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**Long-term forecast paper for The Society of Motor Manufacturers and Traders
(SMMT)**

The future of UK automotive manufacturing in 2025 and beyond



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Executive summary

The UK's automotive industry is poised for continued growth in both vehicle production and local sourcing of components. This paper forecasts that by 2020, the UK will be producing two million vehicles a year, compared to its current annual total of around 1.5 million. By 2020, UK sourcing is expected to increase from current levels of 41% to upwards of 50%. More than 5,000 jobs at vehicle and engine producers could be created, along with up to 28,000 in the supply chain, by the early 2020s. However, these projected figures are based on the assumption that the UK remains in the EU.

The automotive industry continues to invest in the UK, confirming the country's attractiveness in terms of taxation, regulation, labour flexibility and the overall business environment. Government support for new technologies, including electric and hybrid vehicles, as well as autonomous and connected technology, is a major boost to the industry.

Government support must be continued to maintain this attractive environment, and to enable the UK to build on its existing strengths. The potential economic benefit of autonomous and connected vehicle technology alone has been estimated at £50 billion annually; therefore, ensuring the UK has the right regulatory and infrastructural environment, and an appropriately trained workforce to exploit this opportunity is essential.

While significant job creation opportunities exist over the next five to 10 years, in the longer term, there is a clear danger that changes in global manufacturing systems, which the UK will not be able to avoid, will place many existing and imminent new jobs at long-term risk. Automotive factories of the future will be more highly automated and consequently employ fewer people. As a result, industry and government need to future-proof workforce training and skills development, and the apprenticeship system needs to prepare people for very different manufacturing environments than are in operation today.

Introduction

The UK automotive industry is in the midst of a period of strong growth, with potential for further expansion. Car production is rising and some UK plants are already or likely to be soon operating at full capacity. With several new models due to go into production in the UK over the next few years, the industry is on course to produce two million or more vehicles a year by 2020.¹ In parallel, the supply chain is benefiting from an increased commitment to sourcing UK-made components.

Recent research by the Department for Business, Innovation and Skills (BIS) suggests that vehicle manufacturers want to source an additional £4 billion with Tier-1 suppliers in the UK, with a further £2 billion of sourcing available to UK Tier-2 companies.² UK-made vehicles now have an average local content of over 40%.³ This ratio should increase as new vehicles are launched and the re-shoring of component production continues. By comparison, German-made vehicles have an average of 60% local content and this ratio should be a long-term target for the UK vehicle manufacturing sector in order to complete the rebuilding of the country's supply chain.

Most of the potential growth in automotive manufacturing employment is likely to come from suppliers rather than the vehicle companies. While there will likely be expansions at existing vehicle factories, it is unlikely that an all-new vehicle plant will be opened in the UK in the foreseeable future. The components sector will be the source of most employment growth in the near term. This report highlights how, on the back of rising production volumes and increased local sourcing, employment in the UK supply chain in the early 2020s could reach 121,000 – a potential increase of 28,000 from the current level of 93,000.

The pace of technological change in the automotive industry is accelerating. Within the next 15 to 20 years, we can expect to see a radically different mix of vehicle technologies in widespread use. Alternative powertrains, fully connected and partly automated cars are likely to form the majority of new vehicles on the road in the late 2020s; the fully self-driving car, with no driver interaction, may take a little longer to become commonplace.

The potential value to the UK economy of such new technologies is vast, and government policy needs to focus on ensuring the UK economy benefits accordingly. A recent study has suggested that the UK connected car market would be worth up to £51 billion annually by 2030.⁴

¹ This comes from the SMMT's Production Outlook report published quarterly, prepared by AutoAnalysis; the most recent edition is available to members at: www.smmt.co.uk/smmt-membership/member-services/market-intelligence/european-car-and-light-commercial-vehicle-production-outlook-suite/

² <http://www.automotivecouncil.co.uk/wp-content/uploads/2015/03/Growing-the-UK-auto-supply-chain-March-2015.pdf>

³ <http://www.automotivecouncil.co.uk/wp-content/uploads/2015/09/UK-local-sourcing-content-research-September-20151.pdf>

⁴ <http://www.smmt.co.uk/wp-content/uploads/sites/2/CRT036586F-Connected-and-Autonomous-Vehicles-%E2%80%93-The-UK-Economic-Opportu...1.pdf>

The automotive industry and government are engaged in a number of programmes to support the growth of the sector in general and the UK's supply chain in particular. At the centre of this is the Automotive Council and the work streams that operate under its umbrella. In parallel, government and industry have funded the start-up of a number of important initiatives, such as the Advanced Propulsion Centre (APC) and other technology catapults: bodies which are intended to help the UK develop and sustain a leadership position in key future technologies. Integral to the rebuilding of the supply chain and boosting UK component exports is the Automotive Investment Organisation (AIO), part of BIS, established in 2013. This has already secured 14,000 jobs in the UK during its second year of operation, against an initial three-year target of 15,000.

Looking to the next decade and beyond, and assuming, crucially, that there is no worldwide economic crisis **and** that the UK remains within the EU, the prospects for the UK automotive sector remain positive. However, for the industry's recent momentum to be maintained, serious consideration needs to be given to how the industry might evolve beyond the middle of the next decade. With this in mind, this paper addresses some of the key issues which the industry and policy makers need to consider. Specifically, it focuses on the potential scale of the industry in 2025 and beyond, looking at:

- Projected vehicle manufacturing volumes
- How the type of vehicles made might change
- Technologies employed in future vehicles
- Projected employment in the sector and how jobs might change
- The UK's position in the industry compared to Europe and the rest of the world.

