How Artificial Intelligence is Making Transport Safer, Cleaner, More Reliable and Efficient in Emerging Markets

By Maria Lopez Conde and Ian Twinn

Transport in emerging markets often faces acute challenges due to poor infrastructure, growing populations, urbanization, and in some regions rising prosperity, which increases vehicle traffic, cargo volumes, and pollution. Artificial intelligence offers new solutions to these challenges by making market entry easier and allowing countries to reach underserved populations, creating markets and private sector investment opportunities associated with them.

Artificial Intelligence, or AI, is already having a profound impact on the way we interact with the world around us. As a powerful set of technologies that can help humans solve everyday problems, AI has significant applications in several fields.

One such field is transport, where AI applications are already disrupting the way we move people and goods. From scanning traffic patterns to reduce road accidents and optimizing sailing routes to minimize emissions, AI is creating opportunities to make transport safer, more reliable, more efficient and cleaner. There are multiple applications of AI in both advanced economies and emerging markets that exemplify the contributions these evolving technologies can make to economies, though challenges the technology poses must be managed effectively.

What is AI?

AI has made substantial progress in the six decades since it was established as a discipline. Recently, AI advancements have accelerated, supported by an evolution in machine learning, as well as improvements in computing power, data storage, and communications networks.[1]

For the purpose of this note, we follow the definition and description of basic, advanced, and autonomous artificial intelligence that were put forward in EM Compass Note 69.[2] This also means that AI is not one type of machine or robot, but a series of approaches, methods, and technologies that display intelligent behavior by analyzing their environments and taking actions—with some degree of autonomy—to achieve specific targets that can improve various modes of transport.[3]

AI in transport

Market size

AI has already begun to dramatically change the world economy and will likely continue to do so. AI advances could add some $13 trillion to global economic output by 2030, according to analysts.[4] This includes the transport sector, where AI is expected to drive additional disruption. In 2017, the global market for transportation-related AI technologies reached $1.2 to $1.4 billion, according to estimates from global research firms. It could grow to $3.1 to $3.5 billion by 2023 (see Figure 1), registering a compound annual growth rate (CAGR) of between 12 and

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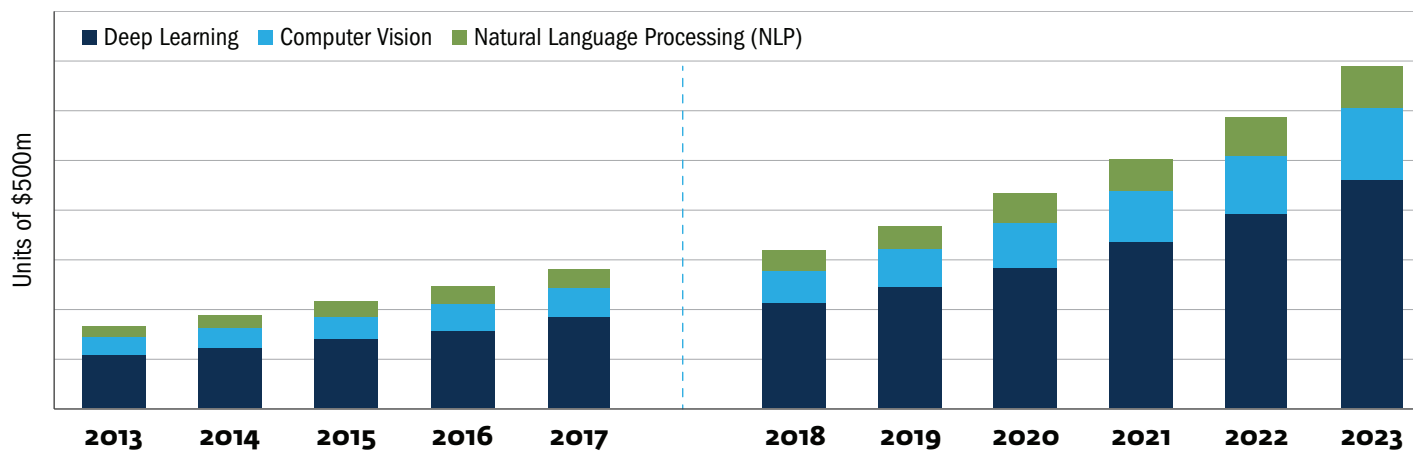
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FIGURE 1 Global Artificial Intelligence in the Transportation Market by Technology, 2013-2023 (US$ Millions)

Source: Prescient & Strategic Intelligence. 2018. "AI in Transportation Market Overview."

