Ref. Ares(2019)916597 - 15/02/2019

EACN
European Automotive Cluster Network
for Joint Industrial Modernisation Investments

European Automotive Cluster Network for Joint Industrial Modernisation Investments

Drivers and motivators for industrial modernisation in the Automotive Industry

Deliverable 2.1

Grant Agreement 821989

Katowice, February 2019

Version: 2.0

Co-funded by the COSME programme of the European Union

ESCP.S EACN Partnership

Project Consortium

Cluster Pôle Véhicule du Futur – Solutions for future vehicles & mobility

CEAGA – Galician Automotive Cluster

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About the 'EACN for Joint Industrial Modernisation Investments' project

The EACN for Joint Industrial Modernisation Investment project (EACN project) has been submitted by eight members of the European Automotive Cluster Network to the Call for Proposals COS-CLUSTPARTNS-2017-3-02. It has been selected for co-funding by the COSME programme of the European Union under the Grant Agreement 821989.

Project partners are Pôle Véhicule du Futur (coordinator, France), Galician Automotive Cluster Foundation CEAGA and Catalonian Automotive Industry Cluster CIAC (Spain), Silesia Automotive & Advanced Manufacturing Cluster SAAM (Poland), Automotive Cluster Bulgaria and Automotive Cluster Serbia, with the support of Automotive-bw and Bayern Innovativ (Germany). The project lasts from October 2018 to October 2020.

The project aims at initiating common R&D and Joint Investment projects between members from different European countries in the field of industrial modernization in the automotive industry, with emphasis on (1) Virtualisation of planning processes, (2) Robotics and Artificial Intelligence, (3) Elasticity of production processes and (4) Skills and Competences.

Table of Content

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Revision history

Version	Date	Author	Description
1.0	**20/12/18**	**Luk Palmen, Ewa Dudzic**	**Initial Draft**
1.1	**08/02/19**	**Luk Palmen, Ewa Dudzic** **Clotilde Nadé, Thomas Röhr**	**Draft** **Additional information provided**
1.2	**14/02/19**	**Luk Palmen, Ewa Dudzic, Łukasz Górecki, Clotilde Nadé, Thomas Röhr, Claudia Bas, Borja Dapena, Miglena Miteva, Igor Vijatov**	**Final version prepared on the basis of the outcomes of the survey and the internal workshops on 12-13.02.2019**
2.0	**15/02/19**	**Clotilde Nadé**	**Document ready for submission for approval**

Document status

Status description	
For Information	
Draft Version	
Final Version (Internal document)	
Submission for Approval (deliverable)	
Final Version (deliverable, approved on) 12 June 2019	X

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List of tables

Abbreviations

AI	Artificial Intelligence
BEV	Battery Electric Vehicle
EACN	European Automotive Cluster Network
EV	Electric Vehicle
FCEV	Fuel Cell electric Vehicles
GBP	British pound sterling
GDP	Gross Domestic Product
HEV	Hybrid Electric Vehicle
ICT	Information and Communication Technologies
M2H	Machine-to-Human
M2M	Machine to Machine
MM	Millions
OEM	Original Equipment Manufacturer
R&D	Research and Development
SME	Small and Medium Enterprise
UK	United Kingdom
WP	Work Package
WTO	World Trade Organisation

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1 Introduction

In a period of 24 months the EACN Partnership wants to support the preparation of five research and development projects or joint investment projects related to industrial modernisation in SMEs in the automotive industry involving SMEs, technology suppliers, research centres and technology parks. Main issues under four topics will be identified, discussed and processed into projects through a set of thematic workshops, brokerage events and good practice exchange.

This document is elaborated according to task 2.1: "Drivers and motivators for industrial modernisation in the automotive industry" in the framework of WP2 "Preparatory phase - Joint Partnership Strategy" of the EACN for Joint Industrial Modernisation Investment project. It presents main trends and events having impact on the way global value chains and business models in automotive will evolve. The analysis was provided from October 2018 until February 2019 by way of intelligence gathering based on available market studies, trend analyses, policy papers, sector forecasts, expert opinions. The results of the analysis form the basis for the elaboration of the EACN strategy in line with task 2.2: "EACN Strategy and roadmap development" of the project.

The report includes a profile of the four topics: (1) the virtualisation of processes, (2) the incorporation of robotics and artificial intelligence, (3) the configuration of flexible, modular and adaptable production lines, (4) the development of new employees' competencies. The report provides answers on the following questions:

- Why are these four topics important for SMEs in the automotive sector, taking into account the identified drivers and motivators for industrial modernisation?
- What are the conditions, challenges and success factors for actions related to these topics for SMEs in automotive?
- Who are the main actors in the change processes related to these topics?

The automotive industry always was – and will probably also be in the future – the place where new production technologies are tested and applied first on a large scale. As such, SMEs have had the opportunity to see what has been going on during the past years at their clients. In many cases they have been urged by their clients to adopt new production technologies, to enter into communication platforms and to provide new solutions for quality control and cost optimisation. The industrial modernisation process companies are going or plan to go through has to strengthen competitiveness of SMEs by way of transforming centralised production systems into decentralised cyber-physical systems within which continuous data flows allow providing real-time analyses of situations, improving demand and supply management, predicting potential deviations and prevent them from happening, as well as providing continuous improvement. These processes however demand for a clear strategic approach and appropriate readiness for a change in organisational culture. Especially for SMEs, the investment issue, the organisational culture issue and the competencies issue are of utmost importance. Industrial modernisation, by way of implementing so-called industry 4.0 technologies in the company's management and production system, implies quite large expenditures and employees' competencies development, among which in the area of data-analysis and data-interpretation. It also includes decentralisation of decision-making processes down to the level of machine operators and maintenance specialists receiving information directly from machines. At the background of global trends, one can state that industrial modernisation is not an option, it's a must.

2 Automotive at the crossroad of disruptive changes

Since the 1990's the European automotive industry has been organised in trans-European rather than national production networks. Assembly plants and branches of multinational Tier 1 suppliers are spread over Europe and cooperate locally with Tier 2, Tier 3 suppliers, often SME's. The 2008-2009 economic crisis was an important turning point for the European automotive industry. The crisis led to consolidation among suppliers and redefinition of supply chains[1]. After several years of decline, car sales on the European market had fully recovered by 2016 reaching 14.6 MM cars sold. However, the *Dieselgate* scandal tempered optimism in the automotive industry and brought back the issue of alternative fuel technologies as well as the average CO_2 emissions target of 95 g/km for 2020 on the agenda[2]. For two decades research and development programs at Original Equipment Manufacturers (OEM) and 1st Tier suppliers have been focusing on: lightweight materials to decrease overall vehicle weight, integration of components, emission decreasing measures, hybrid and electric drive systems, as well as optimising production systems in cooperation with production systems' suppliers. Although the market share of hybrid-electric vehicles in Europe in 2016 amounted 1.8% of all new car sales, European automakers plan to focus on the deployment of plug-in hybrid electric vehicles on a larger scale by 2030. In the meantime China's investment in electric mobility exceeds the sum of investments in Germany, France, USA, Japan and Korea together[3].

The GEAR 2030 High Level Group – established by the European Commission in 2015 – identified five challenges for the European automotive industry[3]:

1. Advanced electric mobility solutions, especially battery systems, and automated driving technologies (including vehicle-to-vehicle (V2V) communication) will require heavy investments in new production processes;
2. Severe climate targets will demand for new technologies reducing car emissions, among others zero-emission and zero-emission capable solutions, lightweight materials and new mobility models (car-sharing) reducing the amount of vehicles in cities;
3. Higher connectivity of vehicles will require solutions concerning cyber-security, big data transfer and processing, smart materials applied in vehicle components. Due to widespread access to information, mobility as a service might lead to the diminishing of the amount of vehicles purchased, especially in metropolitan areas;
4. Increasing non-EU competitors' position on the global market, especially competitors from India and China, while the European market will rather face stagnation or limited growth. In order to maintain a certain position, the European automotive industry will have to invest in new technologies and focus on continuous cost optimisation at the same time by way of introducing advanced production systems;
5. Far reaching digitalisation of production systems and vehicles will require new competencies among employees in the automotive industry. At the same time unfavourable demography in many EU countries will push companies towards fully automatized (including robots and artificial intelligence) production systems, which will pose a lot of pressure on SME's because of the limited amount of funds for these kind of investments.

