Hogan Lovells

Living Mobility Spotlight

Q&A series

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Living Mobility

What is Living Mobility? It is easier to say what it is not. The automotive industry is no longer focused on the traditional vehicle. Not only are the vehicles changing but we are now focused on mobility: different modes of travel for people and goods all connected in new and evolving ways. As this sector changes it will also change how we live because it will change how we move, are connected and even what we do. Living Mobility is an attempt to capture this vibrant evolution of not just our vehicles, and of our mobility networks, but of how we live.

Changes of this magnitude take time. But the rate of change is rapid. Companies development of technology and with it new business models will combine with changes in consumer demand and government regulation to create the future. Change of this magnitude generates a host of novel business, legal and policy issues. We envision Living Mobility broadly with four key characteristics: **Living Mobility is Objective, Inclusive, Unifying, and Sustainable.**

These four elements comprise various opportunities and challenges that are highlighted in the following Living Mobility Spotlight Q&A Series.

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Living Mobility is **Objective**

Living Mobility is Objective

Spotlight on AI and consumer trust

In conversation with Mark Brennan, Lead Innovation Partner, Sector Group Leader Technology and Telecoms

Objective Living Mobility broadly encompasses fairness and transparency in the use of new mobility-improving technologies. As artificial intelligence (AI) paves the way for increasingly integrated transport systems, manufacturers are joining forces with service providers and software developers to deliver innovative mobility solutions. But the promise of AI-enabled transport is not without its challenges. Connecting all hurdles is the crucial need to build consumer trust. Mark Brennan discusses a few of these challenges and the overarching importance of prioritizing consumer trust.

Featured speaker

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What should the mobility and transportation industry keep in mind about consumer trust and AI?

Brennan: It is going to be increasingly critical that our mobility clients be transparent with consumers. The details matter. We are seeing a lot of rapid legal, regulatory, and policy developments for autonomous vehicles (AVs) and unmanned aerial vehicles (UAVs), ridesharing, and micromobility like e-scooters. But long-term success in the market will almost certainly depend on maintaining consumer trust. Data protection, service terms and conditions, and fee structures all can significantly impact consumer trust.

Our clients are innovating to change the world, and we are their strategic advisors. It's really important that we bring an innovative mindset and continually look for opportunities to enhance our services and help them find creative new solutions to their challenges.

We also need to be mindful that assessing risk involves more than the immediate legal issues – long-term impact and reputational harms also play an important role.

What AI developers consider when approaching commercial agreements with manufacturers and service providers?

Brennan: For AI, one question for developers is at what points you need to ensure that somebody is maintaining a level of control. It's not enough to say "We trained the AI and then it decided everything after that."

As advisors, we must make sure that our clients build processes and protections that go beyond core compliance in their commercial agreements.

Is it possible to harmonize service offerings and regulatory compliance?

Brennan: You want your suppliers to be partners, and you want all stakeholders to be aligned and incentivized to identify and address AI concerns throughout the life of the agreement.

How can industry work with government to balance consumer protections with technological investments?

Brennan: We need a thoughtful, comprehensive, and balanced approach. We are seeing a race among some regulators to see who can "regulate more," especially on consumer protection issues.

There seems to be a presumption by some that more regulation is automatically better, without any critical assessment.

There needs to be a holistic approach taken with the first step being a fulsome analysis of whether and to what extent any new requirements are needed, or if there are sufficient developments in the marketplace to protect consumers.

There is also an opportunity for industry leadership, and it's incumbent on stakeholders to make sure regulators are fully informed on the latest marketplace developments and innovative services.

Living Mobility is Objective

Spotlight on data use and transparency

In conversation with Mark Parsons, partner, Technology and Telecoms sector group

Living Mobility is objective and fosters consumer trust based on transparent data usage. Data is the key to mobility solutions in smart cities. But in order for consumers to accept these advanced solutions as part of the way that they live, they must be in a position to trust that their data will be collected and processed fairly and responsibly. Mark Parsons discusses the role of transparency in building consumer trust and optimizing data-enabled initiatives.

Featured speaker

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What should the mobility and transportation industry keep in mind about data-driven mobility solutions in smart cities?

Parsons: As data-driven mobility solutions develop, we must consider best practices for public usage of private information, particularly within the public-private partnerships that are often essential to making smart cities possible. Data protection regulations are now in place in most jurisdictions in the world. But compliance requirements are only part of the discussion. Technology develops much more quickly than legislative frameworks, and in the data protection realm, laws tend to be "principles-based" rather than fixing specific standards. We therefore see industry standards as being key to the mission of achieving public trust. To take a few examples, Internet of Things (IoT) solutions, such as sensors in the home that track temperatures and sensors in smart traffic lights can enable solutions that improve quality of life, but consumer responses to these solutions vary. Acceptance requires trust that general legislative requirements may struggle to achieve on their own. Standards can help build trust in these contexts.

What are some examples of different consumer responses to public use of private data?

Parsons: There are many. Facial recognition certainly divides opinion, as do other AI-enabled identification technologies. In the wake of the COVID-19 pandemic, we have seen a new flashpoint in contact tracing technologies, which have generated very different responses in different countries. This highlights the extent to which demand for transparency varies across jurisdictions, including those in Asia.

How are data-driven mobility solutions developing in Asia?

Parsons: Many Asian jurisdictions benefit from advanced wireless networks and high consumer uptake of smartphones and other forms of mobile connectivity. It follows that we have seen success in creating open data platforms that allow access to real-time transit schedules and live traffic conditions to develop mobility solutions. Development depends on numerous factors like incentives and environment.

Singapore, for example, has identified technological innovation as a clear strategic goal. Law and regulatory policy is often closely aligned with this objective, and so we see Singapore incentivizing innovative developments and even introducing certain relaxations of its data protection laws to create more space for innovation.

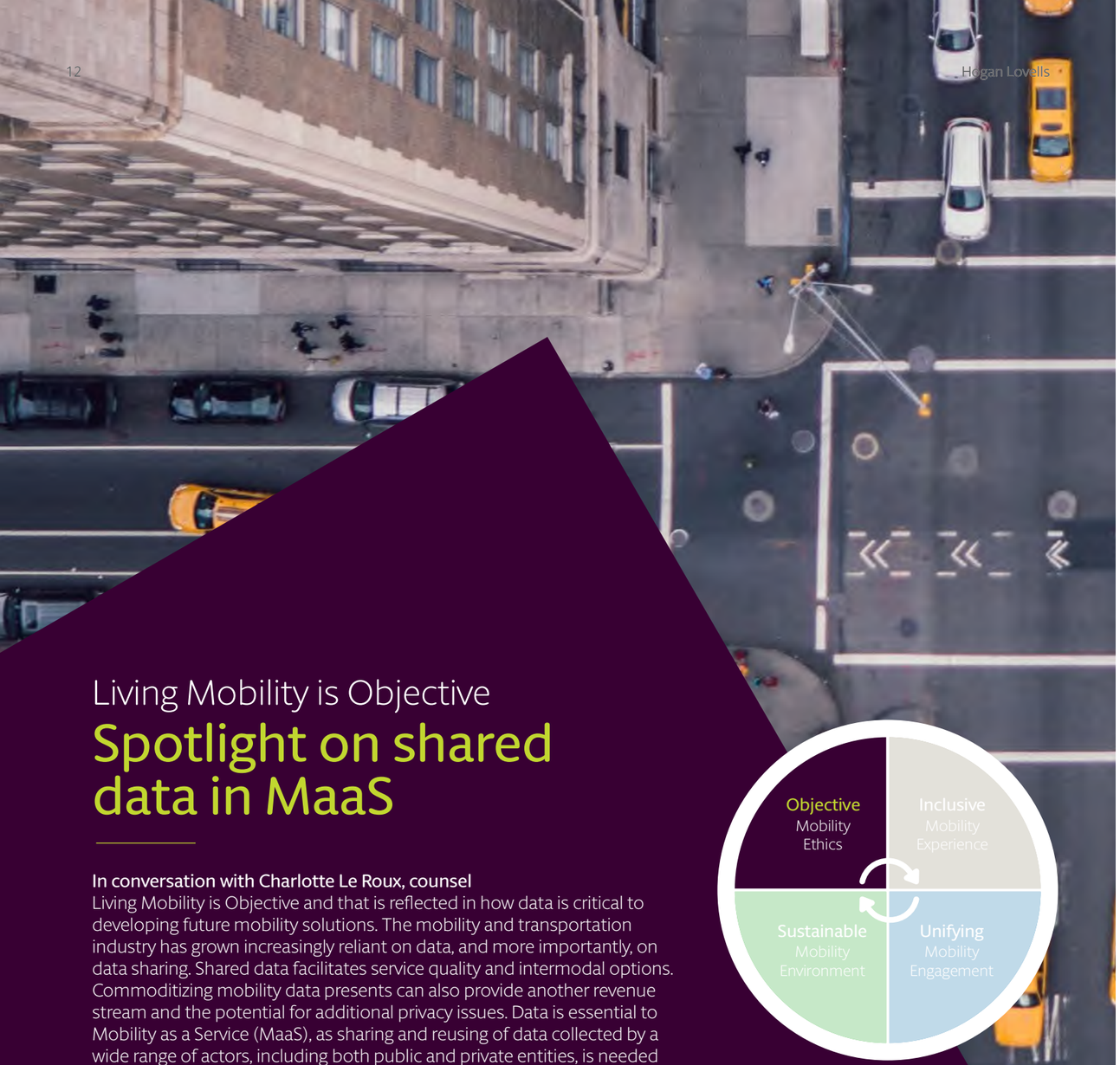
What is the relationship between data usage transparency and data privacy laws?