14.5 percent during 2017–2023, according to studies from P&S Market Research and Market Research Future.[5] The rapid growth of this market is driven by the many benefits AI can deliver to transport, including increased efficiency, pedestrian and driver safety, and lower costs. In 2017, North America is estimated to account for the largest share in the global AI transportation market, at 44 percent.[6]

Opportunities for AI interventions

Though autonomous vehicles, or AVs, get much media attention, AI applications in transport go far beyond driverless vehicles and are already having impact. On a much broader scale, AI can help solve a variety of problems in transport related to safety, reliability and predictability, as well as efficiency and sustainability.

Safety: Road safety for both drivers and pedestrians is a major public health issue. Road traffic-related deaths reached 1.35 million in 2016, up from 1.25 million in 2013.[7] Most of those deaths occurred in low-income countries.[8] While inadequate infrastructure—in particular, poor roads and vehicles without modern safety equipment—plays a role in the high death toll, human error is an important contributor. In the EU, human error (speeding, distraction, and drunk driving) plays a part in more than 90 percent of accidents on roads. More than 25,000 people lost their lives in these types of accidents in the EU in 2017.[9] Researchers believe that AVs could reduce traffic fatalities by up to 90 percent by 2050 in some developed countries.[10] Tesla's first attempt at an AV reduced accident rates by 40 percent when self-driving technologies were activated.[11] While AVs may not be ready for mass deployment in emerging markets in the short term, some ambitious estimates project there will be 10 million AVs on the road by 2020, with 1 of 4 cars being driverless in 2030.[12]

Reliability and predictability: As an enabler of the movement of people and goods, transport is dependent on consistent performance and the ability to forecast arrival and departure times. In public transport, providing timely and accurate transit travel time information can attract ridership and increase satisfaction of transit users.[13] The World Bank's Logistics Performance Index (LPI) includes timeliness as one of its six dimensions of trade to develop an indicator for a country's supply chain management. Uncertain and unreliable infrastructure, as well as congestion, have an impact on reliability and predictability. Urban mobility solution providers, such as Uber and Lyft, use AI in multiple ways to provide reliable pickup and drop-off times for their routes, and such technologies can be harnessed to improve the quality of public transport solutions globally. One example is Via, which is licensing its technology to the New York City Department of Education to design smart bus routes and provide transparency on pickups and drop-offs.[14]

Efficiency: Developing countries often rank low on the LPI because logistics expenditures as a percentage of GDP are usually higher, partly due to a lack of efficiency caused by inadequate infrastructure and poor customs procedures. Whereas developed countries usually spend between 6 and 8 percent of GDP on logistics, these costs can range from 15 to 25 percent in some developing countries.[15] AI can help optimize movements in order to maximize efficiency. In particular, the field of e-logistics—in which Internet-related technologies are applied to the supply and demand chain— also incorporates AI in several ways, such as matching shippers with delivery service providers.

Environmental: The transport sector worldwide is responsible for 23 percent of total energy-related CO_2

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emissions.[16] Without sustained mitigation policies, emissions from the sector could double by 2050.[17] AI technology that reduces the number of inefficient trips at sea and on the road by optimizing routes can improve fuel efficiency and reduce greenhouse gas (GHG) emissions. One eco-friendly AI application is truck platooning, a technique that connects several trucks wirelessly to a lead truck, allowing them to operate much closer to each other safely, realizing fuel efficiencies.[18]

How does the provision of AI-supported business models differ in emerging and advanced economies?

