# Digital Industrial Policy Brief 2

## INDUSTRIAL DEVELOPMENT THINK TANK

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# REPOSITIONING THE FUTURE OF THE SOUTH AFRICAN AUTOMOTIVE INDUSTRY

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## Introduction

The automotive industry's technology direction is the focus of huge attention and substantial hype, much of which has been created by recent government announcements denouncing the future of the internal combustion engine (ICE), and the banning of such vehicles within governed time frames: The United Kingdom[2] and France by 2040[3], and Norway even sooner - by 2025[4]. To put this into perspective, given that vehicle models have a lifespan of six to eight years, vehicle assemblers only have two more generations of ICE model to release into the UK and French markets before they are completely banned. However, before this happens, many people may no longer even be driving their own personal vehicles. The development of autonomous vehicle technology has been advancing rapidly over the last decade, with some industry forecasts projecting that 75% of vehicle travel in major economies will be in autonomous vehicles by as early as 2035.[5]

## Disruptive technologies and environmental pressures

Factors such as tightening environmental legislation in core global markets and the rapid emergence of disruptive technologies with the ability to fundamentally transform the nature of mobility markets and associated vehicle (and automotive component) production are combining to create a "perfect once in a 100-year storm" that will fundamentally re-shape the future of the industry, and by implication its complex value chain, presently comprising a core group of dominant global vehicle assemblers, their authorised dealerships and repair facilities, and their multi-layered component manufacturing supply chains that straddle the globe. The stakes for the established vehicle industry have never been greater.

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[1] Executive Director: Toyota Wessels Institute for Manufacturing Studies; Chairman: B&M Analysts. www.bmanalysts.com

[2] BBC News (2017) [online]. New diesel and petrol vehicles to be banned from 2040 in UK, 26 July 2017.

[3] Independent (2017) [online]. European cities announce bans on petrol and diesel cars as green initiative spreads across continent, 14 October 2017.

[4] Independent (2016) [online]. Norway to 'completely ban petrol powered cars by 2025', 4 June 2016.

[5] Black Rock Institute (2017) Future of the vehicle: Winners and losers: from cars and cameras to chips. Global Insights. April 2017.

Dominant global vehicle assemblers such as Toyota and Volkswagen may have annual R&D budgets of over $10 billion (per their Annual reports), or four times the entire R&D spend of an economy such as South Africa's[6], but these large "war chests" still require clear strategic directions. And yet these are not always clear. For example, will Battery Electric Vehicles (BEVs) replace ICEs in the next five, 10, or 25 years? Will the replacement be universal, or will it concentrate in small passenger vehicles first? What of hydrogen fuel cell vehicles (FCVs)? Hydrogen-based FCVs, such as the Toyota Mira, are for example presently being tested alongside BEV models. What if this technology surges forward? What then happens to the billions of dollars being spent on BEVs by the established vehicle assemblers and potential usurpers like Tesla and BYD? These questions are non-trivial. Each powertrain alternative has entirely different component requirements that fundamentally change the nature of economic activity within individual vehicle model supply chains: creating new commercial opportunities, and closing others off, potentially displacing incumbent technologies, and potentially shifting the entire structure of the automotive value chain.

While the overwhelming evidence of global warming, and a range of other environmental concerns, will likely influence the formulation of government legislation across the globe, and raise the pressure on vehicle assemblers to produce increasingly fuel-efficient vehicles, mounting energy costs are likely to have an analogous impact. Vehicle assemblers able to place highly fuel efficient and/or low environmental impact vehicles in the market will steal a march on their competitors, opening the way for improved financial returns, and major improvements in their market position. If this was the only challenge facing the vehicle industry, it would be daunting enough: How to shift vehicle production from their dominant powertrain (and associated drivetrain) technologies for the first time in over a century?

**Digital disruption**

At the same time as the automotive industry is confronting one major dramatic shift in its development trajectory, it has been tasked with confronting another, potentially even more existential threat: How to deal with the swathe of technology disruptions fostered by the digital revolution (or Industry 4.0)? At the most "basic" level vehicle assemblers and their component manufacturers are needing to explore the emerging role of additive manufacturing, nano-technologies and other new material developments, and the use of "big data" and advanced computing power that has fostered machine learning and Artificial Intelligence capabilities that are powering entirely new intra- and inter-firm process and product technologies with the ability to re-frame entire automotive value chains.