Production trends

The UK is on track to produce two million vehicles a year by 2020, possibly sooner, depending on the success of the new models due to be launched during this period and the allocation of global export markets by some vehicle companies. The details of which models would make up this total are set out in SMMT's quarterly Production Outlook.⁵ The key figures for UK car and light commercial vehicle production shown in the table below and the other tables in this section are taken from the June 2015 edition of this report.

Total UK car and light commercial vehicle production, 2010-2030 (m)

2010	2015	2020	2025	2030
1.37	1.75	2.09	2.13	2.08

UK light vehicle production has grown strongly on the back of major investment by all the vehicle companies in the country, and the global success of a number of key models. Jaguar Land Rover and Nissan underpin this growth, but investment and

⁵ www.smmmt.co.uk/smmmt-membership/member-services/market-intelligence/european-car-and-light-commercial-vehicle-production-outlook-suite/

new models from MINI, Vauxhall, Toyota and Honda are boosting total UK production. In the likely absence of a further all-new vehicle plant, there is a limit as to how far total light vehicle production can reach in existing facilities, but there is still unused or under-utilised capacity at several UK vehicle plants. Provided the UK can retain its competitive edge as a manufacturing location, and subject to key export markets remaining stable, producing over two million vehicles by 2020 is an achievable and realistic target.

In comparison, Germany produces approximately three times as many cars and light commercial vehicles (LCVs) as the UK. It will remain the largest vehicle-producing country in Europe for the foreseeable future. On the basis of known investment plans and model programmes, Spain will be the second-highest European producer of cars and LCVs. France and the UK will vie for third place in terms of total light vehicle production. In addition to being the third-ranked car producer in Europe, the UK is the second-highest producer of premium cars in Europe, behind Germany.

European light vehicle production in major producing countries (m), 2010-2030

Country	2010	2015	2020	2025	2030
Germany	5.7	5.84	6.08	6.2	6.13
Spain	2.37	2.62	2.60	2.63	2.59
UK	1.37	1.71	2.09	2.13	2.08
France	2.19	1.74	2.11	2.08	2.04
Total major four countries	11.63	11.91	12.88	13.04	12.84
Four countries as % of total European production	69%	59%	57%	55%	54%

Together, the four largest vehicle-producing countries – Germany, Spain, the UK, and France – are expected to produce over 12 million vehicles per year in the next decade. This is equivalent to between 55% and 60% of future total Europe production. However, this percentage will actually decline as a proportion of total European volumes, because production will grow faster in the Czech Republic, Slovakia, Poland, Hungary and Turkey. While the UK and France produce similar volumes of light vehicles in total, the UK produces more cars than France (conversely, France produces many more, lower value light commercial vehicles than the UK); this trend is expected to continue, as shown in the next table.

Car production, UK and France (m)

Country	2010	2015	2020	2025	2030
UK	1.27	1.65	2.03	2.07	2.01
France	1.86	1.36	1.71	1.68	1.60

UK vehicle production is also heavily export-focused, with over 78% of production exported in 2014, a significant proportion of which went to Europe. The country's focus on premium vehicles and crossovers means that this is likely to continue for the foreseeable future, the strength of the domestic market notwithstanding: UK consumers have a strong predilection for international brands, in the same way that key global markets want UK brands and UK-built vehicles. The continued health of key export markets will clearly determine the future of UK production.

On a global scale, Europe's importance has declined as production in China and other emerging markets has grown dramatically in recent years. Production in North America fell, as it did in Europe, in the recession in 2008-09, but light vehicle manufacturing in North America is growing once again: it should reach 17.5 million this year, compared to less than 12 million in 2010.

Across the US and in Mexico, both volume and premium vehicle brands are building new factories. Production in Mexico is seen as especially attractive, not just because of the lower manufacturing costs but also because of the many free trade agreements Mexico has around the world. Production in Japan has fallen in the recent past, partly because of the transfer of production overseas, to Europe, to North America and elsewhere, as Japanese vehicle companies followed a strategy of localising production in the markets where demand is highest. In North America and Europe, Honda, Nissan and Toyota predominantly sell vehicles within the same region as their production.

Light vehicle production by major vehicle producing region/country, 2010-2030 (m)

Country/region	2010	2015	2020	2025	2030
Europe	18.23	20.3	22.6	23.5	23.95
NAFTA	11.85	17.5	19.3	19.5	19.6
Japan	9.25	9.14	8.57	8.3	8.1
China	16.75	23.83	32.64	35.35	36.42
Brazil	3.16	2.53	3.13	4.4	4.7
India	3.24	3.75	6.7	10.3	14.4
Korea	4.21	4.49	4.34	4.4	4.5
Rest of the world	7.49	7.7	11.1	13.25	15.33
Global total	74.28	89.24	108.4	119.0	127.0

Source: AutoAnalysis and just-auto.com

Note: Europe means greater Europe, up to the Russian border, and includes Turkey; NAFTA means USA, Canada and Mexico

In general, vehicle manufacturers produce where they sell, but as companies increasingly look at their factory utilisation on a global level, there are some notable scale-driven exceptions to this rule. Recent years have seen increased SUV production for global markets by German premium brands in North America. From a UK perspective, the Honda Civic is already marketed in several markets outside

Europe, but the next five-door Civic will be supplied worldwide **only** from Swindon. The Toyota Avensis estate, made in the UK at Burnaston, is supplied to Japan and is the only non-Japanese-manufactured Toyota model sold in Japan. Other examples of international supply include South African factories producing for European and Asian markets, Moroccan production for Europe, and Volvo China exporting to the US.