Parsons: Data privacy laws fix minimum mandatory standards for transparency. However, compliance with legal requirements does not mean that consumer trust will necessarily follow. Part of the challenge in Asia is that data privacy laws differ from jurisdiction to jurisdiction. We are seeing a recasting of data privacy laws across the region in the wake of General Data Protection Regulation (GDPR), and this holds promise that in some areas at least, there can be convergence towards common global fundamentals. No system will be perfect, but a considered approach to transparency in data-driven mobility solutions prioritizes the trust of citizens from the beginning.

If there's one thing that will impede consumer acceptance of data-driven mobility solutions and smart cities, it's a lack of trust. As privacy laws in the region align around concepts such as data breach notification and accountability models, we see privacy laws as a potential enabler of trust. But in my view, the law can only go so far in this regard and in certain areas at least, industry standards hold promise as both an effective way to manage risk and serve as a communication tool for the public.

How can public-private partnerships address public trust deficits to work towards consumer acceptance of data-driven mobility solutions?

Parsons: It is clear that there is a deficit of public trust in mobility solutions in certain jurisdictions, both in Asia and elsewhere. Lawmakers need to move to address this. There is general enthusiasm for these solutions and how they can improve our lives. Lawmakers should recognize the benefits they can bring, but at the same time develop approaches that take on board the need for transparency. Public-private partnerships can move transparency forward, combining the technical knowledge found in industry with appropriate public sector oversight.



Living Mobility is Objective

Spotlight on shared data in MaaS

In conversation with Charlotte Le Roux, counsel

Living Mobility is Objective and that is reflected in how data is critical to developing future mobility solutions. The mobility and transportation industry has grown increasingly reliant on data, and more importantly, on data sharing. Shared data facilitates service quality and intermodal options. Commoditizing mobility data presents can also provide another revenue stream and the potential for additional privacy issues. Data is essential to Mobility as a Service (MaaS), as sharing and reusing of data collected by a wide range of actors, including both public and private entities, is needed to optimize service quality. Charlotte Le Roux discusses the challenges and opportunities surrounding concerning data sharing.

Featured speaker

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What is MaaS? What is required to make MaaS efficient and attractive to consumers and even to public transportation authorities?

Le Roux: MaaS, Mobility as a Service, is a user-centric digital solution that aims to enhance the value of shared public and private transport modes by improving the mobility experience through personalization. It also aims at optimizing operations to control costs and improve access for all. Mobility in this context includes a range of services much broader than just public transportation to include services such as carpooling, car-sharing and self-service scooters.

The public sector already has a significant amount of data that is generally already easily accessible about use of public transportation, but private sector data is not yet well integrated and is increasingly important for understanding transportation options.

The very first requirement to make MaaS efficient and truly useful is the common sharing, by both public and private entities, of relevant data in a single place (a platform) and in a format allowing interoperability. This interoperability is what makes the data useful in optimizing service provision for consumers and planning capacity by both the public and private sectors. In France, the National Access Point for Transportation Data was created by the French Mobility Law with the ambition of gathering data on the entire mobility system on a national basis.

The next stage in advancing the system is to permit the use of that data by entities that did not initially collected it.

Are private companies reluctant to share their data? If so, are there safeguards to encourage them to do so in a way to benefit the entire transportation system?

Le Roux: Companies data sets are valuable assets that require considerable investment to create and keep up-to-date. From a purely business perspective private entities unwillingness to share a valuable asset is understandable especially when one considers additional legal obligations and risks associated with data sharing. Those legal issues are particularly nuanced. Data “ownership” rights result from a sum of different rights and obligations such as intellectual property rights, contractual rights, confidentiality requirements, business secrecy concerns, and various regulatory requirements that vary by jurisdiction and type of data. An additional complication is found in technical security measures needed to protect the access to data from inappropriate use or hacking. Taken together, these various factors create an overall picture of what level of ownership control and rights a stakeholder has over its data.

Given that context, data sharing is mainly governed by user licence agreement. There are several models for those agreements and a few common concerns. Is data sharing free or with royalties. If royalties are involved, the price matters because if it is excessive, smaller companies may not be able to contribute and benefit from it, from the arrangement to the detriment of the entire system. Does the arrangement require reciprocity so that a party that benefits from the collective database also has an obligation to share the data it collects and thus enhance the database and its utility to all.

How will data sharing benefit both the public and private sectors so that consumers -- the traveling public -- have a better mobility system?

Le Roux: We have excellent examples of where data sharing and cooperation between different actors is proving fruitful. In Sweden and Norway, Volvo has joined a public-private partnership in a cloud-based connected safety service to which it provides real-time data from its connected safety technologies. This service gets information on a range of things including such specific items as where a hazard light has been spotted or slippery road conditions.

Sharing data also facilitates innovation, and broader use of those innovations in turn allows system wide benefits. Mapping applications are a good example. Only a few big companies, mostly tech companies, had the means to map the world and those mapping services where offered with restrictions on use parameters. In response collaborative projects based on open data sets have been developed to meet the needs of other stakeholders. Projects like OpenStreetMap rely on crowdsourced data which is then made available under an Open Database License.

Public data provides another opportunity. Public authorities often have the obligation to share their data either due to requirements at a national or European level, but they rarely have the financial means to utilize that data effectively. For instance, hyperscale capex spending on data centres reached an historic high of over $120 billion in 2019. While these are sums spent by the world's biggest tech companies, it demonstrates the significant cost of data storage. Beyond storage costs, public bodies probably lack of expertise and human resources to develop and exploit shared mobility services. Given the relative advantages of the private and public sectors, cooperation is an obvious route for improving the capacity of the entire transportation system.

What legal actions are companies using to advance MaaS?

Le Roux: To create value from many data sources, mobility companies are developing strong data governance strategies. The first step in doing this properly means fully accounting for the various rules governing the safety and security of their services, the end users themselves and the data about those end users. Of course, privacy rules are another important factor.

