4.1.3. NORTH MACEDONIA

With long tradition in production of parts and components, the automotive industry of North Macedonia was a vital part of integrated automotive industry of former Yugoslavia. Although its automotive industrial facilities were completely destroyed in 2000s, North Macedonia has managed to transform into a good investment location. Company Sanos Skopje (www.sanos.com.mk), the manufacturer of buses and minibuses used in urban and suburb passenger transport may be singled out among several important automotive suppliers.

According to the available 2017 data, automotive industry in North Macedonia is comprised of 50 companies that employ 20,000 employees or almost 1% of total population. Automotive parts account for almost 50% of 4.3-billion EUR of exports in 2018.

Table 4 presents the most important North Macedonian producers of automotive parts, including their product types and locations.

Table 4. Most important producers of automotive parts and components in North Macedonia

COMPANY	PRODUCTS	LOCATION
Jonson Matthey	Exhaust catalyst	Skopje (2 plants)
Van Hool	Buses & coaches	Skopje
Teknohose	Armoured high pressure rubber hoses	Skopje
Mensan Otomotiv	Brake discs	Skopje
Kemet Charged	Capacitors	Skopje
Amphenol	Interconnect systems for safety devices and on-board electronics	Kočanj
Jonson Controls	Cut & trim plant for car seats	Štip
Draxlmaler	Wiring harness	Kavadarci
Coficab	Wiring harness	Kavadarci
Kromberg&Schubert	Wiring harness	Bitola
OWD Electric	Cables, solenoids and mechatronic	Ohrid
Key Safety Systems	Airbag cushions and modules	Kičevo
Marquardt	Printed circuit boards, metal and plastic housings	Veles
MSA	Shock absorbers	Skopje
Visteon	Printed circuit boards	Skopje

4.1.4 SERBIA

Serbian automotive industry is also based on a long tradition of metal and plastics processing and engineering. The first technical school (higher education) in Serbia was founded in 1963. Today, technical knowledge and competencies are received in many vocational schools and faculties.

The roots of Serbian automotive industry can be traced to Zastava enterprise in Kragujevac, founded in 1939. In 2008, this enterprise was transformed into the Company FIAT automobili, with 67% of the company owned by FIAT Chrysler Automobiles Group and 33% by the Government of Serbia. The enterprise restarted production in 2012, after 1 billion EUR investment, and has continued it to this day. Zastava automobili is one of the most cutting-edge production facilities of FIAT Chrysler Automobiles Group, with projected annual capacity of 300.000 vehicles. Currently, the Company is making preparations for production of hybrid and electric vehicle variants. The acquisition by Fiat Group, and certain state subsidies, resulted in significant brownfield and greenfield investments in production of automotive parts and components.

The most significant Serbian producers of automotive parts and components are listed in Table 5, with including their key products and location.

Table 5. Top producers of automotive parts and components in Serbia

COMPANY	PRODUCTS	LOCATION
Batagon Energy	Batteries	Sombor
Magna	Seat covers	Odžaci
Draxlmaler	Wiring harness	Zrenjanin
Mecaplast	Plastic parts	Zrenjanin
Agena Technology	Connecting rods	Ruma
Hutchinson	Rubber hoses	Ruma
Cooper Standard	Rubber hoses	Sremska Mitrovica
Eurozalt	Wiring harness	Sremska Mitrovica
Lames	Window lift mechanism	Sremska Mitrovica
Ikarbus	Buses	Beograd
IPM	Fuel supply	Beograd
Robert Bosch	Wiper system	Beograd
Srboauto	Transmission parts	Beograd
EMA	Superstructures	Knić
Leoni	Wiring harness	Kraljevo, Prokuplje, Niš
Fiat Chrysler Automobiles	Passenger cars	Kragujevac
SCGM	Plastic parts	Kragujevac
Bacchis Osiride	Insulation	Kragujevac
Gomma Line	Rubber hoses	Kragujevac
Adient	Car seats	Kragujevac
Magneti Marelli	Plastic parts	Kragujevac
Tekina	Pressed parts	Kragujevac
TPV Šumadija	Pressed parts	Kragujevac
Zastava Inpro	Trailers	Kragujevac
Sigit	Rubber parts	Kragujevac
Zastava Tapacirnica	Seat covers	Kragujevac
PMC Automotive	Body parts	Kragujevac
PPT	Hydraulics	Trstenik
FRAD	Filters	Aleksinac
Norma	Rubber hoses	Subotica

COMPANY	PRODUCTS	LOCATION
Continental	Rubber hoses	Subotica
	Interior Electronics & R&D	Novi Sad
Mecafor Product	Machining	Kikinda
Le Belier	Aluminium casting	Kikinda
Knott Autoflex Yug	Trailers	Bečej
FKL	Bearings	Temerin
Lear Corporation	Wiring harness	Novi Sad
Aptiv	Wiring harness	Novi Sad, Leskovac
Coficab	Wire	Pećinci
Konkab	Wiring harness	Kovačica
IGB Automotive	Seat heaters	Indija
ZF	Electric drives	Pančevo
Streit Group	Turbocharger housings	Stara Pazova
Carbotech	Graphite brushes	Smederevo
PKC Wiring Systems	Wiring harness	Smederevo
AD Plastik	Insulation	Mladenovac
Yura Corporation	Wiring harness	Rača, Niš, Leskovac
Grah Automotive	LED systems	Batočina
Aunde	Seat covers	Jagodina
Kromberg&Schubert	Wiring harness	Kruševac
Cooper Tires	Tires	Kruševac
Trayal	Tires	Kruševac
Jonson Electric	Electric motors	Niš
Shinwon	Wire	Niš
Ming	Forgings	Niš
Tigar Tyres	Tires	Pirot
Elrad WS	Electronics	Vlasotince
Grunder	Electronics	Vlasotince
Yazaki	Wiring harness	Šabac
Adient	Seat covers	Loznica
Minth	Body parts	Loznica
Mei Ta	Casting	Obrenovac
Greda Metal	Pressed parts	Valjevo
KM Manufactur	Interior parts	Ljubovija
Inmold	Plastic parts	Požega
Autoventil	Valves	Užice
Proleter	Forgings	Arilje
FAP	Trucks	Priboj
Sloga	Hydraulics	Nova Varoš
Vorkwork	Suspension parts	Čačak
FAD	Suspension parts	Gornji Milanovac

In addition to FIAT and a number of smaller producers of automotive industry parts and components, Serbian automotive sector includes bus production plant Ikarbus, located in Zemun (www.ikarbus.rs), and FAP in Priboj, manufacturer of freight vehicles (www.fap.co.rs). Ikarbus produces passenger buses for Serbian and foreign markets based on the license given by Mercedes. FAP produces freight vehicles with an emphasis on dedicated (military) vehicles, also based on previous license granted by Mercedes.

Automotive industry in Serbia employs 45.000 persons and accounts for 14% of all foreign investments. With 10% of total exports and total income of 3, 3 billion €, it is the most important industrial sector with significant prospects⁶.

4.1.5 BOSNIA AND HERZEGOVINA

Automotive industry of BiH, similarly to other countries of region, is based on a long tradition dating back to the times of integrated industry of ex-Yugoslavia. The early days of its automotive industry are linked with special-purpose industry (military vehicles). Later, it was extended to include civilian program. The most important enterprise at the time was Pobjeda, Tešanj (www.pobjeda-tesanj.com), founded in 1954, along with other companies that pursued production of parts and components for common automotive industry (Zastava, TAM, FAP, IMT, Đuro Đaković, etc.). During the war and post-war transition period (1991 – 2000), many enterprises ceased to exist, while others continued production for international market. Since 2000, automotive sector saw emergence of a number of new enterprises producing parts and components for automotive industry, in addition to a limited number of enterprises that have undergone privatisation and managed to survive. Today, automotive sector includes some 30 medium size and large enterprises in the branch, and some 40 automotive companies that may be classified as small-size companies.

Since 2011, export-oriented BiH automotive sector has grown significantly, and is becoming the leading sector in BiH metal processing industry. BiH automotive sector may not be characterised by a large number of companies, but those companies that operate in this sector are certainly some of the fastest growing and best developed in terms of technology, management and organisation. Automotive companies have significant economic power and as such are one of the driving forces of the economy of Bosnia and Herzegovina. The sector is almost entirely export-oriented; meaning that only a small volume of metal parts for automotive industry is placed at local market. The export volume of BiH automotive sector is presented in the Table 6 and in the graph.

BiH has a favourable geographical location in the Southeast Europe being close to many European automakers. It still has a relatively inexpensive workforce and energy (electricity) inputs compared to the most of the Central Europe countries. Many companies operating in the sector are small and therefore flexible in terms of their products and production facilities. The extent of customisation of their products is also sufficient to satisfy the needs of many clients. Delivery is rather fast due to flexibility and vicinity to buyers' markets.

However, BiH business climate poses many limitations for attraction of investments. Although subsidies are provided from the country and entity levels (more information may be found at the website of BiH Foreign Trade Chamber), the level of foreign investments to BiH automotive sector continues to be far below its potential. This may considerably affect BiH competitiveness compared to the other countries, even if compared with those in its neighbourhood, such as Serbia and North Macedonia, who offer far more benefits for investors in many industrial areas, including the automotive industry.

Large scale and more recent foreign investments expected in BiH automotive industry include company PASS Bijeljina with expected 1.100 and Veritas Automotive Sarajevo with expected 630 new employees in the next two years.

6 Serbian Development Agency

Table 6. Export volume of BiH automotive producers (2011-2018)

YEAR	EXPORT VOLUME (MLN KM)	INCREASE (IN %)
2011	194	-
2012	211	8.8%
2013	266	26.1%
2014	308	15.8%
2015	322	4.5%
2016	355	10.2%
2017	354	-0.3%
2018	405	14.4%

Export volume (mln KM)



Source: BiH Foreign Trade Chamber

BiH automotive companies primarily supply the parts and components for European Tier 1 and Tier 2 suppliers. Parts and components produced in BiH include: seats, wheel components, ICE engine components, exhaust systems, cabins, cables, electric vehicle parts, parts for starting systems, plastic, metal and rubber parts, as well as plastic deformation tools. Several companies produce parts and components for machines used in automotive industry⁷.

4.2. CONNECTIONS AND SYNERGIES WITHIN THE REGION AND WITH GLOBAL AUTOMOTIVE MARKET

The existing regional connections and synergies between enterprises in automotive (parts and components) suppliers' value chain are still rather weak. In other words, automotive suppliers' value chains in all regional countries are rather small. The products of one regional company are rarely used as inputs by other regional producers of automotive parts or components, meaning there is little cooperation on regional level.

The producers mainly import raw materials, process it, and export the automotive industry products. A typical process in the companies within automotive suppliers' value chain involves:

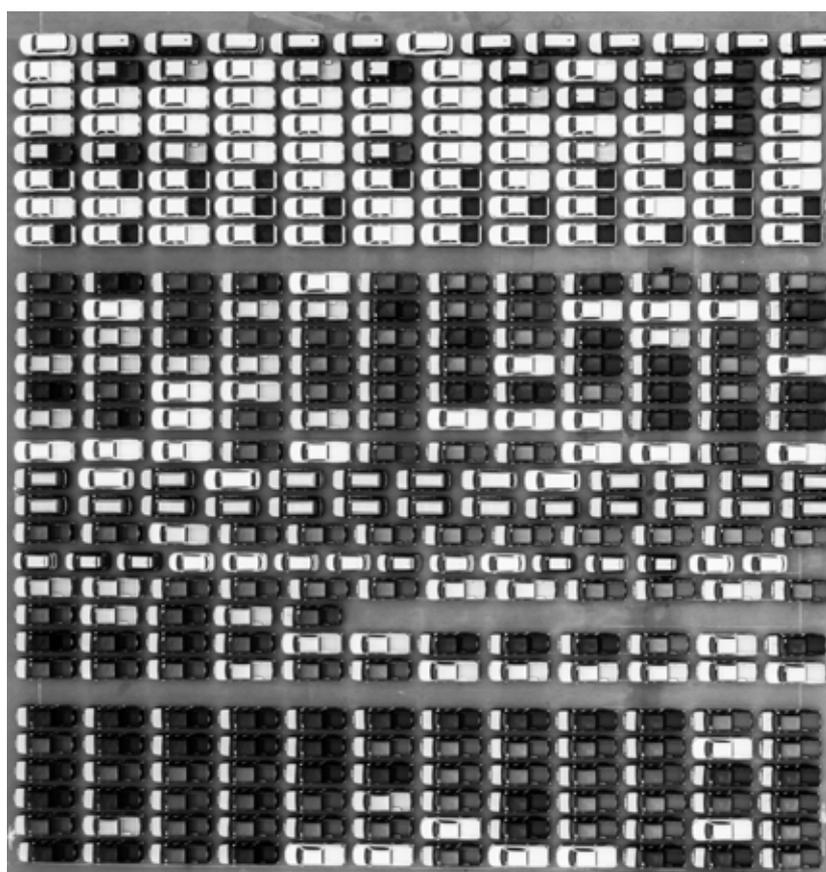
- ▶ Import of production inputs from abroad or purchase from local traders
- ▶ Technical preparations based on specifications provided mainly by foreign buyers

7 BiH automotive industry is explained in more details in the following chapters of the report.

- ▶ Internal processing of supplied materials (cutting, bending, milling, grinding, welding, surface protection, quality control...)
- ▶ Outsourcing of certain processing segments (e.g. surface treatment) to other local companies, but with key production/processing functions kept within the company
- ▶ Quality control, storage and packaging operations, direct delivery of goods to buyers, with rare engagement of sales intermediaries
- ▶ Direct delivery of goods to buyers, with rare involvement of sales intermediaries

An important factor for strengthening and expansion of the value chain is the presence of producers of base and raw materials (foundry, casting, forging, chemical industry, etc.) as an initial link, or the presence of vehicle producers (or at least Tier 1 suppliers) as a final link in the value chain. The region has local producers of raw materials, but their products are rarely used in the production of parts and components for automotive industry, primarily because the quality of products is insufficient to meet the high requirements of automotive industry. Aluminium casting plant Aluminium from Mostar is a positive example of a company who acts as supplier for several automotive suppliers in BiH.

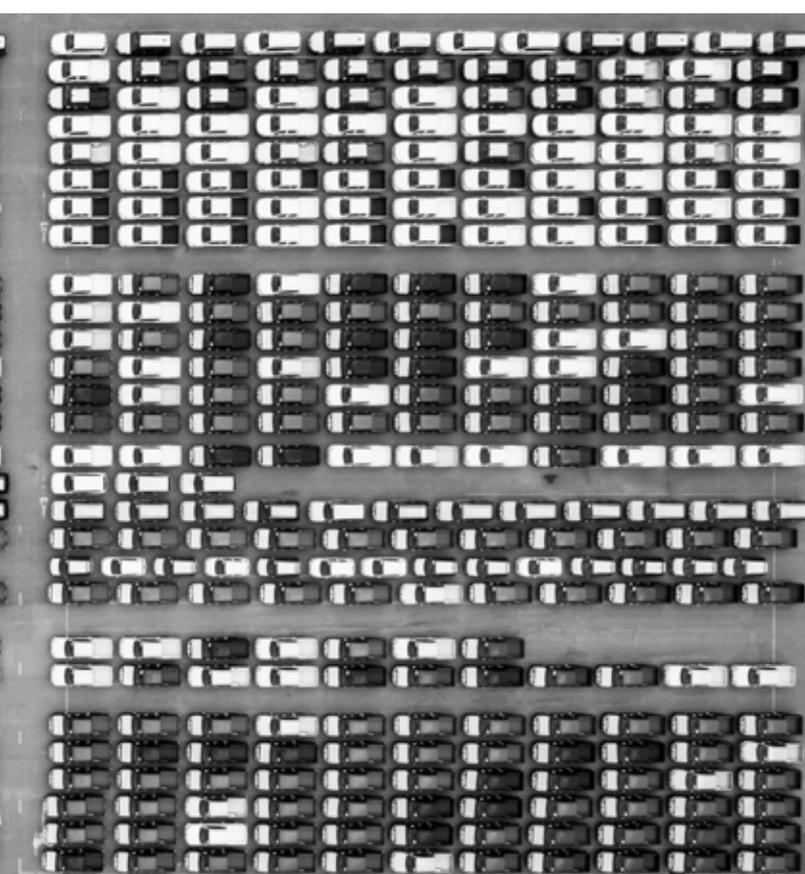
The other generators of additional links in the value chain – vehicle manufacturers and Tier 1 suppliers are scarce in the region. There is only FIAT Automobili from Kragujevac, Serbia, as a direct vehicle producer, who gathers many automotive suppliers characterised by significant volumes and value of produced parts and components. BiH has only one Tier 1 supplier and global standardiser – Prevent Group. Prevent is a direct supplier of components and assemblies for top European vehicle producers, including Porsche-VW Group.