1 Dependent Growth: Foreign Investment and the Development of the Automotive Industry in Central Europe, Pavlínek Petr, Springer International Publishing, 2017, DOI 10.1007/978-3-319-53955-3_2

2 European Vehicle Market Statistics, Pocketbook 2017/18, The International Council on Clean Transportation, 2017, https://www.theicct.org/sites/default/files/publications/ICCT_Pocketbook_2017_Web.pdf [23.11.2018]

3 GEAR 2030 (2017) Ensuring that Europe has the most competitive, innovative and sustainable automotive industry of the 2030s and beyond. Final Report, High Level Group on the Competitiveness and Sustainable Growth of the Automotive Industry in the European Union, DG GROW – Internal Market, Industry, Entrepreneurship and SMEs, https://ec.europa.eu/docsroom/documents/26081/attachments/1/translations/en/renditions/pdf [23.11.2018]

According to the GEAR 2030 High Level Group we have to expect a major shift of technologies and approaches to mobility. For instance PSA focusses on cost cutting measures and improving R&D efficiency (9% of annual turnover invested in R&D) while reducing the amount of platforms from seven in 2014 to two in 2022 (EMP1 and EMP2), five PC Programs and 26 PC bodies, including: six DS, seven Citroën and 13 Peugeot bodies[4]. Volkswagen foresees to spend 34 billion euro worldwide by 2022 on alternative powertrains and technologies for connected and automated vehicles[5]. Again Renault budgeted 18 billion euro by 2022 for its "Drive the Future 2017-2022" plan[6]. Although multinationals provide large research and development programs, the High Level Group pointed out the necessity to invest in digitalization of the entire automotive value chain including SMEs.

The fourth industrial revolution will bring upon severe changes in the way human and machines interact in production processes, information flows as well as flows of goods and services. While lots of SMEs are still considering whether or not to replace manual work by automated pre-programmed processes and robots (from Industry 2.0 to Industry 3.0) or to better integrate separate production modules into one enterprise management system, we are witnessing cyber-physical systems based on intelligent, autonomous machines and systems entering the market. Information technologies have opened up new possibilities to communicate with customers and suppliers. As such, OEMs are able to better manage their product flows in line with customers' demands and requirements and to create just-in-time, just-in-sequence customised supplier networks. The need to quickly adapt to new situations, to plan, implement and deliver in much shorter times than it was the case just a decade ago, demands for new approaches within organisations. Centralised management systems must make place for decentralised decision-making solutions, rigid production lines are being remodified into flexible production systems. Information flows contribute to growing awareness among final customers and increases their bargaining position. The same counts for large companies in relation to their smaller suppliers. The use of supplier portals in tendering procedures has resulted in a stronger negotiation position of OEMs - suppliers' margins have been under pressure for some time now. Continuous improvement has been enabling suppliers to find additional savings in process optimisation, as such safeguarding margins. Still, suppliers have been witnessing diminishing capital reserves and where pushed into the direction of consolidations and mergers on global scale. While multinationals at Tier 1 level strengthened their position as they increased activities in research and development, SME's often were forced to accept a position on Tier 2 or Tier 3 level.

Over time the fourth industrial revolution will contribute to the creation of a more integrated world with autonomous production facilities and intelligent data gathering, processing and decision-making systems. However, one should ask, how long it will take before SMEs in the automotive industry will fully enter into the fourth industrial revolution and provide the necessary industrial modernisation projects to digitalise their organisation? Who will benefit from applying new technologies and who will lose? It is no surprise that the industrial modernisation process is costly and risky, especially for SMEs with limited budgets, limited personnel capacities and limited awareness about available solutions and good practices. Therefore the EACN Initiative wants to create opportunities for SMEs to meet, define needs and verify potential solutions by way of audits, workshops, business to business meetings, good practice show cases and project development support.

[4] https://www.groupe-psa.com [23.11.2018]

[5] https://www.reuters.com/article/us-volkswagen-investment-electric/volkswagen-accelerates-push-into-electric-cars-with-40-billion-spending-plan-idUSKBN1DH1M8 [23.11.2018]

[6] Groupe Renault Facts and Figures, March 2018 edition

3 Main drivers and motivators for industrial modernisation

3.1 Drivers for change

By 2030 several drivers will have a severe impact – positive or negative - on the European automotive industry, especially on SMEs being traditional suppliers to Tier 1 and Tier 2 suppliers. Below one can find a selection of the most important drivers for change. It should be noticed however that predictions related to these trends rarely prove wholly accurate as unforeseeable events can result in altered courses of history. Nevertheless the below information should be taken into account to get a better understanding of the needs for industrial modernisation and as a starting point for defining indicators of change to be monitored by SMEs in the automotive sector wanting to provide a conscious growth strategy for the next decade.

3.1.1 Social trends

Millennials focused on mobility rather than on owning cars – they grew up in the multimedia era and have been witnessing various technological changes that have influenced their way of life. Being online most of the time, they have access to information about the best transport mode to travel from point A to B. Being mobile has become more important than owning a car. After years of decline, public transportation use is growing again. In many countries millennials have undergone the uncertainty of job instability during the financial crisis in 2008-2011. Therefore they are cost conscious and focused on efficient cost-effective solutions. For many young adults, owning a car is no longer a status symbol.

Sharing economy – especially in large cities and metropolitan areas, people prefer using public transport to commute between cities or from home to work and to hire locally bikes, scooters or cars to reach their final destination. Sharing systems serve the so-called last-mile to work or home. Initiatives like Uber, Drivy and other car sharing solutions are revolutionising the market. The introduction of electric scooters in city centres is setting new standards for flexible, fast and low-cost traveling.

Urbanisation and urban sprawl – over 60% of European population lives in urban areas of over 10 000 inhabitants[7]. Cities are constantly growing and connect with smaller communities in their vicinity. Congestions, accidents and pollution are major challenges because of which local and regional governments invest in public transport and support other alternative transport means to daily car use (e.g. bicycles, car-sharing, ride sharing…). At the same time an increasing number of cities are banning classic diesel and petrol cars from their centres.

Aging population, less access to qualified employees, wages up – about 13.3 million Europeans (6.1% of the EU employed population) work in the automotive sector. The 3.4 million high-skilled jobs in automotive manufacturing represent 11.3% of the EU's manufacturing employment[8]. There is a growing shortage of employees with relevant qualifications, especially in the Central European countries. With a fast aging population in Europe, the amount of available workers on the labour market will diminish significantly in the next decade. Since the opening up of the labour markets within the European Union we have been witnessing labour migration from Central Europe to West-European countries. At the same time people from Eastern Europe, mainly from Ukraine, entered the European labour market. Limited access to qualified employees and rising rotation of specialists will push wages higher, while companies try to keep their key-personnel on board.

Customisation, limited editions – More and more OEMs offer their customers more and more options to get personalised vehicles responding to customers' expectations but needing more flexible production tools. Also, car makers like Rolls-Royce, Bentley, Ferrari, Porsche, Jaguar, Infiniti and

[7] https://ec.europa.eu/transport/themes/urban/urban_mobility_en [10.12.2018]
[8] https://www.acea.be/statistics/article/employment [23.11.2018]

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Mercedes have discovered niche segments for limited editions of special cars (50 - 1000 pieces/year) and limited series of car models produced for special occasions. There is a growing number of luxury buyers interested in collecting cars. In the meantime OEMs are analysing their portfolio of historical models to identify iconic classic cars that could be revived again, like for instance: Volkswagen Beetle, Mini Cooper or Fiat 500.

3.1.2 Technological trends

Industry 4.0, Smart Factories, Artificial Intelligence in advanced automated production systems, 3D printing – the fourth industrial revolution is characterised by a set of technologies and advanced solutions allowing companies to increase flexibility and cost efficiency through the application of smart automation solutions, real-time data gathering and processing, decentralised decision making processes, as well as machine-to-machine communication and fully autonomous production systems that can be reconfigured in line with changing needs and demands. On the supply side, digital technologies allow for easier entry and increased product diversity, making it easier for firms to produce, promote and distribute their products at a lower cost[9].

Cyber-security (H2M, M2M) - cyber-physical production systems based on machine-to-machine communications, wireless sensor networks and wireless body area networks demand for an integrated approach on cyber-security in order to cope with safe data gathering, transfer and processing. In environments where artificial intelligence will allow machines to take decisions and provide changes in production processes, cyber-security is of utmost importance at all levels of the organisation – from sensors at the machine level to the level of the enterprise management systems – to prevent third parties from getting unauthorised access or from altering or disturbing production processes.

IoT, connected cars – Internet of Things, or the connection of devices to the Internet in order to gain information, monitor or control them from a remote location, is a fast growing business. From household equipment, utility devices to buildings and cars – each day new solutions enter the world market. IoT platforms like among others: Amazon Web Services, Microsoft Azure, ThingWorx IoT Platform, IBM's Watson, Cisco IoT Cloud Connect, Salesforce IoT Cloud, Oracle Integrated Cloud and GE Predix enable data transfer between devices and data networks. IoT in vehicles allows improving the driving experience. But data gathering also enables car manufacturers to get feedback about the use of cars, about defects and drivers' habits. More and more components in cars will have integrated sensors or built-in smart functional features (smart materials) enabling real-time diagnostics and alerts, providing data-analytics and improving safety. New cooperation partnerships between Automotive OEMs, telecommunication service providers and IT companies pave the way for the development of autonomous cars. New competitors on the automotive market such as Google, Uber, Tesla are often more interested in the data gathered by cars than in the car itself.