The adoption of AI technologies differs across industries and geographies. AI offers the promise of rapidly increasing productivity, but progress has not been even across the board. Some industries are at the vanguard of AI adoption partly because AI applications are more obvious for them. These sectors include healthcare, financial services, and transportation. Nevertheless, there is much variation in adoption across regions due to the state of infrastructure, scientific research, and the talent needed to implement AI solutions. Many EMs lag in the building blocks that enable AI, such as semiconductors, advanced telecommunication networks, and open data repositories. On the other hand, mature economies with established technology firms and research institutes have created ecosystems that are conducive to AI development; such ecosystems are not be present in many EMs.

While the United States is the global leader in AI development, China is leading the way in AI investment and adoption in EMs, with efforts on both the private sector and public sector fronts. On the public sector side, the Chinese government launched an AI strategy reaching to 2030, and private players such as search company Baidu and ridesharing app Didi are heavily investing in AI research.[19] Though other EMs may not lead in producing these technologies, as users of the technologies they can harness the power that AI can unlock, adapting them to their own contexts.

In addition, AI solutions can help EMs leapfrog development. AI-powered technology can allow small players with few assets and little capital to tap into existing resources, such as a city's truck drivers or motorcycle couriers, in order to provide efficient solutions for their clients. This can disrupt traditional business models and bring more cost-efficient solutions to sectors ripe for technological advances. This is already happening in the e-logistics space and can be beneficial in EMs, where barriers to starting a business, such as access to capital, are high.

Emerging market start-ups and mature business in the transportation space are already starting to digitize their businesses or build new tech-enabled business models altogether (such as e-logistics and e-mobility). With these data building blocks, on which AI applications can be further developed, comes the opportunity for further development and application of AI to optimize reliability, predictability, and efficiency.

Mature Economies—Sample Use Cases

In advanced economies, there are several transport subsectors in which AI is already making a significant impact.

Urban mobility: Small-scale autonomous bus trials have been implemented around the world, in places as diverse as Finland, Singapore, and China. Autonomous shuttles are already operational in Norway, Sweden, and France.[20] One example is Olli, a self-driving electric shuttle by Local Motors, an American company powered by IBM Watson. Olli is the first AV to use IBM's Watson and its Internet of Things database to analyze the surrounding traffic and make decisions based on that data.[21] Besides driving itself, Olli also provides its passengers with restaurant and weather information. Olli has been trialed in several U.S. cities. Ride-hailing and sharing platform Uber uses AI for driver and ride matching, route optimization, and driver onboarding.[22]

Traffic management operations: Many AI algorithms are well-suited to solving complex problems such as those posed by traffic operation, and they are being used around the world. One example is SurTrac from Rapid Flow Technologies, a Carnegie Mellon University spinoff, which provides solutions for intelligent traffic signal controls. It has coordinated traffic flows at a network of nine traffic signals in three major roads in Pittsburgh.[23] Rapid Flow helped reduce travel times by over 25 percent on average and wait times declined by an average of 40 percent during trial.[24] It also reduced stops by 30 percent and emissions by 20 percent.[25]

Logistics: Trucking is a key target for AI interventions, with cargo delivery as a potential early space for adoption of AV technology across the world. In 2015, Uber bought driverless technology firm Otto and a year later it completed the first autonomous truck delivery carrying 50,000 cans of Budweiser beer over a distance of 120 miles from Fort Collins to Colorado Springs.[26] Established players like Volvo, as well as trucking firms like Starsky, are also testing their own prototypes.[27]

Railways: GE transportation has developed intelligent technologies to improve the efficiency of their locomotives.