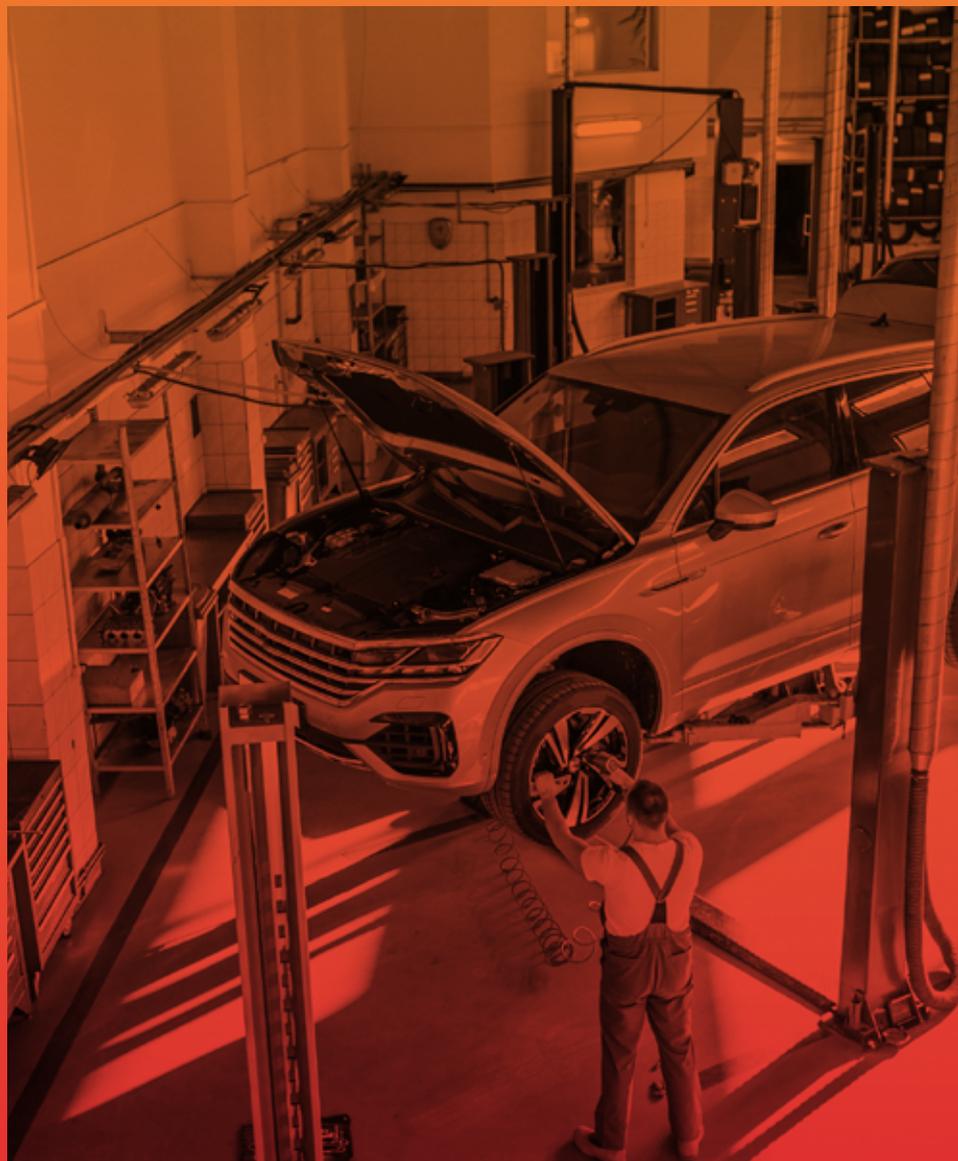
Unlike the weak regional connections and synergies, the connections maintained between the regional producers and global automotive industries are strong, particularly connections with European market. Nearly all BiH and regional producers of auto parts and components export their products to European market, with rare exceptions, such as Turkish market.

Regional suppliers of automotive parts and components may be classified in two basic categories: (1) suppliers who represent a subsidiary of a renowned European producer and (2) suppliers who represent domestic producers with strong partnership relations with their buyers, either intermediaries or vehicle producers. The first category of suppliers provides direct processing of materials in line with the specifications of their parent companies, and normally has only one buyer who is simultaneously their key raw material supplier and owner. The other category, apart from the processing of input materials per buyers' specifications, is also, to some extent, involved in development cycle of a product and normally has multiple buyers from the EU and other countries.

In conclusion, regional automotive industry is fully dependent on foreign, mainly European, vehicle producers and Tier 1 suppliers. Very few companies in BiH and the region are involved in all product development phases in cooperation with their buyers. A predominant number of companies provide processing per their parent companies' specifications, or specifications provided by their buyers, whether they are intermediaries or global automakers. Cooperation between regional companies represents a great potential and future development opportunity, although at present, it is rather poor.



5 OVERVIEW OF BIH AUTOMOTIVE COMPANIES



This chapter includes an in-depth analysis of the data collected on identified BiH automotive sector enterprises. In the first part, chapter gives a general overview of BiH automotive landscape, including the information about the number of automotive companies, their maturity, size, strength, geographical concentration, number of employees, exports, revenues, profitability, and information on the key suppliers and buyers. The second part of the chapter includes relevant analysis of automotive sub-sectors, sub-industries, key technologies and technological competences, materials used and services provided, as well as the analysis of the position and role of automotive companies in the supply chain.

All the above information will help gain an understanding of the position of the BiH automotive companies in the regional and international value chains. This understanding is important to assess an impact that the new automotive trends and technologies may have on BiH automotive companies and to predict their possible performance in the years to come. It will allow us to reach conclusions and provide recommendations for the automotive sector, as well as for certain groups of companies, on what needs to be done to catch up with the on-going technological and market changes impact the sector, i.e. on how to seize the opportunities and avoid the traps, in short, mid and long run.

5.1. GENERAL INFORMATION ABOUT THE BIH AUTOMOTIVE COMPANIES

In the process of identification of BiH automotive enterprises, several available company databases from relevant sources were carefully consulted, in addition to information received from the chambers of commerce. The data base did not include companies in bankruptcy, companies that operate as a part of the same group, and companies with less than 5 employees. At present, BiH automotive landscape includes 67 active companies (including several newcomers) who operate fully or partially, as producers of parts and components. This number includes all companies representing automotive suppliers, provided their share in the automotive sector is not insignificant⁸.

These companies employ approximately 11 thousand persons. Between 2016 and 2018, the number of employees grew by some 2.4 thousand (29%). The revenues of observed companies amounted to 1.7 billion KM in 2018, with average net profit margin of some 8.46%. The total assets amount to 2.1 billion KM (in 2018), while the investments in 2016 – 2018 period exceeded 340 million KM. The overview of general information on selected BiH automotive companies is provided in Figure 3.

Figure 3. Overview of BiH automotive companies

# of companies	Average age	# of employees	Growth in # of employees*
67	18	11k	2.4k
Revenue**	Net profit**	Assets**	Investments*
1.7 billion BAM	8%	2.1 billion BAM	341 million BAM

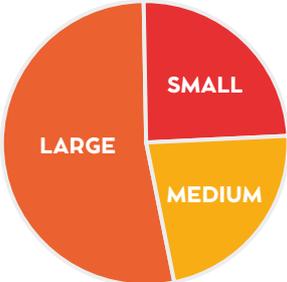
*in last 3 years (from 2016 to 2018)

** Data for financial year 2018

⁸ Established enterprises which have very low share in the automotive industry (below 3% of income) are excluded from this analysis. This does not apply to the newcomers to the industry, who were taken into consideration for their expected future role in the automotive sector.

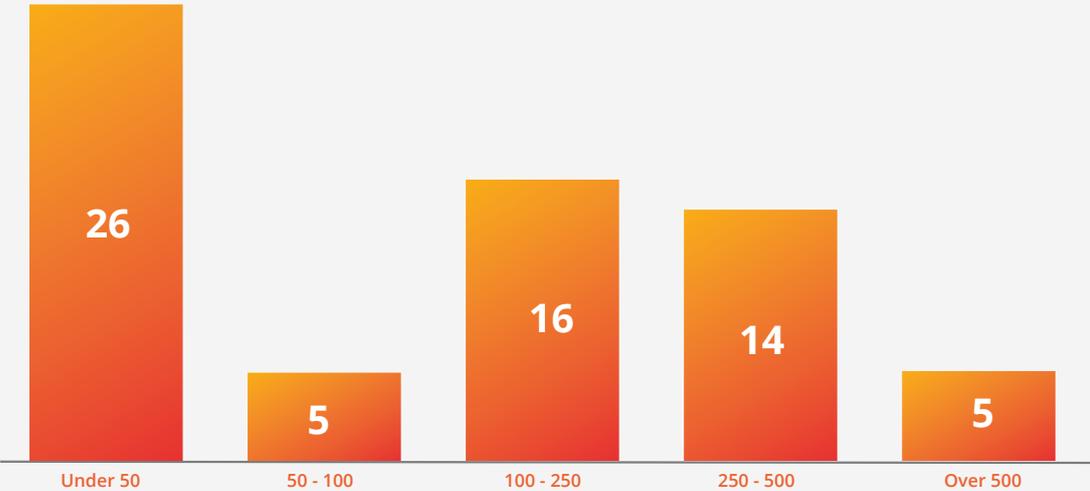
According to BiH's official company size classification, over 50% of BH automotive companies included in the database may be classified as large companies. Small and medium -size companies are almost equally represented, as shown in the figure below.

Figure 4. Structure of automotive companies per size⁹ (according to official classification) (2018)



The structure of selected companies per their workforce size is presented in Figure 5. Although the majority of BH automotive companies (26) employ less than 50 employees, 18 of them employ more than 250 persons, and this makes them important economic pillars in their respective regions.

Figure 5. Structure of automotive companies per number of employees (2018)

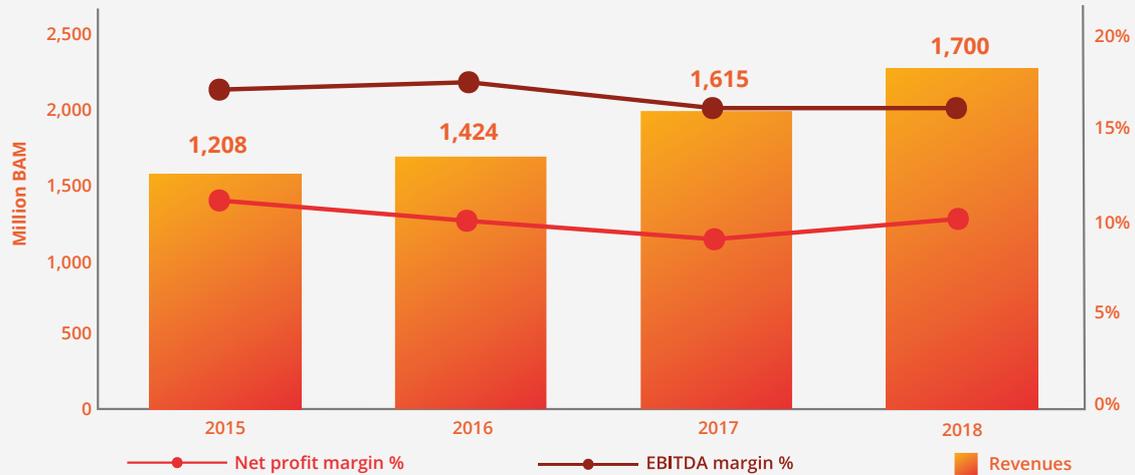


The single largest company in terms of the workforce size is a secondary metalwork producer and component specialist with 653 employees.

The revenues of observed companies display a sharp growing trend in the past 4 years, as shown in Figure 6.

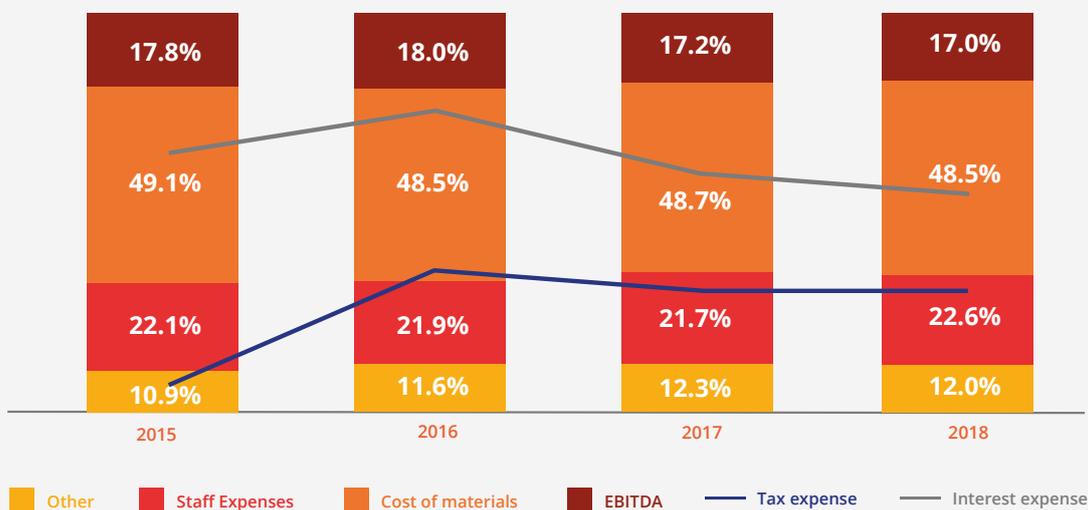
9 The laws on accounting and audit in Federation of Bosnia and Herzegovina and Republika Srpska classify companies per size as follows:
 1. Small enterprises: <50 employees, <1 million BAM property, <2 million BAM income
 2. Medium enterprises: 50-250 employees, 1-4 million BAM property, 2-8 million BAM income
 3. Large enterprises: >250 employees, >4 million BAM property, >8 million BAM income

Figure 6. Revenues, EBITDA and net profit margin of automotive enterprises (2015-2018)



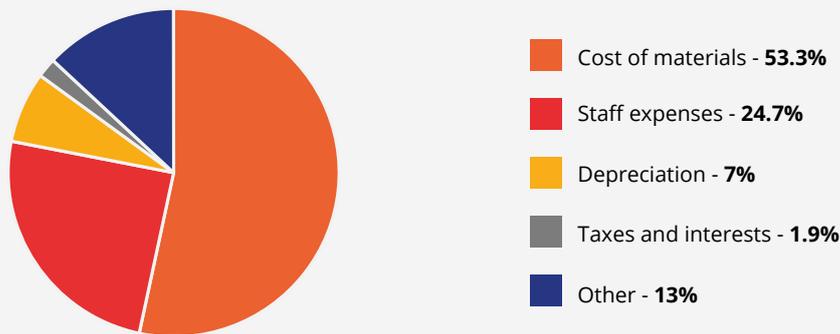
However, notwithstanding increasing revenues, decline is observed in both EBITDA and net profit margins. Increasing revenues and decreasing profits suggest the growth of costs. Decreasing EBITDA trends were driven by decline in staff costs and other expenses, whereas decrease of net profit margins resulted from increased corporate taxes. The changes of the cost structure in observed automotive companies are given in the following figure.

Figure 7. Changes in the cost structure of automotive enterprises 2015 - 2018



There has been a notable growth of taxes (corporate tax) since 2016, primarily due to the effects of new rulebook on income taxes which abolished subsidies for exporters. Exporters have started to pay income tax, which affects the net income of BiH automotive sector companies. EBITDA margin also dropped due to increase of salary and other costs. Declining trend in operational and net income represents a threat as it may limit the investment plans. This is why it is advisable to alleviate financial burden for companies, either by reducing the corporate tax or taxes and contributions paid on salaries. The structure of costs in observed companies is presented in the figure below.

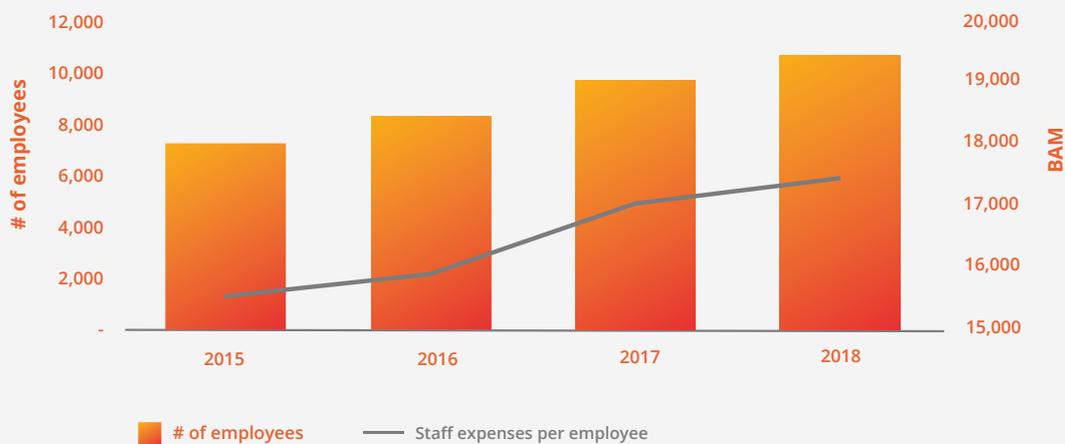
Figure 8. Cost structure of automotive companies (2018)



The above percentage indicates participation of each cost group in income, whereas costs of taxes and interests are linked with secondary axes, with maximum of 2%.

The staff expenses, although not the highest, account for a significant share of total expenses for BiH automotive companies, as presented in the following figure.