Vehicles supplied from ‘unexpected’ locations – selected examples

Vehicle company	Models	Production Location	Markets supplied
Honda	Civic	Swindon, UK	Worldwide
Jeep	Renegade	Italy	US
Mercedes	C-class	South Africa	Europe
Nissan	Rogue	Korea	US
Toyota	Yaris	France	US
Volkswagen	Polo	South Africa	UK

Vehicle factories and their attendant supply chains represent some of the highest value investments that countries can win from international companies: this in turn leads to a highly competitive bidding environment, with different locations seeking to attract vehicle companies with a wide range of financial incentives. Countries across Eastern Europe and US states all competed aggressively for these factories, including those in the following table:

Recent new factory announcements – selected examples

Vehicle company	Location	Plans
Jaguar Land Rover	Slovakia (proposed)	Up to 300,000 vehicles per year
Mercedes/Nissan	Aguascalientes, Mexico	Various vehicles based on Mercedes A-class, to be sold under Mercedes and Infiniti brands
Volvo	Charleston, South Carolina, USA	S60 and others to be confirmed

A new vehicle plant, or expansion at an existing facility, especially when accompanied by increased local sourcing of components, will have significant benefit for the wider economy. Estimates vary widely as to how many additional jobs beyond those in the vehicle plant concerned are created, but it is generally accepted that at least three, and potentially five or more, jobs can be created in the wider economy for every job created in a vehicle plant.

How many jobs each vehicle plant generates depends on the degree of its local sourcing. As local UK sourcing increases, more jobs will be created in the UK supply chain. In terms of the economic impact of local sourcing, evidence of expenditure in the UK supply chain on individual model programmes is compelling. For example, the Jaguar F-TYPE, a relatively low volume vehicle, generated £2.8 billion in lifetime

supplier contracts when it was launched, of which more than half, or £1.5 billion, were awarded to UK suppliers. The recent Land Rover Discovery Sport, Jaguar XE and F-PACE models, which will be produced at much higher volumes than the F-TYPE, have UK sourcing ratios of around 55%. Discovery Sport and XE will each generate around £3.5 billion of UK sourcing throughout their lives.⁶ Production of the new Astra at Ellesmere Port has led to expansion by a range of suppliers in the UK, including AGC/Pilkington, Borgers, Covpress, Gestamp, JCI, IAC, Magna, NIFCO, Tenneco and TI; these companies account for a major part of the £1.4 billion which will be spent with UK suppliers during the Astra's life.⁷

It is unlikely that another new high-volume vehicle plant will be built in the UK within the next decade, especially while uncertainty remains over the UK's position regarding long-term EU membership. However, vehicle companies have continued to invest in UK, partly because they are already committed to ongoing programmes. Whether further long-term investment decisions will be made in the UK's favour ahead of clarity on the EU issue is open to question.

In the last year, the UK has won investment from Japanese vehicle companies. The decisions by Nissan to build the next Juke in Sunderland from 2017, with an investment of £100 million, and by Honda to make its Swindon factory the global supply point for the next five-door Civic, with an investment of £250 million, show that the UK is viewed internationally as an attractive and economically viable location for automotive manufacturing investment, particularly where such investments build on an existing presence.

In terms of all-new investment, the decision by Geely to invest in a new factory, costing £250 million, to build the next-generation London Taxi, confirms the importance of maintaining a modern UK manufacturing base for an iconic British brand. It is important for the UK to retain and maintain the positive attributes which led these companies to decide to keep or expand their manufacturing operations in this country.

The above examples show that the UK is seen as an attractive location for Foreign Direct Investment (FDI). This is also confirmed in data produced by the World Bank, which shows that the UK is one of the biggest recipients of FDI across all sectors in recent years, and within Europe especially, as shown in the following table. The attractions offered by the UK to such investors – notably labour flexibility, government R&D expenditure, R&D tax relief incentives, and extensive industry-university collaboration – clearly need to be maintained.

⁶ IHS Supplier Business Report, Supplying Jaguar Land Rover, 2015 edition, and various Jaguar Land Rover and SMMT press releases

⁷ Information supplied by Vauxhall

Foreign direct investment flows, 2010-2014, total, average and indexed⁸

Country/region	Total FDI 2010-2014 (US\$bn)	Average annual FDI (US\$bn)	Indexed with UK as 1	Index with USA as 1
China	1,248,054	249,611	1.08	4.73
US	1,153,515	230,703	1	4.37
Brazil	378,689	75,738	0.33	1.43
Germany	305,519	61,104	0.26	1.16
UK	264,132	52,826	0.23	1
Spain	178,582	35,716	0.15	0.68
France	112,408	22,482	0.10	0.43
Czech Rep	36,019	7,204	0.03	0.14

The above table shows that, not surprisingly, the US and China have the highest amounts of FDI. Notably, Brazil has outperformed the major European economies in recent years as well.

Within Europe, although the UK has trailed Germany, it has also attracted significantly more FDI than Spain and France, and received around seven times as much FDI as the Czech Republic, which has the highest FDI of all the new EU countries. Maintaining this performance, which reflects the economy as a whole and not just the automotive sector, will be essential for the UK to maintain its position in the global economy.

Changes in the types of cars produced in the UK

In recent years, UK car production has seen a switch in production away from basic, entry or some mid-market cars and towards higher-value premium vehicles. This trend is driven by the UK's cost base, as labour costs mean that the production of small cars is unprofitable. In response, UK vehicle companies have progressively focused on manufacturing higher value, or premium vehicles: in 2010, 37% of UK car production consisted of premium brands, since when this ratio has risen – and should reach 54% by 2020.

This reflects the success of recent model launches by Jaguar Land Rover and its overall range extension, the continued popularity of MINI, and the addition to the Nissan factory of the Infiniti Q30. In contrast, production by mass-market brands, even when it has risen, has grown more slowly than at the premium brands.

