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The era of digitized trucking

Transforming the logistics value chain

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Executive summary

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Just as the arrival of the connected car is already changing how carmakers will operate in the future, the advent of the digital truck will completely transform how freight is transported on the world's highways. Thanks to a combination of new technologies, trucks will move down the road guided by a wealth of information from transportation infrastructure and other vehicles, improving utilization through remote maintenance, increasing efficiency, and boosting safety. Eventually, these trucks will drive themselves, freeing up drivers to take on administrative tasks, and eventually doing away with them altogether.

These advances will have an equally profound effect on the entire logistics system. Trucks will become even more tightly integrated into the entire logistics chain, with the arrival of shipments to factories, warehouses, and end customers timed precisely, as all the players across the supply chain gain full transparency into the whereabouts of their goods. And ultimately, trucks will be able to communicate their contents and destination with other trucks and with technology platforms that will automatically match shipments with trucks with available space, rerouting them as necessary.

As these digitally enabled, cloud-based solutions come on line, they will rearrange how the logistics business operates, rendering obsolete old business models and enabling new ones. Some players, such as the truck makers, will look to offer increasingly sophisticated shipping solutions, taking over much of the territory now controlled by shipping companies and other logistics providers, as will many large end customers. Technology companies will try to enter the market as well, offering their own trucking and logistics platforms — and even, perhaps, their own trucks.

The promise of connected trucks combined with the digital supply chain is huge. But so are the risks for those players that don't move now to begin building the capabilities and business models needed to win in this new world.

Further down the road

Imagine a world in which long caravans of large trucks travel in lockstep down major highways while each of the trucks automatically transmits its whereabouts, estimated time of arrival, and load information to its next stop. The warehouse system automatically assigns each truck to a loading dock, where several autonomous forklifts stand ready to unload it. Then they move the load on to another portion of the warehouse, where it is sorted by machine for local delivery routes and loaded onto the proper small autonomous electric trucks for final delivery.

This "digitized trucking," and the logistics industry of which it is a part, is still at least a decade in the future, but parts of it are already being put in place — thanks largely to two major global trends that are transforming the trucking industry. First, efforts on the part of regulators around the world to manage climate change and to save energy and resources are forcing the industry to develop cleaner, more efficient trucks and optimize the use of heavy vehicles. Second, social and cultural changes are opening up new markets and increasing expectations for the efficiencies to be gained through autonomous vehicles and the digitized supply chain.

The effect of these trends isn't just a matter of how trucks move down the highway, or how the global supply chain is managed. Rather, digitized trucking will transform how virtually every stakeholder in these linked businesses — original equipment manufacturers (OEMs), logistics companies, warehouses, and local delivery businesses — will operate. Some stakeholders will see a wide range of new business models open up, while others will likely struggle as their roles in the logistics chain are diminished.

And in the longer term, the trucking business will likely divide into two distinct markets. Emissions regulations, increased competition, big strides in connectivity, and coming disruptions in the entire logistics chain will primarily affect developed economies. In emerging markets, the issues will involve the need for more reliable and

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economical trucks, a growing interest in regulating emissions, and strong overall growth prospects, but not necessarily the development of digitized solutions. These distinctions will likely last into the foreseeable future.

In this report we focus on developed markets: how the forces behind the transformation of trucking will develop, and what that means for OEMs, trucking companies, and other logistics providers in the long run.

Driven by technology

Perhaps the best way to understand the technologies that are already being implemented in the trucking industry, and how they will transform the industry's many stakeholders, is to break them down into two primary areas: the truck itself and the logistics chain of which it is an essential part (*see Exhibit 1*).