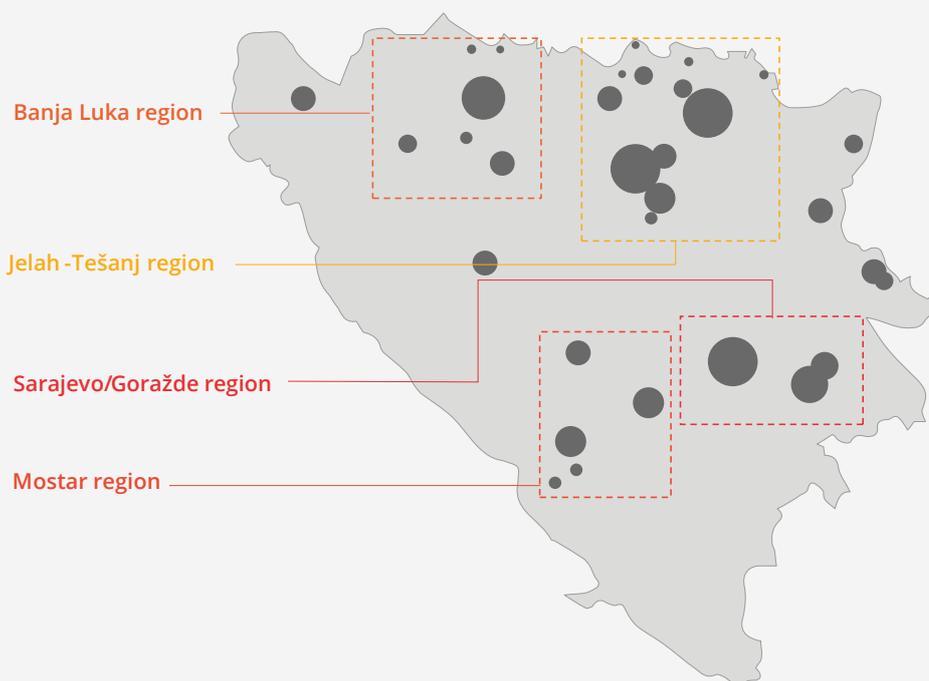
Figure 9. Structure of costs of automotive companies (2018)



The above costs represent average gross annual costs of salaries per employee. In order to attract and secure the required workforce, automotive companies have been steadily increasing the average salaries in the industry over the past several years.

Geographical distribution of BiH automotive companies is presented in the following figure. The size of a circle represents a combination of workforce size and income of all automotive companies in one municipality.

Figure 10. Geographical concentration of BiH automotive companies (2018)



Judging by the above figure, we can identify the following 4 clusters with the highest concentration of automotive companies:

1. Jelah – Tešanj – Gradačac (North-East),
2. Banja Luka – Laktaši (North-West),
3. Mostar – Široki Brijeg (South),
4. Sarajevo – Goražde (East).

BiH automotive companies are supplied by both domestic and international suppliers. However, more than 90% of production inputs are imported. Production inputs are imported, either by BiH wholesalers or directly by the companies, given that the high quality materials used in the production (save the aluminium) are not produced locally. In many cases, production inputs are purchased from buyers or supplied from parent companies. The list of key suppliers is given in the following table.

Table 7. Key suppliers

DOMESTIC / REGIONAL	INTERNATIONAL
Bogner Edelstahl Vitez, Saračević Tešanj, Euro-Metali, BTS Company, Interact Visoko, Hifa Petrol, Rotometal alati, BTS Sarajevo, SurTec Eurosjaj Konjic,	Esco, Metalservice, Acroni, Deutch, Boasch, Hubert-Suhner, Netqm Austria Eusider, Železiarne Podbrezova, Benteler,

RECA Sarajevo,
Teol Tešanj,
Sartorius Libra Elektronik Sarajevo,
Labena Sarajevo,
Tool precision Srebrenik
MI Kemal Kapetanović Zenica,
BNT TMIH Travnik,
ECP Sarajevo,
Alat BH,
FrAmigo Travnik,
Comtrade distribution,
Kimtec
Asbis, Aluminij Mostar,
MDM,
Inoxiu,
Radcom Banja Luka,
Incom Gračanica,
ARV,
Mašinoservis,
Metalcentar,
Šim Tehnik
Čelik d.o.o.
ALCU d.o.o.
Mahle Electric Drives Slovenia
RS Metali Croatia
Zastava Serbia
Sinter Serbia
Unigal Slovenia
Strojotehnika Zagreb
Iscar Slovenija
Tera Si

Standard-Metallwerke,
AV Saldature,
ThyssenKrupp,
Wagener Stahldraht,
Marcegaglia,
Minaco,
High Tech,
Schoeller Werk,
Fischer Edelstahlrohre,
MG ROHR,
Voestalpine Fontargen,
Euro roal,
Rusal,
Hydro,
Sandvik,
Iscar Adient,
Eagle Ottawa,
Gilford,
OKE,
AUNDE
Raffmetal,
Heineken,
Alumetal
A.Raymond,
TeknorApex,
Evonik,
Norma
Celik-Halat, Kromtel Turkey
Wurth,
AlCu,
Meusburger,
Hasco,
Bogner
Steel Plants S. Korea

The automotive sector companies are almost exclusively export-oriented, with an export share of over 80%. Important export markets include: Germany, Austria, Croatia, the Netherlands, Czech Republic, Luxemburg, Hungary, Slovenia, Italy, Spain, and Slovakia, as EU members; as well as Turkey, being the most important trade partner outside the EU. The list of key buyers is provided in the following table.

Table 8. Key suppliers

DOMESTIC / REGIONAL	INTERNATIONAL	AUTOMOTIVE COMPANIES
Aluminij Mostar Zinkteknik Graewe Tativ EMKA Bosnia MAHLE Letrika VOLKSWAGEN d.o.o. Kolektor CCL Elsta Mosdorfer Bosnia, Saraj –Komerç, Enker, MANN+HUMMEL BA, Bekto Precisa, Marbo, Arcelor Mittal, Auto Milovanović, Strong, Hampi, Nuić, Auto kuća LAV, ACS “Školjić” , Lada auto, MGM Bugojno, S.P. Saška, Sim-impex, Džafo-sen, Brčko-gas,	NetQm, Liebherr, Bosch, Corning, Deutsch Telekom, Halle, Engel, Gartner Daimler AG, NIDEC GPM, Turk Traktor, Tumosan, MS Motorservice Int., OE Germany, Textron Motors, O.M.P. Italy, Diesel Technic, Paul Bernhardt Ina Schaeffler Germany; Röders Germany; ThyssenKrupp Germany; Gämmerler Germany; Robert Bosch Germany Mann + Hummel, Delphi, Sogefi, Mahle, UFI, Schmitter, Klaus Baier, Misfat, Jost, Stanztech, Sifa Technology, Asas Filter Brock Alloy Wheels GmbH, Krones AG, ABB Seden, Staacke Hydraulics, Koni ITT, Bobst, Sadev AiB MB PSA, BRITAX, KNOR BREMSE Kroll/Ziller, Rofa, HGG, Moll, IMACO, Springer Deutz,	Ford, Nissan, Fiat, Aston Martin, Volvo, Land Rover, Jaguar, BMW, Opel, Peugeot, VW, BMW, Scania, Iveco, Audi, Porsche, Seat, Mercedes BENZ,

EIB INTERNATIONALE-CENTAR MOTOR

Inox Ajanović
FEAL,
Mandeks,
Mahle,
Jajce Alloy Wheels,
Remus Innovation,
Prevent Components

MAHLE Electric Drives
Tomos
Alpina
AVTO G Slovenia
Torino Rolet, Macedonia

WEBO ATMZELL, WEBO DETROIT

Caterpillar, Liebherr,
Bobcat, Magni, JLG, Kubota, Carraro, Massey
Ferguson
Hella, Odelo,
vAD-Plastic, Tomplast, Sole Spa, Geberit
Group, Fluidmaster, BSH, Grohe Group
HATZ, Autoliv – Magna – Stabilus, Wagner
Ag, Harman, International, Magneti Marelli,
BorgWarner,
Hella (Lunux), Lear, Scheffler Group,
Benteler, SKF, ICSA, SNR NTN, Mahle Ietrika,
Ducati
Energia, Bosman, Bosming, Sarajevoputevi,
KJKP Vodovod i kanalizacija, KJKP Rad,
Euroasfalt
Händle und ZMB Braun, GmbHPraxair,
Wieneberger, Tecomec, Klaxcar, Bosch,
Wega, Siga, Prisma, Vadcris, Emak, Torex Co,
Ciak,
Glencore International AG, Impol Aluminium
Industry, Enital Srl, Trimet, Aluminium SE,
Webasto, Magna
König Metall GmbH & Co. KG, JBC Soldering
SL, Apex
Tool Group, FTM Technologies, Zevatron
Löttechnik GmbH, Standard Metallwerke
GmbH, W&K
Metallverarbeitung GmbH, Schwer Präzision
GmbH
MMTEC, ALBA, WFT, EDAG, Draexlmaier,
Faurecia
NASCAR, Masterwerk, Truckstyle Sweden,
SYTEC Switzerland, Eurolockers, NATARE
Group, Teradiode
Christian Karl Siebenwurst GmbH, Schweikert
GmbH, Labermeyer & Hamberger GmbH,
AWEBA Werkzeugbau GmbH, Gestamp
Umformtechnik GmbH
DIGITAL, Austria, AVANPA, KLAVA, Holland,
ADB, Belgium; RAGNI SAS, NOVEA ENERGIES,
France; VIOMAL, Greece; MEDLE
Schaeffer Group (SKF, FAG), DUCATI Energia,
Benteler, ICSA, NTN SNR, Mahle, ZEDCE

Daimler,
General Motors,
Ford

5.2. COMPANIES' CATEGORIES AND THEIR CHARACTERISTICS

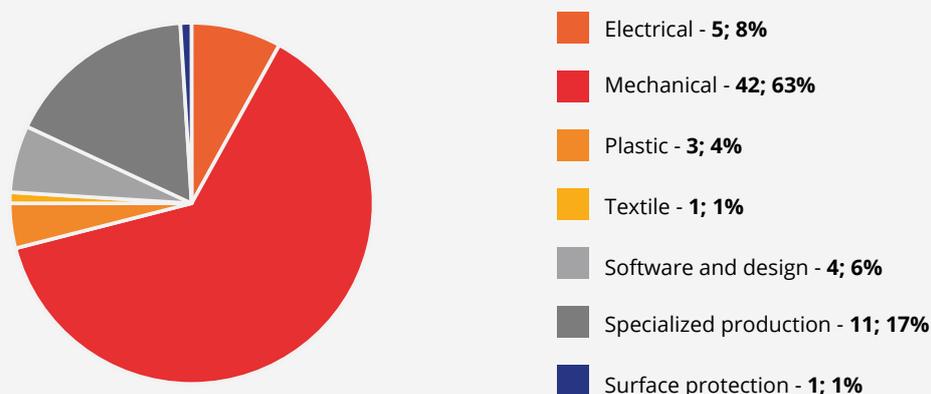
As a part of this research, we performed an in-depth analysis which covered 67 companies in BiH automotive sector. The following criteria were applied in analysis:

- ▶ Affiliation to automotive industry sub-sector
- ▶ Technological background
- ▶ Role in the redesigned value chain
- ▶ Key technologies and technological competencies
- ▶ Prevailing use of material types,
- ▶ Affiliation to the group of established automotive companies and newcomers to the industry.

► State of play with regard to the quality standards

The affiliations of 67 companies to automotive sub-industry were analysed by exploring available data and expertise. Additional data sources were required to be consulted (websites, consultations with additional industry experts) in order to confirm the present findings or to unearth additional data. The analysis of sub-sectors affiliation is shown in Figure 11.

Figure 11. Affiliation of sector enterprises to automotive sub-sectors (2018)



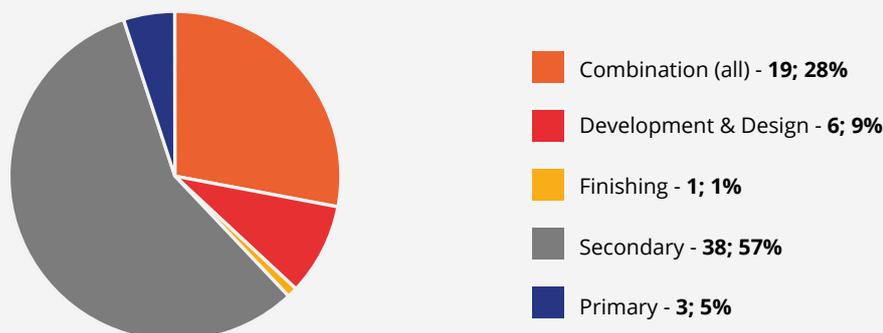
Analysis suggests that the majority of automotive companies (43) operate in the sub-sector of machine processing, whereas 11 companies pursue specialised production (border areas in terms of technologies, materials and products – e.g. plastic fibres, ceramics, filters and rubber). Four companies provide ICT and design services for the automotive industry, and five companies produce electro-components for conventional vehicles. The remaining companies are involved in the textile and plastics processing for automotive industry.

The observed automotive companies were also classified into the following categories based on their technological background:

- Companies that predominantly pursue project design and IT services
- Companies involved in primary processing (processing which enables production of preparatory parts from base materials: forging, casting, extrusion, etc.)
- Companies involved in secondary processing (processing of preparatory parts or standard material shapes: machine processing, plastic deformation, welding, soldering, etc.)
- Companies that perform the final processing operations (surface and thermal processing: painting, galvanization, zincing, nitrating, hardening, etc.)
- Companies performing a combination of processing operations.

Classification of enterprises according to their technological background is presented in Figure 12.

Figure 12. Automotive enterprises structure according to technological background (2018)

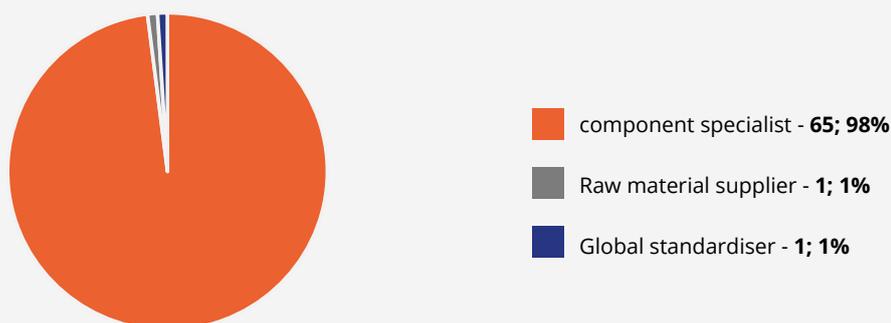


According to the listed criteria, the majority of the companies (38) provide secondary processing, whereas 19 companies combine primary, secondary and/or final processing (finishing). Six companies provide ICT or product design services, and 3 companies perform metal processing. One company is specialised in final processing. Judging by the above data, we may conclude that production processes in the observed companies include standard processing technologies.

With regard to **the role of the companies in redesigned value chain**¹⁰ of global automotive industry, BiH automotive suppliers may be classified in the following three categories:

- ▶ Raw material suppliers
- ▶ Component specialists,
- ▶ Global standardisers

Figure 13. Classification of sector companies based on their redesigned role in the automotive value chain (2018)



¹⁰ According to F. Veloso, R. Kumar - The Automotive Supply Chain, the redefined roles of the automotive suppliers can be described as:

- Systems Integrator – company responsible for designing and integrating components into larger modules, which are delivered directly into the automaker’s assembly plants.
- Global Standardiser – company capable to set the global standard on the component or system level. It can design, develop and manufacture complex systems that can be delivered directly to automaker or through the Systems Integrator.
- Component Specialist – manufacturer of specific component or subsystem intended for the current type of vehicle. This company is usually supplier for the system integrators and global standardiser.
- Raw material supplier – company that supplies the raw materials to automaker or its suppliers.

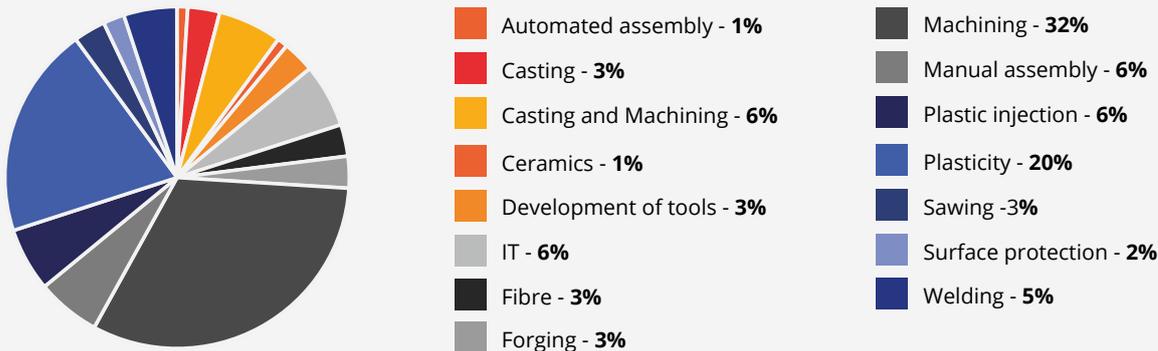
Analysis of 67 companies shows that the majority of observed companies fall under the 'component specialists' category. Three companies may be classified as raw material suppliers, while only one may be regarded as a global standardiser. The analysis shows that almost all BiH automotive companies pursue production of parts and components for global European standardisers.