**Additive manufacturing**

The consequences of each of these disruptions are potentially huge and wide ranging. For example, additive manufacturing has the potential to change the established modality of vehicle consumption. New vehicle assembly start-ups like Local Motors already offer consumers in the United States the option of designing their own motor vehicles on-line using

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[6] Total Research and Development expenditure in South Africa amounted to R29.3 billion in 2014/2015 (Mail and Guardian, 21 April 2017). At an average Rand to US$ exchange rate of 12.77 in 2015, this amounted to only US$2.29 billion (based on average exchange rates available at https://www.nedbank.co.za/content/dam/nedbank/site-assets/AboutUs/Economics_Unit/Forecast_and_data/Daily_Rates/Annual_Average_Exchange_Rates.pdf.); Mail and Guardian (2017) [online]. Survey reveals state of R&D expenditure, 21 April 2017.

standardised computer aided design (CAD) tools that are easy to use, and then 3D printing the designs developed in a Local Motors facility in closest proximity to them.[7] While a boutique, hobbyist-type product offer at present, this type of market positioning is likely to grow as additive manufacturing costs decrease and consumers seek unique but affordable product offerings enabled by new technologies. Less dramatically, additive manufacturing developments are already changing how production is organised for component supply into the aftermarket. Rather than holding large amounts of component stock for obsolete models that are still on the road, many component manufacturers are now using additive manufacturing to make one-off replacement parts, thereby obviating the need to store and maintain expensive tooling and to run large volumes to justify expensive set-up costs.

As new processes, such as digital light synthesis, increase production speeds (by up to 100 times in the case of Adidas' new speed factories[8], and nano-technology enabled smart materials, such as bound metal deposition, are further developed, the automotive value chain may undergo major structural change as additive manufacturing becomes increasingly competitive for original equipment manufacturing. When this occurs, the established nature of production contracts within vehicle assembler value chains may change. This is the reason why large Tier 1 automotive component suppliers to the vehicle assemblers are investing heavily in both new materials development and additive manufacturing.

**New material technologies**

New nano-technologies and associated materials developments are likely to substantially disrupt established automotive value chains independently of the additive manufacturing link. For example, nano-technologies could improve the strength of monocoque vehicle platforms to the point where they displace ladder-chassis alternatives that dominate commercial vehicle production. If this were to happen, the entire supply chain leading into light commercial vehicles (that dominate a large part of the South African automotive industry) would be disrupted[9]. At a more mundane, but nevertheless highly disruptive level, actual supply chain processes could be fundamentally challenged. The standard steel manufacturing process could be altered. New technologies are permitting the manufacturing of steel sheets through a laying, as opposed to rolling process, that has the potential to significantly reduce conversion costs, while simultaneously permitting the manufacturing of thinner steel sheets required for weight reduction in more fuel-efficient vehicles.[10] Similarly, carbon nanotubes, which have a high tensile strength and can carry four times more energy than copper at the same thread size[11] hold the potential to displace complex wiring harnesses in vehicles, thereby disrupting one of the large vehicle system technologies that are presently found in every vehicle.

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[7] See www.localmotors.com

[8] The Economist (2017), 3D printers start to build factories of the future, 29 June 2017.

[9] Monocoque vehicle platforms are inherently lighter and therefore more fuel efficient than ladder chassis vehicles. Ladder chassis platforms will therefore be rapidly displaced by monocoque platforms once they exhibit similar strength characteristics.

[10] The Economist (2017), New technologies could slash the cost of steel production future, 9 March 2017.

[11] Hagel, J., Seely Brown, J., Giffi, C. and Chen, M. (2016: 18). The future of manufacturing: Making things in a changing world. Deloitte Centre for the Edge: A report in the future of the Business Landscape Series. Deloitte University Press. Pp 1-45.

**Big data and machine learning**

One of the biggest disruptors within the automotive value chain is in many ways quite innocuous, namely the increasing use of data to optimise production and supply chain processes. Whilst this has been done in factories and their supply chains for decades, the rapid development of computing power, the growth of available data from processes and products, and the emergence of self-learning (or Artificial Intelligence) machines, has fundamentally changed how firms are optimising their own production, as well as the supply chains in which they are located. Atlantis Foundries represents an excellent South African case study in this regard. The company, which manufactures commercial vehicle engine blocks for several major international engine brands has used Artificial Intelligence (AI) to predict sub-surface defects, and to identify process changes required to prevent the defects from occurring in the first place. The use of AI is noted as having reduced internal scrap and rework rates by up to 90%, with the most difficult challenge emphasised as being a mechanical one, which is keeping the physical machinery operating within the narrow process windows recommended by the continuously evolving AI algorithm.[12]

