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Transforming vehicle production by 2030

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How shared mobility and automation will revolutionize the auto industry

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Executive summary

The auto industry stands on the brink of a revolution. By 2030, vehicle production will have split between mass-market, largely no-frills "cars on demand" that will be rented journey-by-journey and more customized vehicles for those who still want to drive, or be driven in, their own vehicle.

A high level of automation will be needed to produce both types of vehicles, and every process will be affected. The pressure on the workforce will be severe. The industry workforce will be cut by at least 50 percent by 2030, and employees who remain will need very different skills. Automakers must become data managers and mobility service providers as well as vehicle assemblers.

This shift has enormous implications not just for personal mobility, but also for automakers' business models. Competition for profits started to intensify two decades ago when suppliers began doing more of the work that automakers — also known as original equipment manufacturers (OEMs) — had traditionally done, such as building interiors and dashboards. That competition will step up a gear in the new era, as suppliers take on even more of this work, leaving OEMs to figure out where they should best play.

Here are some of our key predictions for 2030:

- Standardized, shared vehicles — used simply to get from A to B — will account for at least 30 percent of the market in Europe, concentrated at the lower-price end. In the U.S. and Asia, an even greater proportion is expected.

- The size of the workforce on assembly lines and in body and paint shops will be halved because of automation and the new types of vehicles being assembled.

- The number of shop-floor logistics roles will be reduced by around 60 percent, partially because humans will be replaced by autonomously guided vehicles.

- The number of data engineers required will almost double in some types of plants, and increase by 80 percent in others, while the number of software engineers needed will rise by as much as 90 percent.

- We expect the time required between R&D and the point of production to shrink from the current three to five years down to two years, to keep pace with technological changes.

Assembly plants — and workforce — of the future

To serve these two types of markets — mass-market "cars on demand" and customized vehicles for individual ownership — as efficiently as possible, two new types of factories are needed. One will be a highly automated "plug and play" plant producing large volumes with minimal variation between vehicle types, and with cost as the main distinguishing feature for ride-sharing companies buying these vehicles in bulk.

The second type of plant, which we call the "flex champion," will produce customized vehicles to help build driver-owned cars. Today's production lines, while allowing for some degree of product customization, are not flexible enough for this new scenario, where autonomous guided vehicles (AGVs) will take each car on its own unique route between assembly stations. OEMs might retrofit some of their existing factories, but they will need to decide on a case-by-case basis whether and how this makes economic sense.

In both cases, robots will do a far greater share of the work than they do today. This means that fewer employees will be needed. We estimate that only 40 percent of the workers with today's skill sets will be needed in the plug-and-play plant, with around 50 percent fewer in the plant making the flex champion vehicles. Roles for remaining workers will change, and employees with new skills will be needed. In addition, there will be a greater degree of human–machine interaction as more intelligent machines work safely alongside humans. In R&D functions, for example, it will be possible to hand over lower-level routine decisions and paperwork to robots with artificial intelligence (AI) capabilities.

To enable automation, automakers and their suppliers must generate and share vast amounts of digital data about the design, dimensions, quality, and location of components, tracking their journey through the factory and beyond. Automakers must manage complex flows of physical materials and become data managers. Indeed, we expect the number of data engineers to double in the flexible plant between now and 2030.

There will be a greater degree of human–machine interaction as more intelligent machines work alongside humans.

Assembly will become simpler, particularly in the plug-and-play plant, with original equipment manufacturers (OEMs) asking suppliers to deliver more and more preassembled modules that can be fitted by robots into a range of vehicles. As mentioned above, this poses a risk to the profits of the OEMs, because as complexity passes to the supply chain, so does value.