In terms of key technologies and technological competencies applied in production processes, machine processing and plastic deformation technologies are prevalingly used in 34 enterprises. The remaining technologies are equally represented, including:

- ▶ Automated and manual assembly
- ▶ Casting
- ▶ Ceramics processing
- ▶ Tool development
- ▶ ICT
- ▶ Production of parts from fibre plastics
- ▶ Forging
- ▶ Plastics processing
- ▶ Leather and textile sewing

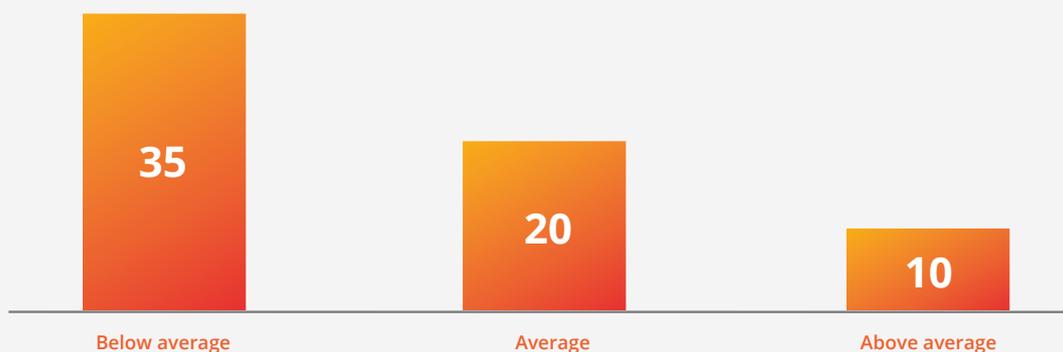
According to analysis findings, it may be concluded that BiH companies use a variety of production technologies and maintain the high level of production flexibility. However, they are predominantly oriented towards technologies that include machine processing and processing by deformation.

Figure 14. Classification of automotive companies based on key technologies and technological competencies (2018)



Through in-depth analysis, BiH companies were benchmarked according to their technological competencies index (for more details please see Annex 4), developed specifically the purpose of this assessment. The index for the observed companies included the normalised and pondered relations of total income, workforce size, equipment value, investments and application of relevant quality standards. Technological competencies index was applied only to production companies and results are presented in Figure 15.

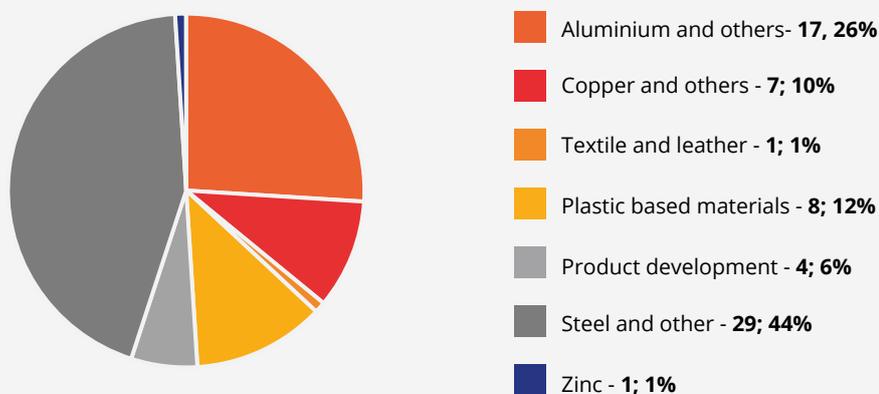
Figure 15. Classification of automotive companies based on technological competence index (2018)



The above figures indicate that the majority of observed companies (54%) have below the average technological competencies. 31% of companies has average technological competencies, whereas 15% are characterised by above the average technological competencies. Two companies were not covered by technological competencies analysis due to a limited public availability of their financial and other information.

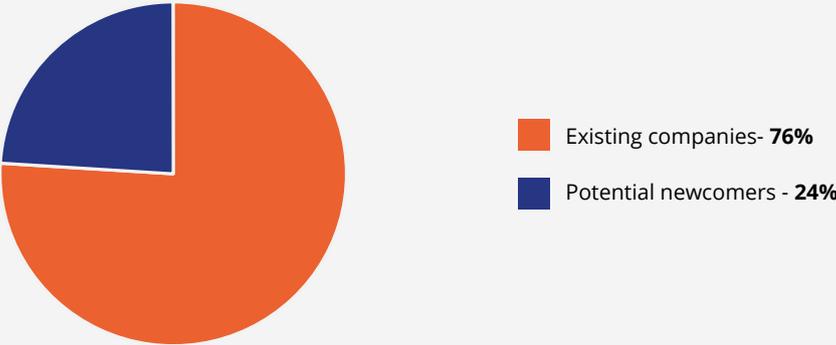
Analysis of prevailing use of material types in BiH automotive companies for production of automotive parts and components is given in Figure 16.

Figure 16. Classification of automotive companies based on prevailing use of material types (2018)



It may be concluded that 29 companies process steel materials, while 17 use aluminium in their production processes. Copper materials and its alloys are processed by 7 companies, while 8 BiH automotive producers process plastic materials. It is also interesting to note that one company uses only zinc and its alloys.

Figure 17. Representation of established companies and newcomers in BiH automotive sector (2018)



The existing automotive companies have positively influenced the founding of new companies. They also influenced the companies from other industrial sectors to join the automotive industry. Some automotive sector companies started as subcontractors of the existing companies to whom certain production processes or services could be outsourced. Others represented branches of larger international companies who perceive BiH as a good investment location mainly due to its industrial tradition, vicinity to EU and relatively well-educated and inexpensive workforce. While tradition and location remain important factors, the third factor - workforce competitiveness / has changed in the recent years and is becoming more of a hindrance than the stimulation for investments.

Introduction of quality standards is particularly important in automotive industry. According to the findings of the research, only 33% of BiH automotive companies have IATF 16949 certificates.



77% of observed BiH automotive companies have relevant ISO 9001 Quality Management System certificate, while 6% is without any formal certification.

Figure 18. Quality standards in BiH automotive companies (2018)



BiH automotive companies primarily produce mechanical parts and components (64%). They are involved in secondary production (57%), with the majority of sector companies (98%) being component specialists. The materials used in production primarily include steel (44%) and aluminium (26%). Among 67 observed companies, 24% are newcomers to the industry. In terms of technological competencies, 15% have above the average technological competence, compared to the selected group of companies. Based on the statistical data presented, we may conclude that BiH automotive industry is the healthiest part of its economy. The workforce size, exports, investments, income and profits in the industry are growing and this trend is expected to continue.



6 CARVING OUT BIH INDUSTRY'S SHARE IN THE FUTURE AUTOMOTIVE INDUSTRY



Over the last two decades, BiH automotive industry has recovered much of its past strength. Positive prospects may be observed in the growing number of companies and employees in the sector, increase in sales and exports, as well as in the areas of know-how and improved technology basis. The biggest challenges involve deteriorating situation with skilled workforce, weak innovation and R&D environment and relatively high dependence on foreign partners, who often simultaneously play the role of buyers and suppliers.

BiH automotive industry may not be characterised by a large number of companies, but those companies that operate in this sector are certainly some of the fastest growing and best developed in terms of technology, management and organisation. The economic power of automotive companies is significant and as such it is one of the driving forces of BiH's economy. It is almost entirely export-oriented, meaning that only a small share of automotive industry parts and components is placed at local market.

BiH companies depend heavily on their foreign partners. Consequentially, any change at international automotive market will immediately reflect on BiH automotive companies. This accentuates the need for timely and proper adjustment to anticipated changes. In this chapter, BiH automotive companies were classified based on their preparedness for future trends. Further, challenges and opportunities for growth have been elaborated bearing in mind the new technologies and market trends in the automotive sector. The final part of the chapter provides several recommendations for the improvement of the situation.

6.1. IMPACT OF THE AUTOMOTIVE TRENDS ON BIH AUTOMOTIVE COMPANIES AND THEIR PREPAREDNESS FOR FUTURE CHALLENGES

In-depth analysis of BiH automotive companies suggests that they are, to some extent, aware of the global automotive trends and their possible impact on the business operations. While being mostly aware of the changes that electric vehicles may bring to the automotive sector, not many BiH automotive enterprises are mindful of the possible consequences that may come from emergence of autonomous vehicles, in technology domain, and through shared economy.

In terms of Industry 4.0 and digitalisation, the companies may be grouped into two categories: those who fully follow the latest developments in this field and those who are trying to do it, at least in certain aspects. All BiH automotive companies pay attention to digitalisation which is required for effective communication with foreign buyers. However, some modern technologies (3D metal printing, laser processing, high-speed processing, and hybrid technologies) are rarely used by BiH automotive suppliers.

All the new trends we have referred to will most certainly influence the future business operations of automotive companies, who are mainly aware of the necessity of timely adjustment. In terms of the possible impact of new trends on BiH automotive industry, the companies may be classified into 3 categories:

1. companies whose production programs are not directly threatened by new trends (some 31 companies in the database fall under this category),
2. companies who are partially threatened by new industry developments (some 30 companies), and
3. companies whose production programs may be exposed to anticipated changes (some 6 companies out of total of 67).

The first group of companies includes companies that produce parts and components used in

all vehicle varieties, regardless of whether vehicles are conventional or the new vehicle types. These companies produce wheel components, ball bearings, aluminium housings and parts, plastic components, parts of cooling and fluid systems, etc. Their role in the global automotive value chain is not under threat since no major changes influenced by new automotive trends are expected to occur in their production programs. These companies perceive the new trends rather as opportunities than threats.

Vehicle components and parts that will not undergo major changes with arrival of electric vehicles and new trends include: chassis, bodywork, wheel assembly, brake assembly, suspension assembly, front and rear light assemblies, car interiors (seats, switches, instrument panels, accessories, car glass units, systems for passive and active protection of drivers, passengers and pedestrians. All these components and parts need to be upgraded to some extent in regard to two dominant requirements: mass reduction and digitisation.

The companies in the next group, who are partially exposed to new trends, produce components for freight and special vehicles and engines (lorries, busses, special vehicles). These companies are aware how new trends will change automotive landscape, but believe there is still no direct threat to their production programs. Being aware of their limitations and threats that new trends may bring, these companies are struggling to develop new projects and introduce new production programs that will allow them to stay competitive in the changing automotive market. Most often they choose to invest in introduction of aluminium and plastic parts.

The third group includes the companies that are threatened by new trends. These are the companies that produce parts for ICE engines, exhaust systems, fuel filters, transmission systems, etc. They are also aware of the changes caused by new trends and they are, similarly to the previous group, developing new projects in order to position themselves in the future market of automotive industry parts and components. The biggest threats arising from anticipated changes are aimed exactly at this group of companies.

Vehicle components and parts whose production will see significant changes due to the emergence of identified global trends include: internal combustion engine assemblies, ICE equipment (fuel injection system, cooling system, combustion management system, storage, transport and fuel purification system, exhaust system), power transformation and transmission systems (gearboxes, shafts).

Vehicle components and parts whose production is expected to grow with arrival of identified global trends include: batteries, battery management, cooling and recharging, electric motor drives, power transmission and transformation systems, autonomous driving safety systems, new communication systems, passenger space heating systems and new IT systems.

However, BiH companies covered by the survey believe that anticipated changes may not arrive so soon. Changes affecting the automotive market will be gradually introduced in the industry, leaving enough time for adjustment. This view is fortified by the fact that electric vehicles are challenged by some specific issues, such as charging infrastructure, disposal of used batteries, the strength of oil lobbies, limited buyers' purchase power, etc. The companies demonstrate a high level of awareness about the situation on automotive industry market owing to their good connections with foreign partners, buyers and suppliers. They also keep themselves in touch with the latest developments through participation at international industry trade fairs. BiH automotive companies are aware both of the chances and opportunities brought by the new technology and market trends and of the challenges and dangers should they miss the chance to adjust.

6.2. POTENTIAL NEWCOMERS TO THE INDUSTRY BASED ON THE FUTURE TRENDS

In addition to the above three groups of already established automotive companies, there is a special group of potential newcomers to the industry. These are the companies who, at present, do not primarily pursue activities in the automotive industry or the companies who are relatively new in the sector, but their products and service portfolios offer good prospects in terms of perceived changes and developments. These companies primarily deal with ICT, product design, precise machine processing, production of electrical parts and components, production of low weight materials, tooling, etc. The key characteristics of 15 companies that fall under this group are further outlined below.

Potential newcomers to the automotive industry may be classified into 3 main categories:

1. ICT companies,
2. companies with technological potential fit for automotive industry,
3. companies that are newly established by foreign automotive companies.

The companies with predominant ICT activities are relatively young and provide services for different industry areas and sectors (industrial design, software, ICT solutions, etc.). In recent years, these companies have become more oriented to delivery of services to automotive industry, mainly to foreign buyers and partners. The companies in this field do not require heavy investments and are not challenged by significant workforce issues, unlike the other two groups of newcomers to the automotive industry. Considering the anticipated trends, this group of companies may represent important future players in BiH automotive industry and in all potential areas: electric, autonomous and connected vehicles, as well as in development of shared economy solutions.

In terms of having the relevant technological solutions, the next group of automotive industry newcomers is represented by mainly established companies with very flexible production base and high technological level (machining, plasticity, CAD/CAM, FEM). Such companies are able to quickly adjust to production of automotive parts and components (this includes existing and new automotive products). They have a large customer base across different industrial sectors and can promptly adapt their production for the automotive industry and meet the requirements for big-volume production.

The third group of newcomers to the industry are, in fact, newly established automotive companies, founded mainly with support from international companies. These newcomers produce parts and components for automotive industry. In most of the cases they represent branches of their parent EU companies. In fact, many act as service providers for their founders and are fully dependent on their parent companies. However, these companies have potential to grow more independent and self-sustained if they succeed in finding the right niche within their group. There are several examples where enterprises founded by foreign parent companies transcended their roles of internal processors to become highly independent enterprises with significant autonomous functions and roles within the group. Depending on the further course of developments in automotive industry, companies in this group may have a chance to play more important role in certain areas.

6.3. CHALLENGES AND OPPORTUNITIES FOR GROWTH OF BIH AUTOMOTIVE COMPANIES

Depending on the characteristics of their production programs, BiH automotive producers are facing varying challenges. Some will need to invest significant efforts to adjust and improve in order to be able to address the new trends, whereas many feel that their position is not threatened and rather see it as an opportunity for growth.

The findings of BiH automotive sector analysis were further deepened by detailed interviews with 12 companies selected from the database of 67 BiH automotive suppliers. These 12 companies were selected based on their economic power, significance in the value chain and importance for automotive industry. The estimates were made on the basis of their workforce size, revenues, the use of new technologies and complexity of production process.

The surveyed companies listed their most significant advantages and disadvantages, as outlined in the following table.

Table 9. Key advantages and disadvantages of the surveyed companies (according to their own opinion)

ADVANTAGES

- Still relatively inexpensive workforce
- Favourable geographic position (close to EU)
- Wide range of production facilities and expertise
- Prompt response, production and delivery
- Flexibility in production
- Tradition in industrial production, European habits and technologies
- Honouring contracts and agreements

DISADVANTAGES

- Weak skills and workforce drain
- Lack of quality standards
- Weaker technology compared to competitors
- Poor infrastructure
- Political and economic instability in BiH
- Poor country image
- Weak position in negotiations (with big players)
- Low investment and development budgets

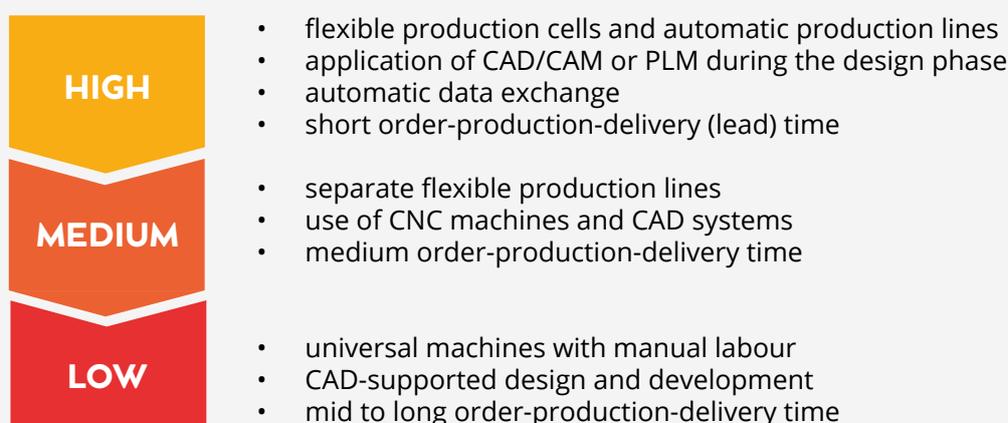
The above advantages and disadvantages indicate the opportunities for growth and challenges for the BiH automotive companies. The position of automotive companies was analysed from several different perspectives, including: technologies, workforce, market position, plans and vision, collaboration, and promotional efforts. The findings on the challenges and opportunities for growth are elaborated below, for each of above aspects.