The connected truck. Like cars, trucks are changing rapidly. In addition to increased efficiency, new sensor and connectivity technologies linking the truck to its surroundings, to the repair shop,

Exhibit 1
The six technological advancements that will transform trucking and logistics
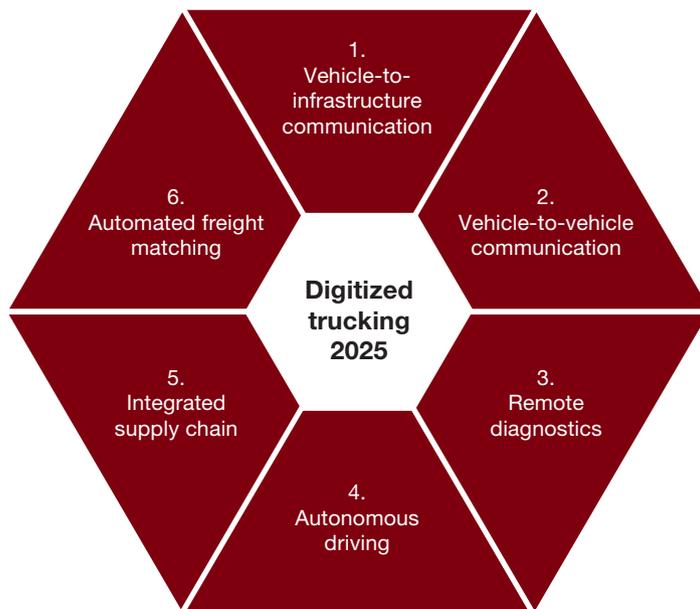
Source: Strategy& analysis

and to other vehicles are making obsolete the notion of the lone truck traveling down the lonesome highway. And in the longer run, they will lead to the brave new world of autonomous trucking.

- **Vehicle-to-infrastructure (V2I) communication.** This technology makes it possible for trucks to remain in constant communication with their surroundings through GPS tracking and digital links between the truck and the road or other infrastructure installations (*see Exhibit 2, next page*). The goal is to optimize traffic flows, automate routing, improve parking efficiency and safety, and allow drivers to be more efficient.

  The technology will provide drivers with real-time information about congestion and accidents and automatically update routes. Automated parking features will provide suggestions on where to park depending on the driver's level of fatigue, regulatory provisions, and the traffic situation. Intelligent road signs will even be able to signal to specific vehicles.

- **Vehicle-to-vehicle (V2V) communication.** Trucks will be able to communicate automatically with other vehicles on the road, decreasing fatalities and improving accident rates. Intelligent telematics systems linking trucks will share information regarding position, speed, and direction, allowing for automated alerts.

  When integrated with advanced driving technology such as adaptive cruise control, collision avoidance systems, and radar, V2V will also enable trucks to save fuel through platooning: moving down the road in tight convoys, close enough to benefit from the decrease in aerodynamic drag. This technology can save as much as 11 percent of fuel costs for a three-truck platoon. Of course, the lead truck won't generate these savings, so an internal payment system will allow the trucks in the platoon to share the savings equally. The first examples of this technology are already coming on the market, but the legal and regulatory status of platooning still has to be worked out before its benefits can be fully realized.

- **Remote diagnostics.** Through constant monitoring of the condition of the truck, remote diagnostics will allow companies to make more timely repairs, develop more efficient maintenance schedules, and considerably reduce truck downtime. It is estimated that the technology can prolong a truck's service life and reduce maintenance costs by as much as 5 percent. The technology will also provide truck manufacturers with detailed understanding of how vehicles are used, as well as the ability to control their electronics remotely. And the attraction for customers is clear: improved utilization of trucks and significant maintenance savings.

Exhibit 2
Examples of improved traffic flow and safety through vehicle-to-infrastructure (V2I) communications

1. Real-time data sharing in combination with intelligent road signs and vehicle information

2. Intersection assistance and hazard warning

3. Automated parking place suggestions

4. Automatic parking and rest necessity notification

Source: Strategy& analysis

The truck monitors its own condition and maintenance status and gives real-time updates to the driver and fleet managers (*see Exhibit 3, next page*). These systems will be able to automatically suggest the nearest repair shop and even contact it about the problem and time of arrival. And because the repair shop will already have the diagnostic information, it can begin making repairs as soon as the truck arrives. This will improve how the repair shop operates, increasing utilization and profits from spare parts, and improving customer satisfaction. It will lead to more integrated service agreements between repair shops and fleet owners. And it will be the first step toward advanced mobility solutions offered by OEMs and other players.

