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MOBILITY AS A SERVICE

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Foreword

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The last decade has been a time of unprecedented change in how we move people through cities. The rise of Mobility-as-a-Service (MaaS) platforms, shared and networked vehicles, and other transportation technologies have changed the way we think about cities, transport, and data. The components of this new mobility environment, the focus of this document, represent an exciting future for us all.

Most acutely, new and disruptive transport will result in profound changes in cities. There are implications for jobs, social equity, and the environment. There are opportunities to shape advances in transportation to improve streets and better connect people; to reshape cities and improve the social and physical health of their residents. There are opportunities to reduce collisions and improve access to healthcare for those who need it most—particularly high-cost, high-need individuals at the younger, and older ends of the age spectrum. There is also the potential to connect people to jobs and change the way cities organize space and optimize trips.

Yet these opportunities also present challenges. Smarter transportation may not always translate into greater sustainability or equity. There is a risk that leaders from the public and private sector may not move fast enough to respond to these changes and achieve the full benefits of new technology. As is the case with any new innovation, the policy and design decisions that planners, engineers, and policymakers make now can frame the future. And one of the most important factors in these decisions is partnership.

Mobility is a space where insurance and actuarial sciences have an important role to play. From scooters to electric trucks and shuttles to flying cars, the reduction of driver-related mistakes, and emerging complexity of components required to operate without failure, require thoughtful discussions and action.

Insurance must be discussed in parallel with the built environment, architecture, licensing, and regulation. In many ways insurance represents a public bellwether for the efficacy of these new forms of transportation—a proxy for public trust. And there are many new forms that can emerge—from dynamic pricing, to use-based platforms, to insurance structures that protect the interests of the software and platforms that are essential to MaaS services. While capital markets may dictate the precise nature of this evolution, ultimately the discussions we have now, the partnerships that we create, will frame the future.

Onward.

Mobility of the future

The concept of travel is changing - quickly. We now trust strangers to drive us around in their vehicles; car owners offer their mini vans for rent by the hour; dockless electric scooters and mopeds are ubiquitous in many cities, available by the minute. Instead of buying, leasing, or owning a vehicle, today we can "subscribe" to the mobility services.

A decade ago these business models seemed futuristic and their presence raises important questions:

- Will they work?
- Can technology support them?
- How will payment work?
- Is insurance available, let alone can it be priced to accommodate task or usage-based consumption?

The answer is yes. Today, this is our reality. But today didn't arrive overnight.

We believe Mobility-as-a-Service (MaaS) will have a similar trajectory: slowly, then all of a sudden. It is not ubiquitous in every city today, but if ride-sharing and last-mile delivery going from infancy to global scale in the last five to eight years is any indication, MaaS will be here before we know it. Megatrends - including urbanization, new transportation consumption patterns, a change in customer expectations, rapidly evolving technology, and city innovations - are shaping the future of mobility.

New models have emerged to address transportation needs across a range of distances. These include ride-share, car-share, car subscriptions, micromobility, with more surely on the horizon. Today, these solutions do not replace but are intended to augment existing modes of transport.

Each represents a step forward in enabling us to shift preferences from private vehicle ownership to MaaS. As illustrated in Exhibit 1, MaaS aspires to provide a single entry point for all possible mobility solutions and allow for integrated and seamless customer experiences, including payment and insurance across the journey.

Companies reshaping mobility and offering on-demand services will need to identify key drivers to changing behaviors, address inconveniences, and understand what we are willing to pay in return for the added benefits. Balancing ideal requirements with regulations, environmental conditions, data-sharing requirements, and city infrastructure readiness will define the winners in this competitive market.

This paper explores the components of MaaS that are present today. It summarizes the landscape, opportunities, and risks.

We believe an exciting future lies in the sum of these parts.

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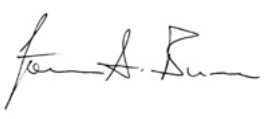


Exhibit 1: Mobility as a Service – an evolving ecosystem

Source: Marsh & McLennan Advantage Insights, Marsh, Oliver Wyman

Dissecting four key sectors of MaaS, here today

In the following sections, we **explore four transportation models**, their adoption trends, and future implications as they get integrated into the MaaS ecosystem: **ride-share, car-share, car subscription, and micromobility.**

RIDE SHARING

The shared mobility trend started with ride hailing. At one point, getting into a stranger's car was considered hitchhiking, but it now happens millions of times a day. With more drivers in more cities, ride-share is becoming a viable alternative to car ownership, especially in urban areas in developed economies.

Technological advances that enable shared mobility include:

- **GPS navigation devices** to optimize a driver's route for the shared ride;
- **Smartphones** to request and accept rides wherever they are; and
- **Rating systems** to establish digital trust and accountability between drivers and riders

Real-time big data and analytics help ride-share companies anticipate customer needs and behaviors, and secure more sophisticated and targeted insurance coverage that appropriately rates and efficiently prices. They aim to create a transportation system that reduces congestion, pollution, and greenhouse gas emissions, while providing value where it is needed most.

> A modal shift in shared mobility is the switch from the one-rider one-car model to the one-rider one-seat-in-a-car model.

Uber Pool, Lyft Line, and other companies like them allow riders to share journeys with others going in the same general direction. In exchange for a slightly longer total travel time, route optimization technology allows drivers to save fuel and reduce emissions. For riders, it allows on-demand travel at a reduced fare.

The global ride-hailing market is projected to reach almost US$200 billion by 2023,[1] and is currently segmented by types, ranging from on-demand and commute, to long distance. On-demand is expected to dominate the ride-share market whereas commute is projected to have the highest growth rate, at 16.5 percent CAGR in the same forecast period.[2]

By region as illustrated in Exhibit 2, Asia-Pacific leads the world with high internet penetration and strong adoption of on-demand rides due to the expanding urban population, an increasing pool of middle-class drivers and worsening traffic congestion. Although the US has dominated the North America ride-share market since 2017, it is Canada that has witnessed a surge in demand for ride-share services in recent years[3] with sharp population growth due to the influx of migrants in search of higher education and better jobs.

Risk Landscape

In general, there are two seismic challenges that the ride-share market must consider:

- Insurance structure and pricing - what coverage is active for the driver, at what point in the journey
- Whether drivers are considered independent contractors or employees

Both challenges continue to evolve, but a current snapshot is offered below.