6.3.1 TECHNOLOGIES

Technological level of companies is an important characteristic, which defines their level of productivity and efficiency. The technological level does not only refer to the machine types and equipment used by companies, but also to the processing methods in production process, design methods, data exchange, and the time required for design, technical preparations and production. The ratio of total income and workforce size is also considered as one of the important indicators of company's technological level.

Considering the scope of the research, three technical levels may be discussed: high, medium and low, as indicated in Figure 19.

Figure 19. Technological levels of BiH automotive companies



The companies that use flexible production cells and automatic production lines and which apply CAD/CAM (Computer Aided Design / Computer Aided Manufacturing) or PLM (Product Lifecycle Management) systems during the design phase are considered high-level companies in terms of their technological level. These companies normally use automatic data exchange systems and maintain short order, production and delivery time.

The second group, with medium technological level, is characterised by production of products on individual flexible production lines, with the assistance of CNC (Computer Numerical Control) machines and CAD systems, and by medium order-production-delivery time.

The third group - low technological level companies are predominantly characterised by production on universal machines and presence of manual labour. Product design and development is performed with the help of CAD system, while order-production-delivery time is mid to long.

The majority of the surveyed companies have carefully considered the new trends (primarily electrical, but also autonomous and connected vehicles, sharing economy, digitalisation, new technologies). However, their compliance with the new requirements depends on the group to which they belong:

- ▶ Companies whose production program is not dependent on new technologies (e.g. wheel assemblies, seats and interiors, housings, safety systems, etc.). These companies are not concerned with new trends. They rather turn to new technologies and digitalisation of their processes.
- ▶ Companies whose production program is dependent on new trends (e.g. parts of ICE engines, manual transmissions for ICE vehicles, fuel filters fluids, etc.). These companies claim that their operations are still not directly threatened, but are aware of potential dangers and are developing mitigation plans to address changes in market requirements.
- ▶ Companies with flexible technology, whose production of parts and components for automotive industry accounts for a relatively small share compared to their total production. These companies have no special plans when it comes to new trends. It will be easy for them to adjust and launch the production of new parts and components.
- ▶ Companies that are essentially production facilities of international corporations. These companies are fully dependent on their parent companies that take care of every aspect of their operations including the impact of new trends.

Each of the above groups of companies has distinctive characteristics in regard to their readiness to embrace the new trends. In principle, the higher the technological level, the more sophisticated production potentials and communication with buyers, and shorter the design-production delivery time. However, the period of transition to a completely new products and services may take much longer than in the companies with low technological level that use universal machines and manual labour.

Several of the surveyed companies are already considering transition opportunities and preparing plans and projects to mitigate the risks associated with the changes in the automotive industry. While the majority of the companies believe that transition will not be swift, some companies, in an effort to reduce their dependence on the volatile automotive industry, are already contemplating production of alternative products for other industrial sectors.

The companies that are more dependent on new market trends are planning to reorganise their production facilities by transitioning to production for other industries. In many cases, this is essentially about the preparation of new tools and supplies, since the core machinery is flexible and allows such transformation.

Transformation of production program will be more strenuous for the companies owned by international corporations, as they have dedicated machines and equipment, and produce for a single buyer – the parent company, i.e. their owner. Such transformation would require significant investments and long implementation period. The actions planned by the surveyed companies in this regard can be summarised as follows:

- ▶ purchase of new technologies and expansion of production (primarily based on processing of light alloys and plastics),
- ▶ extension of existing and construction of new production facilities,
- ▶ development of prototype parts for new vehicles,
- ▶ diversification of buyers (from other industries),
- ▶ digitalisation and automation of business processes, and
- ▶ improvement of internal processes and planning.

Some companies stated they already noticed fluctuations in the automotive industry, claiming that buyers have shown the tendency to change and even cancel orders in the recent months more often than usual. In particular case, this is already affecting performance of one BiH component supplier for automotive industry machines who said that orders have dropped by 10%. The most interesting opinion about anticipated trends and changes in the industry was expressed by the representative of a fast-growing company which produces plastic components for ICE engines: The one, who manages to determine the drive of the future, will surely be the winner. This statement vividly illustrates the current state of unpredictability in the automotive industry.

6.3.2 WORKFORCE

BiH automotive companies included in the database employ some 11,000 persons. The number of employees grew by 28% in the period 2016-2018. The 12 surveyed companies employ nearly 4,150 people or 350 in average. Considering an expected expansion of their business operations, these companies have expressed the need to increase the number of employees in short, mid and long run. In the short-run (2 years), 12 surveyed companies would need some 950 additional employees, in the midterm period (2-5 years) 650, while in the long-run (beyond 5 years) around 1,470 employees. If this prognosis comes true, the total number of employees will grow to 7,220

or by nearly 75%, and that is only in 12 surveyed companies.

The need for the new employees indicates good prospects in BiH automotive industry. However, the workforce is becoming a significant problem, with several factors simultaneously contributing to this development:

- ▶ skilled workforce drain;
- ▶ anticipation of new and additional requirements in terms of skills and knowledge with regard to the new technologies and market trends;
- ▶ growing demand for the workforce due to expected increase in operations of BiH automotive companies.

Dissatisfaction of automotive companies with the availability of skilled workforce at the local labour market has prompted many to focus on human potentials of their new employees rather than on their previous experience. So, the companies decided to invest in workforce training and education. Challenged by low supply of workforce with relevant formal degrees, companies resort to employing the people with only primary education. When it comes to occupational and educational profiles, casting operators, CNC machine operators, welders and locksmiths are the most sought-after employees, while electrical and mechanical engineers are in the highest demand in the group of employees with university degree.

Notwithstanding the good prospects for additional jobs and growing demand for workforce, the overall situation at the BiH labour market is grim. Of all potential business challenges, the workforce is currently the most critical issue for the companies. The key problems include:

- ▶ lack of skilled workforce across the country;
- ▶ workforce has poor skills due to poor practice (vocational schools), poor working habits, low interest in work, lack of foreign language skills, etc.;
- ▶ poor education system which focuses very little on practical workforce skills;
- ▶ high fluctuation of skilled workforce and workforce drain - leaving abroad for better paid jobs;
- ▶ unfair competition associated with unregistered economic activities;
- ▶ high taxes and contributions to paid salaries (around 70%);
- ▶ lack of balance between private and public sector (better salaries in public sector, with less responsibilities)¹¹.

There may be several options to improve the workforce situation. Companies can introduce some internal measures to retain the workforce (increased salaries¹², better working conditions, opportunities for career advancement, professional development of employees, taking care of employees' families, etc.). Some companies have already invested considerable efforts to retain their key employees who are essential for normal and uninterrupted functioning.

¹¹ This is a common opinion of representatives of automotive companies. Unfortunately, it could not be confirmed by hard data directly, as there is no publicly available statistical information on the average salaries in public sector. However, average salaries in an entire processing industry (including the automotive sector) amount to 73% of an average salary paid in BiH in 2018. The assumption that some money is paid to employees in cash, in addition to formally paid salaries, can hardly stand given that BiH automotive companies are primarily suppliers of international companies who normally do not work with cash. In most of the cases, improved financial discipline in the country does not allow an easy transfer of money from formal to informal channels.

¹² Many companies tend to increase salaries to retain their employees. Some have already considerably increased the salaries for certain key positions, so the salaries now amount to 50% of the salaries paid for comparable jobs in the EU. This is only possible for the companies where technology has strong presence, but not for companies with a large share of manual labour.

In the opinion of the majority of the surveyed companies, new technologies and market trends will certainly impact the workforce. The companies expect more frequent changes in orders along with more demanding requirements from future buyers (e.g. product development, prototyping, etc.). As this happens, the companies will need more skilled workforce. In addition, the new skill profiles with new and advanced knowledge will be required. Thus, the companies expect that demand for applied machine programming will grow, as well as for mechatronics engineers and skilled CNC programmers.

The competition between the companies may grow more intense as the companies compete to secure skilled workforce. Some companies are already taking steps to fight their competitors in this area. The choice of location of new factories and production facilities is influenced by the workforce availability more than any other production element and requirement. In factories with serial production the balance between the workforce and equipment is always critical; if costs on workforce grow, the new machines will be purchased instead.

6.3.3. MARKET POSITION

As elaborated before, 63% of 67 analysed BiH automotive companies operates in machine processing sub-sector, 17% pursue specialised production, 8% provide ICT and design services to automotive industry, 6% produce electro-components for conventional vehicles, while the remaining companies process textile and plastics for automotive industry. BiH automotive companies can be predominantly classified as component specialists, with only one global standardiser, no system integrators and several raw material suppliers. Although just a few of these companies maintain direct relations with the lead automotive producers, they are all positioned in the European and global automotive value chains.

The value chain position of BiH automotive suppliers will be analysed more thoroughly on the sample of the 12 surveyed companies. The majority of the surveyed companies produce various parts¹³ for OEM (Original Equipment Manufacturer) component suppliers. Two more companies produce machine components and machines for OEM machinery suppliers. Therefore, 9 of the 12 surveyed companies are essentially product/component suppliers with no direct reach to OEMs. One aluminium wheel maker produces final products, but supplies OEMs through an intermediary. Only 2 out of 12 surveyed companies producing oil and water pumps and plastic components and systems built in vehicles reach the automakers directly.

The suppliers of production inputs originate mainly from the EU (Italy, Germany, Sweden, Slovenia, Croatia, Poland, Slovakia, Czech Republic), but also from Russia, USA, China and South Korea. Only 3 of the 12 surveyed companies have suppliers in BiH, among which one is a trading company and 2 are service/production companies. Approximately one half of suppliers provide actual support to BiH automotive companies in product development, information on new materials, application of technologies and technical advice. 3 of the 12 surveyed companies are already involved in activities concerning production of own production inputs, and one company is developing a solution. The remaining 8 companies believe there are no possibilities for local production/supply of production inputs required for their current production programs.

When it comes to the buyers, all buyers are producers of components for big automotive companies and for OEMs, in 2 or 3 cases. The companies generally maintain good cooperation with buyers with regard to product development, improvement and control, workshops and knowledge transfer, advice, information and ideas exchange, etc. OEMs and their suppliers are the most demanding buyers who tend to help their suppliers improve through a variety of measures (conducting audits, setting yearly goals, reducing claims, costs and prices, improving production processes, knowledge transfer, training, supply of new equipment, quality management, introducing innovations, improving the organisation, etc.).

13 Zinc casting parts, aluminium machined parts, steel rings for ball bearings, oil filters, electrical parts, commutators, housings.

The surveyed BiH makers of automotive parts and components are generally not concerned with the competition, particularly the local one. The foreign competitors that may jeopardise the operations of the BiH automotive companies come from China, South Korea and the USA. There are also nearby competitors in Romania, Poland, Czech Republic, Slovenia and Italy. Overall, cooperation with competitors is rare. Some companies cooperate with their competitors on international markets to be able to address the needs of large-scale projects. There are some examples of cooperation in the country (e.g. SIK and PASS with Saraj-Komerc; TMD with Unis Tok, etc.).

With regard to cooperation between domestic companies, it is important to note that 12 companies from Herzegovina have recently established Metal and Plastics Cluster, which may become a relevant actor in BiH automotive industry. More details on cooperation may be found on the following pages.

6.3.4. PLANS AND VISION

The automotive companies generally develop and follow operational plans and strategies. The vast majority of these companies have permanent and stable buyers. However, the new buyers continue to be actively sought for, with the exception of companies whose exclusive buyers are their parent companies from abroad. Almost all companies have stable market share and constant growth in sales and income (from 3 to 20% at annual basis).

The automotive companies owned by international companies consider their parent companies the leaders in new technologies. Two out of a few of the surveyed companies perceive themselves as leaders in automation and digitalisation, while other companies do not see themselves in a role of a leader in new technologies. The key reason for this is that they do not have their own product development departments. In most of the cases, fully-fledged product specifications are provided by buyers, and the companies are in charge of the production only.

A large number of surveyed companies see themselves in the automotive industry in the next 10 years and beyond. However, they are aware of the challenges arising from new trends and have varied responses to potential threats and opportunities. Some will try to embrace new trends and are already reorganising their facilities, while others would rather limit their dependence on the auto industry and expand their activities to other branches and areas. As response to new trends, surveyed companies are actively considering purchasing new technologies (primarily based on processing of light alloys and plastics), diversification of buyers (from other industries), extension of production facilities, and digitalisation of business processes.

The companies rarely change their production portfolios, and their product assortments remain stable. The key reason for this stability is that automotive industry merchandise is normally produced in series. If there is a need for product change, such changes are gradually initiated by buyers and do not require significant modifications on the part of producers. The production programs in automotive industry are based on project approach, where duration of a single project is usually between 5 and 7 years. As a part of normal development cycle in the automotive industry, some projects continue to run for a prolonged period, some projects are discontinued, and other projects are introduced.

The majority of the surveyed companies perceive transition to production of products for other industries as a matter of preparation of tools and supplies, as their core i.e. basic machinery is flexible and allows such transformation. In terms of the time required, the adjustment to production of other products would take from 15 days to 9 months. However, transformation of production program would be more strenuous for the companies owned by international corporations, as they have dedicated machines and equipment, and produce for a single buyer – the parent company, i.e. their owner. Such transformation would require significant investments and long implementation period.

All surveyed companies have stated that their products are fully compliant with buyers' requirements, but also note that they have an opportunity to suggest product and process improvements. These enhancements usually need to be approved by the buyers before they are applied in production. In many cases, enhancements appear spontaneously – due to the need to increase efficiency and address problems in production processes.

In terms of significant technological and market changes that may impact their operations in the future, one group of surveyed companies stated that the changes will not significantly influence their operations. This group of companies is mainly owned by international corporations, or their products are not subject to changes required by new trends. Another, more significant group of companies emphasised that they would surely need to change or adapt their products and production facilities to respond to the changes and new trends. However, there is no agreement in terms of speed of the upcoming changes, or what they may entail. Many companies believe changes will come slow, due to the strong position of current ICE engines and fossil fuel producers, and technological difficulties in practical application of new technologies (e.g. price, safety and disposal of electric vehicle batteries, speed of charging and charging infrastructure, etc.).

The most of the surveyed automotive suppliers continue to perceive new automotive trends as an opportunity rather than a threat. Some have already responded by expanding production, purchasing new technologies, constructing new production facilities, and even developing the prototype parts for new vehicles. In addition, the companies respond to new trends by improving their internal processes and planning, and by focusing on digitalisation and automation of production processes and on trade fairs and exchange of information with their buyers. It should be noted again that the companies owned by foreign corporations do not have freedom in decision-making in regard to the approaching trends, as decisions are made by the corporations. In several cases, dependence on parent companies is perceived as a limiting factor in better addressing the new technological and market trends. Other, more significant limitations include:

- ▶ failure to fully implement digitalisation in production processes and overall business operations,
- ▶ issues with the workforce skills and availability,
- ▶ burdensome taxes and contributions (to salaries),
- ▶ slow and complicated public administration procedures (red tape),
- ▶ poor country image,
- ▶ lack of interest by quality buyers.
- ▶ unpredictability of the automotive machines market (frequent changes in the last months).

The companies listed the following priority business improvements to be made regarding the new trends: expansion of production facilities, diversification of buyers, investments in new equipment, application of new technologies, improvement of workforce, introduction of product development facilities, implementation of automation and digitalisation of processes (smart factory), better compliance with buyers' requirements, introduction of quality standards and improvement of organisation. These priorities include almost every possible development path. Therefore, it may be concluded that BiH automotive suppliers follow global business improvement trends.

Almost all surveyed companies have developed investment plans. The plans primarily include capital investments into equipment and expansion of production facilities. It is interesting to note that majority of companies failed to mention finances as possible limitation to the implementation of their plans, but focused on the issues regarding the workforce and bureaucratic procedures. When asked where they see their companies in 10-15 years from now, when their plans will have

been implemented, the representatives of the companies, in general, expressed rather optimistic views concerning their production branches and niches. Some companies plan to considerably expand their capacities, along with increased employment (some even up to 500 employees), while other companies intend to introduce new technologies, achieve better strategic positioning, and improve approach towards the buyers.

The surveyed companies usually make investments in technological equipment on annual basis. Nine companies have invested in new equipment, and three companies invested in both, used and new equipment. Some companies face challenges with maintenance of complex equipment with advanced automation level. Such challenges may be addressed by hiring external experts and service personnel of equipment producers. The companies are fully aware of the benefits (higher productivity and efficiency) and the risks (lower flexibility and heavier initial investments) of purchasing new equipment with high grade of automation. The same applies to purchase of used equipment. This equipment is difficult and expensive to maintain, has lower efficiency and productivity, but requires less initial investments. Investment decisions on purchase of equipment are directly related to the companies' views about new technological trends and their expected impact automotive suppliers. The most of the companies expect "changes that will not happen so fast".

6.3.5. COOPERATION

The interviewed companies maintain cooperation with other relevant automotive industry stakeholders when it comes to education (with vocational schools, faculties/higher education institutions, education and training centres), chambers of commerce, associations of employers, certification bodies, and laboratories and institutes, such as Welding Institute Tuzla). They place the highest expectations on the trade chambers and their support in finding buyers through trade fairs, B2Bs and education. A considerable number of surveyed companies relies on their own strengths and have no particular expectations from institutions.