- **Autonomous driving.** Ultimately, of course, these technologies, combined with short- and long-distance radar, laser detection, cameras, sensors, and 3D mapping, will eventually lead to the era of self-driving trucks — and completely revolutionize the entire industry. The first road tests for autonomous trucks are already under way, carried out by OEMs such as Daimler and Freightliner, its U.S. subsidiary. Whether these trucks will be fully accepted around the world is unclear, however, given ongoing regulatory concerns about drivers' control of the trucks and whether the driver or the truck is responsible for the truck's behavior in emergency situations. And the complete elimination of the driver is still far in the future.
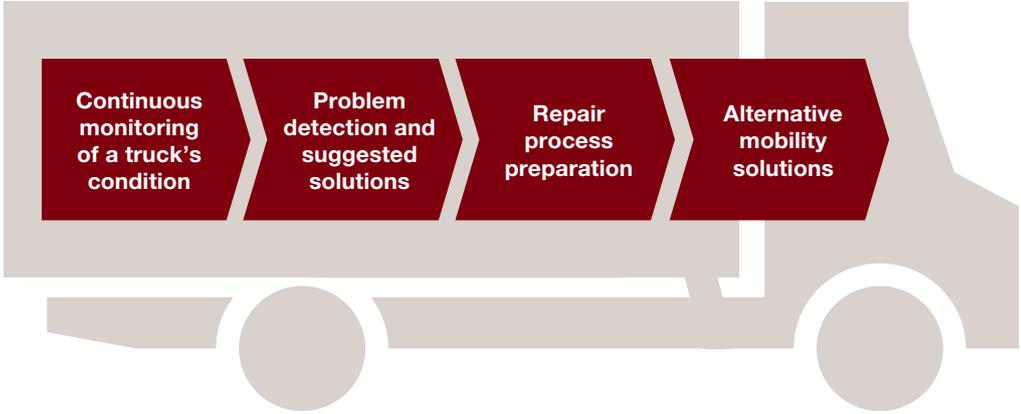
Meanwhile, the development of the completely autonomous truck will likely come in stages. Within the next 10 years, drivers may not be needed in long-haul trucks anymore, but will continue to take over trucks entering urban areas, the way local pilots board large ships as they enter a harbor. And drivers will still be needed for local deliveries. It will take another five years or so before all trucking becomes fully autonomous.

The key advantage of the connected truck over the unconnected truck lies in its total cost of ownership, which will vary by its stage of autonomy. Connectivity itself will play a major role in recruiting younger, more "digitized" drivers, whom trucking companies are desperate to hire, in part because they are less expensive. Automated driving saves money by optimizing accelerating and braking, in addition to platooning. Improved safety will reduce insurance premiums. And drivers can turn their attention to administrative tasks that would otherwise have to be done by others. In the end, of course, the cost of the driver can be eliminated completely.

Drivers may not be needed in long-haul trucks, but will still be needed for local deliveries.

Exhibit 3
How remote diagnostics will improve truck utilization

Continuous monitoring of a truck's condition → Problem detection and suggested solutions → Repair process preparation → Alternative mobility solutions

Source: Strategy& analysis

Exhibit 4, next page, breaks down how much the connected truck and autonomous driving can ultimately save fleet owners. The current annual operating costs are around €115,600 (US$128,900) for an average traditional long-haul truck, and only some of the costs can be reduced through connectivity and automation — notably the cost of fuel. Depending on the stage of automation and on regulatory changes, fleet owners could save between €17,000 and €32,400 ($19,000–$36,100) a year per truck.
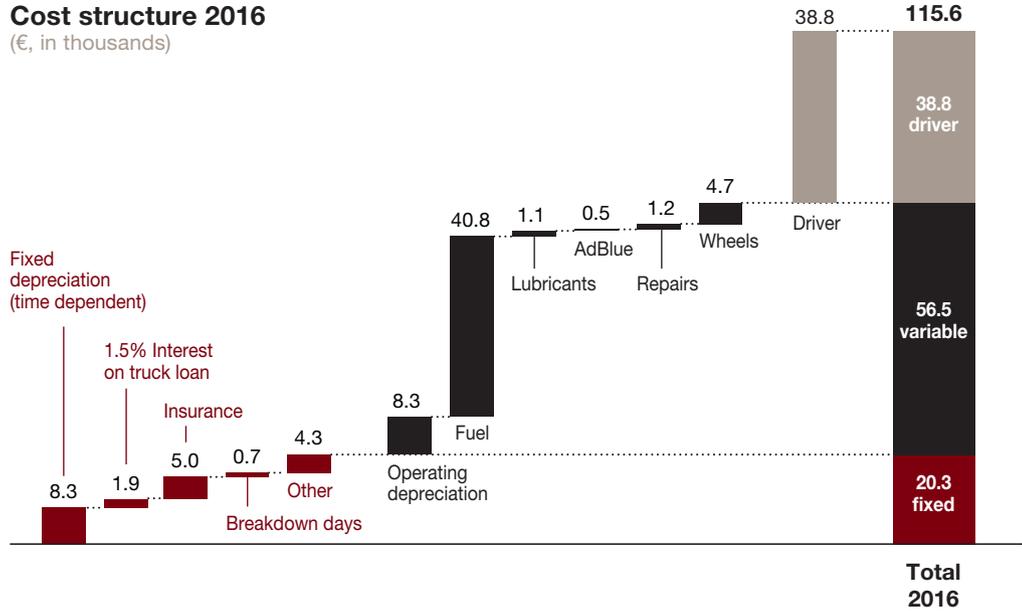
This level of savings, by itself, will completely change the economics of fleet ownership. But this is by no means the only way the trucking industry will be transformed. The connected truck and other technologies, many of them already in place, will also revolutionize the entire logistics industry.

