International Transport Forum | CPB Corporate Partnership Board

Corporate Partnership Board

Emerging Issues and Innovation Challenges

Autonomous Driving, Urban Mobility, Mobility Data, Logistics Performance

OECD

Emerging Issues and Innovation Challenges

Thematic Project Series

The contribution to policy analysis by the Corporate Partnership Board (CPB) is the main focus of interest of the International Transport Forum (ITF) member countries.

Policy analysis projects undertaken by the Corporate Partnership Board (CPB) provide a good vehicle for development of policy advice which add elements of corporate information and business perspectives to the rigorous scientific foundation of the ITF Secretariat's work on economic theory and public policy.

These projects are based on topics with potential policy impact for transport decision-makers in governments or multilateral organisations in which ITF member countries participate. They contribute to enrich the discussion of items on the current transport policy agenda and also help define the upcoming policy agenda.

CPB Thematic Projects are launched within the following two general streams:

Emerging Issues in Transport Policy

Innovation Challenges in Transport Systems

Project topics for the Thematic Project Series are suggested by Corporate Partnership Board Members and consolidated by the ITF Secretariat. Projects are carried out by working groups composed of the interested Partners, the ITF Secretariat and external experts as agreed by the project working group.

The following projects were adopted by the CPB in early 2014:

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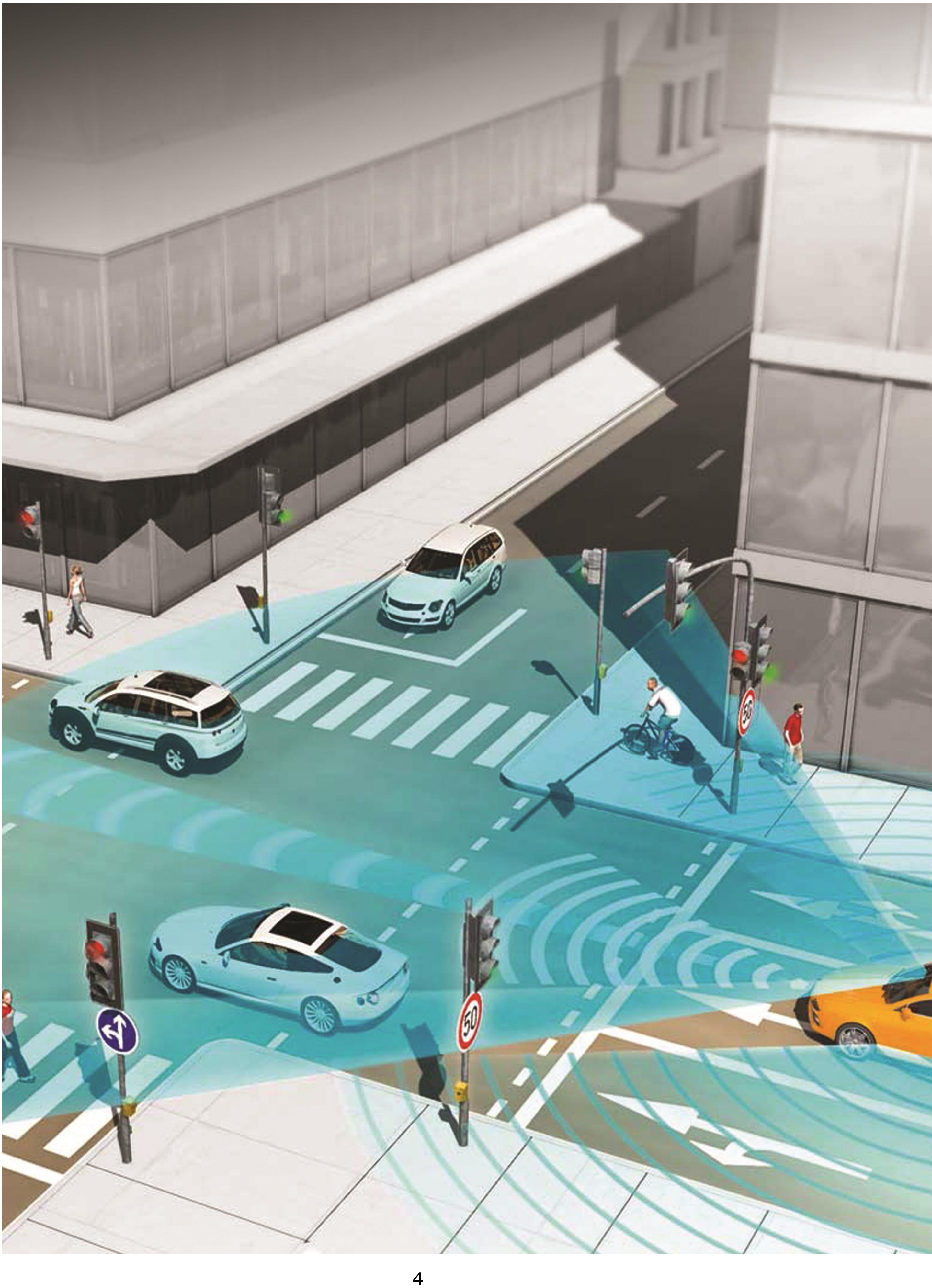
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Autonomous Driving: Regulatory Issues