5G networks, Smart cities – intelligent mobility technologies are enabled by digital cellular networks, powerful computer processors, sensors, data fusion and machine learning.[10] Fifth generation technology will have a big impact on city infrastructure and on the automotive industry. 5G aims to address some of the key future needs of smart cities with higher bandwidth, delivery and performance guarantees, adaptability, energy efficiency, and real-time capabilities[11]. It will enable vehicles dynamically forming a group, driving together, and proceeding at a very short distance from each other. It will allow vehicles to share driving intentions, sensor data, and videos gathered through on-

[9] World Trade Report: The future of world trade: How digital technologies are transforming global commerce, World Trade Organization, 2018

[10] Smith, Brett, Adela Spulber, Shashank Modi, and Terni Fiorelli. Technology Roadmaps: Intelligent Mobility Technology, Materials and Manufacturing Processes, and Light Duty Vehicle Propulsion. Center for Automotive Research, Ann Arbor, MI, 2017

[11] Smart Cities: An Overview of the Technology Trends Driving Smart Cities, Rodger Lea, Lancaster University, March 2017

board cameras with roadside infrastructure, other vehicles, pedestrians and network servers, for safety and traffic efficiency applications, as well as semi- or fully-automated driving. 5G will support remote management of mobility sharing platforms and autonomous public transport vehicles in cities[12].

Electric and hybrid drive systems – prognoses about the share of electric vehicles (EVs) in new car models by 2030 range from 50% to 100%, including battery electric vehicles (BEVs), fuel cell electric vehicles (FCEVs) and hybrid electric vehicles (HEVs). The price of batteries is expected to drop over time, making EVs more price-competitive, with price parity between BEVs and internal combustion engine vehicles reached by 2029. Also battery loading technologies will improve, resulting in a shortened loading time. A challenge difficult to overcome will remain the investment costs for loading infrastructure in buildings, as part of public infrastructure, at filling stations, car parks and in private houses. It is expected that there will be around 17 MM EVs in Europe by 2030, which is still a moderate number. However major changes are anticipated between 2030 and 2050, with all cars sold after 2040 being electric[13].

Autonomous cars – most OEMs follow an evolutionary approach towards the development and commercialisation of autonomous cars. By 2022 level-4 autonomous cars[14] will be able to drive completely autonomously without ever requesting the driver to intervene but initially only on specific roads and thus the driver will have to take over control when the car is exiting that specific road. At the same time IT companies and technology start-ups are focussing on level 4 city-based low-speed autonomous vehicles for specific city centre areas. OEMs create partnerships with IT companies and start-ups to combine efforts in new technology development and demonstration and to include cross-sectoral experiences and competences[15]. It is estimated that autonomous vehicles will account for 40% of the personal mileage driven in Europe in 2030[16].

Lightweight materials – new materials with better performance characteristics are introduced into vehicles, especially for improving crashworthiness, noise and vibration, overall cost, and fuel economy[17]. Among others, the European fuel efficiency standards for new cars and vans, the Directive 2000/53/EC of the European Parliament and of the Council on end-of life vehicles, the Conflict Minerals Regulation (in force from 2021) and other policy measures concerning material use and reuse, have urged OEMs and suppliers to provide research and development programs on new materials and on production technologies allowing to decrease the weight of car components and to replace certain materials. The application of new materials raises the need for new joining technologies and quality testing procedures in production processes. Due to additional functions and features, cars become heavier. At the same time, in order to meet emission standards, they will have to become much lighter than they weight today. For what concerns electric cars, lightweight materials have to come in place of traditional steel in order to compensate the extra weight of the batteries and to increase the driving range.

3.1.3 Economic trends

[12] 5G for the Automotive Domain, Carla Chiasserini, Anthony Magnan, IEEE, March 2018
[13] E-Mobility Trends and Targets, Partnership on Sustainable Low Carbon Transport, November 2018
[14] Society of Automotive Engineers (2018) Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles. SAE J3016 standard
[15] The Future of Autonomous Cars, Ludvig Barrehag, Johan Fagerberg, Berg Insight's, 2016
[16] Five trends transforming the Automotive Industry, Felix Kuhnert, Christoph Stürmer, Alex Koster, PricewaterhouseCoopers GmbH Wirtschaftsprüfungsgesellschaft, 2017
[17] Smith, Brett, Adela Spulber, Shashank Modi, and Terni Fiorelli. Technology Roadmaps: Intelligent Mobility Technology, Materials and Manufacturing Processes, and Light Duty Vehicle Propulsion. Center for Automotive Research, Ann Arbor, MI, 2017

Made in China 2025 – this Chinese master plan for future manufacturing focuses on the support of 10 high-technology sectors with the aim to reach a world leading position and technology advancement independent from Western countries. By way of consolidation of state-owned companies, industrial modernisation, large scale restructuring of sectors facing overcapacity and a stronger focus on environmental issues and intellectual property, China wants to become the strongest economic power in the world. At the same time with the production of higher added value products and services China will try to weaken the position of Taiwan, South Korea, Japan and Germany in the global trade network[18]. It is however expected that highly subsidised value chains in these 10 priority sectors, among which production of electric vehicles, will lead to overcapacity of production facilities rather than to strong companies able to compete on international markets on other differentiators than low prices. The European Union and the United States of America will try to postpone the massive import of these kind of products from China by way of applying strict technical and quality standards in legal frameworks, as well as through putting in place tariffs and regulations concerning the safeguarding of national security[19].

A shift of the middle class' purchasing power value – it is expected that the growing middle class in Asian countries will lead to a shift in the share in total purchasing power value of the middle class from Europe (2009: 38%; 2020: 29%; 2030: 20%) and North America (2009: 26%; 2020: 17%; 2030: 10%) to Asia-Pacific countries (2009: 23%; 2020: 42%; 2030: 59%)[20]. Europe's standard of living will be characterised by stagnation. Taking into account demographic changes and the aging of the population, in order to maintain somehow the standard of living in Europe, it will be necessary to import employees from other parts of the world and to provide automation of services and production processes[21].

Trade wars, protectionism – fore more than three decades global trade has been benefiting from free trade and international agreements allowing favourable movement of goods between continents and countries. However, one can observe growing concerns in countries facing local social tensions, where politicians opt for protectionist measures aiming at keeping foreign products and services out. Protecting own markets can lead to price increases, which has a negative effect on profitability of business and real household income. According to estimations, a global trade war would lead to a decline of European real GDP value of 3,1%[22]. If a severe distortion of the global trading system should occur and be maintained for at least three years, an annual decline of global trade of up to 9% is to be expected[23].

Data collection and processing as value creators - During the last decade, sensor costs declined twofold, bandwidth costs fell by a multiple of 40 and processing costs dropped by a multiple of 60[24]. However, most companies are capturing only a fraction of the potential value of data and analytics. Currently there is a shortage of data scientists, but in the near future this gap between demand and supply could be narrowed as main parts of data collection and preparation processes will be automated. Nevertheless, in order to create value from data, companies will have to employ specialists with new competences. Following experiences of Uber, Lyft, Didi Chuxing, Palantir, Flipkart, Airbnb, DJI, Snapchat, Pinterest, BlaBlaCar, Spotify, Apple, Google, Alibaba and Amazon, business models

[18] Transformation of China and global economic interdependence, Anna Saarela, Directorate-General for External Policies, European Union, 2017

[19] https://www.cfr.org/backgrounder/made-china-2025-threat-global-trade [17.12.2018]

[20] The World in 2030: Global Trends and Risks That Will Shape the World over the Next 20 Years, Ángel Pascual-Ramsay, Álvaro Imbernón Sáinz, ESADEgeo Center for Global Economy and Geopolitics, October 2014

[21] Global Europe 2050, Directorate-General for Research and Innovation, European Commission, 2012

[22] The Rise in Protectionism and the Prospect of a Global Trade War, Francis Généreux, Desjardins, July 2018

[23] The Global Costs of Protectionism, Zornitsa Kutlina-Dimitrova, Csilla Lakatos, World Bank Group, December 2017

[24] Technology and Innovation for the Future of Production: Accelerating Value Creation, World Economic Forum, March 2017

based on digital platforms, data and analytics can secure companies important competitive advantages in selected market segments. On the other hand, these companies tend to come up with game changers on traditional markets, also on the automotive market, trying to launch their concepts of autonomous cars[25]. Continuous access to data will allow companies to get better real-time insight in production processes in order to safe costs and in customer expectations in order to better position products and services and increase revenues. Also from the customer point of view, access to data will enable companies to create new services that enhance the driver's experience. Car data monetization opportunities will grow incrementally for industry players along the mobility value chain, as car data is likely to generate value through increased revenues, reduced mobility cost, and increased safety and security[26].