When it comes to cooperation with their competitors, the majority of surveyed companies stressed the lack of opportunity for such cooperation as they have no competition in BiH. However, some companies mentioned excellent cooperation with other local and regional companies. This cooperation is based on the use of complementary production facilities (processes and technologies) that companies not have in their own production portfolios, such as tool production, surface protection, etc. Such cooperation is established within the same value chain, and it represents a new link in the chain. In one case, cooperation was established with a direct competitor for the purpose of meeting the volume requirements of a foreign buyer. It may be concluded that the majority of surveyed companies is ready for cooperation with good partners on projects of common interest, and without any prejudices. However, BiH automotive companies owned by foreign corporations are rather limited in cooperation with local and regional enterprises. It is easier for these companies to establish cooperation with support institutions than maintain cooperation with other companies.

6.3.6 PROMOTIONAL PRACTICES

Promotional activities of surveyed companies are proportionate to the level of independence from parent companies. The companies owned by international corporations have neither need nor authorisation to develop and use promotional tools, as it is something addressed by their parent companies.

On the other hand, the companies not owned by foreign corporations, and who do business independently, use a variety of promotional tools. This includes visits to specialised trade fairs (Stuttgart, Nuremberg, Frankfurt, Wolfsburg, etc.), B2B meetings, digital marketing, preparation of printed promotional materials, etc. These promotional activities are primarily intended for the EU, but there are also efforts to reach other markets, such as Turkey.

This group of stand-alone companies normally prepares marketing and promotional plans, and understands their importance for its market presence, competitiveness, sales and business operations. The enterprises that develop and implement marketing plans are mostly satisfied with the results of their implementation, but also aware that their marketing efforts could be intensified and improved.

With regard to the changes expected in marketing and promotional approach due to the new technological developments and market trends in the automotive industry, the most of the surveyed companies confirm that these changes would require transformation of promotional approach. This would require finding new buyers in automotive industry and beyond, intensification of visits to specialised trade fairs, better keeping up with the innovations in the industry, etc. The companies that are part of international corporations are not independent in their promotional operations and do not anticipate significant changes in their market approach.

6.4. ACTIONS FOR THE GROWTH OF BIH AUTOMOTIVE INDUSTRY

The actions for the growth of BiH automotive companies that will enable them address the challenges and seize the opportunities are outlined in the text below. The recommendations took into consideration all previously elaborated findings in terms of the new automotive trends, position of BiH automotive sector in the regional market, the current situation in the mapped/surveyed companies, and identified opportunities and challenges.

The primary goal of the actions is to address the challenges and exploit short, mid and long-term opportunities that will allow BiH automotive companies to remain relevant players in the regional, European and global automotive industry. The actions target the different areas, such as:

- ▶ acquisition of new technologies, issues with the workforce skills and availability,
- ▶ development of workforce skills,
- ▶ promotion and marketing.

The recommendations also targeted actions of the relevant authorities that include improvement of business environment.

6.4.1 ACQUISITION OF NEW TECHNOLOGIES

Although acquisition of new technologies is generally relevant for all automotive companies, regardless of their readiness for the new trends, it may be noted that the companies with specialised production and stronger exposure to new trends with regard to production programs, are in much more need of new machines and equipment. If they want to stay competitive in technology areas, BiH automotive companies should do the following:

- ▶ develop new projects aimed at production of additional parts and components tailored to the changing automotive industry, and enabling them to offer products and services required by other industrial sectors;
- ▶ reduce dependence on small number of buyers either through identification of new ones (also considering the needs of the other industries) and/or through the expansion of production portfolios;

- ▶ invest in new, state-of-the-art equipment, simultaneously improving efficiency and mitigating the threat from the growing workforce costs associated with manual labour;
- ▶ introduce digitalisation in production processes and all other spheres of business operations to increase efficiency and improve communication with partners and clients;
- ▶ improve cooperation with other companies to be able to offer products and services of higher added value and in larger volumes.

An importance of timely introduction of relevant quality standards (such as IATF) should also not be underestimated.

The big automotive producers usually have sufficient resources at their disposal to invest in modern equipment; however, the smaller companies, with lower technological level, may require special support and care to stay relevant and competitive in the sector. The future public and donor projects that support companies to purchase new equipment through co-financing schemes should be more sensitive in this sense, regardless of the higher risks associated with investing in smaller companies.

When it comes to support in acquiring new technologies, another significant issue is the choice of technologies. In regard to selection of new equipment, the companies are usually left to their own or advised by their buyers and parent companies. The small and independent companies may find it difficult to make decisions in this regard. What may be useful for many automotive companies in making the right choice is to have support in selecting the most adequate technologies, tailored to the needs of individual companies. This support could be in the form of technology transfer centre or at least an advisory service.

Additionally, organisation of mutual company visits to exchange relevant experience may be a direct measure to help companies acquire new technologies and organise production and other business processes. Similar events have already been organised with support from BiH Foreign Trade Chamber and they could be extended with support from other chambers and tailored to specific industrial sectors, such as automotive industry. Several surveyed companies expressed interest in visiting other companies whom they would also be willing to welcome in their production facilities.

6.4.2. DEVELOPMENT OF WORKFORCE SKILLS

With the growing workforce issues, many automotive companies are already undertaking actions to secure the skilled workforce. The activities identified in this regard, that are also relevant for all companies operating in the automotive sector, include:

- ▶ internal and external practical employee training (new and existing employees);
- ▶ retention of talented employees and head-hunting the new talents;
- ▶ taking care of employees' and their families' needs, being a socially responsible company;
- ▶ providing scholarships for pupils and students;
- ▶ organising open door events for pupils and students.

Although the companies are struggling to address the workforce issues on their own, many of these issues are just beyond their power. The possible solutions, supported with involvement of relevant educational and labour market institutions and authorities, may include:

- ▶ cooperation with educational institutions in developing practical training curricula, adapted to

- ▶ labour market demands and long-term needs of the industry;
- ▶ introduction of hands-on training in schools (vocational, dual) for pupils and adults (additional qualification and prequalification);
- ▶ support in workforce education to BiH automotive producers and exporters;
- ▶ establishment of relevant training centres tailored to the needs of the industry;
- ▶ organisation of on-the-job training in the companies for existing and new employees.

Although important, the above mentioned actions may not be enough. Additional efforts should be made to fight illegal competition and grey economy and ensure larger workforce base for the companies that operate legally. Additional measures, that may significantly improve the situation at the labour market, include reduction of currently high taxes and contributions on salaries and increase in minimal wages in the industry¹⁴. It is also essential to provide approximately similar conditions for employees in public and private sector by balancing the salaries and working conditions. These actions and measures may help increase an interest in employment in private sector, secure the required workforce in the industry, and address the workforce drain.

6.4.3. PROMOTION AND MARKETING

The automotive companies have quite a number of options with regard to promotional efforts. Depending on their readiness for the new trends, some companies will need to invest more resources, in order to improve their position in the value chain, expand the present customer base and/or find the new buyers.

In general terms, promotional efforts represent an extension of activities in other areas and should accompany them. Therefore, actions such as expansion of production facilities purchase of new equipment, application of new technologies, introduction of product development facilities, implementation of automation and digitalisation (smart factory), introduction of quality standards, etc. need to be properly communicated to existing and potential buyers through adequate promotional and marketing channels. Another important sales tool for BiH automotive companies includes improvement of internal organisation and communication channels to enable better follow-up and response to buyers' demands.

The possible actions in this area may involve preparation of joint marketing materials for automotive sector companies (e.g. websites or catalogues with information on the sector and the companies). Facilitating attendance of exhibitions and visits to relevant trade fairs, organisation of B2Bs and buyers' missions and securing sales agents for target foreign markets may also be important marketing tools that help expand the customer base, find new buyers, and keep up with the latest developments and innovations in the industry.

Promotional actions should be tailored to reduce the companies' dependence on a limited number of buyers. The companies that consider changing their production portfolios and expanding their activities to other sectors should also consider identifying buyers in sectors other than automotive industry.

¹⁴ Some automotive company managers claim it is impossible to ask the foreign owners to accept higher wages than those prescribed as minimal.

6.5. RECOMMENDED ACTIONS DEPENDING ON THE READINESS FOR NEW TRENDS

In order to make sure that above proposed actions are specifically tailored for the relevant groups of BiH automotive companies, the authors of this study also considered the needs of the companies in regard to their preparedness for new market trends. Specific actions are made for the following groups of companies:

- ▶ companies that are on the right track,
- ▶ companies that need to partially adapt to the future trends,
- ▶ companies that need to undergo full transformation,
- ▶ companies that intend to leave the automotive sector.

The recommendations are given in the following table. The last row lists the general recommendations for all companies, regardless of their preparedness for new trends, and whether they plan to stay in automotive sector or leave it.

Table 9. Matrix of relevant growth actions for different groups of companies depending on their readiness for new trends, in short, mid and long run

COMPANY CHARACTERISTICS	POSSIBLE GROWTH ACTIONS		
	Short-term	Mid-term	Long-term
Companies not exposed to new trends (producers of wheel components, ball bearings, aluminium housings and parts, plastic components, parts of cooling and fluid systems, etc.)	<ul style="list-style-type: none"> • Introduce the latest technologies • Strengthen cooperation with existing buyers 	<ul style="list-style-type: none"> • Digitalise production and all other business processes 	<ul style="list-style-type: none"> • Monitor the long-term changes in the industry and take appropriate measures to adjust in timely manner • Develop R&D facilities and / or establish cooperation with R&D facilities
Companies partially exposed to new trends (producers of components for freight and special vehicles and engines)	<ul style="list-style-type: none"> • Develop plans and strategies for gradual upgrade of production to fully address the new trends • Expand the customer base 	<ul style="list-style-type: none"> • Introduce new technologies according to new trends • Digitalise production and all processes • Undertake actions to strengthen market position in the value chain 	<ul style="list-style-type: none"> • Pay special attention to the monitoring of industry changes & trends • Introduce product development facilities or establish cooperation with relevant facilities
Companies fully exposed to new trends (producers of parts for ICE engines, exhaust systems, fuel filters, transmission systems, etc.)	<ul style="list-style-type: none"> • Immediately develop investment plans in line with the new trends, with possible introduction of significant changes (new technologies, new products) • Start introducing new technologies and new products 	<ul style="list-style-type: none"> • Broaden technological base for introduction of additional new products • Establishing closer cooperation with existing and new buyers • Digitalization of production and all other business processes 	<ul style="list-style-type: none"> • Introduce own product development facilities or establish cooperation with relevant facilities • Develop new products with the highest possible added value
Companies planning to leave automotive sector and produce for other markets and industries	<ul style="list-style-type: none"> • Take immediate actions to establish connections with new buyers in various new sectors • Develop and implement plans & strategies allowing transfer to new markets and products 	<ul style="list-style-type: none"> • Strengthen market position in the new market segments • Upgrade existing technological base in line with the requirements of new markets 	<ul style="list-style-type: none"> • Increase the level of finalisation of production • Develop new products with the highest possible added value
Common actions relevant for all automotive companies regardless of their fitness to the new trends	<ul style="list-style-type: none"> • Joint participation at trade fairs • Visit other companies to exchange best practices on organisation of production, business processes, etc. 	<ul style="list-style-type: none"> • Introduce QS, particularly IATF 	<ul style="list-style-type: none"> • Cooperate with educational institutions, R&D institutions and ICT companies

7 CONCLUSIONS



“ Being able to deliver high-quality products and remaining flexible to the changing customer needs will be something that the most of the large automotive players will desperately look for ”

“ New megatrends will also gradually shift the focus from “classic suppliers” of predominantly metal and plastics components to the more ICT-like companies able to quickly implement new technological solutions ”

“ A large number of BiH automotive companies do not believe that the new automotive industry trends will be promptly applied industry-wide ”

“ Not being overly concerned with the extent of the foreseen changes, they (automotive sector companies in BiH) still try to prepare themselves for the expected changes to the extent limited mostly by the present human resources (skills) and financial capabilities ”

“ There are evident limitations and threats for the sector in the area of workforce (skills and availability), technological background (low technological base), lack of own facilities for R&D, low level of digitalisation and automation, limitations in certification and QS and modest investments into marketing activities ”

“ With proper support, BiH companies should be able to leverage new automotive megatrends using their flexibility and agility and become even more relevant sector in BiH economy ”

Several new trends on global automotive market will simultaneously bring significant changes in global automotive industry. The countries will be influenced by the trends, and the strongest impact will be felt in the countries with strong presence of automotive industry. Some new technology trends are aimed at automotive industry in particular, while others are relevant for all industries.

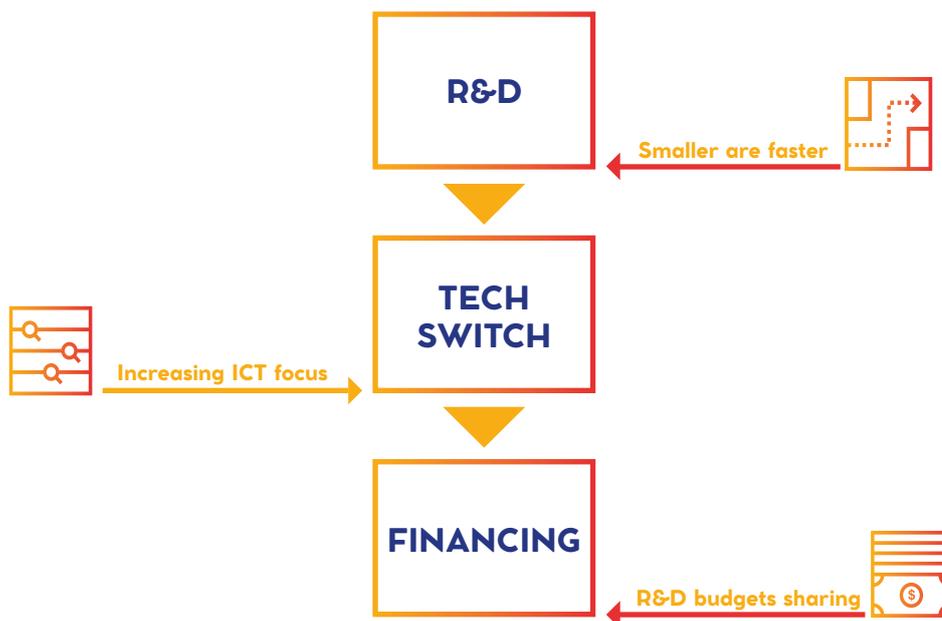
All these changes will impact both BiH and regional automotive industry. Based on our research of automotive industry companies in the region, it is rather obvious that the presence of global automotive industry is not very strong. At present, Tier 3 suppliers that process raw materials are strongly represented. But the industry is changing rapidly and it becomes visible on BiH market as well. The local market companies are of medium and small size, but in the upcoming times this will be their biggest advantage.

Being able to deliver high quality products and remaining flexible to the changing customer needs will be something that the most of the large automotive players will desperately look for. This is a huge opportunity for local BiH companies.

We have to keep in mind that new megatrends will also gradually shift the focus from “classic suppliers” of predominantly metal and plastics components to the more ICT-like companies able to quickly implement new technological solutions in the sector. This is particularly true for the growing market of autonomous and connected vehicles, where the rapid development of new automotive technologies will require swift adjustment to technological changes. The big automotive companies have become aware that they are too slow to timely apply the new technological solutions. This is why they are turning to smaller, high-tech companies, who are able to respond more quickly to swift technology changes, and are willing to outsource the applied research work and share R&D budgets. The automotive companies and their key suppliers become more and more interesting in fast and flexible innovative enterprises quickly developing solutions for application of new technologies.

An overview of the key changes impacting the automotive industry and development opportunities for automotive companies is presented in Figure 20.

Figure 20. New technological and market trends impacting the automotive industry



This report provides an in-depth analysis of BiH automotive companies with regard to their technological background, workforce demand, market position, future development plans and visions, models of cooperation and market approach. The key findings were used to develop the matrix of recommended actions tailored to the specific groups of companies, based on their readiness to face the new trends. The above outlook of the global automotive market was used as a framework to analyse the prospects of the automotive industry, and the main conclusions are presented below.

A detailed statistical analysis of 67 BiH companies in automotive sector was conducted in an effort to forecast the future of regional and BiH automotive companies in the changing global automotive landscape. According to 2018 data, the said BiH automotive companies employ some 11,000 people and generate revenues of 2.2 billion KM (1.12 billion €), while their profits amount to 176 million KM (90 million €). In the period 2016 - 2018, these companies invested 402 million KM (206 million €) to improve production base. Their total assets were worth 2.5 billion KM (1.28 mil €) in 2018. The regions with strong concentration of automotive companies in BiH are as follows: (1) Jelah – Tešanj – Gradačac (North-East), (2) Banja Luka – Laktaši (North-West), (3) Mostar – Široki Brijeg (South), and (4) Sarajevo – Goražde (East).

With regard to their technological level, 59% of BiH automotive companies are below average, 28% average, whereas 13% have above-average technological competence index. When it comes to the quality standards, 30% of 67 analysed companies are IATF-certified (Automotive Quality Management System), and 76% have introduced ISO 9001 quality standard. Over 95% of the BiH automotive companies fall under the group of component specialists, according to the redesigned role in the automotive value chain and this indicates their dependence to developments in the European and therefore global automotive market.