Insurance Coverage Limits By Point In Time

Take Jane, a ride-share driver, for example. When she is "on-app" and looking for riders, is she effectively "driving to work" and therefore her personal insurance covers in an event of claim? Or is she actually "at work" and therefore the ride-share platform's commercial policy likely responds?

In the same scenario, once Jane accepts a ride and begins the journey to pick up the rider, has she started "working"? Note that Jane is not getting paid until the rider enters her vehicle. If coverage gaps like this potentially exist, why would Jane, or other ride-share drivers, offer their services to platforms?

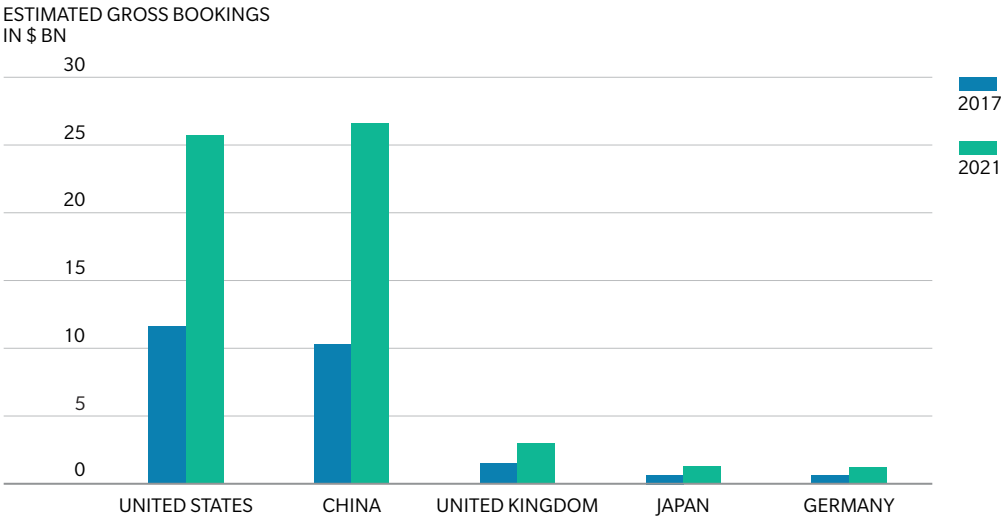
Thankfully, these puzzles have been largely solved in the last five to eight years as ride-share has become mainstream. Insurance has evolved to price different limits and coverage relative to the point in the journey. According to the National Association of Insurance Commissioners[4], there are three periods in the ride-share model, as illustrated in Exhibit 3.

With well-defined and regulated operating periods for the ride-share business model, the often-agreed definition of when drivers are actively engaged in fee-paying rides allows insurers to offer different limits and coverage relative to the point in the journey. Conversely, when the driver is off work (that is, App is off), the driver's personal insurance policy would be triggered in the event of a claim.

Usually for period 1, the ride-share platform's corporate policy responds, but it would require higher limits of insurance during periods 2 and 3, when a ride request is accepted, or the rider is in the vehicle. Increasingly in the US, state legislation has evolved to set insurance coverage rules and standards for ride-share companies.

Quantifying the period within which an accident occurs can also be validated with technology. Triggering

Exhibit 2: Ride-hailing revenue growth projections indicate a continual and rapid growth rate



Source: Statista Digital Market Outlook

different insurance limits by technology is a relatively new phenomenon – but it is now fairly common in the sharing economy and mobility sectors such as last-mile delivery of food and packages, and non-emergency medical transport, among many others.

Are Drivers Independent Contractors?

Another question many ride-share companies once thought answered is now being reconsidered in California with a new law that went into effect on January 1, 2020.

California Assembly Bill 5 (AB5) establishes a three-part test that businesses must satisfy to maintain that a worker is an independent contractor for employment purposes in the state. Some professions — including certain licensed physicians and licensed insurance agents — are exempt, with some conditions. But drivers from ride-share companies and potentially other marketplace contractors are not.

Known as the **ABC test**, for a worker to be considered an independent contractor the business must establish that:

- The worker is free from the company's control
- The duties performed by the worker are outside the usual course of the company's business
- The worker is customarily engaged in an independently established business, trade, or industry

Workers that do not meet all three criteria will be classified as employees, allowing them access to all corresponding benefits and legal protections, such as minimum wage and overtime restrictions.

AB5 codifies the 2018 California Supreme Court decision in the case of *Dynamex Operations West, Inc, v. Superior Court of Los Angeles,* which established a more comprehensive ABC test (encompassing the above criteria) to determine whether an individual is an employee or an independent contractor. The Dynamex criteria replaced a test that had been applied since 1989 following the *S.G. Borello & Sons, Inc. v. Department of Industrial Relations* case. The Borello test looked at a number of factors to determine whether an individual was an independent contractor, although not all factors had to be met.

Another component of the ABC test requires all businesses that use independent contractors, including transport network companies (TNCs), to demonstrate that their core business differs from the services that any independent contractors offer on their platform. This can be more of a challenge for homogeneous gig

Exhibit 3: Ride-share point in time model and corresponding insurance coverage

Generally ride-share platform's corporate policy response (third-party liability) if personal motor insurance does not apply, per accident up to:

- $100,000 in bodily injury
- $25,000 in property damage

Drivers are actively engaged in fee-paying rides, hence require higher limits of insurance:

- Mandatory primary liability coverage, at least $1 million
- Contingent comprehensive and collision, up to actual cash value of car

Source: National Association of Insurance Commissioners (September 2019)

platforms, such as those that offer only one service, as opposed to platforms that offer multiple services that could range, for example, from photography to moving services to driving. This is because many courts could use an "economic means" test to evaluate like activities.

For example, prior to AB5's passage, a ride-share platform could argue that its core business was not transportation services, but rather matchmaking, routing, and payment technology that empowers others to offer rides. Under the new law, if a court applies an economic means test, that platform might need to succeed in arguing that a substantial amount of its income does not come from transportation services.

As illustrated in Exhibit 4, AB5 empowers California's already-active attorney general and certain district attorneys to issue injunctions against businesses suspected of misclassifying independent contractors. To date, it was up to individual workers to take action if they believed that they had been misclassified as contractors and should be considered as employees.

What's Next?

The next chapter of insurance for ride-share is being written just now.