Depending on future model allocations for the UK (by Japanese vehicle companies in particular) this ratio could rise further, towards 60% and above in the next decade.

⁸ This table is derived from data at: <http://data.worldbank.org/indicator/BX.KLT.DINV.CD.WD>

The ratio of UK production of mid-market brands and models has fallen steadily in recent years and is expected to continue to fall further.

UK vehicle production, by vehicle type (%), 2010-2020

Vehicle type	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Premium	37.0%	36.9%	40.2%	41.1%	43.0%	46.6%	49.3%	51.2%	52.7%	54.0%	54.0%
Mid-market SUV and crossovers	28.5%	34.2%	36.9%	31.4%	30.1%	28.2%	27.0%	28.4%	27.7%	26.8%	26.6%
Mid-market hatchbacks and sedans	34.5%	28.9%	23.0%	27.5%	27.0%	25.2%	23.7%	20.4%	19.6%	19.2%	19.4%

Source: analysis of model level data in the SMMT's Production Outlook report cited earlier

Elsewhere in Europe, production of small cars has largely shifted eastwards for cost reasons: to Poland, Romania, the Czech Republic, Slovakia, Slovenia, and Turkey; and to a lesser degree, southwards into Spain. The Ford Fiesta, made in Germany, is the only B-segment car made in high volumes in a 'high-cost' country. No comparable small car is made in the UK today, nor is this likely in the future. The eastwards move is likely to continue. Although Nissan will make its new Micra B-segment car in France from 2016, and some production of the Peugeot 208 will remain in France, it is highly unlikely that we will see further investment in Western Europe in the production of small cars.

Even among the premium brands, there is financial pressure to make a proportion of their high-priced vehicles in 'low-cost' countries; for example, Mercedes makes various vehicles based on the A-class in Hungary. Although the UK has done well to retain much recent investment in premium brand production, it cannot always be certain of winning such investment: for example, Jaguar Land Rover is expected to confirm by the end of 2015 that it will build a plant in 'low-cost' Slovakia, rather than expand with another factory in the UK. Further afield, Audi will make the new Q5 in Mexico, where both Mercedes and BMW will soon produce their own small cars.

Premium brands' changing production geographies – selected examples

Vehicle company	Traditional location	New production locations
Audi	Germany	Brazil, China, Hungary, Mexico
BMW	Germany	Brazil, China, Mexico, South Africa
Mercedes	Germany	Brazil, China, Hungary, Mexico, South Africa
Jaguar Land Rover	UK	Brazil, China, Slovakia (to be confirmed)

In terms of trends in powertrains, the key issue is the rate at which conventionally powered vehicles will be replaced by hybrid, full battery electric, or fuel cell powertrains. Data from IHS suggests that by the early 2020s, there should be a clear shift towards hybrids, although full electric vehicles will not make significant market inroads until the late 2020s.⁹ Some initial, optimistic projections for pure-electric vehicles have not been realised; in 2008/9 there were predictions of one million electric vehicles in the US by 2015 and in Germany by 2020.

Today, there are only around 300,000 electric and plug-in hybrids on the road in the US, and around 30,000 in Germany. Significant market stimulus, through financial incentives or regulatory encouragement, may be required. In the absence of such incentives, the adoption of pure-electric vehicles is expected to be modest at best. In the UK, government support for plug-in vehicle purchases has been confirmed through to early 2016, but if this is not renewed, a reduction in plug-in vehicle purchases can be expected.

Forecasts developed by AutoAnalysis and just-auto.com suggest that hybrid adoption will continue to exceed EV adoption through to 2030, by which point Europe should have a hybrid penetration rate of 25%, versus an electric vehicle ratio of just over 4%. The situation in the UK will depend on the production strategies of the vehicle companies, although the Nissan Leaf and Toyota Auris hybrid, and hopefully other vehicles along these lines, should form the basis for production growth here. Production of the Auris hybrid already accounts for half of Auris production and this ratio should continue to grow.

In the long run, full electric vehicle technology could well be adopted at higher rates than projected, but there needs to be a reduction in battery size and price, and an increase in energy storage capacity, otherwise full battery electric vehicles will likely remain a relatively niche application (the success of Tesla and models like the proposed Audi Q6 e-tron notwithstanding).

⁹ http://www.ukintpress-conferences.com/uploads/SPKEX15/Day2_1_Ben_Scott.pdf contains the IHS data cited here

European and NAFTA hybrid and battery electric vehicle production ratios (%), 2015-2030

Region	2015	2016	2017	2018	2019	2020	2025	2030
Europe								
Hybrid %	3.25	4.6	6.25	8.1	8.9	11.25	17.5	25.1
Battery Electric %	1.0	1.2	1.5	1.6	1.7	1.8	2.95	4.25
NAFTA								
Hybrid %	3.6	5.0	7.25	8.2	8.5	8.7	14.25	17.5
Battery Electric %	0.85	0.85	1.0	1.05	1.1	1.2	2.0	4.0

Source: just-auto.com and AutoAnalysis; note hybrids include plug-in versions.

The growth in alternative powertrains is a direct function of the regulatory environment in which the automotive industry operates, notably the emissions regulations set down in Euro-5 and Euro-6 and similar rules in North America. The outcome of recent market turbulence here remains to be seen, but a move away from conventional powertrains towards hybrids of various forms and partly or wholly electrified systems is unstoppable.