It is significant to note that the newcomers to the industry account for one quarter of 67 identified BiH automotive companies. The fact that several established companies operating in other sectors have considered entering the automotive industry is a testament to the strong potential of the automotive sector for leveraging new business opportunities. These newcomers primarily intend to pursue business operations in automotive design, development of electrical vehicles and their components, and application of software solutions in the automotive sector. In addition, several

companies are starting to work with the lightweight materials, such as aluminium and fiberglass. All these areas of operations are relatively new to the BiH automotive sectors and simultaneously congruent with the new global automotive trends.

With regard to their position and prospects in terms of identified global automotive industry trends, the BiH automotive sector companies are divided three groups: (1) those whose production programs are not directly threatened by new trends (around 31 enterprises), (2) those who are, to some extent, threatened, by new industry developments (also around 30 companies) and (3) those whose production programs could be exposed to the anticipated changes (some 6 companies out of 67 in total).

It may be concluded that BiH automotive industry is well positioned on the regional and the European market. With 11,000 employees, more than 60 companies operating in the sector and strong share in the national exports, BiH automotive industry is one of the most advanced parts of the country's economy. Some BiH automotive companies are the branches of international companies, and this allows them quality monitoring and swift adjustment of their technological setting to the new technological and market trends. BiH automotive companies use a variety of production technologies and this facilitates adjustment to the changing needs in the industry. In general terms, BiH automotive companies (particularly the largest companies) are well prepared to face the future challenges. They carefully observe developments in the automotive suppliers' components markets in an effort to adjust in time and stay relevant and competitive. They obtain information on the future trends and latest market developments from their parent companies, buyers and suppliers, and through the trade fairs that regularly feature the latest market and technological developments.

A large number of BiH automotive companies do not believe that the new automotive industry trends will be immediately applied industry-wide, and do not fear that their current production technologies and automotive products will soon become irrelevant and obsolete. However, given the anticipated automotive industry trends, many BiH automotive enterprises have already developed relevant plans to purchase new technologies, expand their production facilities, develop new products etc. Concerned with their survival in the changing industry, other companies are considering diversification of their product portfolios and shifting to other sectors and industries.

The existing automotive suppliers already feel the change in their behaviour of their customers who expect more development work to be outsourced to their providers. The engineers in top automotive producers are working more intensively with their suppliers' counterparts. This is also the case in the companies located in BiH and other countries of the region. Most of them are aware of the upcoming changes and are willing to make additional investments to provide vehicle components that will be in demand in the near future.



Being aware of the new trends and potential subsequent changes, BiH companies choose their own ways to adapt and stay relevant. The companies may not be overly concerned with the extent of anticipated changes, but nevertheless, they are trying to adjust their approach to their human and financial capabilities. The matrix presented in the previous chapter may help BiH automotive companies to choose the right path and undertake adequate growth actions, depending on their readiness to face the new trends.

On the other hand, sector companies are exposed to obvious limitations and threats in regard to the workforce (skills and availability), technological background (low technological base), lack of their own R&D facilities, low level of digitalisation and automation, limitations in certification and QS, and modest investments in marketing activities.

Facing these challenges may prove to be difficult for single companies. The activities that can and should be implemented by the groups of companies, or even by the sector as a whole, include:

- Joint R&D projects
- Addressing the educational gap by taking an active role in shaping the school/university curricula
- Developing internship programs to help building the necessary competencies
- Developing x-industry development programs for the employees who have the best potential

All the above initiatives can be coordinated by industry associations, chamber of commerce or other government organizations.

It is also worth noting that the level of R&D and technology investments that is required poses a major challenge especially for small and medium size companies. Introduction of targeted tax relief systems or providing other means of financial support may be vital factors that will allow BiH automotive industry to leverage identified opportunities

The 4 major megatrends in the automotive sector: electrified vehicles, autonomous vehicles, shared economy and connected vehicles – give rise to development opportunities in many areas, i.e.: batteries, fast charging technology, hydrogen fuel cells, hybrid vehicles, sensors, connectivity, light (low mass) components, integrations, applied research funding, new exploitation models, etc. The automotive producers that successfully anticipate future demands and desires will certainly take the lead in the industry.

8 ANNEXES



8.1. ANNEX 1: MAPPING DATABASE

GENERAL INFORMATION					TECHNICAL DATA		
#	Name of the company	Location	Establishment	# of employees	Sub-sector	Redesigned automotive value chain role	TCI
1	MAHLE Letrika Laktaši d.o.o.	Laktaši	2003	202	Electrical	Component Specialist	0.24
2	D.o.o. MREŽA-NETWORK	Derвента	2005	281	Electrical	Component Specialist	0.20
3	Kolektor CCL d.o.o.	Laktaši	2005	520	Electrical	Component Specialist	0.27
4	Pobjeda d.d.	Tešanj	1954	376	Mechanical	Component Specialist	0.52
5	SIM TECHNIK d.o.o.	Kotor Varoš	2007	286	Mechanical	Component Specialist	0.46
6	SARAJ-KOMERC	Gornji Vakuf – Uskoplje	1983	383	Mechanical	Component Specialist	0.24
7	ZUPCANIK d.o.o.	Tešanj	2010	20	Mechanical	Component Specialist	0.15
8	EASTCODE d.o.o.	Banja Luka	2001	47	Software development	Component Specialist	0.12
9	JAJCE ALLOY WHEELS d.o.o.	Jajce	1998	206	Mechanical	Component Specialist	1.00
10	HidroRing d.o.o.	Jelah-Tešanj	2004	10	Specialized production	Component Specialist	0.11
11	MDG INTERNATIONAL d.o.o.	Sarajevo	2012	48	Mechanical	Component Specialist	0.14
12	PREVENT CEE d.o.o. (PREVENT BH d.o.o.)	Sarajevo	2005	15	Metal and textile	Global Standardizer	1.00
13	MEDENA-COMMERCE d.o.o.	Tešanj	1998	80	Mechanical	Component Specialist	0.20
14	WEBO BOSNIA d.o.o.	Derвента	2016	15	Specialized production	Component Specialist	0.08
15	PASS d.o.o. (S.E.P. D.o.o.)	Bijeljina	2008	218	Specialized production	Component Specialist	0.35
16	d.o.o. KRUPA KABINE	Bosanska Krupa	2001	249	Mechanical	Component Specialist	0.24
17	PREVENT FAD d.d.	Jelah	2001	164	Mechanical	Component Specialist	0.00
18	UNIS-TOK d.o.o.	Kalesija	1990	362	Mechanical	Component Specialist	0.31
19	Sur Tec-Eurosjaj d.o.o.	Konjic	1996	265	Surface protection	Component Specialist	0.33
20	NIHO MOTORS Export-Import d.o.o.	Konjic	1994	10	Mechanical	Component Specialist	0.07
21	PLAMINGO d.o.o.	Gračanica	1995	258	Plastics	Component Specialist	0.34
22	HST CNC TECHNIK d.o.o.	Gračanica	2006	46	Mechanical	Component Specialist	0.19
23	TIKT MANUFAKTURA d.o.o.	Gradiška	2004	0	Mechanical	Component Specialist	n/a
24	EMKA BOSNIA d.o.o.	Goražde	1996	282	Mechanical	Component Specialist	0.36
25	REMUS INNOVATION d.o.o.	Sanski Most	2012	198	Mechanical	Component Specialist	0.20
26	MANN+HUMMEL BA d.d.	Tešanj	1991	565	Specialized production	Component Specialist	0.66
27	ZINTEKNIK BOSNIA d.o.o.	Mostar	2005	81	Mechanical	Component Specialist	0.80
28	WAGNER AUTOMOTIV d.o.o.	Gradačac	2012	258	Mechanical	Component Specialist	0.62
29	TMD-AGS d.o.o.	Gradačac	2000	35	Mechanical	Component Specialist	0.30
30	TEMAX d.o.o.	Sarajevo	2013	5	Mechanical	Component Specialist	0.10
31	EMKA Bekto d.o.o. (BEKTO-PRECISA d.o.o.)	Goražde	2005	356	Mechanical	Component Specialist	0.61
32	ENKER d.d.	Tešanj	1989	237	Specialized production	Component Specialist	0.09
33	SIK d.o.o.	Mostar	1995	141	Mechanical	Component Specialist	0.24
34	GRAEWE TADIV d.o.o.	Konjic	2006	350	Mechanical	Component Specialist	0.65
35	INTERNATIONAL d.o.o.	Ljubuški	1993	31	Mechanical	Component Specialist	0.32
36	STROLIT d.o.o.	Odžak	2005	176	Mechanical	Component Specialist	0.19
37	Coprotec Sistemi d.o.o.	Orašje	2007	41	Mechanical	Component Specialist	0.37
38	VERITAS AUTOMOTIVE d.o.o.	Sarajevo	2011	116	Mechanical	Component Specialist	0.99
39	OPRUGE-KRAJNOVIC d.o.o.	Gradačac	1996	7	Mechanical	Component Specialist	0.08
40	POSKOM d.o.o.	Orašje	2012	18	Specialized production	Component Specialist	0.13
41	NEXUS BH d.o.o.	Orašje	2015	8	Mechanical	Component Specialist	0.03
42	SLIŠKO d.o.o.	Žepče	2001	90	Mechanical	Component Specialist	0.29
43	Excel Assemblies BH d.o.o.	Maglaj	2012	531	Electrical	Component Specialist	0.08
44	CABLEX BH d.o.o.	Laktaši	2009	341	Electrical	Component Specialist	0.07
45	EUREL BH d.o.o.	Usora	2018	n/a	Mechanical	Component Specialist	n/a
46	KOTEKS d.o.o.	Tešanj	1995	238	Specialized production	Component Specialist	0.19
47	Z A H d.o.o.	Bosanska Krupa	1993	102	Mechanical	Component Specialist	0.22
48	FEAL d.o.o.	Široki Brijeg	1993	462	Mechanical	Raw material supplier	0.90
49	BOSANCAR d.o.o.	Bosanska Krupa	2005	111	Mechanical	Component Specialist	
50	CORE d.o.o.	Sarajevo	2011	20	Software development	Component Specialist	0.09
51	JAKSCHE TECHNOLOGY d.o.o.	Laktaši	2006	39	Specialized production	Component Specialist	0.40
52	TEHPRO CNC d.o.o.	Derвента	2008	126	Mechanical	Component Specialist	0.15
53	Kumal d.o.o.	Teslić	2000	11	Mechanical	Component Specialist	0.03
54	SCAI-ADAPTER d.o.o.	Brod	2005	186	Mechanical	Component Specialist	0.75
55	HIDRAULIKA-FLEX d.o.o.	Laktaši	2006	57	Specialized production	Component Specialist	0.28
56	KOMEL d.o.o.	Sarajevo	1995	19	Mechanical + Vehicle upgrade	Component Specialist	0.18
57	Tehnički remont a.d.	Bratunac	1955	177	Specialized production	Component Specialist	0.12
58	Argerr d.o.o.	Sarajevo	2015	2	Software development	Component Specialist	0.04
59	Begroup d.o.o.	Sarajevo	2005	8	Software development	Component Specialist	0.06
60	Interkomerc d.o.o.	Mostar	1994	81	Mechanical	Component Specialist	0.27
61	Metalskop d.o.o.	Tešanj	1996	10	Mechanical	Component Specialist	0.17
62	VIS d.o.o.	Banja Luka	2001	49	Specialized Production	Component Specialist	0.14
63	Mandeks Molding d.o.o.	Banja Luka	1993	9	Plastics	Component Specialist	
64	CIMOS TMD Ai d.o.o.	Gradačac	2001	653	Mechanical	Component Specialist	
65	TMD Group d.o.o. (TMD MIBO, Kovgrad, Unic-UTL, TMD Automotiv)	Gradačac	2005	410	Mechanical	Component Specialist	1.00
66	Prevent Components d.o.o.	Goražde	2013	159	Plastics	Component Specialist	0.57
67	Prevent Srebrenica d.o.o.	Srebrenica	2005	91	Mechanical	Component Specialist	0.28

8.2. ANNEX 2: OVERVIEW OF SURVEYED COMPANIES

NO.	COMPANY, LOCATION	DATE OF VISIT	PRIMARY ACTIVITY
1.	Sik, Mostar	May 21, 2019	Production of machines and components for dedicated auto industry machines
2.	Zinktechnik Bosnia, Mostar	May 21, 2019	Production of large series precise zinc castings for security, functional and decorative components
3.	SIM-Technik, Kotor Varos	May 23, 2019	Production of small series components for auto industry machines
4.	Kolektor CCL, Laktaši	May 24, 2019	Production of electric parts and vehicle components (commutators and small transformers)
5.	Mahle Lektrika, Laktasi	May 23, 2019	Production of electric components and vehicle equipment
6.	Veritas Automotive, Sarajevo	May 27, 2019	Production of plastic pipes and systems for conduction of fluids and air in vehicles (100%)
7.	Pobjeda, Tešanj	May 21, 2019	Production of oil and water pumps for fright vehicles
8.	Wagner Automotiv, Gradacac	May 22, 2019	Production of aluminium castings for automotive parts and components
9.	Jajce Alloy Wheels, Jajce	May 28, 2019	Production of light metal vehicle parts - aluminium alloy wheels
10.	Saraj-Komerc, Gornji Vakuf-Uskoplje	May 28, 2019	Production of auto parts - filter covers, springs, pipes
11.	TMD Group, Gradacac	May 27, 2019	Production of auto (rings, rotors, pipes, seat parts) and machine parts
12.	Pass, Bijeljina	May 29, 2019	Production of auto parts - plastic and rubber pipes

8.3. ANNEX 3: QUESTIONNAIRE

UPITNIK ZA PREDUZEĆA IZ AUTOINDUSTRIJE / QUESTIONNAIRE FOR AUTOMOTIVE SUPPLIERS

1. Opšte informacije / General information

Prezime i ime sagovornika: / Name of respondent (interviewee)

Kontakti: Contact information

Pozicija: Position

Naziv preduzeća: Company name

Broj zaposlenih: Employees no

Ukupni prihod u 2018: Total Income in 2018

Djelatnost preduzeća: Scope of company activities

Koja je Vaša osnovna djelatnost: Core activities / operations

Koji procenat od ukupne proizvodnje pripada sektoru autoindustrije? / Share of total production in the automotive sector?

Koje dijelove ili komponente isporučujete sektoru autoindustrije i u kojim količinama? / Which parts / components are supplied to automotive sector and in what volumes?

1. _____
2. _____
3. _____
4. _____
5. _____

Koje materijale koristite prilikom proizvodnje komponenti za autoindustriju? / What materials do you use to produce automotive components?

2. Novi tehnološki trendovi / New tech trends

Koje tehnologije koristite u Vašem proizvodnom procesu? / What technologies do you use in your production process?

Univerzalne mašine / Universal machines

CNC mašine (3 osne i/ili 5 osne) / CNC machines (3 axis and/or 5 axis)

Robote (u koju svrhu) / Robots (for which purpose)

Fleksibilne proizvodne ćelije / Flexible production cells

Automatizovane proizvodne linije / Automated production lines

Ostale: / Others

Na koji način vršite projektovanje i razmjenu podataka? / How do you carry out designing and data exchange?

Projektovanje: / Design

Manuelno (ručno, crtež) CAD Ručno programiranje CAD/CAM PLM

Manual (hand, drawing) CAD Manual programming CAD/ CAM PLM

Razmjena podataka: / Data exchange

Manuelno (ručno, crtež) Elektronski (mail, stik) Automatizovano (mreže)
Manual (hand, drawing) Electronic (mail, memory stick) Automated (networks)

Uobičajeno vrijeme od prijema narudžbe do početka proizvodnje je: / Usual time from receipt of an order to start of production is:

< 1 dan <1 sedmica <2 sedmice <1 mjesec <3mjeseca > 3 mjeseca

Less than a day less than a week less than 2 weeks less than a month
 less than 3 months more than 3 months

Uobičajeno vrijeme od početka proizvodnje do isporuke u našoj proizvodnji je: / Usual time from production start to delivery is:

< 1 dan <1 sedmica <2 sedmice <1 mjesec <3mjeseca > 3 mjeseca

Less than a day less than a week less than 2 weeks less than a month
 less than 3 months more than 3 months

Koje standarde kvaliteta posjedujete? / Which QS do you have?

Koji su očekivani budući trendovi u (auto)industriji najinteresantniji za Vaše preduzeće? / Which expected future trends in automotive industry are the most interesting for your company?

Digitalizacija u svim oblastima (Industrija 4.0) / Digitalisation in all areas (Industry 4.0)

Električna vozila (Vaš interes za ovu oblast kao dobavljača komponenti) / Electrical vehicles (and your interest

in this field as a component supplier)

Nove tehnologije (3d print metal/plastika; laserske obrade; hibridne tehnologije) / New technologies (#D print metal/plastics, laser processing, hybrid technologies)

3. Radna snaga / Workforce

Kakve su Vaše potrebe za radnom snagom sa aspekta kvaliteta, stepena stručnosti i broja? / What is your workforce demand in terms of quality, qualifications and number?

- kratkoročne (do 2 god) / Short term (up to 2 yrs)
- srednjeročne (2-5god) / midterm (2-5 yrs)
- dugoročne (preko 5 god) / long term (more than 5 yrs)

Gdje su najveći problemi u pogledu radne snage i kako se sada nosite sa njima? / What are the biggest issues in regard to workforce and how do you deal with it?