With more loss history, and more personal insurers offering gap coverage, will platforms offer different alternatives to drivers? As more sharing-economy companies compete for the same and shrinking gig-labor pool, will more innovative insurance solutions become part of a suite of offerings that lure drivers to offer services on one platform rather than another? What about riders – what more can be offered for riders, when already some credit cards are starting to offer coverage in case riders leave behind their belongings in the shared ride-vehicle?

As of publishing, two other states in the US have drafted legislation like the Californian AB5. Only time will tell whether similar laws are adopted across other jurisdictions beyond the US. Several US Presidential candidates are pledging to support AB5-like legislation. At the same time, several ride-share companies have promised to support a ballot measure potentially creating a "third way" to classify gig workers on a spectrum between employees and independent contractors – coupled with some employee-like guarantees. The bigger question is when and if collective bargaining could be triggered.

CAR SHARING

Car ownership can be expensive. The average car is parked over 90 percent of the time. The owner must bear the cost of maintenance and insurance to use the vehicle only a fraction of the time.

Car-share and car subscriptions (described in the next section) are two emerging transportation models that aim to address this underutilization issue. Car-share provides on-demand, short-term access to a vehicle usually reserved through a mobile application. Users are then charged by either time or distance.

Several varieties of car-share models exist. A standard model is round-trip car sharing, which requires us to borrow and return vehicles at the same location. A more flexible model is point-to-point car -share, which allows customers to pick up a vehicle at one location and drop it off at another. The latter is rapidly becoming a model of choice for most of us.

Unsurprisingly, there has been a surge in popularity for peer-to-peer (P2P) platforms for car-share, due to the increasing number of owners willing to rent out their idle cars on short-term basis for extra revenue. Turo and Getaround are two examples of a marketplace for owners with underutilized cars and individuals looking for a flexible rental option. Vehicle owners are covered by the platform's liability insurance and are contractually protected against theft and physical damage. Individuals who rent the cars also have access to insurance, typically included in the cost of the trip, structured by and purchased from the platform.

Automotive original equipment manufacturers (OEMs), such as, for example, Daimler, Ford, and General Motors, are also experimenting and have developed their own versions of car-share. In all cases, insurance is either offered or bundled with maintenance, use of the vehicle, and other perks. Consumers appreciate avoiding the hassle of evaluating and shopping for insurance options. If provided by the platform – OEM-backed, dealer-backed, or P2P – the platform inherits the cost and any subsequent inconveniences or headaches. Since insurance is such a large part of the cost of goods being offered as a service, the way the insurance is structured and priced becomes a competitive advantage. In a slim-margin business that is quickly evolving, there are some tactics based on experience to consider below.

Risk Landscape

While advantages are aplenty, the shift towards platform car-share has opened a raft of new risks for not only the renter, but also the owner and the P2P platform. Who owns the vehicle is important.

Traditionally, car-share is assumed to utilize fleet-owned vehicles rented out to the public by either OEMs or traditional rental companies, such as, for example, Hertz and Avis. Vehicles are operated, maintained and owned by the respective companies, while renters can access vehicles by the minute, hour, or day.

In the case of P2P platforms, the ownership of risk and liability now lies with personal vehicle owners rather than the rental car companies, which elevates the question of liability and point in time. As with any novel business models, the regulatory environment for P2P platforms is complex and continually evolving. Hence, the regulatory environment may result in gaps in coverage for both vehicle owners and P2P platforms. Let's take a closer look.

Addressing Liability Risks With On-Demand Car Sharing

Evaluating the car-share market through an insurance lens, the OEM-backed programs and P2P platforms have a few similarities with how insurance is provided relative to traditional rental companies.

As of the date this paper was published, Car2Go - the former car-share program of Daimler that has merged with BMW's ShareNow venture-provides insurance as part of the single car rental rate. Viewed as a benefit, insurance is often combined with maintenance and 24-hour roadside assistance, providing their customers convenience and ease-of-mind with a simple pricing structure. P2P platforms, such as Turo and Getaround, offer the same, though these are where similarities in insurance coverage end.

Traditional rental companies - such as Hertz and Avis, for example - provide consumers with add-on options during the rental process and offer a variety of coverages including first- and third-party bodily injury and personal damage.

Exhibit 4: Several employment practices could be affected by the new contractor law

For employers, the California new contractor law (AB5) could represent a costly change and expansion of risk profiles

1 WORKERS' COMPENSATION PROGRAMS

- More individuals would be eligible for statutory workers' compensation benefits in the event of work-related injuries
- Reclassification of employment status could increase insurance purchasing costs for employers
- Premiums increase could be passed on to consumers, affecting revenues and margins

2 EMPLOYMENT PRACTICES LIABILITY AND WAGE-AND-HOUR RISKS

- Misclassification of workers eligible for overtime wages could create significant legal exposures
- In California, expansive workplace protections would apply to a much larger worker population and range from discrimination and sexual harassment to wrongful termination

Source: Marsh

Insurance coverage offered or bundled in OEM-backed programs are mostly at minimum financial responsibility (MFR) limits as required by law, varying by state in the US and elsewhere, to meet vehicle registration requirements.

This coverage is different from what is typically offered by P2P platforms, as they host privately owned vehicles whose insurance protection provided to renters matches that of the vehicle owners. In the states of California, Oregon, and Washington, renters are provided with a combined single limit, which is three times that of the respective state minimum.

While car-share laws are continuously evolving, it is crucial to point out that most personal motor insurance excludes coverage when owners rent out their personal car. Commercial use exclusions here operate similarly to that of ride-share. To address the blurring of commercial and consumer use, P2P platforms like Getaround and Turo, for example, provide third-party liability and physical damage coverage to vehicle owners with a combined single limit of $1 million.[5] First-party damage caused by renters is also supplemented, typically based on the total repair cost or actual cash value of the vehicle.

In general, car-share vehicles are mostly insured, either by P2P platforms or through self-procured commercial motor insurance by the owner. However, there is often a gap in coverage when personal vehicles listed on car-share platforms are not in rental. For instance, vehicles that are parked on streets waiting to be driven are "off-rental" and are neither qualified for coverage under personal auto insurance nor by the P2P platforms.

It takes comfort to know that the insurance market has been providing the necessary coverage capacity in closing this gap and has offered solutions to P2P platforms today. The main challenge is ensuring the adequate coverage is priced competitively.

What's Next?

As technologies further advance, there is huge potential in leveraging usage-based insurance as the new standard for mobility-services companies. This will greatly impact car-share as insurers typically price insurance on units, rather than charging renters based on average miles driven by state or number of vehicles active on the platform, which are often lagging factors.