Why

Many cars sold today are already capable of some level of autonomous operation and prototype cars capable of driving autonomously have been and continue to be tested on public roads in Europe, Japan and the United States. These technologies have arrived rapidly on the market and their future deployment is expected to accelerate since autonomous driving promises many benefits – including improved safety, reduced congestion and lower stress for car occupants.

With the uptake of on-road autonomous driving being years rather than decades away, authorities will have to adapt existing rules and create new ones in order to ensure the full compatibility of these vehicles with the public's expectations regarding safety, legal responsibility and privacy. This project looks at what issues will have to be considered at a strategic level by authorities as autonomous vehicles arrive on our roads.

How

We undertook this study on the basis of meetings and discussions amongst project partners, desktop research and invited the contribution of an external expert – Bryant Walker Smith, of the University of the South Carolina School of Law and the Center for Internet and Society at Stanford Law School.

What we found

Autonomous technologies are maturing and some autonomous driving is here already
Many of the core technologies required for partial autonomous driving are available today. Some of these are mature and a few are already being deployed in commercially available vehicles.

Self-driving cars seem a near-term possibility but their range of capabilities is unclear
A few major car manufacturers and several technology firms have announced the commercial production of highly autonomous vehicles starting in 2017. By 2030, many observers expect there to be a wide range of such models on the market and some may be self-driving. It is not clear at present to what extent these vehicles will be capable of self-driving in all circumstances.

Road safety is expected to improve with vehicle automation but this effect remains untested at a large scale and may not be immediate or linear

Most crashes involve human error - if greater autonomous operation reduces or eliminates these errors then benefits may be massive. However, most driving involves no crashes - the real safety test for autonomous cars will be how well they can replicate this crash-free performance. Results from early prototypes are promising though new types of crashes may emerge as autonomous technologies become more common, e.g. crashes resulting from the car handing control back to the driver or from mixing autonomous and conventional vehicles.

There are many possible technological configurations for autonomous driving…

The move towards autonomous driving may involve different technological configurations. Some rely on greater connectivity between cars and between cars and infrastructure. These entail the development of common communication protocols, encrypted security standards and investment in new types of infrastructure or upgrading those which currently exist. Others rely more on vehicle-embarked sensor platforms and require little infrastructure investment. Both models require precise digital representations, including high definition maps, of their environment.

…and there are two incremental paths towards full automation

The first involves gradually improving the automation in conventional vehicles so that human drivers can shift more of the dynamic driving task to these systems. The second involves deploying vehicles without a human driver in limited contexts and then gradually expanding the range and conditions of their use. The first is generally embraced by traditional car manufacturers and the second by new entrants.

Use and business cases are closely linked to automation pathways

Incremental advances in automation in conventional vehicles are likely not to fundamentally change vehicle market dynamics. Individuals will likely buy and own cars much as they do today. Automated driving will be available for certain situations (motorways, parking, congestion, motorway platooning). Because the human driver must resume active control when prompted to do so, such conditional automation raises particularly difficult issues of human-machine interaction that have not been satisfactorily solved.

Self-driving cars on the other hand, will not face the same issue of human-machine coordination though their use will likely be confined to contexts where the vehicle can confidently handle the full range of driving complexity. Such highly specific contexts include particular routes and low-speed operation. Self-driving cars have the potential for much more disruption as they may be deployed in fleet-wide systems that fundamentally re-shape individual travel and have an impact on several incumbent industries including public transport and taxis.

Some authorities are developing regulatory frameworks for prototype testing though little anticipatory action is taking place on potential use cases

Several jurisdictions have passed or are considering rules that enable the testing, licencing and operation of autonomous technologies and vehicles. Most address the safe operation of these vehicles on public roads though there is little coordination amongst jurisdictions at present. We could not find evidence of anticipatory regulatory action addressing the potential use cases that could result from large-scale deployment of highly autonomous vehicles – e.g. the provision of quasi-public transport or taxi-like operations.