Autonomous and connected vehicles

Autonomous vehicle technology could be worth over £50 billion a year to the UK economy by 2030.¹⁰ This business will also generate substantial employment opportunities in the supply of autonomous vehicles and the associated technology, including service providers, with many potential jobs **outside** the existing automotive supply chain. The industry is steadily moving from full driver control through various levels of driver assistance on the way to highly and finally fully automated cars. This trend is summarised in the following table:

Autonomous and related vehicle technology adoption, 2010-2030 and beyond

Technology Category	2010	2015	2020	2025	2030	Beyond 2030
Safety	Blind spot monitoring, Lane departure warning	Intelligent speed adaptation, Lane Keep Assist, Emergency Braking	Emergency Driver Assistance			
Connectivity		V2V, V2D and V2I spreading; Cloud Navigation beginning		Full connectivity achieved		
Autonomy	Cruise Control Park assist begins	Adaptive Cruise Control Park assist becomes widespread	Traffic Jam Assist	Highway Autopilot Valet Park assist	Remote parking, automated urban driving	Fully automated end to end journeys

Source: KPMG report on Connected and Autonomous Vehicles, page 7

At present, over half of the cars produced in the UK have some form of connectivity fitted. Fitment of early-stage autonomous technology, such as lane keep assist and adaptive cruise control, is very low at less than 2%. Within 10 years, however, such technologies are expected to be adopted more widely, reaching penetration rates of over 50% with standard fitment on premium vehicles in developed markets. By the mid-2020s, if not sooner, almost all cars produced in the UK should come with full connectivity. KPMG suggests that fully autonomous vehicles could account for as much as 25% of vehicle production by 2030.¹¹ This equates to over 500,000 autonomous vehicles if the UK grows its production to two million vehicles a year. Achieving such a penetration rate for autonomous vehicles will require the current government-funded trials to be proven successes, **and** for UK vehicle manufacturers to adopt autonomous technology on production vehicles extremely rapidly. At this stage, while it is reasonable to expect fully functioning autonomous vehicles to

¹⁰ <http://www.smmmt.co.uk/wp-content/uploads/sites/2/CRT036586F-Connected-and-Autonomous-Vehicles-%E2%80%93-The-UK-Economic-Opportu...1.pdf>

¹¹ <http://www.smmmt.co.uk/wp-content/uploads/sites/2/CRT036586F-Connected-and-Autonomous-Vehicles-%E2%80%93-The-UK-Economic-Opportu...1.pdf>, page 9

appear during the next few years, a 25% penetration rate may be optimistic, even by 2030. In North America, for example, despite industry's enthusiasm, autonomous cars are not expected to be on the road until 2025, and are not expected to account for even a fifth of annual sales in 2035.¹²

Forecasting the adoption rate of fully autonomous vehicle technology is a challenge because the technology is still in its development phase, the pilots and experiments of Google and Apple notwithstanding. The regulatory environment is also far from being finalised. Tesla, which has disrupted the powertrain market with its electric vehicles, is also optimistic regarding autonomous vehicles: back in 2013 the company stated that it expected to have products available within five years; two years on, Toyota has also recently indicated that it plans to have autonomous vehicles ready for market in five years, ie in 2020.¹³

The market launch dates appear to be receding. Although the move to autonomous vehicles is underway, as with full electric vehicles, analysts are beginning to scale back some of the early very optimistic figures regarding mass-market adoption. A recent study by the Boston Consulting Group suggests that the real increase in autonomous vehicles' adoption will occur in the 2030s.¹⁴

Although the timeframe for autonomous vehicle deployment is growing, the arrival of such vehicles represents a major technology shift and an opportunity for the UK. The fact that the UK lies outside the European protocols on driverless technology creates a significant opportunity to become a real-life technology test-bed, leading the way on R&D, winning inward investment, and gaining a commercial advantage over close rival nations such as France and Germany. Various government reports have also highlighted the potential for this technology.¹⁵

However, UK consumer attitudes currently lag behind government and industry enthusiasm for the technology. For example, in 2014, while 13% of cars sold across Europe had some form of automatic emergency braking fitted (around 60% in Sweden and Norway), in the UK the fitment rate was just 3%. A similar rate applied to UK fitment of lane keep assist versus over 50% in Sweden, nearly 30% in Norway and over 20% in Switzerland.¹⁶ The potential for higher penetration in the UK and elsewhere is clear, with driverless and autonomous technology offering significant commercial opportunities for vehicle companies, fleet operators, consumers, infrastructure providers, and suppliers alike. However, for this potential to be fully realised, industry and indeed government need to convince UK consumers of the benefits and advantages of such systems.

¹² <http://www.autonews.com/article/20140409/OEM06/140409813/safety-mandates-forecast-to-drive-autonomous-car-sales>

¹³ http://my.teslamotors.com/it_IT/forum/forums/elon-musk-talks-google-bring-driverless-tech-tesla-cars and <http://www.autonews.com/article/20151006/OEM06/151009894/toyota-unveils-new-self-driving-safety-tech-targets-2020-autonomous?cciid=email-autonews-daily>

¹⁴ <https://www.bcgperspectives.com/content/articles/automotive-consumer-insight-revolution-drivers-seat-road-autonomous-vehicles/>

¹⁵ <https://www.gov.uk/government/publications/driverless-cars-in-the-uk-a-regulatory-review>, <https://www.gov.uk/government/news/uk-to-lead-development-of-driverless-car-technology>

¹⁶ <http://www.telegraph.co.uk/finance/newsbysector/transport/11835267/UK-lags-behind-Europe-in-adopting-driverless-car-tech.html> contains these figures and more examples along the same lines

Much of the recent development of autonomous vehicles has been led by companies from outside the automotive sector. These disruptive new entrants will undoubtedly change the balance of power within the industry: established car companies have yet to adjust fully to the arrival of internet technology-led companies in their traditional space. Within the next few years, we can expect production versions of 'experimental' cars developed by new entrants such as Apple and Google to challenge established automotive brands.