What if insurance carriers were able to provide real-time pricing based on a combination of KPI's such as time or trip and factor in the renter's driving profile all at the same time?

By integrating software, telematics, and other fleet management solutions, P2P platforms can better determine the rental status of vehicles and driving behaviors of the renters. Insurance carriers are also able to better assess risks as data is collected and analyzed using sophisticated algorithms, which in turn help businesses better understand their risk profile and manage risks accordingly.

CAR SUBSCRIPTIONS

Over the past 18 months, car subscription is fast becoming an alternative to owning or leasing.[6] It is yet another shared mobility model aimed to address the underutilization of personal vehicles. These programs offer individuals access to a suite of cars, with maintenance, roadside assistance, and insurance often included for one all-inclusive price.

Though the market is still in its infancy and the basic structure of car subscription services is constant, a recent Oliver Wyman study shows a significant split in the market. While some people are willing to pay for a selection of top-grade cars; others are primarily interested in the subscription model's lack of hassle. As illustrated in Exhibit 5, over 54 percent in both Germany and the US preferred a relatively low-cost package ($500 per month) and just about a quarter would pay more than $2,000 per month.

The main advantage of the subscription model is that it reduces the cost of commitment while increasing flexibility. Sharing and rental do not lock the driver in for a long period – neither to a particular car nor through a large outlay of cash. Ownership, on the other hand, provides the convenience of a car always ready for use, but it comes with long-term commitments – either through a big onetime payment or by financing, which means carrying debt for several years. Another differentiator between car subscription programs and traditional car leasing is the ability to "flip" in and out of different cars every month, or in some cases with just a few days' notice, often with a concierge delivering the vehicle to you. For example, you could drive a sedan during the week and switch to a sports car or an SUV for a weekend trip.

Several automotive OEMs - including, for example, Porsche, Volvo, Audi, Mercedes-Benz, Cadillac, and Lexus - have launched car subscription programs.

Dealers have also launched car subscription services partnering with platform-based companies such as Flexdrive, Fair, and Clutch Technologies, for example, in view of the growing market potential in the past four to five years. Access to an array of vehicles across the same brand is one of the advantage dealerships provide over the OEM-backed programs.

Primarily in response to underutilized vehicles that dealerships historically waited to sell or lease, platform-based companies now enable dealerships to monetize their assets. For example, by listing vehicles on the Flexdrive platform, dealerships are able to utilize matching technology and purchase insurance through Flexdrive for their customers. In essence, Flexdrive becomes the middleman and acts as a one-stop shop for both the dealership as well as anyone looking for a hassle and paper-free subscription service.

Risk Landscape

Automotive OEMs face similar risks with car subscriptions as with car-share. The general trend with short- or long-term car subscriptions is such that the insurance coverage is generally higher than what is provided with on-demand car-share programs, which is usually the MFR. For instance, Care by Volvo, a 24-month subscription program, provides drivers with bodily injury and property damage coverage that has higher limits than state requirements, as well as a $1 million combined single limit in liability coverage.

The favorable pricing for higher limits by OEMs is not without justifications.

Unlike car-share programs, OEM-backed car subscription fleets are usually brand new and often accompanied by a suite of perks and other concierge services, and hence offered mostly by more premium automotive OEMs. The higher cost of entry for the consumer, often better credit score of the "member" translates to markets viewing car subscription programs as better risk when compared to car-share, resulting in favorable pricing for higher limits. In short, the risk profiles of the driver, renter, or subscriber are not all the same.

Toward the other end of the spectrum, dealerships have the flexibility to either stock their fleet with brand new vehicles or employ late-model used cars. Understandably, the quality and quantity of fleet available for subscription services will directly impact the risk profile of the dealership, hence affect the risk exposures and different insurance coverage needed.

Case in point, Fair and Flexdrive, for example, are often viewed differently by insurance markets when compared to OEM-backed car subscription companies. A variety of factors come into play – non-traditional insurance carriers who provide the capacity are often unfamiliar with tech-platforms to begin with, which leads to viewing the risk differently and therefore rating insurance in an unnecessarily cautious way. Some carriers are driven by ratings based on the value of the vehicle rather than the traditional rating method, which depends on the vehicle types.

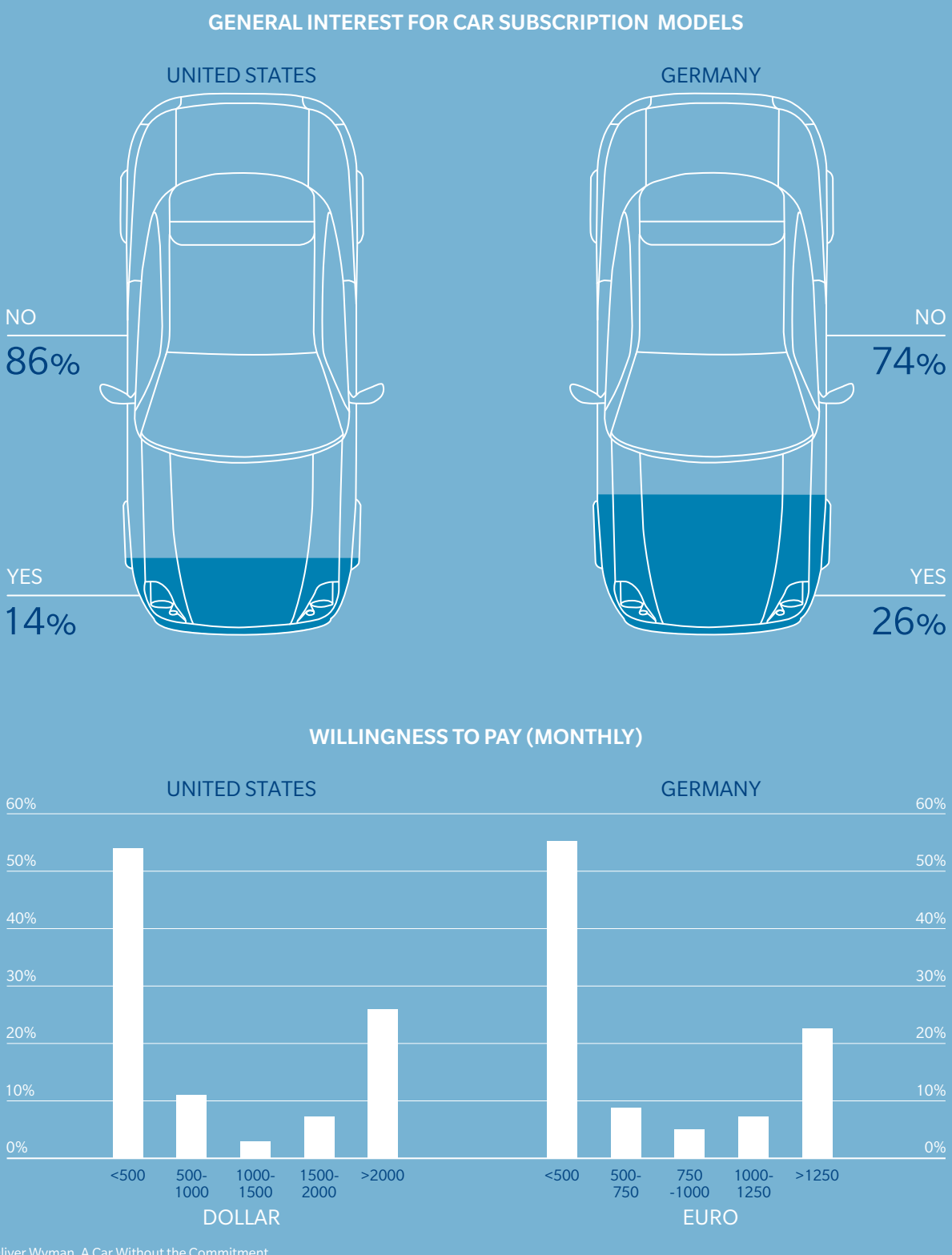
While the value of the vehicle may include the depreciation cost that is often crucial when assessing used vehicles that are part of dealer-backed subscription plans, markets should keep in mind that the type of vehicle is just as important. A rating basis that takes the type of vehicle into consideration accounts for the cost of repairing vehicle parts, which can vary drastically, depending on the make and model of the vehicle. Insurers should strive to understand the technology just as much as the driver profile – since both are inputs that define the risk profile of the platform.