Another major AI-induced digital disruption finding its way into the automotive industry is the introduction of virtual reality-based digital twins for automotive production (e.g. both Siemens and General Electric already offer this service when developing new factory equipment and associated layouts[13]). Using new AI visualisation technology, factories can now be created virtually and then fully experienced using virtual reality headsets. An identical virtual version of an actual physical facility allows for the progressive design and simulation of processes and individual machine performance – to the point where optimal operational performance is achieved virtually and then transferred into the physical factory. The same digital twin technology can be used for product development. Maserati recently developed its new Ghibli model over a 16-month period using digital twinning technology, a full 20 months shorter than its usual standard.[14]

From the more accurate reading of market demand, to the optimisation of products, production and associated materials planning, AI is likely to become ubiquitous within manufacturing over the next few years. As highlighted by The Economist[15] this has resulted in over US$20 billion being invested in AI-based mergers and acquisitions in 2017; with $4.2 trillion of value creation projected to emerge from AI over next 20 years, $1.4 trillion of which will be generated in enhanced marketing and sales and $1.3 trillion from supply chain optimisation[16].

**Artificial Intelligence and robotics**

AI is also overturning a standard manufacturing principle, which is human and machine separation in factories.[17] Unlike previous generations of industrial robots AI-enabled robots

[12] Casting South Africa (2017) [online], Atlantis Foundries embraces the Fourth Industrial Revolution, http://castingssa.com/atlantis-foundries-embraces-the-fourth-industrial-revolution. Accessed 5 October 2018.
[13] The Economist (2017), The Gemini makers: Millions of things will soon have digital twins, 13 July 2017.
[14] See footnote above.
[15] The Economist (2018), In algorithms we trust, 31 March 2018.
[16] See footnote above.
[17] See footnote 10 above.

can work safely alongside humans. For example, “Baxter,” a US$22,000 general-purpose robot developed by Rethink Robotics, can work alongside humans, and with simple path guidance can be continuously retrained to undertake new tasks by moving its arms to mirror new paths. This guidance can then be automatically extended to all other “Baxters” where the change is required, ensuring a high level of operational flexibility. A “female” version of Baxter, named Ms Charlotte, already operates in large volumes at BMW’s Spartanburg plant in South Carolina, USA. The plant had over 40 Ms Charlotte’s in 2017, with the figure projected to increase to 60 by the end of 2018.[18] The use of such AI-enabled colleague-robots, or “cobots” in factories is projected to increase at a rate of 40% per year over the next five years by research firm Research and Markets[19], with the take-up in metal fabrication, and metal and plastic forming activities particularly likely given the uniformity of the materials used and the standard, routinised nature of the production processes involved.

**IoT – the greatest disruptor**

The technologies briefly reviewed above only pose an existential threat to the established automotive industry when they are combined with the impact of the Internet of Things (IoT). In combination with IoT, the various discrete technologies being developed coalesce to fundamentally challenge the nature of automotive markets, and the notion even of automotive mobility. Rapidly advancing automotive telemetry, which effectively plugs vehicles into the Internet of Things, while also allowing vehicles to “see” their immediate environment (for example, through LIDAR[20] systems), has provided the basis for the development of Autonomous Vehicles (AVs). Presently being tested in a variety of locations, AVs are potentially the global automotive industry’s most substantial ever disruptor. This is not an exaggeration. Once AVs have been sufficiently tested and have proven their safety, they will fundamentally transform global mobility markets. Critically, it is not only drivers that are displaced by AVs. Fully autonomous vehicles will not need steering wheels or driving aids (no driver), air bags or side impact bars, highly engineered accident crumple zones or seat belts (no chance of crashing), nor powerful engines or associated componentry, such as large brake disks (they will drive at exactly the speeds specified by law). AVs will potentially also not need to be made of steel or aluminium. If they cannot crash, biodegradable textile skins may be the future. What then of vehicle assembly operations? Will they still have body shops, paint shops, and complex assembly lines? Will vehicle assemblers still employ the many thousands of skilled people that they do today – both within their own operations and those of their suppliers? If AVs are mechanically much simpler to manufacture, with core technology transferred to their digital “componentry”, will it be easier for AVs to be printed in additive manufacturing workshops without much human interaction?