Other legal considerations include competition issues on data usage and data sharing as well as a myriad of commercial and contractual issues about who can use the data.

Privacy rules are particularly stringent in the EU. How might the industry balance meet those requirements and have robust MaaS offerings?

Le Roux: In the context of MaaS, personal data are likely to be shared in order to deliver a personalised service. New Data Protection Acts are being unveiled in many countries and new rules always have a certain amount of uncertainty. At the level of the European Union, the GDPR has been enforced for almost three years now so actors have thus reached a certain degree of maturity and awareness regarding their obligations under the GDPR.

Compliance with the minimization principle requires care because it is tempting to collect a wide range of data to enable future innovation, but such wide collection would not be compliant with this core principle. This requirement also means deep awareness of what one actually collects as sometimes systems actually collect or store more data than many realize or plan for.

Furthermore, in some cases, there is absolutely no need to communicate personally identifying data to ensure the quality of the mobility service. In those contexts, data could be anonymized and not hurt functional capacity. The position of European data protection authorities, however, makes implementing the anonymization process extremely demanding.

Finally, MaaS logically requires a large degree of access to geolocation data. However, users of those services largely understand the necessity to share their location while moving so they are used to this type of data sharing. Still, compliance with privacy rules requires transparency about what is collected and how it is used and then appropriately safeguarding this data to make sure it is not reused for other purposes.

Living Mobility is Inclusive

Living Mobility is Inclusive

Spotlight on 5G enabled accessibility

In conversation with Ari Fitzgerald, partner

Inclusive Living Mobility encompasses equity and transparency in the use of mobility-improving technologies. Service providers, disability advocates, and automakers are working together to address some of the mobility challenges experienced by people with disabilities. Potential solutions include automated and standardized transit functions that otherwise require the assistance of other people. But automating and standardizing functions require a reliable signal and the lower latency made possible by 5G. Ari Fitzgerald discusses a few of the challenges specific to 5G and accessible transport options.

Featured speaker

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What are some of the policy considerations relating to 5G that the mobility and transportation industry should keep in mind?

Fitzgerald: As a policy matter, the mobility and transportation industry should be thinking in advance about the accessibility of its designs. At the highest level of automation, an autonomous system will make it safe for people who are physically incapable of ever operating a standard automobile to be transported in the vehicle without any other person being present. We should strive to make sure that those with physical disabilities that prevent them from taking over control of a vehicle in which they are being transported have essentially the same ability to benefit. This is similar to a concept long embraced by the communications industry called universal design.

What is universal design?

Fitzgerald: Universal design establishes as a primary goal for any developer of products or services that they be universally accessible. The communications industry has embraced universal design for many years. While it may seem intuitive now, it was not so when cell phones were first introduced. Initial cellphone designs made it difficult for many people with physical disabilities to use them. Individuals with hearing loss, for example, were unable to use early generation cellphones without attaching clunky TTY devices, which essentially eliminated the benefits of mobility. The first generation of digital mobile phones could not be used by people who wore hearing aids. They also could not be operated simply via voice commands and brail was not included on their keypads, making use by the blind virtually impossible.

This led Congress to pass Section 255 of the Communications Act in 1996. That law required that telecommunications services and equipment be made accessible to people with disabilities if "readily achievable."

In 2010, the Twenty-First Century Communications and Video Accessibility Act (CVAA) expanded upon these congressional efforts and updated the law for modern communications.

How would universal design apply to the mobility and transportation industry?

Fitzgerald: As the mobility and transportation industry moves towards autonomous vehicles, revenue generation will depend largely on selling the experience. Automakers should think of ways to import universal design concepts into their vehicle interiors in particular.

How would universal design apply to the mobility and transportation industry?

Fitzgerald: As the mobility and transportation industry moves towards autonomous vehicles, revenue generation will depend largely on selling the experience. Automakers should think of ways to import universal design concepts into their vehicle interiors in particular. Broadly speaking, the mobility and transportation industry should be thinking in terms of universal design (i.e., ensuring at the conceptual stage that the total experience is designed in a way that makes it accessible to the greatest number of people possible at the outset of the offering, as opposed to later through accommodations and adjustments) and incorporating this concept into whatever tech-based mobility offerings they are developing.

What is the role of government subsidies in expanding 5G to rural areas?

Fitzgerald: Many expect 5G to soon enable faster and more reliable communications within cities. Theoretically, the same benefits could be realized in rural areas – but deploying advanced communications networks in sparsely populated areas is very expensive. From the very beginning, the U.S. Congress and regulators recognized that bringing new infrastructure (roads, electricity and, yes, communications) to rural areas would be more expensive than bringing that same infrastructure and services to cities. Yet, they decided that as a public policy matter it would not be appropriate to leave rural infrastructure deployment exclusively to the whims of the marketplace. That is why government subsidies were provided to ensure that a basic level of infrastructure and service would be affordable to people in rural as well as urban areas. So should it be with 5G because 5G will not reach rural areas based on market forces alone.

What regulatory hurdles might impede the development of 5G-enabled accessible mobility?

Fitzgerald: For many years, the FCC has focused on getting licenses to operate over large chunks of the radio spectrum required to support 5G in the hands of commercial mobile providers in the hope that they would deploy advanced networks broadly. More recently it has focused on breaking down other barriers to 5G deployment, including local governmental regulatory barriers that make densification of communications infrastructure (and the capacity gains created thereby) more cumbersome, and the sheer cost of deployment in sparsely populated areas.

The FCC's role is to do everything in its power to get 5G networks deployed to as many places as possible. We have a recent smart example. In May, the FCC proposed to redefine the amount of subsidy it provides to support rural mobile broadband through the use of reverse auctions, which essentially award the subsidies to those companies that are willing to submit the lowest bid in the auction to cover and serve a particular rural area. In this way, the FCC is adding an important competitive element to its rural subsidy program, which should help ensure that limited government subsidy funds are stretched as far as possible. If the lowest-cost provider doesn't end up serving the communities it indicated it would serve in the reverse auction, it can be sanctioned and forced to repay the government subsidy.

It is important to remember that the FCC focuses most of its efforts on directly regulating communications services and the infrastructure used to provide those services. For the most part, the FCC will not be involved in directly regulating the mobility and transportation industry. With that said, the mobility and transportation industry will increasingly be affected by the FCC's decisions, especially in the areas of spectrum, 5G, and accessibility, as it continues to roll out autonomous vehicle technology.

Living Mobility is Inclusive

Spotlight on drone delivery services

In conversation with Lisa Ellman, partner

Living Mobility is inclusive. Commercial drone delivery and Urban Air Mobility will increase mobility options, expand service accessibility and ultimately improve communities. In times of crisis, drone-enabled accessibility is not only a matter of convenience but also a life-saving tool critical to medical care. Lisa Ellman discusses the societal benefits of drone and Urban Air Mobility operations and some of the relevant policy issues.

Featured speaker

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Why are Unmanned Aircraft Systems (UAS) and Urban Air Mobility (UAM) so valuable to the mobility and transportation industry?

Ellman: First, it is important to understand that Unmanned Aircraft Systems (UAS) refers to the aircraft, communication links and ground control equipment. UAS is often used interchangeably with small drones. To be precise, the aircraft itself is called an unmanned aerial vehicle (UAV). Urban Air Mobility (UAM) refers to passenger or cargo-carrying aerial vehicles that are usually operated without an onboard human pilot.

Collectively, UAS and UAM represent an opportunity to reduce congestion and advance sustainable aviation technologies. In this way, the mobility and transportation industry can capitalize on industry disruption by embracing innovation.

What are current and future use cases for UAS?

Ellman: With UAS, industry and other stakeholders can increase mobility options, expand service accessibility and ultimately improve communities. Commercial drones or UAS have been used for safe and efficient delivery of medicines, groceries and other essential goods. For example, a drone was used to deliver a donor kidney to surgeons. Drones have also been critical to search-and-rescue missions, law enforcement operations and in response to natural disasters.