MICROMOBILITY

Today, micromobility refers to vehicles that carry one or two passengers[7] primarily for personal use. They are electric, weigh less than 1000 pounds, generally travel less than 15 miles per hour, and can be owned or shared. Micromobility solutions include bikes, scooters, and mopeds. They address the need for trips on average less than five miles, which accounts for approximately 60 percent of all trips in the US.[8] In the future, we will see commercial use of these vehicles in areas such as last-mile food or package delivery.

Only 18 months in, micromobility adoption rates have eclipsed ride-hailing growth rates. The mode has moved approximate 30 trillion passenger miles annually across the world.[9] An explosion of e-bikes, e-scooters, and mopeds in the US and Asia have led the charge. For example, there are over 1,000 bike-share systems today (compared to 74 in 2005), with over 200 located in the US alone.[10] Even more impressive is the e-scooter segment, which was almost non-existent in 2017 and grew to take up nearly half the global micromobility market in 2018. Southeast Asia and India may have the fastest shift to micromobility, given a high percentage of two-wheeler ownership in these regions.[11] The same holds true for China, where non-electric bikes are already popular.

Exhibit 5: General interest for car subscription models



Source: Oliver Wyman, A Car Without the Commitment

Multiple factors have contributed to this explosive growth:

- **Efficient**: In high-traffic cities, bikes, and scooters can move people faster and potentially more safely
- **Cheap**: The users' cost-per-mile of operating an e-scooter can be as low as a third of the cost of conventional transportation options, including ride hailing. Both are heavily subsidized today – so we will need to watch as this evolves. This is aided by reduced battery costs for electric vehicles, which make electric bikes and scooters increasingly affordable
- **Eco-friendly**: E-bikes and e-scooters are generally friendlier to the environment. They are also better for city planning, given the increased demand for road space
- **Enable access to public transport**: An increasing number of people are moving to cities, but fewer people are choosing public transportation due to distance, access to ride hailing, and historically lower prices. Bikes and scooters address this issue by providing first- and last-mile transport