Exhibit 4
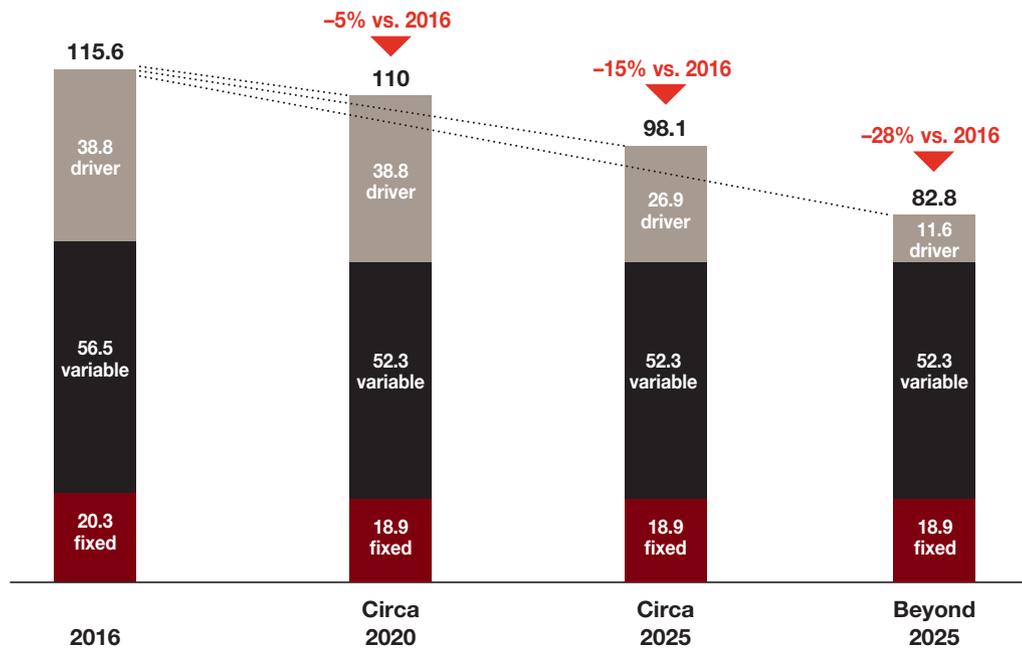## Reduced operating costs with autonomous driving technologies

Cost structure 2016
(€, in thousands)

Fixed depreciation (time dependent)	8.3
1.5% Interest on truck loan	1.9
Insurance	5.0
Breakdown days	0.7
Other	4.3
Operating depreciation	8.3
Fuel	40.8
Lubricants	1.1
AdBlue	0.5
Repairs	1.2
Wheels	4.7
Driver	38.8

115.6

38.8 driver
56.5 variable
20.3 fixed

Total 2016

Future cost structure
(€, in thousands)

	2016	Circa 2020	Circa 2025	Beyond 2025
	115.6	**110** −5% vs. 2016	**98.1** −15% vs. 2016	**82.8** −28% vs. 2016
driver	38.8	38.8	26.9	11.6
variable	56.5	52.3	52.3	52.3
fixed	20.3	18.9	18.9	18.9

Note: "Other" includes tax, testing costs, fixed rate for cleaning, and communication costs.