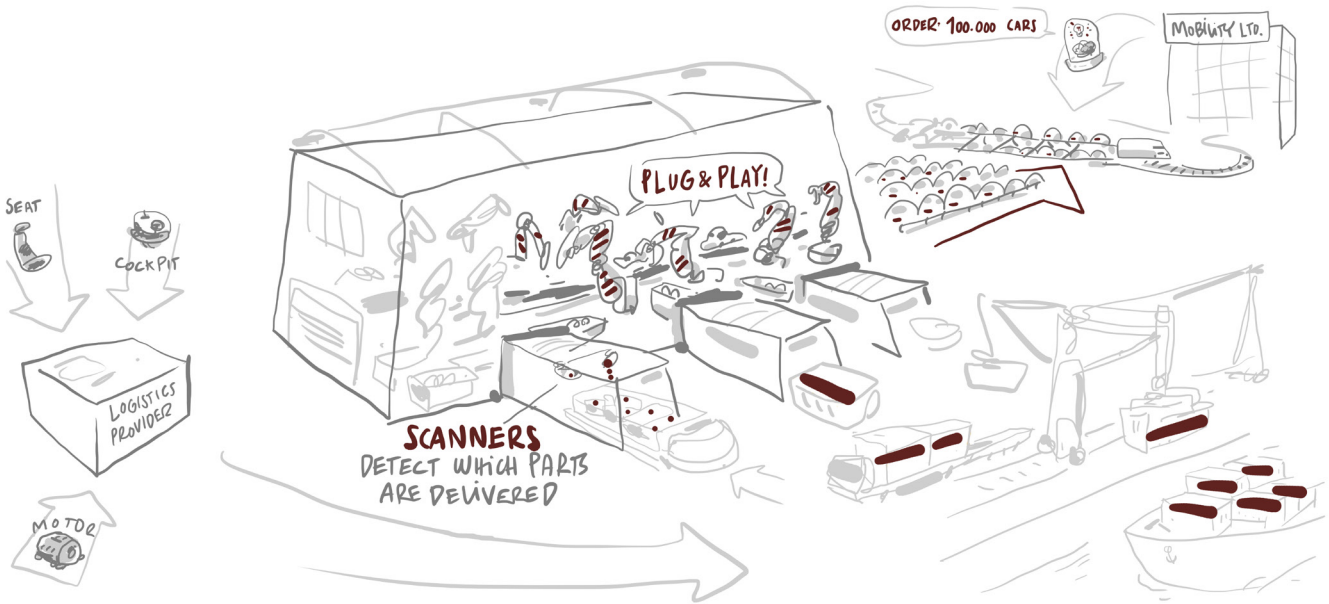
The most significant threat to the OEMs from the new shared-vehicle market, however, is the risk of losing contact with their customers, who will deal directly with "mobility-as-a-service" companies instead. This new class of company will buy standard cars in bulk and rent them to the public for single journeys using online platforms and apps. One key question: Will OEMs that offer their own on-demand mobility services be able to compete with technology businesses that are set up for that express purpose? If not, they risk becoming a supplier to the mobility companies, no longer setting the rules of the game.

Below, we set out in detail our vision for how the two new types of vehicle factory mentioned above will operate, and the impact of these production changes on the size and role of the automotive workforce.

Plug and play

Shared mobility will gain importance very rapidly. OEMs already offer mobility services, such as Daimler's Car2go, which provides pay-per-ride Smart and Mercedes-Benz cars for hire in U.S. and European cities. However, as demand increases, particularly among young, urban drivers who don't aspire to own a car, we believe OEMs will need to create new production facilities to produce high volumes of standardized vehicles as cost-effectively as possible.

In this new market, drivers won't care about the color of the paint or the hardware inside. They will simply pick up the nearest car to get them where they need to go. Even in scenarios where a person will want to use a particular type of vehicle for a particular purpose — using a pickup truck to carry a heavy load, for instance — OEMs will produce standardized versions of these vehicles, for sale on a bulk order basis. Any individualization will happen when the car connects with the



driver's phone to offer access to that person's music, contacts, and social networks. Whether the vehicle is autonomous or driver-controlled, powered by electricity or gasoline, the vehicle will still essentially be a standard model. This means that price will be the main differentiator for mobility-as-a-service companies that buy the cars and provide the client interface.

The employees left in the plant will be there to control and survey the system, and to fix problems. Assembly will be carried out by robots, and to make that simpler, more ready-built modules will come into play (*see Exhibit 1, next page*).

The use of preassembly is rising to another level with, for example, the engine, transmission, and axle combined on one platform and delivered to the OEM's plant to be fitted into a common body using standardized connections. At the moment, final assembly is complicated by a variety of parts, screws, clips, and adhesives. The plug-and-play plant of the near future will require standardized parts that fit together like Lego bricks.