Globalisation vs. regional concentration, the era of mega platforms – leading global OEMs are rethinking their platform strategies in response to the pressures generated by intensifying competition, new consumers and state regulators. The new mega platforms take a more holistic approach, focussing rather on differentiation based around how a vehicle is purposed and a more modular approach with increasing room for complex infotainment, safety systems, connected car systems and advanced power trains. While OEMs count on greater economies of scale, reduced development costs, shorter development times and greater manufacturing flexibility, they will expect from their suppliers to secure regional presence, proactive technology innovation and greater volumes. This could lead to further consolidation of suppliers in order to meet these volumes as well as to a diminishing amount of Tier 1 suppliers with whom OEMs will prefer to cooperate[27].

3.1.4 Ecological trends

Climate change – despite the efforts of countries to fulfil their targets set out in the 2015 Paris Agreement[28], climate change will have drastic effects. Disruption in weather and climatic patterns will lead to competition and possible conflicts over resources, with spill over into the political realm. By 2023, all countries will be expected to indicate trajectories and possible targets for greenhouse gases reduction efforts beyond 2030. Because climate change places strains on resources, it can lead to, or trigger social upheavals, and can indirectly lead to wars and subsequent migratory flows. Europe will continue to be one of the main recipients of climate-related migration. It is close to the climate-insecure areas of North Africa, the Sahel, East Africa, and the Middle East[29].

Regulations on emissions – mandatory CO_2 standards have stimulated the diffusion of innovative vehicle efficiency technologies and designs in the European Union[30]. In October 2018 the European Council proposed new emission targets for 2025 and 2030[31]. Average CO_2 emissions of new passenger cars registered in the EU will have to be 15% lower in 2025 and 35% lower in 2030, compared to the

[25] The age of analytics: Competing in a data-driven world, McKinsey & Company 2016
[26] Car data: paving the way to value-creating mobility Perspectives on a new automotive business model, Advanced Industries, McKinsey & Company, March 2016
[27] Five Critical Challenges Facing the Automotive Industry: A Guide for Strategic Planners, Mark Fulthorpe, HIS Automotive
[28] Paris Agreement, UNFCCC, 2015, https://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf [23.11.2018]
[29] Global Trends to 2035: Geo-politics and international power, Oxford Analytica at the Request of the Global Trends Unit, DG European Parliamentary Research Service, September 2017
[30] 2020–2030 CO2 standards for new cars and light-commercial vehicles in the European Union, Peter Mock, The International Council on Clean Transportation, November 2016
[31] Proposal for a Regulation of the European Parliament and the Council setting emission performance standards for new passenger cars and for new light commercial vehicles as part of the Union's integrated approach to reduce CO2 emissions from light-duty vehicles and amending Regulation (EC) No 715/2007 (recast), COM(2017) 676 final/2, http://ec.europa.eu/transparency/regdoc/rep/1/2017/EN/COM-2017-676-F2-EN-MAIN-PART-1.PDF [04.01.2019]

emission limits valid in 2021. For vans, the Council maintains the targets as proposed by the European Commission: 15% in 2025 and 30% in 2030. The real-driving emissions (RDE) test procedure for measuring vehicle emissions under the Worldwide Harmonised Light Vehicles Test Procedure (WLTP) will allow car manufacturers to report more robust and more representative data (measured values instead of declared values)[32].

Circular economy – the concept of avoiding waste by way of better product design, preventive measures and reuse of materials in new value streams – not necessarily in the same sector – can lead to improved resource productivity by up to 3 percent annually in Europe, less dependency of the European economy on external resources and new opportunities for material and product innovations. Especially the Automotive industry will look for new production technologies to enable better reuse of materials and components (remanufacturing) made of them. The introduction of electric and autonomous vehicles on a larger scale will drive companies into the direction of lighter materials, materials that increase vehicles' lifetime and enable easier reuse at the end of the vehicle life-cycle. Especially SMEs will have to take into account the impact of the development of low and zero emission vehicles on their production processes regarding reuse, recycling and substitution of spare parts, raw materials (steel, aluminium, glass, plastics, etc.), critical raw materials and hazardous substances coming from vehicles and vehicle components[33].

3.1.5 Political trends

Growing interdependence and fragmentation – in 2030 five of the ten largest economies in the world will be economies whose governments tend to encourage the expansion of state-owned companies and national champions. The influence of Western institutions will decrease, as will the position of international multi-country free trade treaties. At the same time trade will be regulated by bilateral agreements and changing coalitions formed and resolved by opportunistic great powers. The combination of weak demand, high debt, an ageing population an expected slowdown in productivity growth and lower consumption in Europe and Japan could lead to longer periods of stagnation and shrinking economic power[34]. Global economic and geopolitical issues will be ever more interlinked. Negotiations on climate change, cyber security, finance or trade will be increasingly influenced by the geopolitics of assertive new powers[35].

Brexit - The EU accounted for 44 percent of United Kingdom's (UK) exports and 53 percent of its imports. Total UK–EU trade was 3.2 times larger than the UK's trade with the United States, its second-largest trade partner. In general UK–EU trade is substantially more important to the United Kingdom than to the EU[36]. But for what concerns the automotive sector the situation is different. In 2017 EU27-UK export of vehicles amounted 2.3 MM vehicles worth about 38 400 MM euro and UK-EU27 amounted 804 332 vehicles worth about 14 500 MM euro. In that same year EU27-UK export of parts and accessories was about 11 400 MM euro worth (14.1 MM units) and UK-EU27 about 3 800 MM

[32] https://www.consilium.europa.eu/en/press/press-releases/2018/10/10/co2-emission-standards-for-cars-and-vans-council-agrees-its-position/# [17.12.2018]

[33] GEAR 2030, Ensuring that Europe has the most competitive, innovative and sustainable automotive industry of the 2030s and beyond, final Report – 2017, High Level Group on the Competitiveness and Sustainable Growth of the Automotive Industry in the European Union, DG GROW – Internal Market, Industry, Entrepreneurship and SMEs, 2017

[34] The World in 2030: Global Trends and Risks That Will Shape the World over the Next 20 Years, Ángel Pascual-Ramsay, Álvaro Imbernón Sáinz, ESADEgeo Center for Global Economy and Geopolitics, October 2014

[35] Global Trends to 2030: Can the EU meet the challenges ahead?, An inter-institutional EU project with the participation of the European Parliament, the Council of the European Union, the European Commission and the European External Action Service

[36] Brexit: The Economics of International Disintegration, Thomas Sampson, Centre for Economic Performance, Department of Economics, London School of Economics, Journal of Economic Perspectives—Volume 31, Number 4—Fall 2017—Pages 163–184

euro (21.7 MM units)[37]. From an assembly perspective, the UK was ranked the fourth biggest automotive manufacturing location within the EU in 2015. If however the EU and the UK will not reach an agreement within the two years of official negotiations, the EU treaties expire, and trade would follow only the basic set of WTO rules. This could lead to a sharp decline of output to less than 1 million units of light vehicles produced in the UK by 2022 and re-allocations of OEMs' activities to other European production plants[38]. Suppliers also will have to reconsider their operating and sourcing models to maintain cost and time efficiency. On the other hand the UK could provide a currency policy that includes a weaker GBP which could result in a better export position for UK suppliers to car manufacturers based in the EU[39].

European Union's unity under pressure – globalisation has brought countries and economies closer together, at the same time it has increased gaps between social classes within countries. Since the financial crisis in 2008 several social groups have witnessed decreasing purchasing power due to moderate incomes and growing costs of living. Migration streams from outside the European Union as well as internal migration have led to unsatisfied voters looking for safety, stability in their local habitat, job security and social welfare. While populistic parties are making use of this situation, it is not unthinkable that Europe can turn once again towards a more fragmented territory. Diminished freedom of movement of goods and people could have a negative impact on economic growth, especially for the automotive industry in Europe that is based on international supply chains.

[37] Brexit and the Auto Industry: Facts and Figures, European Automobile Manufacturers Association, March 2018

[38] Brexit: Impacts on the UK Automotive Sector, Bulletin 2017, Brexit Expert Group Automotive: Reiner Kunz, PricewaterhouseCoopers AG

[39] Navigating Brexit in the Automotive Sector, Deloitte, July 2017

3.2 Motivators for change

The above-mentioned trends can potentially lead to situations with specific consequences for the automotive industry in Europe, especially for SMEs. Challenges could be motivators for those SMEs that are open for change, but could also be a sign for others to terminate their activities in the automotive sector and look for new opportunities in other sectors.