Additional investment and operational costs for autonomous technology are included. Costs are based on annual driving of 140,000 kilometers. Due to rounding, numbers shown here may not add up precisely to the totals provided.

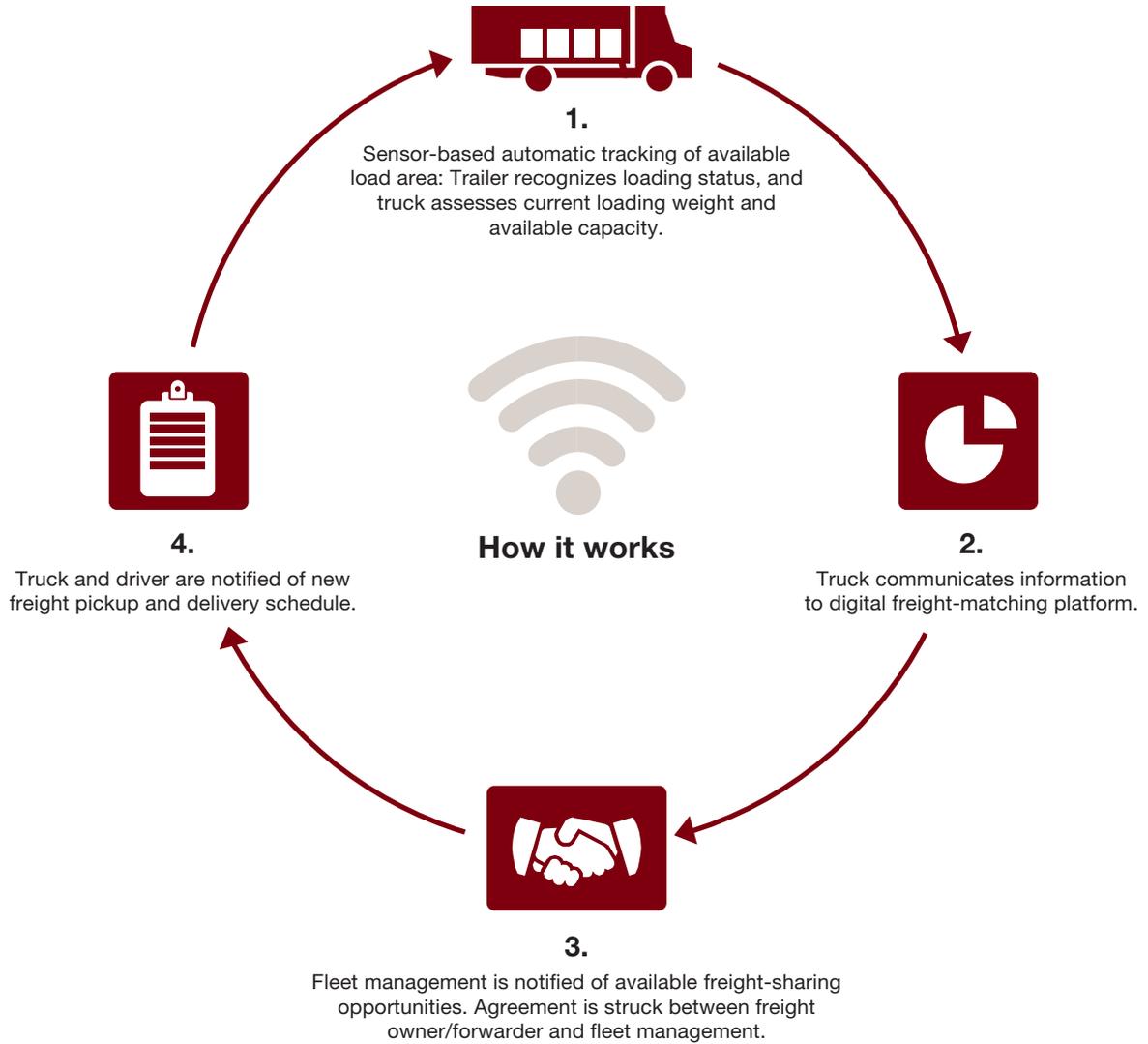Source: Lastauto Omnibus (May 2016); Strategy& analysis

Digital logistics

As critical as the connected truck will be in bringing sweeping changes to the global transport of goods, its very connectivity will allow it to be fully integrated into the entire logistics effort. That in turn will fully enable two key elements of the effort: the integrated digital supply chain and freight matching.