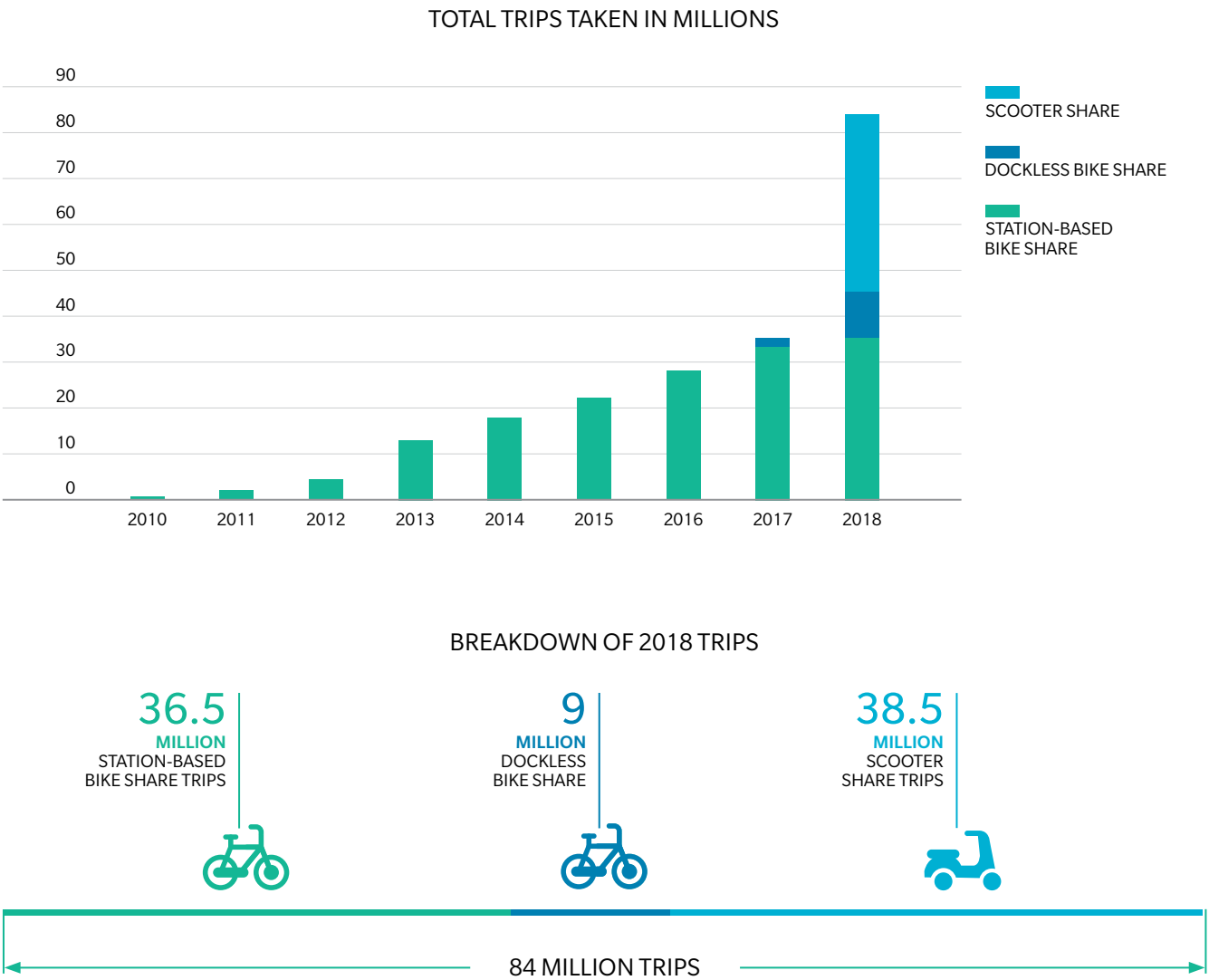
Risk Landscape

Micromobility platform providers face similar risks as an individual's ownership and use of bikes and scooters, but on a larger scale. Unlike ride-share, car-share, and car subscription that shift risk from individuals to commercial entities, the volume of scooters and bikes on the roads with traffic present newer risks. It is the scaling of these services that stresses the tension between personal and commercial insurance solutions.

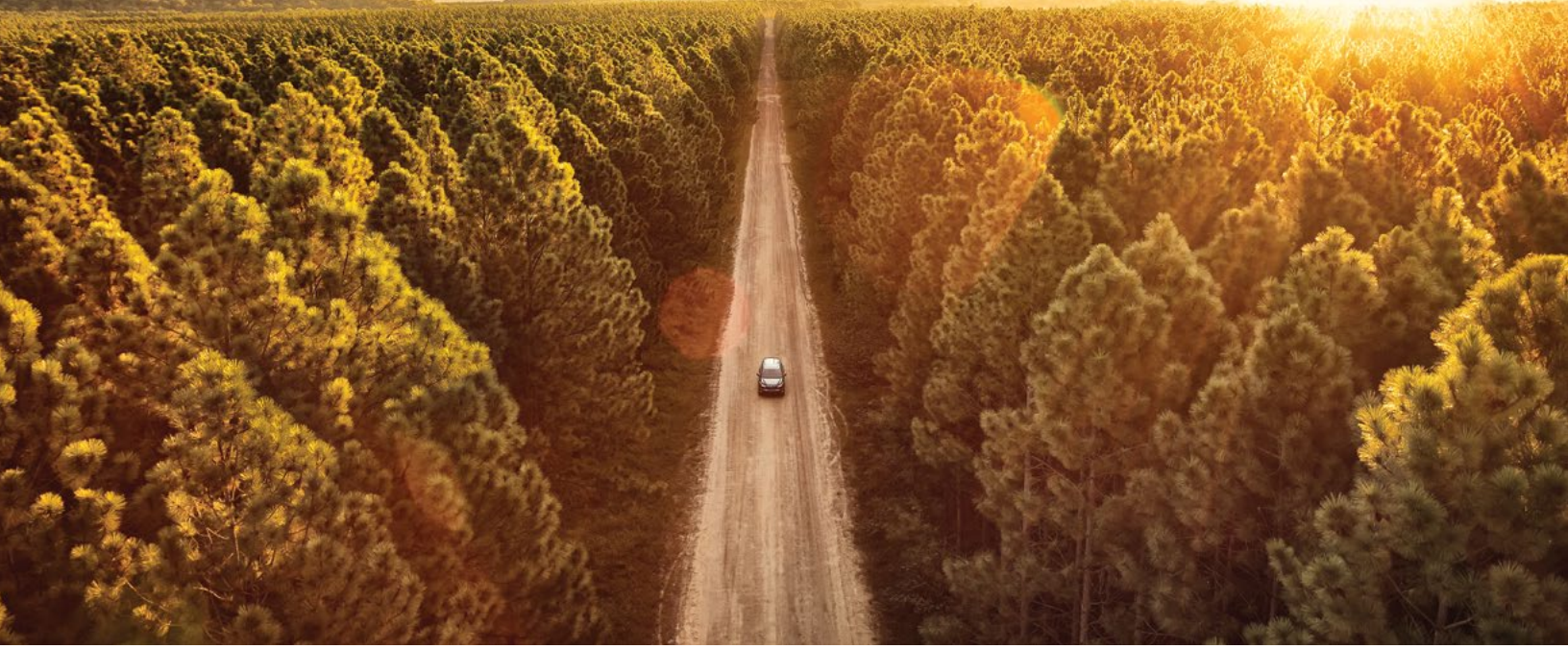
The ride-share economy embodies this trend – Uber and Lyft, for example, challenged personal motor insurance and built a commercial coverage solution for their drivers and riders throughout the three periods defined.

The scaling of shared assets also involves the creation of a regulatory framework to reasonably protect the public from bodily injury or property damage. While most countries and states require drivers to have auto liability insurance before legally driving a motor vehicle, some regulators are exploring a similar philosophy of risk-shifting to the scooter or bike user for micromobility – albeit with far lower limits. It remains early days for this mode of transport. More developed markets like Europe and US tend to be setting the pace for how public will trust, cities will grant permission, and how platforms can build accountability.