Initially, Google or Apple vehicles will probably be sold in direct competition to established brands, but whether this will continue in the long run remains to be seen; much will depend on how vehicle distribution and sales channels evolve. The adoption of fully autonomous technology also requires significant legislative, regulatory and insurance issues to be resolved, the timing for which remains uncertain.¹⁷

Autonomous vehicles would also allow for a radical product redesign. Ultimately, the steering wheel and conventional driver cockpit area could become redundant. On balance, however, the majority of vehicles on the road (and coming off UK vehicle production lines) in 2025 are likely to retain the similar broad look of today's vehicles. Even so, these vehicles must still offer full connectivity, autonomous technology and a range of alternative powertrains to remain competitive.

A key issue affecting the timing for radically re-imagined vehicles is the length of the industry's model cycles. Although timings are reducing, model cycles still generally last six to seven years. Powertrains, whose life cycles do not coincide with specific vehicles, can have a longer in-use life, between 10 and 12 years, although regulatory requirements may well shorten some engines' lifespan. On this basis, for most vehicles, 2025 is only one and a half model cycles away; given the nature of platform engineering, car companies need to utilise platforms for two or more model cycles, and consequently it is difficult to see how a significant proportion of new vehicles made in 2025 would actually incorporate radically different designs; it seems more likely that novel designs, such as the self-driving pods involved in current UK trials, will remain a niche segment of the overall market mix.

The UK automotive sector's strengths and weaknesses

As noted previously, the UK has one of the highest levels of FDI in Europe; continued commitment by foreign investors to the UK will be essential for the country's recent economic dynamism to continue. This dynamism and the general political environment are clearly attractive to investors in the automotive industry, especially those with existing investments to protect, such as Nissan and Honda. In the supply chain, Magna, a major international Tier-1 components supplier, has recently acquired Stadco, one of the leading UK independent pressings and stampings suppliers.¹⁸ Companies such as Stadco, with established business relationships

¹⁷ <https://www.gov.uk/government/publications/driverless-cars-in-the-uk-a-regulatory-review> highlights the challenges faced here

¹⁸ <http://www.prnewswire.com/news-releases/magna-signs-agreement-to-acquire-stadco-530394461.html>

including Jaguar Land Rover, will remain attractive investment candidates for overseas investors, especially if vehicle production volumes remain strong and continue growing as predicted.

The key strengths and attractions of the UK automotive industry can be summarised as:

- Stable economic and political system
- Comparatively low tax regime
- Less onerous labour laws and rules compared to most other EU countries
- Unions which are committed to maintaining and developing the manufacturing sector
- Supportive approach from government, including funding and practical support for new technologies, eg through the APC and technology catapults
- Proven ability to produce premium and crossover vehicles
- Materials and lightweighting technology, including new materials such as graphene
- Strong history of automotive design, and leading position in luxury vehicle production
- Strong motorsport engineering and low-volume motorsport vehicle production sector, with potential for rapid technology transfer to mainstream vehicle engineering
- Full vehicle and engine development capability, especially at Jaguar Land Rover, Bentley and Ford
- Strong industry-university collaboration.

The UK's possible future strengths, or opportunities, lie in:

- Advances at the APC and other technology catapults
- The potential for the UK to act as a proving ground for autonomous vehicles
- Continued technology transfer from motorsport into production vehicles.

In terms of weaknesses, or areas for concern which need to be addressed to help the industry continue to grow, there are the following:

- An over-dependence on a limited number of companies for full vehicle and engine development capability
- A lack of Tier-1 R&D capability
- Key decisions regarding investment, R&D and sourcing by some vehicle companies and most Tier-1 suppliers located outside UK
- Industry concerns over a lack of skilled labour, for both existing manufacturing environments and the factories of the future.

And in terms of potential threats, there are the following:

- Continued acquisitions of UK suppliers, which risks taking development work, decision-making and potential returns from R&D away from the UK
- Failure to benefit from advances made by the APC and affiliates if funding is withdrawn

- The threat to the sector and its potential growth that would flow from an EU exit
- Restrictions on work permits for highly skilled workers from outside the EU; the potential inability of overseas investors to bring key workers to the UK could deter or limit investment in R&D, and limit long-term job creation potential
- The threat to existing and even future jobs from continued automation, unless the industry plans ahead

Potential further employment in the UK automotive sector

At present, around 160,000 people are employed in automotive manufacturing, including vehicle and engine production, and the wider supply chain. AutoAnalysis has undertaken plant level analysis for the major UK vehicle and engine manufacturers which suggests that manufacturing employment totals approximately 68,000, with 93,000 in the supply chain. The anticipated growth in vehicle production and increased UK sourcing of components should boost employment both at the vehicle companies and across the supply chain.

With production above two million units a year in the 2020s, we can expect to see more than 5,000 new jobs created at vehicle and engine facilities, and as many as 28,000 within the supply chain by this time. This would raise total employment in automotive manufacturing from the current 160,000 to nearly 200,000 by the early 2020s.

Output of two million vehicles a year equates to a 14% rise on the projected 1.75 million production figure for 2015. Similarly, were the industry to increase local content from 41% to over 50%, this would actually mean an increase of 25% in UK purchasing spend from the current level. Such impressive increases however would **not** result in a direct 'one-for-one' increase in employment for several reasons; some of the recent increase in employment at the vehicle companies has been to prepare for production growth which has not yet fully materialised. In addition, some vehicles' recent volumes have been lower than could be produced due to the models' particular life cycle status.