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BOX 1 Examples of AI models finding their way into the transport sector

1. Artificial neural networks (ANNs):

Description: They are inspired by the neural networks found in a human brain. They use previous experience and data points with varying weights to make decisions. ANNs can handle complex problems as they operate with large amounts of data, detecting nonlinear relationships. *(Gharehbaghi, Koorosh, 2016. "Artificial Neural Network for Transportation Infrastructure Systems." MATEC Web of Conferences, 81 (05001), 2016.)*

Uses: Some more sophisticated Global Position Systems (GPS) use ANN to determine the mode of transportation being used by gathering data from a GPS, an accelerometer, and a magnetometer. This is analogous to humans "feeling" distance by considering several data points. Furthermore, ANN models can be used in public transport to help predict arrival times for buses at stop areas. *(Gurmu, Zegeye Kebede, and Wei Fan, 2014. "Artificial Neural Network Travel Time Prediction Model for Buses Using Only GPS Data." Journal of Public Transportation, 17(2), 2014.)*

2. Artificial Immune System (AIS)

Description: This algorithm takes its inspiration from human biology, specifically, how human bodies react to disease-causing agents known as antigens. AIS models the feature extraction, pattern recognition, learning, and memory of human immune systems.

Uses: AIS are useful for pattern recognition, anomaly detection, clustering, optimization, planning, and scheduling. Engineers have used AIS to create a real-time regulation support system to help public transport networks find solutions when the network experiences a disturbance. *(Masmoudi, Arij, Sabeur Elkosantini, Sabeur Darmoul, and Habib Chabchoub, 2012. "An Artificial Immune System for Public Transport Regulation." HAL, August 2012.)*

3. Fuzzy Logic Model

Description: Modeled after human decision-making, fuzzy logic assigns data with numeric values between 0 and 1 to denote uncertainty. TutorialsPoint. "What is Fuzzy Logic?" Artificial Intelligence Tutorial. This system has been used for over 30 years and is best for situations with ambiguous conditions where the consequence for each action is unknown. *(Chattaraj, Ujjal, and Mahabir Panda. "Some Applications of Fuzzy Logic in Transportation*

Engineering." Lecture, Department of Civil Engineering, National Institute of Technology, Rourkela. Scientific American, 1999. "What is 'Fuzzy Logic'? Are There Computers That Are Inherently Fuzzy and Do Not Apply the Usual Binary Logic?" October, 1999.)

Uses: Fuzzy logic has potential for modelling traffic and transportation planning problems as they are ambiguous and vague. It also has traffic control applications, as it can signal time at a four-approach intersection and determine for how much time cars should be stopped. *(Chattaraj, Ujjal, and Mahabir Panda. "Some Applications of Fuzzy Logic in Transportation Engineering." Lecture, Department of Civil Engineering, National Institute of Technology, Rourkela.)*

4. Ant Colony Optimizer (ACO)

Description: This algorithm simulates ant colony behavior: the way ants choose their paths based on their own wish to take a short route and pheromones that relay the experience of other ants with each path. *(Kazharov, Asker, and V Kureichik, 2010. "Ant Colony Optimization Algorithms for Solving Transportation Problems." Journal of computer and Systems Sciences International, 49(1) pp. 30–43.)* This mechanism helps ants find the quickest course between two points. In computer science, this problem is also called the Traveling Salesman Problem, in which a salesman must visit X towns and return to the starting point using the path with the minimum cost.

Uses: ACOs can be used for better routing of public transport buses, as well as ride-sharing platforms that pick up various users, such as Via or Uber Pool.

5. Bee Colony Optimization (BCO)

Description: Similar to ACO, this algorithm takes the collective foraging movements of honey bees as an example of organized team work, coordination, and tight communication. The bees' movements inside the hive help scientists optimize movements for machines. *(Kaur, Arvinder, and Shivangi Goyal, 2011. "A Survey on the Applications of Bee Colony Optimization Techniques." International Journal on Computer Science and Engineering, 3(8) 2011.)*

Uses: BCO can be used to optimize travel routes, diminishing travel times, number of waits, delays, and air and noise pollution.