Even more fundamentally, and here comes the real existential threat to the global automotive industry: If AV passengers (remember there are no drivers) are supremely comfortable in the

[18] The Economist (2017), For robots to work with people, they must understand people, 17 August 2017.
[19] See footnote above.
[20] Light Detection and Ranging (LIDAR) is a remote sensing technology that uses light in the form of a pulsed laser to measure distances to physical objects (https://oceanservice.noaa.gov/facts/lidar.html). These light pulses, which are often combined with other recorded data, can generate precise, three-dimensional information about the shape of the immediate environment around a vehicle, and to accurately monitor and predict object movements, making them an essential complement to broader IoT technologies.

cabin, moving from Point A to Point B rapidly and safely, and working or being either entertained or educated using IoT enabled technology, the technical dimensions of the AV may become superfluous to them. So superfluous in fact, that vehicle ownership no longer remains important. One extreme forecast argues that that by 2030 transport-as-a-service (TaaS) providers will supply 95% of United States passenger miles using fleets of autonomous electric vehicles[21].

Will the world's middle-class population buy private use AVs in the future, or use "robo-taxi" service providers, such as Uber or Lyft, or any range of potential future competitors? If it is the former, then the disruption will "only" relate to vehicle technologies, platform configurations, and associated production activity within automotive value chains. If it is the latter, then the disruption will be much more fundamental: The power of individual vehicle brands will shift dramatically. The nameplate on vehicles will become materially less important, while "robo-taxi" platforms and their differentiated service packages will displace individual private vehicle ownership and concentrate purchasing into a small group of TaaS platform providers, whose own brand strength, more likely defined by their proven safety, speed of service response, and the comfort of their passenger cabins, could trump that of the vehicle assemblers. This would change the century-long dominance of vehicle assemblers within highly coordinated producer driven Global Value Chains, and shift power to the TaaS providers who increasingly dominate the interface with final users. Global vehicle demand aggregates could also potentially shift dramatically as "robo-taxis" are used up to 23 hours per day (with 1 hour set aside for daily maintenance), rather than the standard private vehicle ownership use model of only a fraction of this time.

Such a shift in human and merchandise mobility would be the ultimate disruptor. Everything about the modern global automotive industry would potentially change. The Boston Consulting Group suggest four scenarios in respect of AVs.[22] The first is the private ownership of AVs alongside conventional vehicles, while the second is the full takeover of vehicle ownership by AVs. Neither of these scenarios represent an existential threat to the established automotive order, but the third scenario certainly does. This is a scenario where urban transport is dominated by 'robo-taxi' TaaS providers. The fourth scenario is potentially even more disruptive, however. It envisages a future where urban transport becomes entirely dominated by the 'ride sharing revolution'. When modelled by BCG, the first two scenario have a negligible effect on the number of vehicles in cities, but the third and fourth scenarios have dramatic effects with the number of vehicles reduced by 46% and 59% respectively. Whether the global automotive industry sells 140 million or only 60 million vehicles in 2035 (versus 100 million vehicles presently) will have a profound impact on the destiny of the automotive industry and its GVC structure.

### The power of combinations

Combine the dramatic development of IoT with other disruptors, such as additive manufacturing, the increased use of smart materials, nano-technology, machine learning,

[21] Arbib, J. and Seba, T (2017). Rethinking Transportation 2020-2030: The Disruption of Transportation and the Collapse of the Internal Combustion Vehicle and Oil Industries. RethinkX. May 2017.

[22] Boston Consulting Group (2016) [online] http://www.automotivebusiness.com.br/abinteligencia/pdf/BCG_SelfDriving.pdf Accessed 27 May 2017.

artificial intelligence and robotics and the impact becomes even more profound. Provided these changes are good for the environment and reduce energy consumption (which they are bound to), government legislation is likely to further encourage the shift. Of course, key questions remain. How rapidly will these changes occur? Will their ongoing combination and recombination accelerate or slow down the speed of disruption? Does the automotive industry have another five, 10, or 25 years making driver-controlled, ICE vehicles for mainly private owners that are acutely brand conscious? Equally, will people be driving their own vehicles using autonomous functionality to improve (and make safe) their driving experience, or will the conversion to full vehicle autonomy have already occurred over the next 25 years?

**South African consequences**

From a South African perspective, a key question is how rapidly South Africa, and the broader African market, follow these dramatic disruptions? With 112,000 employees, R74 billion of Gross Value Added annually, seven major vehicle assembly plants around the country, sizable export programmes[23], major technology spill-over effects, and a considerable contribution to the distressed South African tax basket, these are also discussion points that should be of paramount importance to the senior private and public sector leadership of the country. The stakes are not only high for the global vehicle assemblers and their component manufacturers, but for every country with a major automotive industry.