In addition, investment in automation, general efficiency and productivity improvements mean that higher vehicle output per employee should be evident in future. Finally, the nature of the production process varies (more labour per vehicle is required at luxury car plants than at the volume manufacturers); equally, the amount of spare capacity available at each plant also varies, so the number of additional workers required to cope with any increase in vehicle production varies widely.

Interviews undertaken by AutoAnalysis across the industry suggest that for every 1% increase in vehicle production, an increase of between 0.33% and 0.66% in employment can be required. Applying these to expected increases in production on a **plant by plant** basis at the vehicle and engine plants suggests that these operations could create between 5,000 and 9,500 more jobs by the early 2020s, with

as many as 28,000 further jobs across the UK supply chain. This is shown in the table below:

Job creation potential with rising vehicle production and increased local sourcing

	Current employment	Potential future employment	Potential future employment
		Low end f/cast	High end f/cast
Vehicle and engine plants	68,000	73,000	77,500
Scenario 1: supply chain employment, with increase only in vehicle production	93,000	99,100	105,300
Scenario 2: supply chain employment, with increased vehicle production and local sourcing	93,000	114,000	121,000

Rising vehicle production and locally sourced suppliers clearly represent welcome opportunities for job creation. However, industry and government need to recognise that many of these jobs will likely be overtaken in the long run by changes in the nature of manufacturing. Beyond the creation of these jobs, the country needs to prepare its workforce for the factory of the future, as discussed later in this paper.

Industry and government

Following the 2008-09 recession, the UK automotive industry and government developed an increasingly close relationship. The creation of the Automotive Council, the strategies developed by its many work streams, and the various technology catapults, such as the Advanced Propulsion Centre (APC), are not seen elsewhere in Europe. The publication of government’s automotive strategy in 2013 and the establishment of the Automotive Investment Organisation (AIO) have placed the automotive industry at the forefront of the agenda for inward investment and technology development.¹⁹

Although Spain has set out a similar strategic intent²⁰, there are no other comparable examples of such close industry-government relations in Europe, especially among the other established automotive manufacturing locations. The new automotive-producing locations, Turkey, Slovakia, Poland and Hungary, for example, all have well developed and successful inward investment strategies, but they have not created comparable ‘technology catapults’ or bodies such as the Automotive Council.

Continued inward investment, both for component production and, on occasion, R&D activities, is testament to the attractiveness of the UK’s business environment. However, it is likely that the current uncertainty over the UK’s position regarding its

¹⁹ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/211902/13-975es-driving-success-uk-automotive-strategy-for-growth-and-sustainability.pdf

²⁰ <http://www.investinspain.org/invest/en/sectors/automotive/overview/index.html>

EU membership could lead to some delay regarding further investment in the automotive sector. However, it is essential that the excellent work carried out to date by the Automotive Council, the APC, the AIO and others needs to continue. Industry needs to maintain its recent and current levels of commitment, and government needs to do the same.

With the industry on the verge of several major technological shifts, existing government support needs to be maintained as an absolute minimum in order for the UK to attract further investment in manufacturing and R&D. The UK has cutting-edge research underway in autonomous vehicles, electric vehicles and alternative powertrains. Historically, the leading companies in these fields have been based abroad, but work now being undertaken in the UK places the country in a potentially far stronger position.

In addition, for all the potential technological opportunities open to the UK, it also has to address a major issue concerning its workforce's skills. The Automotive Council skills work stream has highlighted the problems in this area and the role which government and industry needs to play.²¹ The factories of the future will require a different set of skills to those in use today, as discussed in the next section.

Vehicle manufacturing in 2025 and beyond

There is widespread debate regarding the factory of the future and how manufacturing environments might develop.²² Much of the evidence in this area covers all-new factories or where established operations have been substantially remodelled. A critical challenge for the UK's automotive industry is how it adopts the best practices of the factory of the future when it cannot necessarily justify or afford to invest in completely new factories. Even when new vehicles are launched or new supply contracts are won by UK suppliers, this business frequently has to be conducted within the confines of existing operations. Rarely are all-new factories laid out in the most optimal fashion with the most up-to-date equipment.

The ideal factory of the future as described in these reports is highly automated, employing significantly **fewer** people than traditional factories. Moreover, these factories feature most or all of the following:

- Sustainable manufacturing systems.
- Advanced information and computer systems, including simulation and modelling tools for design and manufacturing.
- Advanced automation, including self-learning or artificial intelligence systems.
- The use of new materials, such as nano-materials and as graphene, even if their use in the automotive sector remains limited at present.

²¹ <http://www.smmmt.co.uk/wp-content/uploads/sites/2/Jo-Lopes-Automotive-Industrial-Partnership-Open-Forum-18-March-2015.pdf>

²² For example see: http://publications.arup.com/Publications/R/Rethinking_the_Factory.aspx and https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/283903/ep29-factory-of-the-future.pdf

- Reconfigurable systems which can be speedily adapted for new products.
- Fast ramp-up production systems: the time to peak production is continuously shortening.
- A workforce with very different skills to the present day; machining and traditional manufacturing skills will be replaced by the need for advanced programming and machine control skills.

The technologies required for the factory of the future, or intermediate concepts such as Industry 4.0 and the Industrial Internet of Things, are widely available, if not yet widely used. As these tools are adopted, factories of the future will increase their level of automation, and the number of people employed in these factories will consequently fall. While employment in traditional automotive manufacturing environments will likely rise in the medium term, boosted by rising vehicle production and increased UK sourcing of components, factories of the future “will lead to de-skilling of traditional process and craft skills such as machining and welding, whilst re-skilling in the new advanced technologies (although) craft skills will remain essential in the finishing of premium and luxury goods”.²³

The implications of this for the automotive industry, and indeed government policy, are profound, but have yet to be fully addressed. Craft skills will certainly be required by companies such as Rolls-Royce and Bentley, but elsewhere much of the industry will feature increasing levels of automation, overseen by a smaller number of workers equipped by different core skills to today’s factory workforce.