Now, during the COVID-19 pandemic crisis, drones are being used for contactless delivery of medical supplies. Manufacturers of personal protective equipment are partnering with drone companies to distribute supplies to help medical workers.

But the societal benefits of drone deliveries extend beyond health care and will impact daily life. Drones are being used for contactless deliveries from coffee shops, cafes, libraries as well as pharmacies – making social distancing a little easier. Commercial drone delivery creates new accessibility options for homebound individuals or residents of rural areas. Future use cases will likely continue to extend the physical reach and scope of services.

What legal and regulatory considerations should the mobility and transportation industry keep in mind for future UAM and UAS cases?

Ellman: We must acknowledge that policy lags behind innovation. Historically, this lag has often resulted in regulations that impede technological development. Understanding this general trend in policy development is important for industry to keep in mind because it focuses the industry on the importance of helping government to understand the technology it seeks to regulate. Another important concept to consider is the dynamic and varied nature of drone policy. In the United States, federal rules govern the safety of drone operations in all states and provide baseline operational requirements. More stringent regulations and certification requirements apply to drones conducting air carrier (i.e., package delivery) operations. States and localities typically regulate privacy and property rights.

In the European Union (EU), the EU Implementing Regulation 2019/947 provides new rules for drone operations including aerial categories. These rules will partially replace domestic laws for EU member states when the measure enters into force in December 2020. This effort is an important step towards harmonizing different legal frameworks for drone operations that currently exist among EU member states.

The speed at which technology advances and the dynamic nature of regulatory policy highlight the need for industry to work with all levels of government towards policies benefitting both industry and the public. For example, the Commercial Drone Alliance is an independent non-profit organization that works with the government to develop such policies and educate the public.

Public understanding of the benefits of these novel technologies is critical to their advancement and enables the evolution of the mobility and transportation industry. Prioritizing public education bridges knowledge gaps and engenders consumer trust. In this way, education supports both industry growth and public benefit.

Living Mobility is Inclusive

Spotlight on MaaS platforms

In conversation with Richard Diffenthal, partner

Living Mobility is inclusive: a characteristic that encapsulates both the underlying transportation modes utilized by users, and the digital platforms through which users access those transport options. Lowering the barriers to participation in these mobility options while expanding the range of services offered should foster greater levels of engagement and inclusion. Richard Diffenthal discusses some of the opportunities for Mobility as a Service (MaaS) platforms.

Featured speaker

Richard Diffenthal

Richard Diffenthal was a partner in the Corporate & Finance practice at Hogan Lovells, having joined the firm as a trainee in 2004. Richard unexpectedly died in early 2021. Richard was an outstanding lawyer and a truly inspiring colleague and friend, and we are grateful for his contribution to this content.

What is MaaS?

Diffenthal: Broadly speaking, Mobility as a Service (MaaS) refers to types of service that utilize digital channels to facilitate access to various mobility services, such as payment, planning, and booking options. Some refer to MaaS platforms as providing a single access point in a seamless mobility spectrum. But AI-enabled MaaS platforms are far more complex.

Are there any challenges with MaaS?

Diffenthal: Beyond the technical aspects of MaaS platforms, we should keep thinking about what it means to be able to participate in such an ecosystem. Luxury brands can send any car within their fleet to pick you up and drop you off depending on your needs. But how one gets access to that luxury platform or how platforms differentiate between customers could raise concerns in respect of a range of issues, not least with respect to any bias in the underlying algorithms that underpin the platform.

Equally, if you're a platform operator and you're trying to move to an entirely autonomous fleet, one has to decide if people will really care what kind of car picks them up as long as they know that it's going to get them where they want to go at a price they want to pay.

There could be some tension between the manufacturer of vehicles and a MaaS platform operator, assuming they are not one in the same. Does the vehicle become commoditized? Do you really need to differentiate between brands and marks? What's more important to the consumer? Is it the vehicle that they're picked up in or the platform that they're using? And always there is the issue of inclusivity.

What are some of the challenges for inclusivity?

Diffenthal: We must acknowledge that mobility networks can embed inequalities. For example, if wealthier populations choose private transportation options or ride-hailing services while others have more limited options, including public transit, this could exacerbate network congestion. For another example, geographic inequities can stem from platform connectivity requirements. Residents of areas with poor or unreliable mobile coverage are effectively excluded from MaaS options that are only accessible through online channels.

Regarding new business models, what makes MaaS payment platforms unique?

Diffenthal: The way consumers will pay for MaaS differs from consumers who are in the market to buy a car. Subscription payment models make sense for MaaS. Even traditional car buying could shift if services like maintenance, insurance, connectivity, and fuel or energy are bundled into the cost of the car itself, consumers might like the convenience of an all-in fixed price because it provides certainty over their spend.

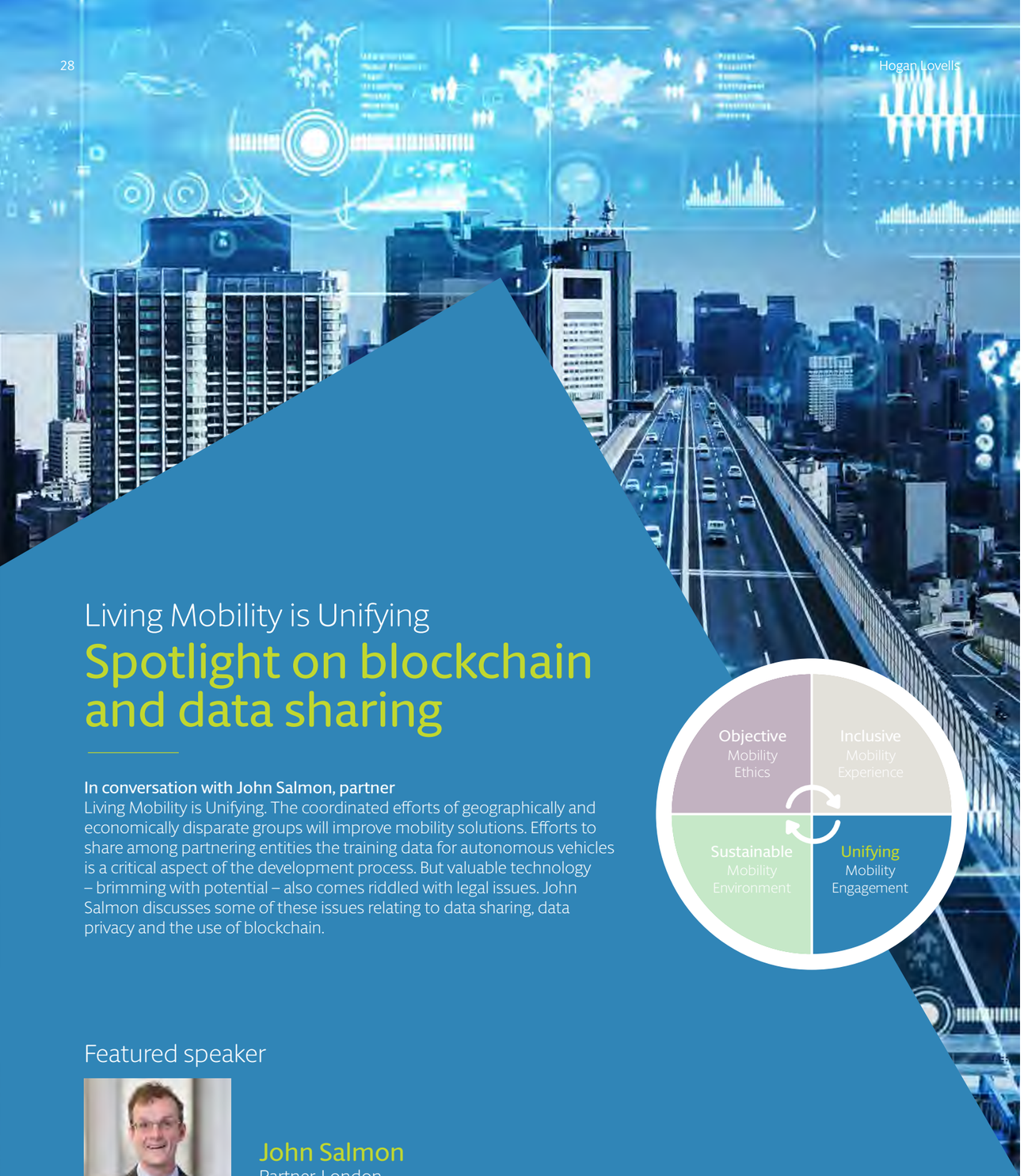
Will consumers want to know about the technological architecture that enables MaaS platforms? For example, how AI or blockchain are used?