Navigating the disruptions is likely to be a substantial challenge for lead firms in the global automotive industry, and particularly their R&D facilities in mainly developed economies. The challenges are as (or perhaps even more) significant however for smaller automotive economies, such as South Africa's, that aspire to significantly build their industries in the future. Smaller economies have little impact on the changes occurring, have little choice but to adjust to rapidly changing market and production forces within the GVCs they are part of, and have only limited resources to spend on understanding what changes are likely to occur. The consequences for an economy such as South Africa's, are potentially very substantial; and yet the potential impact of the digital disruptors is largely unclear.

The South African government is to shortly announce the South African Automotive Masterplan, with aspirational objectives of achieving 1.4 million vehicles of production by 2035 (or 1% of global vehicle production), local content of 60%, domestic market consumption of 1.2 million vehicles, substantially deeper black industrialist participation within the automotive value chain, and the development of more advanced infrastructure, automotive technologies and associated skills – in alignment with the standards of leading competitor economies. These objectives, which are all realisable are likely to be fundamentally challenged by the digital disruptions covered in this briefing note. While South Africa has theoretical annual new vehicle demand of around 2.2 million units[24], will South Africa breach 1.2 million units of domestic sales in 2035 in the context of AV "robo-taxis" or a shift to the 'ride sharing revolution' as identified by BCG? Will South Africa, and the continent more broadly, remain the last redoubt of the ICE, or will the country and/or continent experience a rapid transition to Battery Electric Vehicles and/or Hydrogen FCVs per the trajectory of developed economies? What will

[23] Well over half of all South African produced vehicles are exported, with most of these exports destined for developed economy markets.
[24] This is based on South Africa's geography and population size and assumes much higher per capita income – to above US$28,000).

happen if South Africa or the continent fails to transition? Who will the South African automotive industry export to if the local market is dominated by privately owned, driver-controlled, ICE-based vehicles? And if the industry does transition rapidly to AVs and alternative powertrains, what then of the role of the incumbents?

Do the seven established vehicle assemblers in South Africa still hold centre court in respect of the industry's future development? Should the South African government be negotiating its automotive policies with existing industry stakeholders, or should there also be engagements with potential "rob-taxi" providers such as Uber (or BYD or Tesla, two leading BEV innovators), or even Waymo, the AV subsidiary of Alphabet (Google's parent company)?

The above questions are complicated enough for any industrial policy development process to deal with, but an additional layer of complexity is added when consideration is given to the composition of vehicle manufacturing. Whether South Africa makes the transition to vehicle autonomy or not over the next couple of decades, what and how will domestic vehicles and their thousands of components be made? Deepening local content is central to the further development of the South African automotive industry, particularly in relation to employment generation, but any local content target is notional in the context of major technology changes that are likely to fundamentally change the economics of vehicle production in future. The combined impact of IoT, nano-technology, new "green" materials, "big data" use, machine learning, Artificial Intelligence, robotics, additive manufacturing, and entirely new propulsion technologies could fundamentally change the concept of vehicle manufacturing. Who are the leading global component manufacturers investing in new materials and additive manufacturing technologies, new production and supply chain processes? As the economics of vehicle production change, who becomes more important?

Herein lies the South African automotive industry's existential crisis. When will all of this happen? And when it does, what form will it take place? As developed economy disruptions manifest, what are the consequences for vehicle production in an economy such as South Africa's? Will industry development opportunities be created, thereby supporting the realisation of the South African Automotive Masterplan's aspirational objectives, or will opportunities be closed off as the industry transitions to an entirely new operating model?

**Some preliminary responses?**

Defining an appropriate local policy response to the digital disruptions likely to re-shape the global automotive industry is a daunting challenge. While many of the digital disruptions referenced in this briefing note are transversal, and agnostic of specific manufacturing value chains, it is also clear that the way the disruptions combine and become existentially disruptive will be value chain specific. An appropriate South African government response consequently appears to require four mutually reinforcing dimensions.

First, any response needs to be adaptable. Following Dani Rodrik's framework for an effective 21st century industrial policy[25], South African industrial policies will need to be constantly reviewed and reoriented in alignment with the development and associated combination and recombination of disruptions.