Table 1: Situations, potential consequences and motivators for change concerning SMEs as a result of identified trends affecting the automotive industry in Europe

Situation	Potential consequences	Motivators for change concerning SMEs
Decreasing demand for light vehicles in Europe	Reduction of the amount of OEM production plants in Europe, consolidation of activities in selected regions Reduction of the amount of suppliers, insourcing of production and pre-assembly activities by OEMs Improved demand and supply management at OEMs through the use of advanced ICT solutions in order to improve relations with customers and Tier 1 suppliers OEMs looking for features and functionalities to improve the driver's experience and create value for market niches (limited editions)	Monitor decisions of OEMs and Tier 1 suppliers in your region Diversify within the automotive sector by way of increasing the amount of clients Diversify through entering new sectors and markets Be ready for medium and small series production of components Be ready for larger orders; look for opportunities to cooperate or merge with other companies Propose solutions that create additional value (features and functionalities)
Pressure on margins at all levels of the value chain	OEMs focussing on standardised platforms and defined range of common components for different models Integration of components, material-reduction solutions, increased pressure on Tier 1 suppliers to provide R&D Focus on reusability of components, remanufacturing of components Reduction of the amount of suppliers, insourcing of production and pre-assembly activities by OEMs Improved supply management at OEMs through the use of advanced ICT solutions in order to improve insight in production processes and cost structures at Tier 1 suppliers Optimisation of production systems through full automation and application of advanced robots	Focus on continuous improvement Apply virtual planning methods to verify opportunities for cost reductions and improved flexibility of production infrastructures Implement ICT solutions for data collection and processing in order to identify hidden costs and provide prevention measures Verify possibilities for automation and integration of production processes by way of introducing new production technologies Take up a pro-active growth policy including focus on R&D in cooperation with your clients Be open for changes in materials and the way components will be designed and produced

Situation	Potential consequences	Motivators for change concerning SMEs
Increased added value by way of improving customers' experiences	OEMs focussing on standardised platforms and defined range of common components for different models – limiting costs of basic parts, increasing focus on special features Integration of standardised components; diminishing the amount of Tier 1 suppliers Increased cooperation with suppliers of specialised solutions in ICT, materials, limited edition component packages Shorter car model lifecycles Shorter time-to-market for new car models	Being a supplier of standardised components and systems – focus on cost optimisation and cost-efficient production systems Being a supplier of features and functionalities – focus on R&D, innovation project management and efficient communication with your clients Be prepared for an increased amount of small orders of higher added value (integrated components, functional components) Apply virtual planning methods to verify the technological and economic feasibility of new projects Optimise production systems with special focus on flexibility to cope with a larger amount of small orders Invest in employee competencies
Intelligent components and systems for electric and autonomous vehicles	Increased integration of sensors in traditional components Focus on lightweight materials to compensate additional weight of electronics Redefinition of the value chain, increased pressure on prices of basic plastic and metal components New material and production competencies concerning the production of multi-material smart components Increased quality and security requirements	Focus on cost optimisation and cost-efficient production systems including advanced robotics; invest in production technologies for multi-material smart components Be prepared for quality and security requirements at all levels of the organisation (clean production, safe data transfer, product traceability, quality control at all stages of the production process) Gain competencies in new joining and bonding technologies Gain competencies in new materials
OEMs strengthening their position in mobility ecosystems (bike, scooter, car, bus, air vehicle) in cooperation with new suppliers	Increased cooperation between OEMs and suppliers not directly related to the automotive industry before Suppliers required to participate in projects on autonomous driving and mobility platforms (technology risk shift) Decreased share of the car production value in the overall value system with increased share of smart features and mobility services	Be prepared for a diversification of the product focus, scope on strategic competencies that can be applied in several product areas Calculate the risk of participating in projects and prepare personnel for engagement in product development and demonstration projects Be prepared for new competitors and price pressure Invest in flexible production systems allowing to cope with the production of components for functional vehicles and limited series of vehicles for dedicated mobility projects

Situation	Potential consequences	Motivators for change concerning SMEs
Low-emission, zero-emission, eco-friendly lightweight vehicles	Increased pressure on suppliers to take into account environmental issues: energy management, circular economy, emissions, renewable and eco-friendly materials Increased importance of filter-technologies Increased focus on lightweight materials and their recycling process at the end of the vehicle life-cycle	Get acquainted with new materials Focus on continuous improvement of environmental management issues: energy, emissions, material recuperation, material saving Invest in production systems that use less energy, allow to minimize scrap and cause minimum emissions
Lack of skilled employees	Headhunting of high-qualified employees Increased rotation of employees Automation of standardised and risky operations Integration of operations in production systems resulting in a diminishing of the amount of operators	Apply virtual planning methods to verify which operations can be integrated and further automated Cooperate with machine suppliers on the integration of operations and development of new production technologies Provide automated processes and robots in order to engage employees in activities with higher added value for the company Increase the use of information management systems and smart data gathering and processing on machine level in order to set and optimise production processes without the human interference Develop HR policies to strengthen employees' loyalty towards the company and to improve employees' competencies

4 The role of the EACN in promoting industrial modernisation

The European Automotive Cluster Network (EACN) is an initiative of European automotive clusters which monitors changes in the European automotive industry. Founded in early 2017, EACN incorporates currently nine European automotive clusters from Bulgaria, France, Germany, The Netherlands, Poland, Serbia and Spain. Its objective is to enhance competitiveness of the cluster members by stimulating cross-regional joint research and investment projects in four domains: product innovation, new production methods, optimised processes and people's skills. EACN partner clusters represent 1,400 companies and institutions (most of them are SMEs) employing more than 300,000 people.

Within the European Automotive Cluster Network for Joint Industrial Modernisation Investment project the partners underline the importance of the ongoing industrial modernisation processes to improve SMEs competitiveness in a changing European automotive industry. Key enabling technologies in production processes in automotive play an important role in improving resource efficiency, process efficiency and boosting product innovations. But at the same time it is a challenge for SMEs, as they have to make strategic choices that impact on business models and competencies. SMEs are reluctant towards investment processes that go beyond the current business models scoping mainly on project-to-project investment decisions. The basic idea behind the initiative is that common developments and investments allow minimising risks and costs, sharing experiences and building confidence between partners to prepare future collaborations.

4.1 Definitions – A clear focus

The EACN project will build a strategic interregional collaboration and strong industry cooperation focused on four pillars:

1. Virtualisation for planning processes (simulation and modelling);
2. Robotics & Artificial Intelligence in production processes;
3. Elasticity of production processes in SMEs;
4. Skills and competences of people.

In order to maintain a clear scope during audits, discussions and project development, the EACN Partnership has decided upon the below presented definitions.

Virtualisation for planning processes (simulation and modelling) – allows creating a digital copy of a production facility by incorporating sensor data acquired from monitoring physical processes and equipment with virtual models and simulation models. The virtualisation enables plant managers, team-leaders and operators on the shop floor to better manage growing complexity, reduce equipment downtime and optimize processes. The imitation of real-world processes over time is achieved by adoption of tools such CAx, Factory Layout design, Material and Information flow design, Manufacturing Networks Design, Manufacturing Systems Planning and Control, Manufacturing Networks Planning and Control, Augmented and Virtual Reality in product and process design, planning and verification[40].

Robotics - Inclusion of robotics in production processes allows performing duties that are dangerous or unsuitable for human workers. Robots are defined as reconfigurable automation technologies characterised by being automatically controlled, reprogrammable, multipurpose manipulators programmable in three or more axes[41]. Attempts to reaching ever higher levels of automation the interaction between human and machines has brought up new forms of human-machine interaction with cobots: collaborative robots which are more flexible and capable of learning and interacting hand-in-hand with humans using human-machine interfaces.

When we talk about collaboration, we talk about the action of working with someone to produce something. In the case of robotics, what really defines this collaboration is the behaviour of the robot during this interaction. According to ISO 10218, Parts 1 and 2, the following types of collaborative characteristics are associated with robots:

- Monitored stop: the robot surrounded by a closed area works individually. However, occasionally human access is allowed to do a specific task during which the robot is inactive. When the operator has left the protected area the robot will continue its task. This was the most common application of industrial robots in the past.
- Handwriting: useful for "pick and place" systems, for example. The robot is equipped with a sensor to his wrist that detects the forces of the human hand guiding him to the required position during the training phase. The robot is inside a closed area and the collaboration is given only during training. It can be a standard industrial robot equipped with a sensor of detection of forces on the wrist and the appropriate software.
- Speed and distance monitoring: the robot has some zones programmed in a way which reduces or increases its speed depending on the presence of a human. The robot would get to

[40] Mourtzis, D., Doukas, M., Bernidaki D.: Simulation in Manufacturing: Review and Challenges. Procedia CIRP, 25 (2014) 213 – 229

[41] https://www.sciencedaily.com/terms/industrial_robot.htm [12.12.2018]

stop safely in front of an excessive proximity. It can be a standard industrial robot with an artificial vision system; applies to shared environments with humans.