The smart-freight locomotives are equipped with sensors that collect data and feed it into a machine-learning application. The app analyzes the data and facilitates real-time decision making.[28] In Europe, 250 locomotives from freight carrier Deutsche Bahn Cargo have been retrofitted with GE's performance management software to monitor brake performance, motor temperature, and other conditions to predict maintenance. The system is more accurate because it feeds on real-time data on the locomotives' conditions rather than set metrics, like distance traveled. The smart locomotives were reported to have reduced locomotive failure rates by 25 percent in Deutsche Bahn's pilot project.[29]

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Marine: Autonomous ships are one obvious application of AI in the shipping sector. Shipping companies like Nippon Yusen and Rolls-Royce's marine operation (now Kongsberg) are testing their prototypes, the latter of which successfully tested an autonomous ship in Finland in 2018. But AI also provides the opportunity to optimize networks and routes, which could reduce fuel costs and emissions. In 2018, Hong Kong-based shipping line OOCL partnered with Microsoft's AI research center to optimize their network operations, a 15-week effort that generated savings of $10 million per year for OOCL.[30]

That same year, American company Sea Machines Robotics worked with the world's largest shipping company, Maersk, to install AI situational awareness technology on Maersk's ice-class container vessels.[31] This marked the first time that computer vision, Light Detection and Ranging (LiDAR), and perception technologies were used on a working ship. Sea Machines claims its enhancements can diminish operational costs by 40 percent.[32]

Aviation: Many companies have been looking into using drones for cargo delivery. For example, Nautilus, a California-based start-up is developing a cargo drone with a 90-ton capacity.[33] Beyond unmanned aerial vehicles in aviation, aircraft makers are already using AI to solve problems pilots face in the cockpit and predictive maintenance. English start-up Aerogility has been working with low-cost carrier EasyJet since 2017 to automate daily maintenance planning for its fleet, including forecasting heavy maintenance, engine shop visits, and landing gear overhauls.[34] The manufacturer Airbus uses a similar tool, Skywise, to offer predictive maintenance and data analytics. Other potential areas of focus include AI assistants for customer service and facial recognition for passengers.

Emerging Markets—Sample Use Cases

Traffic management operations: Just like in Pittsburgh, many cities around the world are beginning to use AI to help them solve traffic flow problems. In Bengaluru, India, where traffic jams are common, Siemens Mobility built a monitoring system that uses AI through traffic cameras that detect vehicles and calculate density of traffic on the road, and then alters traffic lights based on real-time road congestion.[35] Alibaba, China's e-commerce giant, launched "City Brain" to minimize road congestion, utilizing data from traffic lights, CCTV cameras, and video recognition to make suggestions for traffic flow management.

Trucking: China Post and Deppon Express, two Chinese logistics companies, are using intelligent driving technology from Fabu to deploy autonomous trucks on Chinese roads this year. The trucks were successfully tested at Level 4 of autonomy, which means they can operate under select conditions without human input.[36] (Automation in vehicles is measured on a standard six-level classification system where Level 0 entails no automation and Level 5 is full automation).

Aviation: There are opportunities for AI technologies in drones, with many applications for deliveries of all sizes and types. In places without established infrastructure such as parts of Sub-Saharan Africa, drones are being used in healthcare. In Rwanda, American start-up Zipline partnered with the Rwandan government to launch the world's first commercial drone delivery service, flying medical supplies—namely blood—by air faster than transport on wheels.[37] A Beijing-based start-up, Sichuan Tengden Technology, is developing a drone capable of carrying 20 tons of cargo and flying up to 7,500 kilometers.[38] Smart airport applications are also available, such as the initiative in Chinese airports to use intelligent navigation systems equipped with facial recognition and big data analysis for a paperless and more efficient experience.[39]

Logistics: Established logistics players can also harness the benefits of AI in their operations. Logiety, a Mexican company, is using machine learning to streamline the international customs and taxing process by classifying and sorting products for import and export by material, size, and weight, as well as matching them with their corresponding tariffs.[40]

Investment Opportunities

E-logistics is the most promising area for immediate investment opportunities that involve AI applications in EMs. Poor roads, suboptimal truck utilization, unreliable tracking and routing, as well as a lack of transparency in cargo movement, all hinder the efficiency of traditional logistics. A host of new start-ups have been utilizing technology, including AI, to help solve the efficiency and reliability problems that the traditional logistics industry faces, introducing data analytics and optimization to lower costs.