Exhibit 6: The shared micromobility market in the US has grown at an explosive rate



Source: NACTO, Macquarie Capital (USA), April 2019



A look at future scenarios

FUTURE SCENARIO ONE: COMMERCIAL FREIGHT

A number of trends are shaping the future of freight management, but two in particular stand out. First, the explosion of e-commerce is placing increasing demands on shippers to scale up their commercial freight capabilities within their overall supply chain. At the same time, the trucking industry is facing a significant shortfall of drivers.[12] The widening supply-demand gap is a result of supply shortages resulting from changing demographic profiles in many developed markets (such as aging and retiring) and growing demand owing to the need to keep goods moving in an era of strong global trade growth. As a result, the funding for truck technology development including autonomous trucks was estimated at $1 billion in 2017—up 1,000 percent in just three years.[13]

Three future models are emerging in commercial freight:

- **Freight brokering** enables shippers and carriers to connect on-demand to ship specific loads. Freight brokers add value by acting as a demand/supply aggregator, creating transparency in load management, and reducing friction for shippers and carriers. Existing players in this area, for example, include Transfix, Convoy, and Uber freight, which provide apps that serve as an aggregated 'marketplace'.
- **Autonomous trucks** take the driver out of the driver seat, over time solving the driver shortage issue and enabling safer and more predictable travel. Emerging technology companies such as Starsky Robotics and TuSimple, for example, embed AI and visual learning to develop fully autonomous trucks. For example, Tesla, a maker of consumer vehicles, has showcased a commercial truck with level 5 autonomy and electrification for greater efficiency. Finally, automotive OEMs like Volvo and Paccar are innovating in partnership with Nvidia –a video game developer that repurposed incredibly powerful computing capabilities – to develop autonomous trucking solutions.
- **Mashup of freight brokering and autonomous trucking** combines the advantages of connecting demand and supply with an autonomous fleet of vehicles. As an example, autonomous truck developer Starsky Robotics and digital freight broker Loadsmart have collaborated to complete the first-ever automated dispatch and delivery of goods by self-driving vehicle without any human involvement in the logistics chain.

Some companies are proactively addressing this challenge by partnering with educational institutions to support existing drivers. For example, TuSimple recently launched a first-of-its-kind autonomous vehicle certificate college program

for a role they see a need for professional training in – that of a "safety driver".[14]

As autonomous trucks become more commonplace in the next decade, commercial freight companies will need to rethink the roles that their drivers will play in the future.

FUTURE SCENARIO TWO: ROBO-TAXIS

Ride-share has already taken off in urban areas as an increasingly preferred and more cost-effective way to commute. However, there are aspirations to make the ride experience even safer, more cost-effective, and frictionless through the shift to robo-taxis – which are simply vehicles that are autonomous, electrified, and summoned on-demand by the consumer.

The key enablers are progress in vehicle connectivity (5G), electrification, share mobility, and autonomous driving, which could reduce the total cost of ownership and avoid about 70 percent of car crashes.[15] The global robo-taxi market is growing at a CAGR of 113 percent and expected to reach $2 trillion by 2030.[16] The following are three areas where robo-taxis are emerging:

- **Existing TNCs** are exploring autonomous vehicles as a future alternative to their existing ride-share approach. In the present-day context, there are regulatory and safety implications with fleet ownership and drivers, who can either be seen as "gig workers" or "employees". These can amount to costs and risks that can be drastically reduced with the shift to robo-taxis. Players in this space include, for example, ride-share firms such as Uber, Lyft, and Grab.
- **New vehicle companies,** like Tesla and Waymo, are also promising to enter the robo-taxi fleet market and have completed extensive road testing of their vehicles. Tesla also has potential access to an autonomous fleet of vehicles from existing customers – who can allow their cars to double up as robo-taxis when idle and generate revenue for them. Part of Tesla's vision is to undercut TNCs with the cost per mile of a robo-taxi being less than $0.18, as compared to current ride-share of $2-$3 per mile.[17]
- **Existing automotive OEMs** are also thinking about their future automotive use scenarios – especially robo-taxis for urban areas and car-share and car subscription in both urban as well as suburban areas. For example, General Motors (GM) and Volkswagen are among automakers with leading roles. Cruise, the self-driving company that GM bought in 2016, already has an existing fleet of 180 all-electric GM cars that was intended for launch by the end of 2019.[18] Another example is Amazon, which recently announced its intention to buy 100,000 of Rivian's electric delivery vans by 2030 to strengthen its logistics network, while cutting down on its carbon footprint.

For all companies that are rushing to capture a first-mover advantage in the robo-taxi market, the key success factors would include working closely with local governments to inform regulations, ensure necessary infrastructure is in place, and establish effective partnerships within the ecosystem.

FUTURE SCENARIO THREE: INTEGRATED MOBILITY

The long-term aspiration for mobility players is to be part of the customers' mobility journey as it evolves across modes. Integrated mobility would then allow users to access a wide range of mobility solutions, on-demand, for one all-inclusive price. In the future, integrated mobility will enable seamless integration of transport modes, including on-demand and autonomous options, as well as ancillary services not traditionally part of the travel experience.

The smart mobility global market is anticipated to generate revenues of $270 billion and profits of $125 billion by 2040.[19] Different types of companies – such as legacy transportation companies, equipment manufacturers, digital giants, and technology startups – are expected to enter this market in the short to mid-term, through various strategies, which include:

- **Organic expansion**: Existing mobility disruptors are organically growing their mobility portfolio. For example, Uber launched a new organization called New Modalities in June 2018 to develop a suite of multi-modal services that integrates car- share, bike-sharing, public transport, and micro-mobility solutions.
- **Smart mobility applications:** Whim and Moovit, for example, are ecosystem agnostic applications that aim to connect a suite of public transport, ride-share, car-share and micromobility solutions for the cost of a single subscription fee.

Shifting towards integrated mobility is a challenging business issue. Mobility players have to deal with technical and regulatory considerations – the need for data, technology retrofitted on legacy vehicles, open ecosystems, city readiness, and most of all, determining the right economic model that provides a seamless experience for the customer.

Developing mobility ecosystems in cities

Cities are balancing the risks and rewards of embracing new mobility, too. Ultimately, they will have a large role in shaping how societies operate and compete in the future. What separates cities that lead from the fast followers?

A new Urban Mobility Readiness Index from Oliver Wyman uses five basic criteria to rank the cities — system efficiency, social impact, innovation, market attractiveness, and infrastructure.

Exhibit 7 illustrates the findings from the first edition of the index, identifying five cities as the best prepared overall for the New Mobility — Singapore, Amsterdam, London, Shanghai, and New York. In sum, they boast a healthy combination of existing infrastructure from continual investments, rapid technology adoption, engaged private sectors, and forward-looking policies that facilitate managed growth.