Exhibit 1

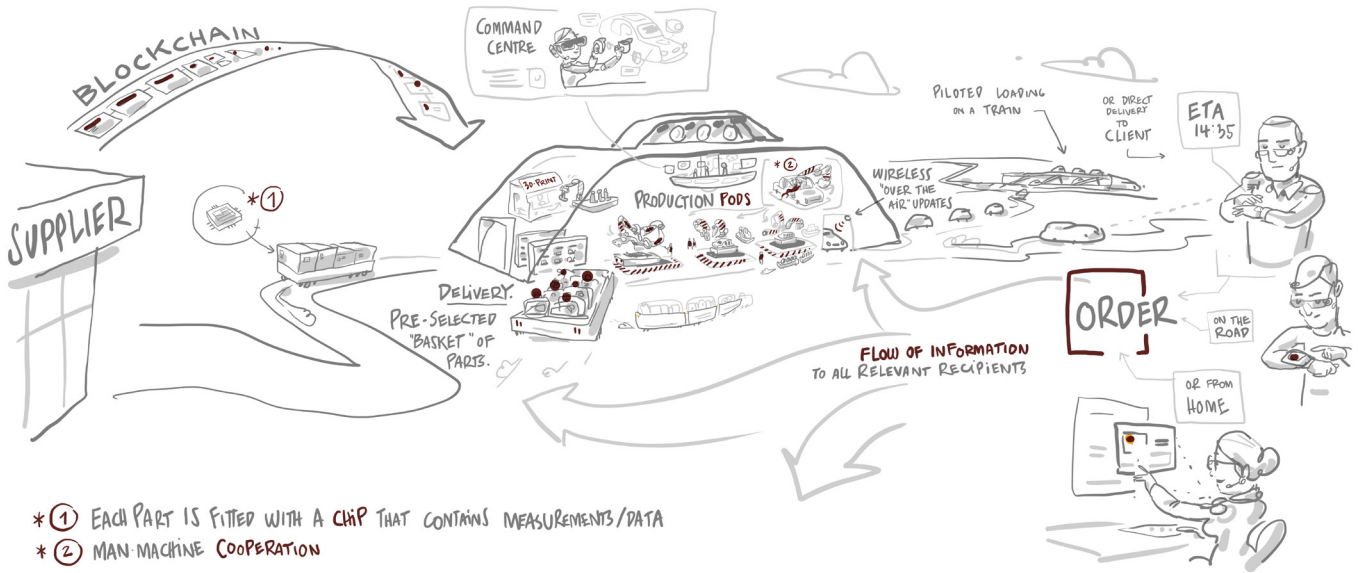
Rebalancing the auto workforce: More jobs in data, fewer in operations

Department	Job profile	Change 2018–30		Cause
		Plug-and-play plant	*Flex champion*	
Production	Data engineer	78%	98%	Increasing importance of data
R&D	Industrial data scientist	89%	89%	Increasing importance of data
R&D	Software engineer	75%	91%	Greater use of machines operated by software
Production	Robotics and industrial automation expert	54%	81%	Increase in use of machines, especially by suppliers
Production	Smart machine maintenance engineer	45%	58%	Increase in use of "smart" machines
Production	User experience designer	28%	28%	Increased demand driven by more complex processes and machines
Production	3D-printing expert	18%	30%	Increase in production via "additive manufacturing"
R&D	3D-printing expert	18%	26%	Use of 3D prototyping
R&D	Process developer	16%	21%	More complexity in processes
Production	Electrician	7%	7%	More mechanization
Production	Maintenance electronics	0.9%	–6%	Slight increase in mass production, slight decrease in flexibility
Production	Mechanic	–5%	–5%	Use of plug-and-play processes and machines
Production	Health and safety officer	– 5%	–11%	Heavy-duty work done by machines
Production	Maintenance mechanic	–18%	–18%	Better preventive maintenance
Production	Shop-floor manager	–18%	–18%	Machines needing less guidance
R&D	Construction	–16%	–21%	Artificial intelligence and software automation
Production	Line manager	–24%	–24%	More efficient processes and automation
Production	Operative production	–52%	–37%	Automation
Production	Shop-floor logistics	–63%	–56%	Use of autonomous guided vehicles

Source: Strategy& in collaboration with RWTH (Rheinisch-Westfälische Technische Hochschule) Aachen University