Known as e-logistics companies, the services these start-ups specialize in tend to fall into three categories: (1) transportation data enablers, which provide platform-as-a-service offerings to improve transportation/location services; (2) long-haul/inter-city transportation, which usually

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aggregate truckers and shippers to facilitate the movement of goods across cities through a digital platform; and (3) last-mile/intercity transportation, which aggregate local delivery drivers and SMEs/e-commerce companies for last-mile delivery solutions within cities. Over $4.2 billion has been invested in the global e-logistics sector as of December 2017.[41]

AI is helping fuel the success of e-logistics providers in emerging markets. Since 2015, IFC has invested in nine e-logistics companies across China, India, Brazil, Sri Lanka, and Africa. Launched in 2015, Shadowfax, an IFC investee, is an Indian last-mile express logistics start-up that integrates with e-commerce companies' online deliveries through its partners, the drivers. A leading player in the space, Shadowfax is operational in 80 cities and services large corporate clients across the food, grocery, fashion, and consumer durables industries, mostly utilizing motorbikes. To power its delivery platform, Shadowfax uses an AI-driven solution named Frodo to optimize delivery routes. "Frodo determines, for instance, which partner would be able to go and the most optimal route for the rider," the company's vice-president said this year.[42] Machine learning is also incorporated into the algorithm, so that Frodo tracks data points, timeliness, and driver performance to continue optimizing routes.[43] In 2019, IFC invested $4 million in Shadowfax as part of a Series C round to help the company expand to new cities and customers.

Players like these utilize powerful AI technology and asset-light business models to provide e-logistics service to large clients in the disorganized and fragmented logistics sector in India—a sector that is expected to grow at a compound annual growth rate of 10.5 percent in the next two years. This is essential, as India, which has made much progress toward reducing logistics costs in recent years, still spends between 13 and 14 percent of GDP on logistics.[44]

Loggi, another IFC investee company and one of Brazil's newest unicorns, is a logistics start-up that connects couriers to customers that need express last-mile delivery services. The company already uses an app to connect motorcycle delivery drivers and its clients in various sectors. In order to fund its expansion over the next five years, the company is looking to leverage AI and big data to optimize delivery routes and timeliness. To that end, the company is looking into attracting a team of programmers.[45] IFC has invested over $9 million in Loggi since 2017.

Though not strictly AI, investments in big data and digitization more broadly form the building blocks of AI technology. Start-ups and mature companies that digitize faster and have more tech-enabled business models will have

the data necessary to deploy AI to optimize their reliability, predictability, and efficiency. China's Uber-for-trucks start-up Full Truck Alliance, an IFC investee, collects data from its truck drivers on delivery and reliability and utilizes that information to provide ancillary services, such as credit lines to its customers alongside partners. Full Truck Alliance also boosts efficiency by matching trucks, loads, and drivers, and helping them find gas stations. The company generates revenue from membership fees from companies that use the system for long-haul services, as well as truckers' shipping fees, highway toll-card refills, and fuel purchases. In 2018, Full Truck Alliance also invested in plus.ai, a driverless truck start-up based in California that can assess how to deploy driverless technology on long-haul routes in China. In 2016, IFC invested equity to support the company's growth in the world's largest logistics market. This allowed IFC to participate in an innovative company that is enhancing efficiency in a fragmented industry.

The applications for AI in urban mobility are extensive. The opportunity is due to a combination of factors: urbanization, a focus on environmental sustainability, and growing motorization in developing countries, which leads to congestion. The rising predominance of the sharing economy is another contributor. Ride-hailing or ride-sharing services enable drivers to access riders through a digital platform that also facilitates mobile money payments. Some examples in developing countries include Swvl, an Egyptian start-up that enables riders heading the same direction to share fixed-route bus trips, and Didi, the Chinese ride-hailing service. These can be helpful in optimizing utilization of assets where they are limited in EMs, and increase the quality of available transportation services.