- Limitation of power and strength: the robot is in more rounded forms, in order to facilitate the dissipation of energy in case of impact, and usually works at reduced speeds. The robot is able to detect external forces in its path and stop if they are excessive. This is not a standard robot, it requires strength limitation features, does not require security elements but a risk analysis.
- Detection of forces: we associate it by defect with a collaborative robot. External forces applied are detected by sensors in each of the axes of the robot. Marketed as safe, of rounded shapes, made of soft materials (such as skins), compact and lightweight. They are very interesting for their ease of programming and integration.

"*Cobot*" is a word of jargon, referring to collaborative robots. It is often used to identify robots with detection of forces features, even if there are robots without this feature that, through other features, collaborate with the human being at different levels. The robot with force detection is the one that most quickly associates with a collaborative robot. They are equipped with sensors for detecting forces on all axes and are usually equipped with other systems such as artificial vision cameras or software for several training applications which try to facilitate their programming and integration in the productive environment. This allows to program the robot to stop or even move in the opposite direction. Also, it allows to guide by hand with the advantage of being intrinsically safe. It is about making them compatible with human beings, so that they can interact by releasing, for example, repetitive tasks that do not add any value. It is often sought to be mobile, low-weight, some with wheels and with axle controller integrated, so that they can be placed in a new position and make them work immediately after a quick and simple training phase.

Artificial Intelligence (AI) – the significance of the AI in the manufacturing process lies in a broad range of its applications. AI enables machines to learn from experience, adjust to new inputs and perform human-like tasks and allows manufacturer to analyse the generated by factories, operations and consumers data and transform them into decisions[42]. Quality management, predictive maintenance and supply chain optimization are among the most promising immediate opportunities for applying AI in production systems[43]. 44% of Forbes Insights survey respondents coming from automotive and manufacturing sectors considered AI as "highly important" to the manufacturing function in the next five years, while almost half – 49% – said it was "absolutely critical to success"[44]. In respect to the automotive sector, McKinsey defined three levels of AI: (1) narrow AI, the current state-of-the-art with existing software that automates a traditionally human activity and often outperforms humans in efficiency and endurance in one specialized area; (2) general AI/human-level AI describes the capacity of machines to understand their environment and reason and act accordingly, just as a human would in all activities across all dimensions, including scientific creativity, general knowledge, and social skills; (3) Super AI is reached when AI becomes much smarter than the best human brains in practically every field. Super AI systems can make deductions about unknown environments[45].

Elasticity of production processes – concerns the configuration of systems in such a way that production of different products is possible without retooling, downtime is minimised, production of

[42] https://www.sas.com/en_nz/insights/analytics/what-is-artificial-intelligence.html [12.12.2018]
[43] Technology and Innovation for the Future of Production: Accelerating Value Creation, World Economic Forum, March 2017
[44] https://www.forbes.com/sites/insights-intelai/2018/07/17/how-ai-builds-a-better-manufacturing-process/#fa3f53a1e842 [12.12.2018]
[45] Artificial Intelligence – Automotive's New Value-Creating Engine, McKinsey Center for Future Mobility, McKinsey&Company, January 2018

highly customised and unique products is provided efficiently and production capacity can be shifted between products in line with demand[46]. Flexible production systems are composed of self-organising workstations that allow producing small lots of individualised products. Flexibility can also be achieved by organisational solutions resulting in flexibility of operating time available, flexibility of competencies and operators skills (multi-skilled operators), as well as general flexibility of resources benefiting from sharing resources[47]. A precondition for flexible production systems is the connection between all machines and the company's management system (manufacturing execution system, enterprise resource planning system, supervisory control and data acquisition system), so that information gathered from sensors can be transferred, interpreted and processed (using AI) into decisions for continuous improvements.

The EACN Partnership sees opportunities in interregional learning and cooperation as a means to support the change processes related to industrial modernisation, enhancing the potential for competitive production processes and improving companies' position in the global automotive value network. Among others by way of thematic workshops, brokerage events, good practice exchange and project development support, SMEs will get the opportunity to get acquainted with available solutions in the above-mentioned fields, to identify and formulate their needs and projects and to get into contact with other companies with similar problems and needs to start cooperation in developing or purchasing solutions by sharing costs and risks.

4.2 Importance of industrial modernisation for SMEs in automotive

Why the four topics concerning industrial modernisation are so important for SMEs in the automotive industry, taking into account the identified drivers and motivators for industrial modernisation?

The EACN Partnership acknowledges that industrial modernisation is not a goal on itself but a change process including investments and competencies development planned and executed with the aim to safeguard or increase revenues, decrease costs, get better insight in customers' needs and requirements and react more flexible to changes in the automotive value chain. Almost all member states have initiated some kind of promotional campaign or support policy referring to "Industry 4.0", "Factories of the Future", "Reindustrialisation", "Industrial Digitalisation", "Industrial modernisation". More than 70 audit methodologies have been developed globally to analyse and define the companies' readiness level or the companies' level of advancement in deploying new production technologies and ICT technologies. Among them the "Industrie 4.0 readiness" methodology of the VDMA's IMPULS-Stiftung and the Singapore Smart Industry Readiness Index prepared by the Singapore Economic Development Board in partnership with TÜV SÜD. These and other methodologies have been taken into account while preparing the methodological approach for the identification of thematic issues for industrial modernisation in SMEs in the automotive industry, the initiation of thematic workshops and for the project development process within the EACN for Joint Industrial Modernisation Investments project. While the focus will be on SMEs, also regional governments and their agencies will be involved in discussions and good practice exchange concerning support measures that could ease the transformation processes in SMEs. Nevertheless one should bear in mind that SMEs have limited resources (capital, people, information), limited client base and limited space for change (organisational structures, key competencies, infrastructure). As such one should clearly define the relationship between the scope of industrial modernisation solutions and the expected added value for SMEs on the process, the technology and the organisational level, as presented below.

[46] https://www.uky.edu/~dsianita/611/fms.html [13.12.2018]

[47] Flexible Manufacturing Systems: Industry 4.0 Solution, I.P. Gania, A. Stachowiak, J. Oleśków-Szłapka, Poznan University of Technology, 24th International Conference on Production Research (ICPR 2017), March 2018

Table 2: Industrial modernisation pillars, dimensions and technologies and their added value for SMEs

Building block	Pillar	Dimension	Technologies	Added value for SMEs
Organisation	**Talent** – skilled self-learning workforce open for change, talent development programmes focusing on multi-skilling, leadership able to guide workforce through change	Workforce learning and development – training programs focused on competencies in data analytics, data interpretation, system integration, software development, increased human-machine integration Leadership competency – management's awareness of available technologies, management's ability to plan and execute change processes	Virtual Reality in training applications Human-machine communication tools Human-machine ergonomics analysis	Improved focus on strategic competencies Improved ability to change Improved human-machine cooperation Continuous learning culture Continuous improvement culture
	Structure and Management – flexible, collaborative management, flat organisational structures with decentralised decision-making processes, open information sharing, increased team collaboration among organisations	Inter- and intra-company collaboration – formal channels that enable employees to share information and work together, organisation culture and systems that enhance and support cooperation Strategy and governance – clear vision and goals, roadmap for action	Visualisation of main indicators Human-machine communication tools	Improved decision-making through decentralised processes Efficient and effective change process planned, implemented, monitored
Process	**Operations** – planning and monitoring of processes to convert resources into products and services at the lowest cost	Vertical integration – integration of processes and systems across all levels in the organisation to establish a connected, end-to-end data thread that permits seamless data exchange, analysis, and decision-making	Data analytics Wireless communication for monitoring and control Sensor networks Virtualisation (digital twins)	Improved communication between all levels of the company Increased flexibility and operational efficiency Improved decentralised decision-taking processes Quick and accurate response to changes Cost reduction through prevention measures