[25] Rodrik, D (2004), Industrial Policy for the Twenty-First Century, Paper prepared for UNIDO, September 2004.

Second, engaging with specific disruptions is a transversal challenge that aligns best with a country's national system of innovation, as opposed to individual GVC-specific industrial policy frameworks. The digital disruptions reshaping the trajectory of the global automotive industry are not automotive-specific. If South Africa is to shift its marginal position in relation to the specific digital disruptions that are recasting industrial activity, transversal skills development and technology policies will need to be developed and deployed.

Third, how the disruptions manifest in the automotive industry is a sector specific challenge, requiring clear knowledge of how digitalisation will combine and then recombine to shift both the nature of mobility, and the fundamentals of vehicle production. As this represents the primary commercial and social interface between digital disruption and the physical production and commercial market space, the role of sector-specific (or perhaps rather value chain-specific) industrial policy is likely to remain critical.

Fourth, and perhaps most importantly in the context of the pace of digital disruption, it seems highly appropriate for the South African government to collaborate with the private sector in navigating value chain complexities. Returning to Rodrik[26]: *"The right model for industrial policy is… strategic collaboration between the private sector and the government with the aim of uncovering where the most significant obstacles to restructuring lie and what type of interventions are most likely to remove them. Correspondingly, the analysis of industrial policy needs to focus not on the policy outcomes—which are inherently unknowable ex ante—but on getting the policy process right."* The domestic industry's marginal position globally makes it both extremely vulnerable to digital disruption, and potentially well positioned to play a role in the testing or piloting of emerging technologies. If South Africa is to gain from the combining and recombining of digital disruption within the automotive industry, a public/private institutional approach is clearly required: an approach where the public and private sector collaborate on the proactive positive positioning of South Africa within the automotive industry's rapidly evolving digital space.

While the future profile of the global automotive industry is unclear, this brief review of digital disruptions within the industry, raise some clear medium-term lessons for the South African automotive industry that potentially lay a starting framework for the development of a proactive response.

1. The future of motor vehicles is green. Alternative powertrains (BEVs and/or FCVs) within light weight monocoque vehicle frames will increasingly dominate global consumption and production. If South Africa is to continue exporting into the world's major markets this type of production will need to be facilitated.

2. Vehicle autonomy will be fundamentally transformative – in terms of vehicle use and production. As autonomy progresses through its phases, the embedded technology within new vehicles will shift accordingly[27]. Unless telemetric products and new

[26] Rodrik (2004: 4)

[27] The early consequences of this have been captured in an Australian National Productivity Commission report on the Australian automotive industry, where it was noted that "…in the decade to 2010, Toyota added new components and subsystems worth $1400 to its base model Camry, while the Camry's recommended retail price in the United States fell by an average of 1 per cent each year in real terms over the same period" (2013, 49). In a South African environment, where metal pressing,

powertrains (and their associated drivetrains) are manufactured in South Africa, local content will likely decline in future. These technologies need to be attracted to South Africa.

3. Technology will be controlled by multinationals. The vast sums of money being invested in AVs and green mobility by the world's leading digital corporations (Google, Amazon, Microsoft) and established vehicle assemblers (and their component manufacturing partners) is unlikely to lead to major fragmentation of the global automotive industry's dominance by a few players. Some players may change, and the dominance of incumbent vehicle assemblers may change in favour of TaaS providers like Alphabet or Uber, but the platform effects of vehicle autonomy appear analogous to those of global production systems.

4. Automotive value adding processes are likely to fundamentally change. New materials, additive manufacturing, nano-technologies, machine learning, AI, robotics and the application of IoT within value chains will change the economics of vehicle production and consumption. Supporting the South African automotive industry as it incorporates these technologies will be essential to its long-term success. Many of the digital disruptions cut across all manufacturing sectors and need to be supported at that level, but their specific combinations within the automotive industry also need to be understood and responded to.

It is these types of automotive-specific developments that require a GVC-specific response on the part of national government and local automotive industry stakeholders. The South African automotive industry is no different to any other small, second tier automotive economy globally: it is both vulnerable and potentially well positioned in relation to digital disruptions. Whether the industry wanes or prospers is dependent on the actions taken by stakeholders over the period of the South African Automotive Masterplan.

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metal fabrication, plastic moulding, and sub-assembly and assembly processes, dominate automotive value addition, the consequences are potentially significant; National Productivity Commission of the Australian Government (2013). Australia's Automotive Manufacturing Industry: Productivity Commission Preliminary Findings Report, December 2013.