While AVs might already be deployed in mature economies, EM countries may have to wait before they can capitalize on this technology fully. KPMG's Autonomous Vehicle Readiness Index, which measures 25 countries' levels of preparedness for autonomous vehicle adoption, only includes five developing economies: China, Russia, Mexico, India, and Brazil. They occupy the last four spots on the list, except for China, which ranks above Hungary, at number 21 out of 25.[46] This is partly because some of these countries, including Brazil and Mexico, do not have many homegrown companies working on AVs at the moment. Some studies show Level 4 or 5 AVs may be commercially available in the 2020s, but their deployment will be limited by cost and performance. In the 2040s, approximately 40 percent of vehicle travel could be autonomous in mature economies.[47] Some EMs, including India and China, might see faster adoption than others.

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Risk and Challenges

AI can improve productivity and efficiency, but it may also have significant socioeconomic effects that must be managed. Some of the most significant effects are outlined below:

Loss of jobs: More than four million jobs will likely be lost in a quick transition to AVs in the United States, according to a report by the Center for Global Policy Solutions.[48] These jobs would include delivery and heavy truck drivers, bus drivers, taxi drivers, and chauffeurs.[49] AI is likely to accelerate the transition toward a service economy, upending established economic development models by speeding up job losses for low-skilled workers in many fields, including transport.[50]

Cost: A major constraint on the growth and development of AI in the transport market is the potentially high cost of some AI systems, including hardware and software. In addition, restrictions on foreign exchange and complex import procedures for computing equipment can pose additional barriers.[51]

Poor and underdeveloped infrastructure: Low-income and fragile countries face an enormous challenge in utilizing AI-based transport applications, as their infrastructure is not ready for implementation and is incapable of providing maintenance and repairs. A lack of reliable power sources and weak telecommunications networks is part of this obstacle. Countries that make few investments in technology research and hard infrastructure as a percentage of GDP may have a harder time harnessing the power of AI.

Lack of skills and education: Demand for AI experts has grown over the last few years in developed countries and EMs where AI investment is increasing. A lack of skilled AI talent has been widely cited as the largest barrier to AI adoption in developed countries.[52] The critical shortage is even greater in EMs (with the exception of China).[53] It takes time for a country to effectively incorporate new technologies, particularly complex ones with economy-wide impacts such as AI. This means it takes time to build a large enough capital stock to have an aggregate effect and for the complementary investments needed to take full advantage of AI investments, including access to skilled people and business practices.[54]

Regulatory requirements: The regulatory requirements for AI are difficult to predict, especially when it comes to assigning responsibility when machines, like humans, make mistakes. Although research shows that AVs could reduce traffic deaths, it is unclear who would ultimately be held liable if an AV were to cause an accident, harm, or fatality.

Privacy concerns: Asking users to opt in and provide more personal data for machine learning requires robust privacy laws. These laws must be balanced against the benefit of having more data in a telecommunications network.

Conclusion

AI holds the promise of dramatically increasing productivity and efficiency in several sectors, including transport, and these changes are not in some distant future; they are happening now. AI is already helping to make transport safer, more reliable and efficient, and cleaner. Some applications include drones for quick life-saving medical deliveries in Sub-Saharan Africa, smart traffic systems that reduce congestion and emissions in India, and driverless vehicles that shuttle cargo between those who make it and those who buy it in China. With great potential to increase efficiency and sustainability, among other benefits, comes a host of socioeconomic, institutional, and political challenges that must be addressed in order to ensure that countries and their citizens can all harness the power of AI for economic growth and shared prosperity.

Please see the following additional reports and EM Compass Notes about artificial intelligence and technology and their role in emerging markets and private investments in infrastructure: *Reinventing Business Through Disruptive Technologies—Sector Trends and Investment Opportunities for Firms in Emerging Markets* (March 2019); *Blockchain: Opportunities for Private Enterprises in Emerging Markets* (January 2019); *How Technology Creates Markets—Trends and Examples for Investors in Emerging Markets* (March 2018); *Bridging the Trust Gap: Blockchain's Potential to Restore Trust in Artificial Intelligence in Support of New Business Models* (Note 74, Oct 2019); *Artificial Intelligence: Investment Trends and Selected Industry Uses* (Note 71, Sept 2019); *The Role of Artificial Intelligence in Supporting Development in Emerging Markets* (Note 69, July 2019).

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