- **The integrated supply chain.** It will soon be possible to integrate the truck into real-time logistics data across the entire supply chain, from parts and materials suppliers to manufacturers to warehouses and distributors and finally to the end customer. Thus, for example, when a customer sends an order to a manufacturer, the system will send back a report on the availability of the goods and timing of shipment, enabling the manufacturer to optimize its just-in-time production schedule. Once the goods are available, the shipment will be dispatched from the warehouse along a predetermined route. If an accident or heavy traffic impedes the on-time arrival of the truck, the system can automatically determine a new route, and send a new estimated delivery time to both the shipper and the customer. Given the delay, the system will then calibrate changes in the shipping rate and cost of the goods. Moreover, manufacturing customers whose goods are delayed will be able to make immediate changes in their production sequences to avoid loss of production capacity while waiting for the missing parts. All that's needed now is their approval of the changes.

- **Automated freight matching.** Thanks to their ability to communicate with fleet management and with shippers of goods — and in the future with cloud-based solutions for freight matching — trucks will eventually be able to determine whether they can take on additional freight. The truck trailer itself will be able to determine through sensors its available space and weight, as well as scheduled route, ETA, and other relevant information, and communicate this data to a digital freight-matching platform (*see Exhibit 5, next page*).

Trucks will eventually be able to determine whether they can take on additional freight.

Exhibit 5
Freight-matching information flow

1.
Sensor-based automatic tracking of available load area: Trailer recognizes loading status, and truck assesses current loading weight and available capacity.

How it works

2.
Truck communicates information to digital freight-matching platform.

3.
Fleet management is notified of available freight-sharing opportunities. Agreement is struck between freight owner/forwarder and fleet management.

4.
Truck and driver are notified of new freight pickup and delivery schedule.

Source: Strategy& analysis

In turn, the platform will notify the driver and fleet management about available freight-sharing opportunities, and an agreement can be struck between the truck operator and the shipper. Ultimately, with the aid of smart cloud-based solutions, goods sitting in a warehouse equipped with their own communication chips will be able to contact trucks directly to find their own transportation to their intended destination. At this stage, not only will the efficiency gains throughout the supply chain be significant, but freight brokers themselves will no longer be necessary, as standard logistics processes will be digitized all the way through to when the invoice is submitted to the customer.

Industry transformation

The combination of technologies that underlie the connected truck and the digitally integrated supply chain has already begun to transform the entire logistics business. Expect to see further development of a hub-and-spoke delivery structure, with the logistics industry profoundly changed and many current players no longer relevant.

Hub-and-spoke. Thanks largely to the automation of the truck, the use of large distribution hubs will become much more common — indeed, necessary. Trucks will have the ability to drive the majority of hub-to-hub routes completely without human interaction (*see Exhibit 6, next page*). In a first step, platooning between these hubs will increase highway capacity by as much as 50 percent and play a key role in the regulatory debates around autonomous vehicles, thanks largely to the technology's huge impact on fuel consumption and CO_2 emissions. And it will significantly raise the utilization rates of trucks. Further improvements will come as trucks become increasingly automated.