Gdje vidite njihova rješenja, kratkoročno i dugoročno? / What are solutions in short and long run?

Da li Vaše preduzeće preduzima nešto po pitanju obrazovanja i obuke radne snage? / What does you company do in regard to vocational education and workforce training?

Kako očekujete da će novi trendovi uticati na Vaše potrebe za radnom snagom? / In your opinion, how will the new trends impact your workforce demand?

4. Pozicija u lancu vrijednosti (dobavljači, kupci, konkurentnost) / Value chain position (suppliers, buyers, competitiveness)

Kakva je Vaša pozicija i uloga na tržištu dobavljača autodijelova (u EU i ostalo)? / What is your position and role in the automotive suppliers value chain (EU and other)?

Ko su Vaši najvažniji dobavljači i odakle su (BiH, Ex Yu, EU) i približni %? / Who are your core suppliers, where are they from (BiH; Ex Yu, EU) and approximate share (%)?

Da li od Vaših dobavljača možete očekivati podršku u smislu transfera znanja o novim tehnologijama, materijalima i trendovima? / Can you expect support from your suppliers in terms of knowledge transfer about new technologies, materials and trends?

Da li postoji mogućnost da sami vršite proizvodnju nekih od repromaterijala (odlivci, otkivci i sl.)? / Is there a possibility that you produce, on your own, some of the needed production inputs (casting, forging and similar)?

Ko su Vaši najvažniji kupci i za koje proizvode (udjeli%), da li su to trgovci/distributeri ili direktno proizvođači? / Who are your main buyers and for which products (in %). Are these traders/ distributors or direct producers /?

Da li od Vaših kupaca možete očekivati podršku u smislu transfera znanja o novim tehnologijama, materijalima i trendovima? / Can you expect your buyers to support you in terms of knowledge transfer about new technologies, materials and trends?

Ko su vaši najzahtjevniji kupci i kako vas oni podstiču da unaprijedite svoju ponudu? Možete li ispuniti njihove zahtjeve? / Who are your most demanding buyers and how do they push you to improve your production? Can you fulfil their requirements?

Koje su Vaše najvažnije prednosti i nedostaci u odnosu na konkurenciju (domaću i stranu)? / What are your most significant advantages and disadvantages compared to your competition (domestic and international)?

Da li se suočavate sa novim konkurentima i kakve su njihove karakteristike (domaći/strani/nivo tehnologija/niša)? / Do you face new competitors and what are their characteristics (domestic/international / technology level / niche)?

Da li saradujete sa bilo kojim od svojih konkurenata na pitanjima od zajedničkog interesa (npr. udruženja privrednika, lobiranje, unapređenje vještina itd.)? / Do you cooperate with any of your competitors in the matters of common interest (e.g. employers' associations, lobbying, skills improvement etc.)?

5 Prilike, planovi, vizija i saradnja / Opportunities, plans, vision, cooperation

Da li imate stalne kupce (isti kupac zadnjih 5 godina)? Koliko je stabilo vaše tržišno učešće i da li dugoročno planirate proizvodnju? / Do you have regular buyers /same in last 5 years)? How stable is your market share and do you plan your production in long run?

Da li sebe vidite kao predvodnika nekih novih tehnoloških rješenja i da li bi bili u mogućnosti pratiti promjene u autoindustriji? Gdje se vidite za 10 godina (i dalje aktivno u autoindustriji ili ne, i gdje)? / Do you see yourself as a leader in new tech solutions and would you be able to keep up with the changes in the automotive industry? Where do you see yourself in next 10 years (still in automotive sector or not, and where)?

Koliko često mijenjate asortiman proizvoda? / How often do you change your production assortment

Da li ste u mogućnosti prilagoditi svoje postrojenje da proizvodite neke druge proizvode i koliko vremena bi vam trebalo da pređete u neku drugu industriju? / Can you adjust your production facilities to production of other products and how much time would it take you to transition to another sector/industry?

Koliko su proizvodi koje proizvodite prilagođeni kupcu i definisani isključivo specifikacijom kupca? Da li imate mogućnost da uvodite inovacije prilikom proizvodnje i da predlažete inovativnija rješenja? / To what extent are your products adjusted/ adapted to buyers needs and defined exclusively by buyer's specification? Do you have possibility to innovate and propose more innovative solutions?

Postoje li značajnije tehničke ili tržišne promjene u autoindustriji koje mogu da utiču na Vašu konkurentnost? / Are there significant technical or market changes in automotive industry that may affect your competitiveness?

Da li ove promjene / novi trendovi u autoindustriji otvaraju prilike za Vaše preduzeće ili predstavljaju prijetnje? / Do these changes / new trends open new opportunities for your company or do they represent threats?

Kako Vaše preduzeće ide u susret novim trendovima u autoindustriji (digitalizacija, električni automobili, nove tehnologije)? / How does your enterprise embrace the new trends in automotive industry (digitalisation, electrical vehicles, new tech)?

Koji su Vaši nedostaci ili ograničenja da kvalitetnije odgovorite na nove trendove? / What are your limitations to better embrace these trends?

Koji su Vaši prioriteti za unapređenje poslovanja u odnosu na pomenute nove trendove? / What are your business improvement priorities in regard to the said new trends?

Da li imate izrađene planove (investicije) za dalji razvoj i šta vas sprečava da ostvarite poboljšanja? Gdje vidite Vaše preduzeće u narednih 10-15 godina ako se planovi ostvare? / Do you have prepared development / investment plans and what prevents you to achieve improvements? Where do you see your company in the next 10-15 years if you succeed to achieve these plans?

Koliko često ulažete u nabavku opreme i mašina, da li oprema koju nabavljate polovna ili nova, te koliko je zahtjevno održavanje iste? Da li bi po Vašoj procjeni bili efikasniji da imate napredije mašine ili su ove koje imate sasvim dostatne za asortiman koji proizvodite? / How often do you invest in purchase of new equipment and machinery? Is the equipment you purchase used or new and how demanding is its maintenance? Would your production be more efficient should you have more advanced machines or are the ones you have adequate for your production assortment?

Da li saradujete sa ostalim akterima relevantnim za autoindustriju (obrazovne institucije, privredne komore, udruženja, laboratorije, instituti, sertifikaciona tijela, itd)? / Do you cooperate with other relevant automotive stakeholders (education institutions, chambers, associations, labs, institutes, certification bodies, etc.)?

Da li i koje od institucija sa kojim saradujete mogu najviše doprinijeti realizaciji Vaših budućih planova? / Do the institutions you cooperate with contribute to implementation of your plans and which ones?

Da li imate uspostavljenu dugoročnu saradnju sa drugim proizvođačima iz regiona (ako da, pojasniti)? / Do you have established long-term cooperation with other producers from the region (if yes, please elaborate)?

6. Marketing

Koje marketinške i promotivne alate koristite u svom poslovanju (digitalni marketing, sajmovi, korištenje profesionalnih usluga, lične veze i poznanstva, i sl.) i ka kojem/im tržištima su usmjerene Vaše promo aktivnosti? / What marketing and promotional tools do you normally use in your operations (digital marketing, trade fairs, professional services, personal connections, etc.)? Which markets are targeted through your promotional activities?

Pripremate li marketinške i promotivne planove i kako ste zadovoljni njihovom realizacijom? / Do you prepare marketing and promotional plans and are you satisfied with its implementation?

Da li će novi trendovi u autoindustriji zahtjevati promjene u Vašem promotivnom pristupu? / Will new automotive trends require changes in you promotional approach?

8.4. ANNEX 4: TECHNOLOGICAL COMPETENCIES INDEX („TCI“)

The purpose of TCI is to provide standardised measurement of technological competencies and capacities of automotive companies in BiH that are included in database developed for the purpose of this Project.

TCI is a relative measure of technological capacities of an individual company against other companies included in the database, i.e. 67 automotive companies in BiH. In this regard, TCI does not provide a relative measure of technological competency position for a BiH automotive company compared to other automotive companies that are not included in the database, i.e. regional or global companies.

The index was designed to have a range between 0 and 1, with 0 being a lowest and 1 a highest score, and to facilitate comparison of the TCI between the companies. In this regard, data was normalised prior to its inclusion in an index, using the following formula:

$$x_{norm} = \frac{x - x_{min}}{x_{90th} - x_{min}}$$

where x represents original value, x_{norm} represents normalised value, x_{min} represents minimum value of data for all companies in the database, and x_{90th} represents 90th percentile of data taken into consideration in regard to all companies in the database.

By adjusting the normalisation formula to use 90th percentile instead of a maximum value, TCI was adjusted for any outliers that may skew the results. Furthermore, this allows for more than one company in the database to have maximum TCI score of 1 (or minimum of 0).

Based on consultants' judgement and expertise in this field, following data was regarded to have an impact on technological competencies for an automotive company in BiH, and was therefore included in TCI:

- ▶ **Revenue per employee** reported in financial year 2018 (“RPE”);
- ▶ **Net book value of equipment** as at 31 December 2018 (“E”);
- ▶ **Net book value of assets, plant and equipment** as at 31 December 2018 (“PPE”);
- ▶ Total value of investments in assets, plant and equipment for financial years 2017 and 2018 (“I”);
- ▶ **Certification in IATF-16949** / international Quality Management System Standard for the Automotive industry (“S”).

The abovementioned data was weighted based on its perceived impact and importance regarding the measure of technological capabilities, and final TCI formula was developed as follows:

$$TCI_t = 40\% * RPE_{norm} + 35\% * E_{norm} + 10\% * I_{norm} + 10\% * S_{norm} + 5\% * PPE_{norm}$$

Other factors may affect technological competency level of an automotive company in BiH as well, and the purpose of TCI is not to provide an absolute measure, but to provide an outline of technological capacities of 67 BiH automotive companies included in the database. Therefore, TCI is based on quantitative data on these companies that were available to the consultants at the time, and does not include various qualitative and non-quantifiable factors that may also be applicable in this regard.

8.5. ANNEX 5: CASE STUDIES

CASE STUDY 1: COMPANY WHOSE PRODUCTION PROGRAM IS NOT DIRECTLY THREATENED BY THE NEW TRENDS

Current situation

A typical BiH automotive sector company, who is not threatened by the new trends in the automotive sector, is either a medium size (50 to 250) or a large size (250+ employees) company, with mid to high technological level, and pursues secondary production.

The production program includes parts and components used in all vehicle varieties, regardless of whether they are conventional or new vehicle types. Its role in the global automotive value chain is not under threat as it is not expected that new automotive trends will bring any significant changes to its production program. The company sees new trends as an opportunity rather than a threat. The company pursues metal processing or specialised production (e.g. plastic fibres, ceramics, filters and rubber), and produces metal or plastic automotive parts and components.

- ▶ 31 out of 67 companies (46%) may be classified under this category.
- ▶ Over 80% of sales are generated from export activities.
- ▶ Net profit margin is between 10 and 20%.
- ▶ Material expenses account for the largest share in costs (approx. one half) as well as sharply growing staff expenses, currently amounting to approx. one quarter of total costs.

TECHNOLOGICAL BASE

- flexible production cells and either automatic or flexible production lines
- CAD/CAE & PLM systems in design phase and production management,
- CNC machines and CAD/CAM systems in production phase
- mid to short order-production-delivery (lead) time

PRODUCTION INPUTS

- imported, either through domestic wholesalers or directly
- supplied by buyers
- supplied by parent companies

RAW MATERIALS

- steel
- aluminium
- copper
- plastics based materials

PRODUCTS

- wheel components
- ball & conical bearings
- aluminium housings and parts
- plastic components
- parts of cooling and fluid systems, etc.

KEY BUYERS

- parent companies
- suppliers of components for automotive producers - large systems positioned higher in the automotive supply chain,
- automotive producers, directly, in some cases

THE NEXT STEPS TO ADDRESS THE GLOBAL TRENDS

SHORT-TERM

- joint participation at trade fairs
- visiting other companies to exchange best practices on organisation of production, business processes, etc.
- introduction of the newest technologies
- strengthening cooperation with existing buyers

MID-TERM

- introduction of QS, particularly IATF
- digitalisation of production and all other business processes

LONG-TERM

- cooperation with educational institutions, R&D institutions and ICT companies
- following and observing the long-term changes in the industry and taking proper measures for timely adjustment
- development of their own R&D facilities and/or cooperation with R&D facilities

CASE STUDY 2: COMPANY WHOSE PRODUCTION PROGRAM IS TO SOME EXTENT THREATENED BY NEW TRENDS

Current situation

A typical BiH automotive sector company exposed, to some extent, to the new automotive trends, is either a small size (up to 50) or a medium size (50 to 250 employees) company, with mid technological level, and pursues primarily secondary production.

Such company typically produces components for freight and special vehicles and engines (lorries, busses, special vehicles). It believes that the changes arising from the new trends will have delayed effect on its production programs. Being aware of its limitations and potential threats, this company seeks to develop new projects and introduce new production programs that will allow it to stay competitive in the changing automotive market. Most often this company chooses to invest in introduction of aluminium and plastic parts.

- ▶ 30 out of 67 companies (45%) fall under this category.
- ▶ Over 80% of sales are generated from export activities.
- ▶ Net profit margin is between 10 and 20%.
- ▶ Material expenses account for the largest share in costs (approx. one half), as well as sharply growing staff expenses, currently amounting to approx. one quarter of total costs.

Critical moment for this group of companies includes preparation of plans and projects to mitigate the risks associated with the changes in the automotive industry arising from the new trends. The key success factors for survival include development of strategies and plans for gradual upgrade of incompatible production areas in an effort to fully address the new trends. More details are provided in a table below which includes the steps to address the global automotive trends.

TECHNOLOGICAL BASE

- single flexible production lines
- use of CNC machines and CAD systems
- medium order-production-delivery (lead) time

PRODUCTION INPUTS

- imported, either through domestic wholesalers or directly
- supplied by buyers
- supplied by parent companies

RAW MATERIALS

- steel
- aluminium
- copper
- plastics based materials

PRODUCTS	<ul style="list-style-type: none"> • components for freight and special vehicles and engines
KEY BUYERS	<ul style="list-style-type: none"> • parent companies • suppliers of components for automotive producers - large systems positioned higher in the automotive supply chain, • automotive producers, directly, in rare cases

THE NEXT STEPS TO ADDRESS THE GLOBAL TRENDS

SHORT-TERM	<ul style="list-style-type: none"> • joint participation at trade fairs • visiting other companies to exchange best practices on organisation of production, business processes, etc. • developing plans and strategies for gradual upgrade of production to fully address the new trends • expanding the customer base
MID-TERM	<ul style="list-style-type: none"> • introduction of QS, particularly IATF • introduction of new technologies in line with new trends • digitalisation of production and all processes • undertaking actions to strengthen market position in the value chain
LONG-TERM	<ul style="list-style-type: none"> • cooperation with educational institutions, R&D institutions and ICT companies • focusing special attention to following the industry changes & trends • introducing their own product development facilities or establishing cooperation with relevant facilities

CASE STUDY 3: COMPANY WHOSE PRODUCTION PROGRAM MAY BE THREATENED BY NEW TRENDS

Current situation

A typical BiH automotive sector company, which may be threatened by new trends in automotive sector, is either small (up to 50) or medium size (50 to 250) company, with mid to low technological level, and pursues primarily secondary production.

This company produces parts for ICE engines, exhaust systems, fuel filters, transmission systems, etc. It is aware of the changes and is developing new projects aimed at positioning on the future market of automotive industry parts and components. The biggest threat may come from expectation that the current products may be less required in the automotive market.

- ▶ 6 out of 67 companies (9%) may be classified under this category.
- ▶ Over 80% of sales originate from export activities.
- ▶ Net profit margin is between 10 and 20%.
- ▶ Material expenses account for the largest share in costs (approx. one half), as well as sharply growing staff expenses, currently amounting to approx. one quarter of total costs.

Critical moment for this group of companies includes prompt research of transition opportunities so as to develop adequate plans to mitigate the risks associated with the changes in the automotive industry. The key success factors for survival includes development of strategies and plans that will allow gradual shift from current products to the new ones. aligned with the new trends, with more details provided in the table below under the next steps.

TECHNOLOGICAL BASE

- universal machines with manual labour
- CAD supported design and development
- mid to long order-production-delivery (lead) time

PRODUCTION INPUTS

- imported, either through domestic wholesalers or directly
- supplied by buyers
- supplied by parent companies

RAW MATERIALS

- steel
- aluminium
- copper
- plastics based materials

PRODUCTS

- parts of ICE engines
- exhaust systems
- fuel filters
- transmission systems, etc.

KEY BUYERS

- parent companies
- suppliers of components for automotive producers - large systems positioned higher in the automotive supply chain

THE NEXT STEPS TO ADDRESS THE GLOBAL TRENDS

SHORT-TERM

- joint participation at trade fairs
- visiting other companies to exchange best practices on organisation of production, business processes, etc.
- development of investment plans in line with the new trends, with possible introduction of major changes (new technologies, new products)
- launching the introduction of new technologies and new products

MID-TERM

- introduction of QS, particularly IATF
- broadening of technological base for introduction of additional new products
- establishing closer cooperation with existing and new buyers
- digitalisation of production and all other business processes

LONG-TERM

- cooperation with educational institutions, R&D institutions and ICT companies
- introduction of their own product development facilities or establishing cooperation with relevant facilities
- development of new products with the highest possible added value