Diffenthal: Ultimately, I don't think consumers will actually care. From an end-user perspective, does it really matter if the underlying architecture is blockchain-based or not? Or is it more important that the platform is easy to use?
While transparency and fairness are important from a business and public policy perspective – and as noted above it will be important to consumers feeling the impact of bias – as a practical matter consumers tend to care more about the interface. For end users, the UX/UI is probably the most important thing, not necessarily the rails that underpin the service.

That's not to denigrate the importance of having the right rails – I just don't know that that's something that consumers will necessarily attribute as much value to as the industry does. Whether Operator A is blockchain-enabled and Operator B is not will likely be far less critical to the consumer. Most likely, the end user will do an A-B test and the one which has the slicker interface, more reliable service, more vehicles on the road, shorter wait times, whatever it might be – those will be the things that matter from a consumer perspective.

Now if you're thinking about mobility in a broad sense that encompasses private vehicle, last-mile, public transportation and you're trying to loop that all together, then the challenges might be for other stakeholders, not necessarily the end-user. Those stakeholders could be really interested in a blockchain-enabled platform because of some of the advantages that those systems would have around immutability, transparency and auditability, particularly in an ecosystem which is bringing together multiple stakeholders, in a way that perhaps other technologies may not. Achieving accessible mobility solutions requires collaboration of different stakeholders across technology, communications and financial sectors. I think one's view on the technology structure probably depends on your role within the system and what you are looking to do.

Living Mobility is **Unifying**



Living Mobility is Unifying

Spotlight on blockchain and data sharing

In conversation with John Salmon, partner
Living Mobility is Unifying. The coordinated efforts of geographically and economically disparate groups will improve mobility solutions. Efforts to share among partnering entities the training data for autonomous vehicles is a critical aspect of the development process. But valuable technology – brimming with potential – also comes riddled with legal issues. John Salmon discusses some of these issues relating to data sharing, data privacy and the use of blockchain.

Featured speaker

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Why is data so valuable to the mobility and transportation industry?

Salmon: Modern artificial intelligence (AI) thrives on data – the more data you give the AI, the more accurate the models AI. Machine Learning is the process through which the systems in the autonomous vehicles (AVs) learn the parameters of the operational design domain within which the systems complete certain dynamic driving tasks.

Broadly speaking, society has become increasingly reliant on data in daily life and the resulting challenge concerning data value generally revolves around control and ability to use.

If the value of data continues to climb, what should the mobility and transportation industry keep in mind about managing data resources?

Salmon: Beyond the increasing value of data, the fuel of AI training, industry should consider the sheer volume of data to be managed. Together, the increasing value and the vast volume of data set the stage for a battle brewing about who owns data. Specifically, the battle is about access to and control of the data. It's not just a battle of AV developers but manufacturers, insurers, and suppliers – along the entire supply chain. And blockchain is one way to address the complexity of managing vast amounts of data.

What is blockchain?

Salmon: Blockchain is a form of distributed ledger technology (DLT) that makes it possible to store data on numerous nodes on a network with identical entities stored across the DLT network. In this way, DLT makes it difficult for any users to gain control of the network unless it is possible for them to gain control of over 50% of the network nodes. The appeal is that blockchain technology increases transparency through traceability of data entries on the network and improves efficiency by removing intermediaries and transaction costs. Financial institutions and the insurance industry already use blockchain to manage data.

How might distributed ledger technology be used in the mobility and transportation industry?

Salmon: There are many blockchain use cases for the mobility and transportation industry. From warehousing to payment for shared services, to delivery tracking, distributed ledger technology offers the same possibilities for transactional efficiency as it does in financial institutions.

Businesses along the supply chain could also use blockchain to move data internally and with outside partners without compromising privacy. For example, AV data sharing amongst agreeing manufacturers turns on privacy research that you can bring an algorithm to data and train AI models collectively. The value proposition is that it is possible to come to an agreement with other organizations without giving up privacy of the underlying data.

For the mobility and transportation industry, there are a myriad of possibilities around sharing data and working together across trust boundaries to get things done.

Living Mobility is Unifying

Spotlight on trade and supply chains

In conversation with Juan Francisco Torres-Landa, partner, Leader Latin America

Living Mobility is Unifying. The automotive sector is an example of interconnectedness as supply chains are global and players along those supply chains depend on each other. But manufacturing globally means playing by the rules of the jurisdictions your consumers call home. Trade agreements can facilitate global supply chains, but they involve a myriad of legal issues. Technology and business models also "travel" internationally. Juan Francisco Torres-Landa discusses some of the issues relating to the impact of trade on the future of mobility in Latin America.

Featured speaker

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Why is trade so critical to the mobility and transportation industry in Latin America?

Torres-Landa: Mexico plays a significant part in the global mobility and transportation industry, specifically the automotive industry. This industry is particularly interconnected because the product manufactured – the automobile – culminates from so many companies along the supply chain.

This is one reason a free-trade agreement (FTA) can positively impact the mobility and transportation industry. The interconnected supply chain requires nimble companies with the ability to pivot in order to accommodate market needs and varying trade rules to operate on a global scale. An FTA is one way industry can achieve this adaptability.

What is a free-trade agreement?

Torres-Landa: A free-trade agreement (FTA) lays out rules for economic activity among participating countries. To boost trade, partnering countries agree to reduce barriers to trade among participating countries by lowering tariffs and eliminating non-tariff barriers, for example. To foster investments, the FTA includes preferential rules of origin to incentivize use of local suppliers – that is, suppliers located in countries within the FTA.

How might free-trade agreements generate industry resiliency?

Torres-Landa: Trade flexibility can positively impact economic development and the mobility and transportation industry by helping industry pivot where necessary to meet changing market conditions. What enables adaptability – or resiliency – is a level of certainty that the public sector provides and the private sectors requires to adopt good business decisions and benefit the community. The Mexico-United States-Canada Treaty (USMCA) represents an opportunity for industry to evolve and adapt during a time of industry disruption.

Within Latin America, how might public and private sectors work together to advance electrification and shared services?

Torres-Landa: For shared services, compliance is critical. One example of this is the performance of micromobility companies in Latin America. For example, micromobility used to be very visible in Mexico City. But certain micromobility ventures were not successful in part because some companies entered the process without getting fully licensed and thus experienced compliance issues. There were four to five visible micromobility players; now there are only two.

In contrast, transition to electric vehicles (EVs) is well under way in Latin America. In Mexico, we are already seeing some practical ways public and private sectors are working together to advance electrification. New vehicle and ownership taxes have been eliminated for EVs and street charging stations in Mexico are free of charge. Internal combustion engine (ICE) vehicles may not be driven one day a week in certain areas, a restriction that does not apply to EVs. And published import duties on EVs have been reduced from 15% to zero.

But hurdles remain. Two significant challenges to electrification are price point and a limited number of charging stations, particularly outside of main urban areas. A strategic growth plan is needed. While servicing EVs is simple compared with ICE vehicles, service shops where repairs can be made are limited and that increases operational costs and resulting inconveniences.