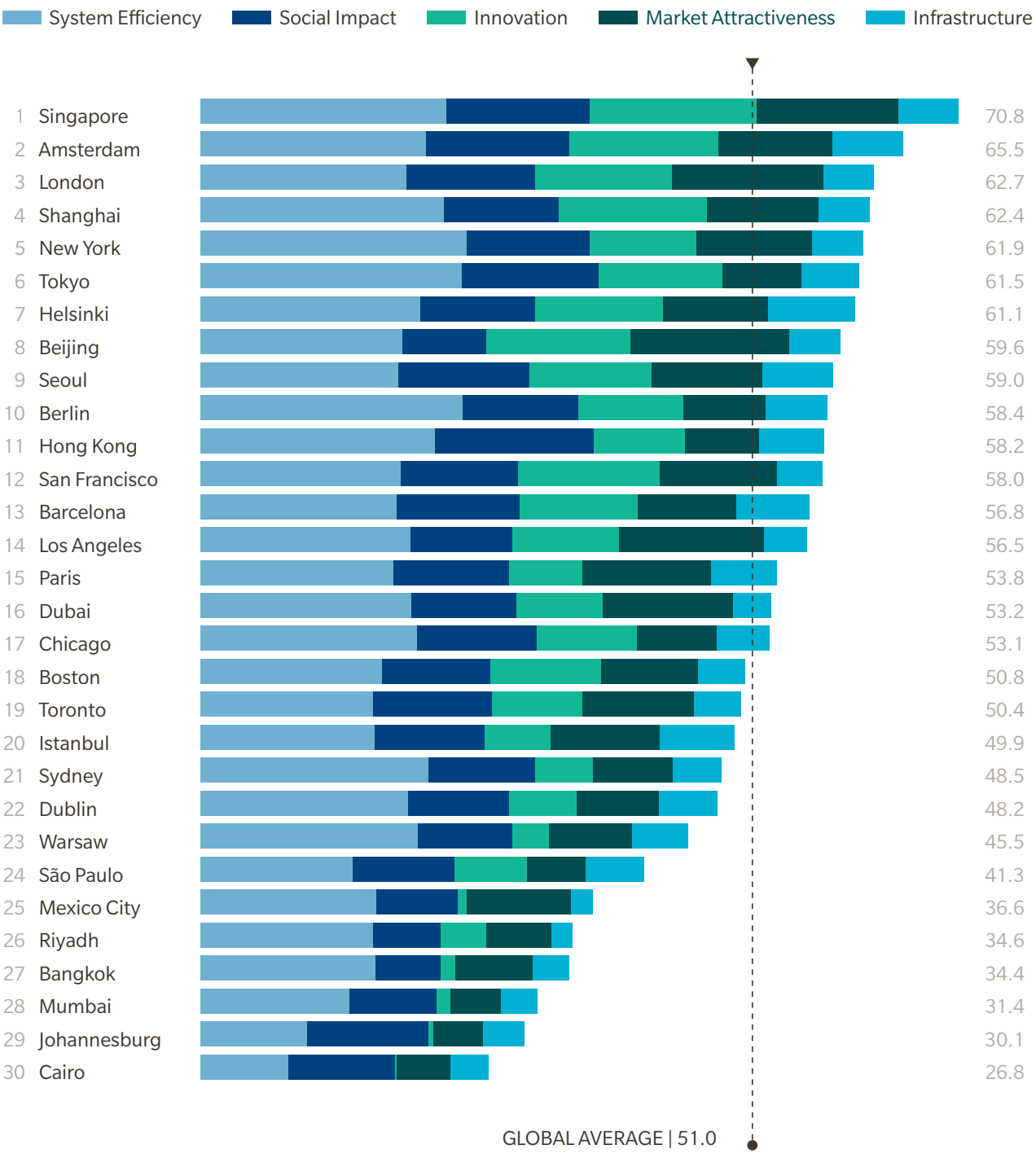
Leading cities, such as the ones highlighted above, embrace growth-minded policies: some that are fit-for-purpose now can become quickly obsolete due to the rapid technological advancements – it will depend on policymakers to proactively calibrate and make swift decisions. Cities that embrace new technology will reap early rewards and increase their readiness to succeed in the future.

Lagging cities, on the other hand, suffer from chronic infrastructure inefficiencies coupled with limited investment by the private and public sectors. A dearth of major universities and research centers results in limited innovation and advancement to support the development necessary for local mobility services. Governing bodies in these cities may also lack the political will to realize a better future for mobility, which can lead to substantial delays in mobility projects and limit direct investments in mobility solutions. The mobility ecosystems in these cities will not develop at a comparable pace as those in cities with money and resources and that score higher in rankings.

For cities to move up the ranks, targeted investments are key. While richer cities are likely to perform better, it is the astute and forward-looking cities that make all the difference as they invest their resources more wisely. Urban mobility leaders also adopt a more welcoming approach to cutting-edge technology and business models that can solve their unique transportation concerns.

It is important to recognize that each city is unique. Urban leaders and planners seeking to adapt must recognize what makes their cities different and reflect those unique opportunities and challenges in their own mobility strategies. Some cities are already taking the lead in terms of urban mobility, but there is no reason that the rest cannot develop and improve their urban mobility now. The race has started, but for cities it is more of a marathon than a sprint.

Exhibit 7: Urban Mobility Readiness Index - Full ranking of cities



Source: Oliver Wyman Forum

Conclusion – parts are present today

An exciting future lies in more than the sum of these parts – ride-share, car-share, car subscription, micromobility, on-demand freight, robo-taxis, integrated mobility, and more. Taken together, MaaS has opportunities and challenges. Winners will "solve" the MaaS opportunity in collaboration with cities and with each other.

Take micromobility, for example. While ride-share was less conspicuous and took cities by surprise, after 18 months, the days of dropping fleets of e-scooters in a city without permission from public authorities are already over. Now, e-scooter companies often compete with one another for access to cities. The competition often includes a RFP, which asks pointed questions about trust, safety, and insurance.

This effectively creates a “market” for trust and safety – where companies are incentivized to compete on various grounds, such as: Are helmets required? Use existing bike lanes or build new ones? What type and how much insurance is required? Who owns which components of rider liability?

This “race to the top” is ultimately good for the public, riders, and platforms alike. The result is that insurance becomes part of a strategy that is a competitive advantage, rather than merely a cost.

For true MaaS to go from sporadic to ubiquitous, winners will have to navigate the complications, while improving unit economics and evolving business models.

Payment and trip planning must be seamless MaaS offers a future that is greener, safer, with more productivity and less congestion. We’re excited to meet you there.

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