The routing of the trucks will be entirely data-driven and freight matching between the centers will become common. Increases in transparency and efficiency will radically reduce the amount of time goods will be stored in the distribution centers, thanks to just-in-time delivery planning along the entire supply chain.
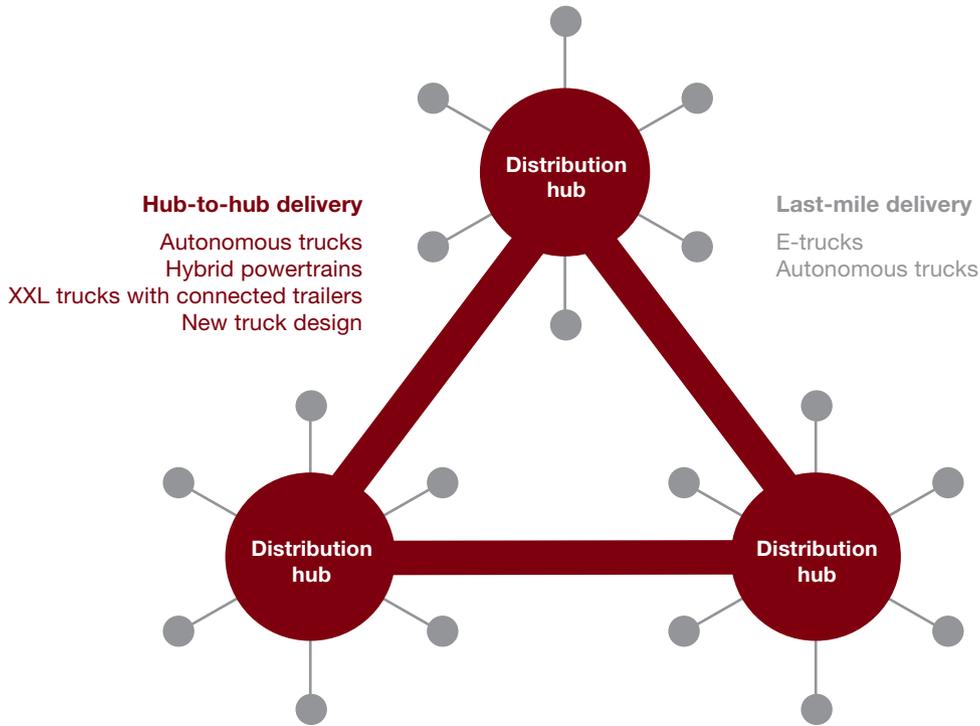
The long-haul trucks themselves will change as well. Alternative powertrain solutions such as hybrids will become much more common in an effort to reduce fuel costs and CO_2 emissions. And much longer combinations of trailers, already in service or the test phase in several European countries, will become common across the continent.

At the local level, actual drivers will make deliveries from the hubs in smaller hybrid and fully electric trucks, reducing pollution and fuel consumption. Ultimately, however, these trucks, too, will become autonomous. And the rise of so-called smart cities, incorporating sensors and communication technologies into their roads and infrastructure, will lead to more intelligent routing, decreased traffic, and easier delivery processes for the local trucks. Moreover, notification

The rise of smart cities will lead to more intelligent routing, decreased traffic, and easier delivery processes.

Exhibit 6
The hub-and-spoke network will be implemented much more widely

Hub-to-hub delivery

Autonomous trucks
Hybrid powertrains
XXL trucks with connected trailers
New truck design

Distribution hub

Last-mile delivery

E-trucks
Autonomous trucks

Distribution hub

Distribution hub

Source: Strategy& analysis

of delivery to recipients will be more precise, leading to a better customer experience and higher customer satisfaction in the world of online shopping.

The logistics chain. The current logistics chain is dependent on several different, clearly distinct market players, from the OEMs that build the trucks, to the fleet operators that deploy the trucks, to the logistics providers that organize the shipping of goods, to the end customer. The coming changes in truck technology and logistics processes within the global trend toward digitization will have a profound effect on how the chain is organized, with some players increasing their roles and others disappearing completely. Larger, more heavily utilized trucks will decrease the sheer number of trucks needed, forcing OEMs to look for value elsewhere in the supply chain — although overall logistics volume will likely increase in the future. But greater connectivity and, eventually, autonomy will allow them to participate more fully in both leasing and shipping.

As OEMs move upstream into these businesses with smart mobility solutions, however, they will put increasing pressure on current fleet operators and logistics providers. Already, some downstream companies, like Walmart and FedEx, are building their own trucks to fulfill their logistics needs; this development will put increasing pressure not just on OEMs but on the logistics providers as well.

Three scenarios

Given these changes, three different scenarios for the future logistics business are possible, depending on how aggressively the various players in the overall supply chain pursue the coming opportunities (*see Exhibit 7, next page*).