Building block	Pillar	Dimension	Technologies	Added value for SMEs
Building block	Pillar	Dimension	Technologies	Added value for SMEs
	Supply chain – interconnected networks to manage flows of goods and information, real-time process optimisation, increased transparency, customization	Horizontal integration – information exchange across the value chain through interoperable and transparent networks, within which all stakeholders are able to coordinate and optimise their processes, tasks and decisions		Shorter time-to-market Quick feedback from customers Increased cooperation in development projects Better resource management
	Product Lifecycle – digital twins for improved design and engineering processes, improved decision making at each stage of the product lifecycle	Integrated product lifecycle – integration of people, processes and systems along the product life cycle within digital tools and systems		Improved prototyping Improved production Improved product use monitoring and feedback
Technology	**Automation** – flexible production systems, integration of multiple systems, large range of products produced in smaller batches, customization	Shop floor (production), Enterprise (administration), Facility (building infrastructure) – automation systems across all three layers converge and interact dynamically with one another as a single integrated whole	Cloud computing Data analytics Machine learning Artificial intelligence Internet of Things Big data Cyber-physical systems Cybersecurity 3D production	Improved predictability Quick response to changing needs Increased flexibility Improved optimisation of processes, assets and resources Prevention measures in maintenance, prolonging machine life-cycle
	Connectivity – wireless data transfer within interconnected systems, interoperability of systems, open inclusive communication networks	Shop floor (production), Enterprise (administration), Facility (building infrastructure) – interconnected systems to communicate with one another seamlessly		

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	Intelligence – collection, integration, processing and analysis of data, autonomous decision making by machines	Shop floor (production), Enterprise (administration), Facility (building infrastructure) – ability of IT and OT systems to identify and diagnose deviations, identify causes, predict potential future failures and to autonomously learn and adapt		Independence from human interactions in standardised production processes

Source: based on the "Industrie 4.0 readiness" methodology of the VDMA's IMPULS-Stiftung and the Singapore Smart Industry Readiness Index prepared by the Singapore Economic Development Board in partnership with TÜV SÜD.

4.3 Conditions, challenges and success factors for action

What are the conditions, challenges and success factors for actions related to the four topics concerning industrial modernisation for SMEs in automotive?

A survey among 20 SMEs in 6 clusters provided in January 2019 showed that SMEs in automotive expect different impacts of identified trends on the automotive industry. Especially issues related to industrial modernisation and digitalisation of vehicles and factories are expected to have a positive impact on the industry.

Table 3: Expected impact of trends on the automotive industry in Europe according to 20 SMEs in automotive

Trends	Negative impact	No impact	Positive impact
Decreasing demand for vehicles in Europe	6	11	3
Problems with availability of skilled employees	8	6	6
Increased role of IT in vehicles and factories	0	9	11
Intelligent components and systems for electric and autonomous vehicles	1	5	14
Increased international competition and disintegration	15	3	2
Increased added value of vehicles by way of improving customers' experiences with digital solutions, at the same time diminishing profit margins for suppliers of traditional components	2	8	10
Increased pressure on the way companies produce vehicles and care about the environment	8	7	5

Source: a survey among 20 SMEs in automotive, cluster members of the EACN Partners, provided in January 2019.

SMEs in the automotive industry have been undergoing similar changes as large companies have in respect to quality, safety and cost optimisation. For the period 2019-2021 SMEs that took part in the survey foresee the following strategic priorities (listed in order of importance):

- Introduction of improved or new relations with customers
- Introduction of improved or new products
- Focussed market expansion
- Introduction of improved or new production processes
- Improving profitability through introduction of products with higher value added
- Improving profitability through investment in monitoring and data management systems
- Improving profitability through traditional continuous improvement programs
- Introduction of improved or new logistic processes
- Providing organisational restructuring in view of expected growth
- Introduction of improved or new relations with suppliers

Although studies and reports show the benefits of the application of new technologies in production and management systems, in practice there are several issues that hinder SMEs from investing in these kinds of solutions. Among others:

- A lack of standards concerning interface technologies that enable full integration of machines and processes in a single integrated network for data collection, data analysis and performance improvement. SMEs rather follow the system and quality requirements of their clients than defining own standards. SMEs often do not have their own IT department, which means that the managers themselves have to assess the various technologies with regard to their technological maturity and business potential[48]. Because of the lack of turn-key solutions, most projects have to be tailored to the specific conditions in the company, which leads to higher costs that often exceeds SMEs' budgets and to potentially less lasting solutions.
- A lack of competencies to analyse data and a lack of readiness to decentralise decision making processes. SMEs often apply centralised decision making processes (on the level of the board

[48] The Challenges of Industry 4.0 for Small and Medium-sized Enterprises, Christian Schröder, Friedrich-Ebert-Stiftung, 2017

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or the company owners) based on historical data and practical experiences. However, IoT solutions allow gathering and processing big data, and preparing recommendations for action even on the level of the operator on the shop floor. It would mean that the management has to trust employees in taking decisions based on information flows directed to them. Lack of transparency, failure to update production data and the insufficient quality of the data, unsatisfactory early identification and previews, slow reaction time in the case of deviations and changes requested by the customer – these are the shortcomings identified by a majority of SME[49]. Inadequate security measures to secure safe data transfer and knowledge management are often standing in the way of an overall information sharing culture in SMEs. Besides the issue of trust, there is also a problem of available competencies in diagnostics and data-analysis among employees to interpret data, diagrams presented on dashboards on computer or tablets.

- A fear for "overinvesting" in infrastructure and systems that cannot be "laid-off" in times of economic stagnation or recession as it is the case with employees. On the other hand also a fear for reactions from workers in family companies with high social and emotional bonds, when the idea of industrial modernisation is linked in a negative way with the lay-off of employees that will no longer be necessary thanks to process optimisation.

Industrial modernisations is not an option, it is a must in order to stay competitive in the automotive industry. The integration of new solutions to develop cyber-physical production systems allowing real-time information exchange (M2H and M2M) and networked vertically and horizontally demands for a clear strategic focus, for awareness of conditions in the ecosystem one is active in and for substantial investments to prepare and implement new solutions. In relation to this, the group of 20 SMEs identified the following indicators applied in strategic processes and continuous improvement processes in their companies (10 most applied indicators listed in order of importance):

- Overall productivity increase.
- Increase in revenue.
- Overall reduction of costs per unit produced.
- Reduction of time-to-market for new products.
- Overall reduction of downtime costs.
- Reduction of costs of quality.
- Overall reduction of maintenance costs.
- Increase of amount of products produced in a certain time frame for a specific part of the production process.
- Return on investment concerning projects dealing with organisational changes and improved management.
- Return on investment concerning projects dealing with production process improvements.

In terms of expected impacts of industrial modernisation investments, these indicators were strictly related by the companies to the four topics covered in the EACN initiative.

[49] Industry 4.0 Needs SMEs, Prof Dr Werner Olle, Dietke Clauß, the Chemnitz Automotive Institute (CATI) and CARNET GmbH, Chemnitz, February 2015

Table 4: Expected impact of industrial modernisation initiatives in four topics on SMEs

	Expected impact (5 most expected in order of importance)
Virtualisation for planning processes (simulation and modelling)	1. Reduction of time-to-market for new products 2. Increase in revenue 3. Overall reduction of costs per unit produced 4. Overall reduction of downtime costs 5. Overall productivity increase
Robotics & Artificial Intelligence in production processes	1. Increase in revenue 2. Overall productivity increase 3. Specific productivity increase concerning automated production operations previously done manually 4. Reduction of costs of quality 5. Overall reduction of costs per unit produced / Overall reduction of downtime costs
Elasticity (flexibility) of production processes	1. Increase in revenue 2. Overall productivity increase 3. Reduction of stockholding costs 4. Overall reduction of downtime costs 5. Increase of amount of products produced in a shorter time frame for a specific part of the production process / Overall reduction of maintenance costs
Employees' competencies in the area of data-analytics and Human-Machine cooperation	1. Overall reduction of maintenance costs 2. Increase in revenue 3. Overall reduction of costs per unit produced 4. Overall reduction of downtime costs 5. Reduction of costs of quality

Source: a survey among 20 SMEs in automotive, cluster members of the EACN Partners, provided in January 2019.

Research done among companies in Germany[50] and Italy[51] show that SMEs expect the following advantages from industrial modernisation:

- To analyse the functioning of production lines, to identify areas for improvement and to provide exponential improvement in performance of the whole system.
- To simulate extreme situations and prepare better risk management plans.
- To make decisions and make more accurate forecasts.
- To identify and quantify the resources necessary for increasing the system's efficiency.
- To check and supervise the use of resources in the individual phases of the production process.
- To integrate and share information on all levels of the company.
- To optimize overall business performance.

SMEs expect that solutions applied in industrial modernisation projects are integrated in existing systems and processes without the necessity to provide severe changes in software, systems and hardware. Applications should take into account a modular approach, so SMEs can follow a step-by-step investment process, providing change over a longer period of time. Applications should also allow

[50] The Challenges of Industry 4.0 for Small and Medium-sized Enterprises, Christian Schröder, Friedrich-Ebert-Stiftung, 2017

[51] Michele Dassisti, Hervé Panetto, Mario Lezoche, Pasquale Merla, Concetta Semeraro, et al. Industry 4.0 paradigm: The viewpoint of the small and medium enterprises. 7th International Conference on Information Society and Technology, ICIST 2017, Mar 2017, Kopaonik, Serbia. 1, pp.50-54, 2017, ICIST 2017 Proceedings. <http://yuinfo.org/icist2017>. <hal-01526397>

employees using them without the necessity to provide severe modifications (rather plug-and-play) or to acquire specialised skills.