Urban congestion is an overarching issue that needs collaboration between the public and private sectors. In cities like Mexico City we still see overreliance on individual vehicles causing congestion, while the extensive subway system is insufficient because it requires more connections to other transit systems to match actual consumer needs. This combination triggers an urban planning nightmare.

There is a huge opportunity to do things better, but it will require significant investments. Just as economies are increasingly integrated around the world through the irreversible process that is globalization, unifying efforts between public and private sectors at the national level will become increasingly important in the future of mobility. The trend is permanent, but a pragmatic and technically savvy planning process is required to maximize benefits.

Living Mobility is Unifying

Spotlight on PPP for future mobility

In conversation with Liang Xu, partner

Living Mobility is unifying. Collaboration between the public and private sectors to improve mobility solutions is an important illustration of the unifying aspect of living mobility. In China, the integration of the public and private sectors is particularly profound. For example, a business enterprise can partner with local government to bring advanced technology to an area in exchange for help in growing its business. Limited concerns about data privacy also create a rich ecosystem for machine learning. Liang Xu discusses technology developments and the impact of public-private partnerships (PPP) on the future of mobility.

Featured speaker

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What should the mobility and transportation industry keep in mind when considering technology developments specific to China?

Xu: Broadly speaking, people in China are more accepting of AI and technology than people in other parts of the world. From a data privacy perspective, the Chinese people are more tolerant of personal data usage and more accustomed to accepting technology than people in Europe and the United States. Consciously exchanging data for convenience is part of daily life.

For example, people in China have been using apps like WeChat for years to complete everyday tasks. When logging onto an app like WeChat, there are usually standard Privacy Policy and Terms and Conditions requiring consent for certain collection, processing and use of personal data. In China, people agree to use these apps because the platforms make life so much easier.

Platforms capable of ordering meals, booking medical appointments and paying at grocery stores simplify life. People in China have a basic understanding that their data is an asset and are willing to disclose their personal data in exchange for the convenience of accessing these services, if the data processing activities of such apps and platforms are conducted within a reasonable scope. This premium placed on convenience is one distinctive feature of Chinese culture impacting industry.

How has public sentiment on data privacy impacted AI development in China?

Xu: Beyond making life more convenient and more fun, apps and platforms demonstrate the power of AI to optimize convenience when provided with data that is physically grounded in daily activities. Deep learning can only optimize on data made available to the algorithm. Companies in the U.S. and Europe amass data from public activity on virtual platforms like videos watched, posts "liked" and searches made.

In China, AI capacity is supported by data beyond online activity. Chinese companies gather data from public activities in daily life like physical purchases and trips taken. Because of the robust data pools, AI can be applied broadly to daily life.

How do public-private partnerships (PPP) in China impact developing technologies like EVs?

Xu: In terms of electric vehicle (EV) technology, the public sector works with the private sector to bring advanced technologies to cities by offering financial incentives from local governments.

For many years, the Chinese government has been trying to invest in and encourage the development and use of EVs as a solution to air pollution. Financial incentives include tax breaks, interest-free loans, and investment funds supplied by state-owned institutions that provide equity to private companies to help them develop their technology and grow their business.

These incentives for EVs are offered not only for potential environmental benefits. It is also about the creation of jobs and a better future. China is the world's largest EVs market and EVs are very popular among Chinese consumers: EVs sales have surged in China not only for the current market leader, Tesla, but also for emerging EV brands (some of which are listed in the U.S.) as a result of which their stock price is soaring.

Considerable efforts have also been taken towards the development of autonomous vehicle (AV) technology (particularly autonomous buses and taxis, which are being rolled out on a pilot basis in certain Chinese cities) together with the underlying 5G infrastructure.

How might public-private partnerships (PPP) impact industry supply chains in China?

Xu: From the supply chain perspective, public-private partnerships are things local governments are on top of. For example, semiconductor technologies are in high demand and a local government realizes it needs good technology in the area. The local government considers its options and shops around for the best deal – the best partnership. Sometimes the partnership involves an equity investment by a state-owned entity (for example, through the establishment of a joint venture with the foreign investor); some other times, the local government's role is limited to providing a space for the business (for example in a high-tech industrial park) and the other relevant financial incentives discussed above.

For business enterprises, negotiations with local authorities often involve an "investment cooperation agreement" enforceable against the local government. Contractual safeguards prompt delivery on a party's promise to maintain a good relationship with the local government. As a practical matter, keeping good relations with local authorities is important as support is needed almost on a daily basis after setting up operations. If all parties are acting reasonably, then partnerships work well. If a party is not honouring its commitments, recourse can involve reporting to higher levels. Such efforts help protect the interests of involved parties and maintain good relationships.

At the end of the day, mutually beneficial partnerships represent opportunities for improved mobility solutions.

Living Mobility is Unifying

Spotlight on MaaS in Russia

In conversation with Vironika Pilyugina, partner

Living Mobility is Unifying. Government coordination with the private sector to develop multimodal transport solutions is one way to foster the unifying element of modern mobility. State-sponsored efforts to improve infrastructure and expand mobility options are often critical to integrated, multimodal transport. In Russia, the transport system has changed dramatically over the past decade, particularly with regard to Mobility as a Service (MaaS). Vironika Pilyugina discusses the development of state-sponsored MaaS in Russia generally but focuses more specifically, on Moscow.

Featured speaker

Vironika Pilyugina
Former partner, Moscow

What developments should the mobility and transportation industry keep in mind when considering shared services in Russia?

Pilyugina: During the past decade, the Russian government has increasingly developed the public transport network. The State Program of Moscow Transport Development prioritized congestion reduction as early as 2010 when traffic challenges in Moscow were identified as a critical issue. Several years ago, the Moscow Department of Transport and Road Infrastructure Development recognized that more than half of its citizens take public transport on a daily basis so public transportation is already heavily used.

The market for passenger transport services in Russia, excluding air travel and urban transport, is substantial as it exceeds 1 trillion rubles. The largest segments here are taxi services (over RUB 700 billion), commuter trains and long-distance trains (RUB 250 billion). Intercity buses account for over 150 billion rubles.

Beyond integration of shared transport modes, how is micromobility developing in Russia?

Pilyugina: Shared service operators are adapting to the dynamic, connected market by offering mobility solutions for moving both people and goods. Logistic solutions include delivery services and are evolving rapidly. Predominantly in cities, people-moving solutions include micromobility options like bike sharing and e-scooter sharing.

The new services coming forward are not provided directly by the authorities but are widely endorsed and promoted by governmental entities. While some of the services involved are new the involvement of government authorities is not new. Many state-sponsored infrastructure developments like pedestrian spaces, detached lanes for public transport, tunnels and bike lanes have been gradually introduced since 2010.

Are there other notable mobility developments in Moscow?

Pilyugina: Continued developments include new train stations and metro lines for underground and overground transit. Modern metro trains (Moskva) have more passenger seating than the older models and other features like improved noise insulation and better air conditioning. For overground transport, the Moscow Central Diameters (MCD) is a project that was introduced within the past five years to connect surrounding towns with the Moscow city centre. Also, Moscow renewed its bus fleet and released Vitayz M trams, with the capacity of three passenger vehicles for passengers with reduced mobility.

Additionally, the recent e-bus launch in Moscow includes supportive infrastructure with charging stations located along the city bus route.

How are intelligent transport systems (ITS) and "digitization" streamlining transit and improving urban congestion in Moscow?

Pilyugina: Digitization of transport services has played an important role in improving mobility options for people in Moscow. In 2018, the metro stations started being equipped with turnstiles that use Android Pay, Samsung Pay and Apple Pay. Other convenient payment methods include the transport smartcard (Troika), which is part of the Metro Moscow app. Ticket systems that are digitized make it possible for passengers to transition more seamlessly between modes.