Thus, while there is a near-term opportunity for increased UK automotive employment, in the long term there is a very clear risk that other changes will place new and many existing jobs at risk. Looking ahead into the 2020s and beyond, both the automotive industry and government need to recognise that some, and quite possibly the majority, of today’s job descriptions will not be appropriate to future manufacturing environments.

There are already examples of this; for example, one UK vehicle plant recently introduced a new production cell for fabricated assemblies occupying around one-third of the space of the previous arrangement, using just two robots (versus eight before), producing finished products at more than three times the speed of the previous set-up, and using half the workforce required previously. The Factory of the Future report specifically highlights how a smaller footprint for achieving the same output as existing factories, if not a higher output, will be a defining characteristic of future manufacturing operations.²⁴

While developments along these lines will occur on a case-by-case basis, they will certainly happen. They will also have significant long-term implications for the kind of training required for the workforce for the factory of the future. This needs to be reflected in government's policy for apprenticeships, which needs to be future-proofed to ensure that it prepares people for the world of work in 10 to 15 years’ time and later, and not simply for the world of work today.

²³ Factory of the Future, page 7

²⁴ Factory of the Future, page 17

In preparing this paper, AutoAnalysis spoke to a range of manufacturing operations across the industry. Several respondents expressed concern over what the future manufacturing environment would mean for employees' skill requirements. In particular, they were unsure how government's plans for three million apprentices by 2020 will reflect the automotive industry's need for a new set of skills in its future workforce. At this stage, an industry-wide consensus on what should be done in this area has not emerged: however, this should be addressed as a matter of urgency, especially since government has turned its attention to the economy's productivity and how this can be improved.²⁵

Some component suppliers, for example, are considering changing their recruitment policies: if the apprenticeship system is funded solely through a levy, these companies are considering reducing or even ending their current conventional graduate recruitment policies in key areas. Ultimately, this could be replaced by an apprenticeship system which would see employees moving on from apprenticeships to full degrees, including up to master's level, while at work; in this way the companies believe they will be better able to ensure they develop the workforces needed for the future. An unintended consequence could be reduced employment opportunities for graduates, something which government would, presumably, wish to avoid.

Trouble on the horizon?

The projections in this report – and indeed those used by many analysts and observers in the industry – assume that economic conditions remain largely as they are now, or hopefully improve, and that the UK remains within the EU.

The automotive industry has certainly had fluctuating fortunes in recent years and is known for its cyclical nature; however, low global interest rates, incentives for vehicle sales in various markets, and attractive pricing by the car companies, have helped industry volumes recover from the depths of the 2008-09 recession. Continued low interest rates and low inflation create both a disincentive to consumers to save money **and** should also encourage business to invest. Although the Bank of England has suggested that interest rates will rise soon, a fear of deflation amongst other economic indicators has delayed the decision. The European banking authorities also show no sign of raising interest rates.

Concerns over the BRIC countries in general, and China in particular, are more of a worry, especially for European vehicle companies who have either invested heavily or have been reliant on exports to China to maintain European production volumes and corporate profits. The German premium brands and Jaguar Land Rover are arguably most exposed in this regard, although they have all already transferred some production for the Chinese market to factories in China: having done this, their European operations have actually become less dependent on the Chinese market, although at a corporate level this exposure remains.

²⁵ <https://www.gov.uk/government/news/productivity-plan-launched>

While recent growth rates in China are unlikely to be repeated, the Chinese authorities have a clear interest in maintaining the current levels of economic activity. It is not yet clear to which degree the recent downturn in the Chinese economy will impact European vehicle production volumes in the long term; leaving aside unavoidable short-term concerns, the real impact may not be apparent until the start of 2016 at the earliest.

Another issue, highlighted earlier, concerns the UK's relationship with the EU and the planned referendum on EU membership. Broader political events, especially the refugee crisis and events in the Middle East, may shift the EU debate away from the economic case for membership towards social and political issues. This could well change public opinion, irrespective of the economic arguments favouring continued membership.

The full implications for the automotive industry and further investment in the UK in the event of the UK leaving the EU have yet to be worked out, although reduced long-term commitment by European, Japanese, and US vehicle and component companies to the UK cannot be discounted, and to some observers would be highly likely. A survey across the industry for SMMT by KPMG in 2014 highlighted how more than two-thirds of automotive industry respondents wanted the UK stay in the EU; a similar proportion believed the UK's exit would significantly damage their business and put further investment in the UK at serious risk.²⁶

Regulatory costs continue to bear down on the industry, such as energy prices, the cost of complying with emissions rules, safety technology and the whole area of autonomous vehicles. Given that these, and other costs, are only going to increase, vehicle companies will likely collaborate as a means of controlling costs, potentially leading to further industrial restructuring and a renewed burst of M&A activity by both vehicle companies and suppliers. The risk to the UK in particular is that further decision-making and control over companies' strategies would move overseas.

The UK automotive industry has made major strides forward in recent years with rising production, increased local sourcing and investment in new products and technology by both industry and government. There are many challenges still to be met, but the sector is poised for a long-term successful future in the UK, provided that the positive developments which have underpinned the recent rise are not wasted.

²⁶ <http://www.smmmt.co.uk/wp-content/uploads/sites/2/SMMT-KPMG-EU-Report.pdf>