Flex champion

This second area of vehicle production must feature the highest possible degree of flexibility. Individualization and customization are already important today, and most assembly lines offer good flexibility. The line producing a certain brand of luxury vehicle, for example, makes the coupe, the sedan, and the estate car. Assembly lines today deal with a range of types of vehicle on one line. Some vehicles take more time to assemble than others, depending on complexity of model (for example, a luxury version of a particular model might have more interior features or a larger engine). Typically OEMs will build in, and budget for, the extra time needed to allow workers on an assembly line to assemble a more complex vehicle that occasionally comes along on the same line on which the simpler vehicles are being assembled. Currently, the average amount of extra time that's budgeted does not add a great deal to the average time taken for workers to complete assembly of all vehicles on the assembly line — the so-called utilization rate. But in the scenario we



predict, there will be more variations of vehicle model to assemble — and more often — on the same assembly line. That is due in part to a greater mix of features like internal combustion, hybrid, and fully electric engines for each model. As these variations increase, so the utilization rate will drop, until the economics of producing vehicles in this way are no longer efficient.

Focusing on one element helps to illustrate the point. In electric vehicles with batteries, the vehicle's body design has to take account of the fact that a battery has a large charge capacity. For safety reasons, the battery cannot be mounted in the way traditional engines and associated equipment are. The battery's assembly is also completely different from an internal combustion engine's. So instead of one assembly line with a fixed sequence of stations, in the "flex champion" plant, each vehicle will take a unique route through the stations that relate to its specifications, made possible by AGVs taking the vehicle around the factory.

It is worth noting that highly customized production already exists at the very top, "prestige" end of the market — at plants for extreme sports cars, for example. But the companies making them do not produce the volumes that would be required to support the broader premium market. Nor do they make such cars quickly enough.

Doubling down on data

Data management will be essential in both the plug-and-play and the flex champion scenarios. This includes full transparency of real-time data from suppliers on the location, delivery time, dimensions, and quality of thousands of components, as well as data transparency on progress through the assembly process. In the flexible plant, data will also be vital for managing complexity. In both production models, each part must have a "digital twin," or digital record, of details such as its exact measurements, weight, and where it was made. Essentially, this will require the OEM that's making a physical vehicle to produce a digital model as well (and, by the way, dispensing with paper documents that are common in current production processes).

Data will help in other ways. It would be possible, for instance, to build an intelligent system for a "self-correcting" body shop. If the machines and workers know a roof is arriving from a supplier with dimensions or steel quality that varies in specification for its eventual purpose, they can adapt the way they fit it to the rest of the vehicle, reducing scrap and time spent reworking.

Data will be vital for managing complexity.

Work environment of the future

Based on survey data gathered from automotive industry experts, in conjunction with the University of Aachen, we calculate that by 2030 the number of people working on the assembly line and in the body and paint shops will be halved because of automation and the advent of the new assembly models outlined above. There will be a cascade of other effects across multiple types of automotive jobs.

For example, shop-floor logistics roles will be reduced by around 60 percent by the same year, partially due to humans being replaced by AGVs. These changes will gather speed as soon as 2021, by which time we expect reductions of more than 20 percent in both categories of assembly plant roles.

OEMs must start now to build the workforce they will need over the next decade, both by hiring people with the right skills and by retaining and retraining their existing employees.

We estimate that by 2030 the number of data engineers will almost double in the flexible plant and increase by 80 percent in the plug-and-play plant, while the number of software engineers needed will rise by 90 percent and 75 percent, respectively.

Things generally will need to speed up too. We expect the time between R&D and production to shrink to two years by 2030, from between three and five years now, to keep pace with technological changes. This makes agile ways of working imperative. It will pay to have flatter hierarchies to speed up decision making, to engender continuous collaboration between development and production teams, and to "reverse mentor" older workers with digitally native younger staffers.

Geographically, we expect these changes to happen fastest in the U.S., where labor and health and safety laws make job changes and reductions, and human–machine interaction, relatively straightforward. In Germany, the transformation will be slower because of union influence and more permanent contracts among workers.

The road ahead

Since Ford began mass-producing cars more than a century ago, the car itself has transformed time and again. However, the business model involved in selling one vehicle to one owner has not altered much in that time.

The shift to shared use, accompanied by ever-greater individualization, is about to overturn that model, and OEMs must change. If they don't, they risk being overtaken by tech companies offering mobility-as-a-service directly to customers, and going to the cheapest supplier for bulk deliveries of standard vehicles.

OEMs should act now, making the right choices for their production models and future workforce.

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