MaaS passenger services are now also largely available through smartphone apps. Taxi service is primarily used through in-app requests or bookings. Public transport operators use mobile apps that are made available for passengers to download. These apps offer service information in several languages and also provide planning options to determine routes.

And citizens are involved in mobility improvements through another app – the Moscow Helper app. People using this app can report parking violations to help the city maintain pedestrian crossings and prevent accidents caused by improperly parked vehicles.

Living Mobility is Sustainable

Living Mobility is Sustainable

Spotlight on climate change and EVs

In conversation with Mary Anne Sullivan, senior counsel

Environmental sustainability is a primary goal of the mobility future many envision. To reduce the environmental impact of transportation, sustainable energy sources are needed and transportation modes need to minimize GHG production. Electric Vehicles (EVs) are a significant aspect of this effort as they are a focus of policy-makers and the industry. Market predictions forecast over half of all passenger vehicle sales to be electric by 2040. But the success of these electrification efforts depends on complex factors like policy, cost parity, consumer trust and charging point availability. Mary Anne Sullivan discusses a few of these factors impacting EV development worldwide.

Featured speaker

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How is electrification impacting the mobility and transportation industry?

Sullivan: Some rail has long been electric. Other sectors are behind the automotive industry when it comes to electrification. The aviation and maritime industries are facing pressure to reduce their carbon emissions. So I expect changes will be coming, but they are not commercially viable yet.

How will the pandemic impact EV development?

Sullivan: Electric vehicle (EV) development is experiencing the same COVID-19 pandemic-related market slowdowns as the rest of the transportation industry. But there is no reason to think that the impact will persist in the long term. Lots of new vehicle models are ready to be rolled out.

Will energy efficiency regulations accelerate or impede EV adoption?

Sullivan: In the U.S., fuel efficiency standards have historically been the primary driver of EV adoption. In Europe, concern about climate change has been behind the growth of EVs. In China, fuel efficiency, air quality, and climate change all support EV deployment. Going forward, I expect to see more emphasis on climate change rather than fuel efficiency standards driving EV adoption in the U.S.

What is range anxiety?

Sullivan: In the context of EVs, range is the distance an EV can travel before recharging. Range anxiety refers to concern that an EV has insufficient battery power to reach its destination – or the next charging point. Range anxiety is a significant deterrent for many consumers to take the plunge on an EV.

To overcome range anxiety, how can industry work with government to build out EV infrastructure?

Sullivan: State-by-state in the U.S. and at the national level around the world, both governments and individual companies are increasingly focused on reducing carbon emissions. That creates a shared interest in developing charging infrastructure. For example, New York recently approved a more than US$700 million request by utilities in the state for funding to build out charging infrastructure.

What can be gleaned from jurisdictions around the world about facilitating EV adoption?

Sullivan: The main message is that policy matters. The technology is ready; the infrastructure appears when the demand is there. But the places where EVs are most common are where government policy – either mandates or incentives – has been supportive. California and Norway see the highest EV penetration. Both were early adopters of strong climate policies. A recent study by the International Energy Agency showed that aggressive policies supporting EVs could almost double the level of EV sales by 2030, compared to more modest policies.

How can industry promote ethical sourcing in EV battery supply chains?

Sullivan: Cobalt is an essential mineral used in lithium-ion batteries. More than half of the world's cobalt comes from mines in the Democratic Republic of Congo. Because independent miners sell cobalt to bigger mining companies before it gets to OEMs, it can be hard to know if the cobalt is ethically sourced. One potential solution could be for manufacturers and suppliers to agree to track sourcing across global supply chains. It is important that OEMs work closely with suppliers to monitor materials going into the lithium-ion batteries.

Living Mobility is Sustainable

Spotlight on transformative transactions

In conversation with Sarah Shaw, partner, Industry Sector Co-Head Energy and Natural Resources

Living Mobility is sustainable. In the mobility and transportation industry, sustainable practices will need to extend throughout the entire supply chain if sustainability goals are to be met. As the low carbon economy gains momentum, expectations of stakeholders are shifting and environmental, social and governance (ESG) principles are becoming embedded in business strategy. With new priorities come both new opportunities and challenges. Sarah Shaw discusses how these opportunities and challenges are having an impact on deal-making in the industry.

Featured speaker

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How is commercial sustainability impacting deal-making in the mobility and transportation industry?

Shaw: The mobility and transportation industry is facing unprecedented disruption across the whole supply chain. It is a critical time for global players of all sizes who are working to adopt environmentally sustainable practices. The result is that sustainability issues are playing an increasingly important role in transactions. In some cases sustainability is even driving M&A activity or providing an impetus for the creation of joint ventures, partnerships and other strategic alliances.

In evaluating potential transactions, it can be difficult to quantify ESG opportunities and risks along the supply chain.

An increasing number of global organizations are turning to the United Nations Sustainable Development Goals to measure progress with regard to sustainability. Achieving these goals requires profound, systemic change.

What are the Sustainable Development Goals?

Shaw: The Sustainable Development Goals (SDGs) are a set of 17 objectives set out by the United Nations. The SDGs or Global Goals address challenges ranging from poverty and inequality to climate change. Particularly relevant in this context – and in fact underpinning all SDGs – is SDG 16. SDG 16 calls for peace, justice and strong institutions, which are essential for sustainable supply chains.

Many public and private sector organizations are collaborating across jurisdictions to seize this opportunity around the SDGs. For example, many cities in the United Kingdom have made commitments to net zero carbon by 2030. For some organizations, shifting from one-off, localised contractual arrangements to long-term, strategic, multi-jurisdictional partnerships can be transformative in meeting ESG goals.

What makes a partnership or other transaction transformative?

Shaw: A joint venture, partnership or strategic alliance is transformative if it disrupts the status quo and makes a radical difference in an organization's progress against a given objective. Deals are becoming increasingly ambitious. They are also being increasingly driven by a desire to innovate, for example, by transforming supply chains and allowing businesses to compete more effectively in today's rapidly changing world. Innovation is key when it comes to sustainability. Organizations can either work towards achieving sustainable goals in a piecemeal fashion on their own or consider how to partner with another organization in order to accelerate the rate of progress.

Living Mobility is Sustainable

Spotlight on EV charging infrastructure

In conversation with Alex Harrison, former partner, Energy and Infrastructure

Vehicle electrification is one step towards the sustainable mobility future many envision. But where and how fast we will charge electric vehicles remains uncertain and depends on the viability of domestic charging solutions and the impact of the transition to autonomous and shared vehicles. Alex Harrison discusses electrification developments and the need for interoperable and smart charging infrastructure to support future electrified mobility.

Featured speaker

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How is electrification impacting the mobility and transportation industry?

Harrison: Electrification is becoming increasingly important to the mobility and transportation industry. Historically, electric vehicle (EV) sales have been driven largely by government and policy. We are seeing advances in technology and vehicle choice driving growing popularity and affordability of electric and hybrid options on the consumer side. But price disparity, range anxiety and a perceived lack of access to charging stations still act as hurdles for uptake. Tackling these challenges to support the EV growth curve remains an immediate priority.

Are any of these challenges specific to mass electrification of fleets?

Harrison: Fleets will play a major role in the transition to electric vehicles. They are significant bulk purchasers of new vehicles, which will in time create a buoyant market for used electric vehicles. They can also act as anchor tenants for charging infrastructure and through shared mobility can provide consumers with access to electric vehicles without needing to own one. Fleets tend to have different and higher mileage profiles to personal vehicles and will need access to a reliable charging ecosystem to support that demand.

What about repurposing existing infrastructure?

Harrison: One key to developing smart, sustainable cities in a cost-effective manner is the repurposing of existing infrastructure. London, like other major cities, is a good example of an area where using the existing electricity infrastructure on the street, for example through lamppost charging, can allow for more rapid rollout of EV charge points.