1. **OEM downstream integration.** OEMs will continue to manufacture autonomous vehicles, given their detailed knowledge of vehicle functions, maintenance, and efficient operation, and they will continue to own the underlying connected and autonomous truck technology. Thanks to their control of the truck technology, however, they will be in a good position to take over more and more of the functions of the leasing and trucking companies by providing mobility solutions to the market. Having the most modern truck fleet available and the ability to optimize operational costs by using big data, they will be able to offer especially cost-effective solutions. The challenge will be to avoid competing against their own customers or to find models that allow them to enter the market in parallel with other players.

   The OEMs will also start to expand into freight-matching solutions to gain additional control of the logistics chain and to add another brick to their digitized business models, further improving their positions as full mobility service providers.

2. **End-customer upstream integration.** Here, the end customer uses its market power to move upstream to become a logistics provider. This could happen in two ways: Either the customer simply meets more and more of its own logistics needs, or it actually builds the trucks — most likely in partnership with an OEM — that it needs to carry out the transportation of its goods, as Walmart and FedEx are already doing. Either way, no fully digital overhaul of the logistics business will be necessary, since all supply chain activity will take place within the customer's own business. At the same time, however, no end customer will be able to capture the entire market.

Exhibit 7
Three potential scenarios for the logistics value chain

Logistics stakeholder chain today

| Component supplier | OEM | Leasing operator | Trucking company | Logistics operator | End customer |
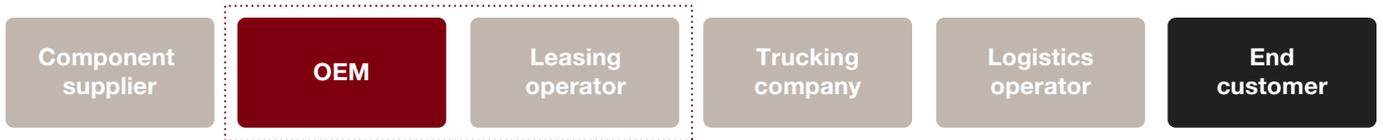
Alternative logistics stakeholder chains 2030

Scenario 1: OEM downstream integration

| Component supplier | OEM | Logistics operator | End customer |

Scenario 2A: End-customer integration with logistics

| Component supplier | OEM | Trucking company | Logistics operator | End customer |

Scenario 2B: End-customer integration with OEM

| Component supplier | OEM | End customer |

Scenario 3: Disruptive outside player

| Component supplier | Disruptive outside player | End customer |

Source: Strategy& analysis

3. **Disruptive outside player.** In this scenario, a tech company uses its strengths in software and innovation to move into the logistics business. A prime example would be Google, which is already the front-runner in autonomous driving technology. The company takes an innovative and disruptive approach to every business it enters, and given its advanced digital technology and experience, it could very well supply its own freight-matching digital solutions. Google's weakness, of course, is its lack of knowledge and experience in manufacturing actual vehicles. Another player could be Tesla, which recently announced a goal to build long-haul trucks with pure electric powertrains, and if it succeeds — a very difficult task, given the demands on the typical long-haul truck — the company would likely develop digitized mobility solutions for the truck as well.

These scenarios offer different visions of the future of the trucking and logistics industries, as the players develop more and more advanced digitized solutions and processes. In every case, however, various players — OEMs, end customers, tech companies — are putting real pressure on traditional logistics providers, threatening their very survival.

The traditional specialized trucking and shipping companies face the greatest risk — as the new entrants essentially take over their business, or at least become significant competitors. The added value that the traditional, typically midsized companies provide is simply not enough to enable them to survive as the industry becomes more digitized. In a connected and digitized logistics world, the only remaining traditional process will be the physical transportation of goods from A to B. Virtually every other main and supporting logistics process — from order placement and acceptance through delivery of documents and invoice submission after dispatch — will be fully automated. The end-to-end digitization of transport is not far away — the first solutions are in the testing phase already and will soon come on the global market.

The era of digitized trucking

The radical transformation coming to the trucking and logistics industries over the next 10 or 15 years presents many risks but also opportunities for all the players in the business. For some, the risks will be so great that they will likely not survive. For others, success will depend on their ability to understand the opportunities available to them, and to build or buy the capabilities needed to aggressively pursue them. The real risk lies in failing to move forward.

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