The 20 surveyed SMEs in the EACN initiative indicated that they see EACN as an opportunity to develop common solutions with other SMEs in automotive in the following areas (in order of importance):

- The development of a portfolio of industrial modernisation projects
- Industry 4.0 competencies among the employees - A competencies development policy to improve data-analytics and human-machine cooperation
- The development of a strategy for industrial modernisation
- Robotics & Artificial Intelligence in production processes (real-time data gathering and processing from machines, machines communicating with employees)
- Elasticity (flexibility) of production processes (production lines transformed into flexible production units integrated in a company management system with real-time data transfer)
- An organisational culture promoting continuous improvement and decentralised decision making processes
- Virtualisation for planning processes (simulation and modelling, a digital twin to simulate changes in production configurations and to analyse feasibility of new production projects)

4.4 Main actors supporting industrial modernisation

The six clusters involved in the EACN initiative engage not only companies from the automotive industry, but also technology suppliers, technology centres, universities and training organisations that deliver technologies and services for industrial modernisation. They will be invited to participate in the thematic workshops and matchmaking events as well as in the project preparation processes and as such will be able to present best practices, demonstrate specific solutions and discuss tailor-made proposals for identified problems and challenges.

Among the EACN Partners, CIAC has several years of experience in project idea generation and project development by way of organising workshops and applying the online cluster project management platform for daily cooperation between the cluster members. In the field of industrial modernisation issues like additive manufacturing, blockchain and exoskeletons have been discussed in workshops, tested in dedicated projects and their results have been disseminated during best practices exchange meetings in the respective companies. CIAC promotes cooperation between SMEs, universities and technology suppliers to define and elaborate solutions that fit the potential of the SMEs (especially in terms of financial and organisational feasibility). Almost 30% of the partners of CIAC are technology providers and technology integrators that are interested in cooperating on European level within the EACN initiative.

In the framework CEAGA the initiative “AUTOMOTIVE PILOT 4.0” engages 29 SMEs being part of the Galician automotive value chain. The main objective is to promote the transition of Galician automotive companies to the "Factory of the Future" through the investment in Industry 4.0 technologies and the dissemination of experiences and results among other companies in the sector. These companies will be invited to the workshops in the EACN initiative. Also worthwhile to mention is the CEAGA Corporate University (UCC), founded in 2010, with the aim to transform the automotive industry into a model offering higher added value, so as to be able to compete in an increasingly globalised market. Among others the training program for Lean 4.0 Team Leaders provides company employees in the world of Industry 4.0 and their changing role in the production process. Among the

CEAGA members one can find the following technology suppliers and integrators: ABB, Bosch Rexroth, Cromados Estévez, Decuna, Emenasa Industria y Automatismo, Europrecis Galicia, Herlayca, Hypnon Programming, Industrias Delta Vigo, Ingeniería Gallega de Sistemas Automatizados, Isega Technology, Itera Técnica, Ledisson Automation & IT, Lightbee Mobility, Probotec Procesos Industriales, Roboting Automation and Programming, SH Robotic, Tecdisma, Unimate Robótica, Utingal, and Vigotec.

PVF offers a support service for its members to guide them through the Industry 4.0 change process by way of audits, expert support and workshops. 4iTec is an innovative platform which proposes to pool development costs on common or generic themes, by maximizing financial support through a public / private system. The leverage effect allows to multiply by 10 each euro invested. The benefit for the company is to be able to accelerate its transformation project in order to offer more competitive products on the market and faster. Additionally PVF closely cooperates with its technology suppliers, universities and technology centres promoting innovations in this field. Holo 3 is a technology transfer centre specialising in optical techniques. The centre provides services, produces equipment for online control, and assists companies in the introduction of innovative optical technologies. BEAM, a manufacturer of industrial machinery for additive manufacturing, could be involved in the topic of elasticity of production processes and contribute with its experiences. SEW-Usocome has developed software for automation and control processes and could be a valid partner in the discussion on modelling solutions for SMEs. The company CPC Analytics works on solving and anticipating problems of variability and instability which are an obstacle to improving operational performance. CPC Analytics has strong competencies related to data analytics and artificial intelligence. In the field of virtual and augmented reality Overview Immersive Technology has an expertise in terms of projection, immersion and ocular perception and develops customized ultra-high-quality display solutions. This company could contribute to the EACN initiative in the topic of virtualisation and simulation. An important issue that probably will be raised during the workshops is the quality of working conditions, including ergonomic aspects, of the operators on the shop floor. Ergo Briante supports companies in assessing ergonomic working conditions through applying virtual reality solutions and delivers consultancy and training. PVF cooperates also with other technology suppliers being multinationals that are active in several countries, among others KUKA (robotics) and ACTEMIUM (industrial processes). In the educational sector the University of Strasbourg, the Ecole Nationale Supérieure de Mécanique et des Microtechniques (the National School of Mechanics and Microtechnology), the University of Technology of Belfort-Montbéliard (UTBM), Télécom Physique Strasbourg, ECAM Strasbourg and INSA Strasbourg (National Institute of Applied Sciences) could be invited to share their experiences in competencies development for Industry 4.0 among students and employees.

In the ecosystem of ACB in Bulgaria one can find FESTO, a global leader in automation, who provides a training centre to support interdisciplinary competencies' development among employees, and is also active in ACS in Serbia and SAAM in Poland. SMC INDUSTRIAL AUTOMATION BULGARIA creates specific industry-centric 4.0 solutions. Bulgaria is an important centre of software companies dealing with Internet of Things in Central Europe among which Bosh Engineering Center and Bosh Software Innovations. However, most of the SMEs in the cluster have not yet initiated industrial modernisation projects. As such ACB will benefit from the experiences of the other clusters and support links between its members and technology suppliers from the other clusters in the EACN initiative. Also ACS will encourage its SMEs to consider industrial modernisation change processes. Industry 4.0 topics are being discussed with the following ACS members: cadcam-group, the Faculty of Technical Sciences Novi Sad, the Faculty of Mechanical Engineering of the University of Belgrade, FESTO, INVENIO ENGINEERING SOLUTIONS, INMOLD, Mitsubishi Electric Europe, TPV Šumadija and TRIGO SERBIA.

EACN for Joint Industrial Modernisation Investments
Grant agreement 821989 – © 2019 EACN Project Consortium
Co-funded by the COSME programme of the European Union

SAAM cooperates closely with the Silesian University of Technology in the Silesian Competence Centre of Industry 4.0 (SCCI 4.0)/ Digital Innovation Hub that provides support at various stages of the digital transformation process to industrial SMEs and large enterprises. The SCCI 4.0 scope of activities include: awareness creation, ecosystem building, testing and validation, digital maturity assessment, project facilitation. SCCI 4.0 is currently preparing a training program for Industry 4.0 Leaders in companies. One of the cluster members is EMT-SYSTEMS, a private specialised training centre in broadly defined Industry 4.0 engineering technologies delivering dedicated training modules to more than 6 000 people per year. The cluster encompasses several technology suppliers and integrators, among them: AIUT, AMISTER, Cyberus Labs, Data Interchange, EVATRONIX, Exergon, FESTO, Future Processing, ifm electronic, Object3, OMRON Electronics, pf electronic and RMA. They are active in the field of automation, robotics, artificial intelligence, data transfer, data security and management of flexible production systems.

5 The next step

This report has been presented during the internal workshop of the EACN Partners in Poland on 12 February 2019, on the basis of which the Partners have defined the framework of the EACN Strategy that will pave the way for the actions promoting and supporting industrial modernisation processes in SMEs in the automotive industry. Issues covered in this report will be referred to during audits, thematic workshops and matchmaking events. The report will be made available to the cluster members, in the first place to those who took part in the survey, and will be presented on the EACN website.

6 Contact

For more information about the European Automotive Cluster Network for Joint Industrial Modernisation Investments initiative, please check the website: www.eacn-initiative.eu or contact us: info@eacn-initiative.eu.

You may also contact one of the cluster organisations which participate in the EACN project activities:

Pôle Véhicule du Futur
www.vehiculedufutur.com

Katowice Special Economic Zone SA, Silesia Automotive & Advanced Manufacturing
http://silesia-automotive.pl/

Galician Automotive Cluster Foundation
www.ceaga.com

Automotive Industry Cluster of Catalonia
www.ciac.cat

Automotive Cluster Bulgaria
www.automotive.bg

Automotive Cluster Serbia
www.acserbia.org.rs