How will the charging ecosystem need to account for other technological developments in the mobility industry like autonomy and shared services?

Harrison: The charging ecosystem of the future will need to account for the emergence of ridesharing models as well as the shift to autonomous vehicles. With both business models, annual mileage per vehicle will likely significantly increase so charging demand will also increase. I've seen one estimate of autonomous vehicles travelling up to 25,000 miles a month - and therefore change the infrastructure needs for an optimal charging footprint.

How does the "charging footprint" factor into development of the charging ecosystem?

Harrison: The EV charging footprint refers to the speed, frequency and location of charging points. This concept is important to development of charging infrastructure as a variety of charging solutions will be needed. This optimal footprint will vary from country to country and within countries between, for example, urban and rural environments. Home, workplace, destination and en route charging solutions will need to offer access to varying charging speeds, to mirror consumer demand, most likely underpinned by different pricing and revenue models. A potential source of additional revenue for home, workplace and some destination charging solutions is the supply of power from vehicle to grid (V2G), vehicle to business (V2B) and vehicle to home (V2H). This would allow EVs to become energy storage supporting a domestic, corporate, national or regional energy system. This interoperability ties into "smart" charging.

Why is "smart" charging so important to the development of EV charging infrastructure?

Harrison: "Smart" charging will facilitate optimal charging behaviours for consumers. But the importance of "smart" charging is even more fundamental to the EV charging ecosystem. To anticipate exponential growth in EVs, the charging ecosystem needs to be "smart" to timeshift and smooth out the load on the energy system. Suppose everyone returns from work and begins to charge their EVs at the same time (typically coinciding with existing peak demand on the electricity system). This is the kind of significant increase in peak load on the national electricity network that "smart" charging works to avoid.

How will risk factors related to EV charging interoperability be balanced for optimal rollout?

Harrison: At the moment, the market is characterised by a large number of charging solution providers and differing charging technologies. This results in users needing a multitude of Apps or access cards and subscriptions. Over time, the market will naturally consolidate around the most successful technologies and the charging solution providers that are able to scale and build reliable demand for their services. If needed, governments may legislate for interoperability.

Living Mobility is Sustainable

Spotlight on hydrogen

In conversation with Arjun Garg, partner

Living Mobility is Sustainable. Hydrogen has the potential to be a sustainable fuel source that could be used in many transportation modes. The by-products of a hydrogen fuel cell are simply water and heat, so the sustainability of hydrogen as a fuel source depends ultimately on how the hydrogen is sourced. Arjun Garg discusses the promise of hydrogen as an enabler of sustainable mobility and the challenges for adoption of hydrogen as a clean fuel.

Featured speaker

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What role can hydrogen play in improving the sustainability of mobility and transportation?

Garg: Hydrogen power is attractive because it offers potential to address sustainability through technology. Hydrogen can be a green alternative to fossil fuels. The chemical reaction of hydrogen with oxygen generates energy to power a vehicle, and the by-products are water and heat—no emission of CO_2 or other greenhouse gases. Depending on how cleanly the hydrogen is produced and distributed to users, it could be a near zero-emission fuel source. Moreover, hydrogen is non-toxic and unburdened by the typical risks of environmental contamination associated with other energy sources.

What kinds of transportation applications does hydrogen have?

Garg: Innovators are exploring any number of hydrogen applications for ground, air, and marine transportation. Hydrogen will not necessarily be an optimal solution for every use case, but active efforts exist to use hydrogen to power cars, buses, trucks, trains, airplanes, drones, ferries, shipping vessels, and more. Today, there already are hydrogen-powered cars, buses, and trucks on the road, along with hydrogen refueling stations, in various countries around the world—although still in relatively small numbers. Hydrogen-powered trains have already been running trials in Europe and are moving into regular commercial operation. Similar progress from demonstration to commercial deployment is occurring for marine vessels. Aviation manufacturers are working to retrofit existing aircraft with hydrogen powertrains as well as develop clean-sheet designs for new hydrogen propulsion aircraft.

What are the main challenges in moving toward adoption of hydrogen in transportation systems?

Garg: The merits of hydrogen are appealing in theory, but have to be proven commercially viable in practice. The challenges break down into four categories: production, distribution, cost, and performance. How can hydrogen be cleanly produced at mass scale? How can hydrogen be distributed effectively to end users? Will hydrogen be cost-effective for operators? And will hydrogen-powered vehicles meet performance expectations, including safety requirements?

All these challenges involve a mix of technical, economic, and policy considerations. And they all tie back to the physical characteristics of hydrogen that create advantages and limitations.

If hydrogen can be consumed cleanly, what concern is there with the sustainability of hydrogen as a fuel source?

Garg: The concern for sustainability turns principally on how hydrogen is produced. Even though hydrogen is abundant, it does not typically exist in isolated, pure form. Rather, it is commonly a component element of water (H_2O) or hydrocarbons such as methane (CH_4). Some processing has to be done to extract hydrogen from water or hydrocarbons. For hydrogen as for other fuel sources, the extraction process factors significantly in the cleanliness of the supply. The extraction process itself requires significant energy input, and it leaves a by-product (oxygen from water, or a carbon compound from hydrocarbons). Ideally for environmental purposes, the precursor would be water, the energy input to process it would be renewable or carbon-neutral, and the by-product would be oxygen. Development is ongoing to realize the goal of producing green hydrogen that is affordable at mass scale. One idea being explored is to produce hydrogen during periods when renewable power generation creates electricity supply that otherwise outstrips demand, taking excess energy for which the grid has no use and converting it, through electrolysis of water, into hydrogen as an energy store. That hydrogen could then be used as fuel for transportation or for shoring up the grid when electricity demand surges.

Apart from its environmental impact, what are advantages and disadvantages of hydrogen as a transportation fuel?

Garg: Hydrogen not only can be clean, but also offers important practical advantages. Most focus on five major advantages of hydrogen. First, hydrogen is an abundant element with effectively unlimited availability. Second, a hydrogen fuel cell is perhaps two to three times more energy efficient than a fossil-fueled internal combustion engine, meaning that, pound-for-pound, hydrogen moves a vehicle farther than gasoline does. Third, re-fueling with hydrogen can be completed in minutes, faster than recharging a battery and potentially faster than refilling with fossil fuel. Fourth, a hydrogen fuel cell has no internal moving parts, so it can be more reliable and quieter than a conventional engine. Fifth, hydrogen delivers consistent performance as it gets depleted. These advantages must be weighed against disadvantages. Perhaps the most significant challenges relate to storage and movement through the supply chain. Hydrogen has to be stored under high pressure as a gas or at very low temperature as a liquid to reduce its volume to a manageable level, complicating its movement through the supply chain and its incorporation into vehicle designs. Successful commercialization of hydrogen-powered transportation will require finding applications and supply chains that affordably capitalize on hydrogen's benefits while overcoming its limitations.

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Top trends to watch:

- Combining all modes of transport.
- Consumers accepting robots.
- Consumers requesting content.
- Current vs future business investments.
- Enhanced Connectivity, Telematics and Infotainment (5G).
- Health, Privacy and Cybersecurity concerns.
- Impact of trade control on production and technology.
- Interior design transformation.
- Mass transit transformation.
- Micromobility.
- More virtual testing.
- Return of ownership.
- Shared platform technologies.
- Smart cities.
- Sustainable Transportation and Living Mobility.

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Awards and rankings

- Tier 1 in Transport: Rail and Road – Litigation and Regulation, *Legal 500*, United States, 2020-2023
- Band 1 in Transportation: Road (Automotive), *Chambers USA*, 2019-2023
- Transportation Practice group of the Year, *Law360*, 2019-2020
- Band 1 in Transportation: Aviation: Regulatory Nationwide, *Chambers USA*, 2016-2023
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