Policy insights

Automated driving comprises a diverse set of emerging concepts that must be understood individually and as part of broader trends toward automation and connectivity

Vehicle automation is part of much larger revolutions in automation and connectivity. The recent hallmarks of these revolutions—personal computers, mobile telephones and the Internet—have converged with each other and are now blending with machines that sense and manipulate the physical environment. These machines include not just automated motor vehicles but also drones, personal care robots, 3D printers, surveillance devices and many others. Vehicles will change with growing automation but so too will their role in society in ways that are hard to foresee. Policies should account for this uncertainty and ensure sufficient resilience to adapt to these changes, or at a minimum, not block those that are desirable.

Uncertainty on market deployment strategies and pathways complicates the regulatory task

Autonomous vehicle regulation should ensure safety and prevent, or at least mitigate, market failures. This task is complicated by uncertainty on what it is that should be regulated and the risk that regulation may in fact lock in one automation pathway over a potentially better one. Though regulators may target autonomous vehicles as a special case out of convenience, it may be preferable to adapt existing rules as much as possible.

Early regulatory action may be desirable but carries risks as well; prematurely codifying requirements can freeze unrealistically high or low expectations into the law in a way that ultimately causes that law to lag rather than to lead. Some regulatory flexibility seems desirable – allowing circumscribed uses such as low speed urban operation or motorway platooning could occur before implementing a blanket set of rules.

Incrementally shifting the driving task to machines and algorithms and away from people will require changes in insurance…

Liability remains an important barrier for the manufacturers and designers of autonomous vehicles. Expanding public insurance and facilitating greater private insurance could provide sufficient compensation to those injured by an automated vehicle while relieving some of the pressure on the tort system to provide such a remedy. Enhanced vehicle insurance requirements by manufacturers, especially if combined with greater flexibility in the administration of this insurance, could also provide a third-party check on the safety of automated systems.

…and may have an impact on what information developers and manufacturers of autonomous vehicles share and with whom

Education of public actors and of the public at large is essential to the development of effective regulations and realistic expectations. Governments can facilitate this education by encouraging developers to share specific data about their products and processes in order to benefit from more flexible regulation. In some cases, it may be desirable to audit specific algorithms that directly impact public welfare – e.g. those that govern loss-loss decisions by automated vehicles.

Regulators and developers should actively plan to minimise legacy risks

Vehicles with automated driving systems that are introduced in the next few years will be neither perfect nor transitory. Years after these early models have become outdated, many of these vehicles will still be on the road. A key goal for both regulators and developers should be limiting the physical risk of these systems through a variety of technical and contractual tools to enable monitoring and over-the-air updates. Designing vehicles for sensor or other system upgrades may also help reduce legacy risks.

For more information on the findings of this projects, please click here

Urban Mobility: System Upgrade

Why

What if all car trips in a city were undertaken by a fleet of fully coordinated self-driving vehicles?

In light of rapid urbanisation, the development of self-driving cars and a "shared economy" (based on optimising usage of spare capacity), we investigate the potential impacts of a radical upgrade to today's urban mobility system.

How

We explore this question on the basis of detailed mobility data including origin, destination and timing of all trips for a mid-sized European city. We developed a model to test various alternative transport system configurations that nonetheless would provide the same level of mobility (locations and timing) as today. We explore two different self-driving vehicle concepts – "**TaxiBots**" which can be shared simultaneously by several passengers, while "**AutoVots**" pick-up and drop-off single passengers sequentially. We look at two different time periods (24 hr. average and peak-hour only), and model scenarios with and without high-capacity (HC) public transport (in the form of rail or bus rapid transit). We report impacts on car numbers, volume of travel, congestion and use of space.

What we found

The same mobility can be delivered with fewer cars…
TaxiBots combined with high-capacity (HC) public transport could remove 9 out of every 10 cars in the city. Even in the scenario that least reduces the number of cars (AutoVots without HC public transport), nearly eight out of ten cars could be removed.

…but the overall volume of car travel will likely increase…
The same TaxiBot system as above will result in 6% more car kilometres travelled than today because cars have to make detours to pick up and drop off customers. An AutoVot system in the absence of HC public transport will nearly double (+89%) car kilometres travelled due to repositioning and servicing trips that were otherwise carried out by public transport.

…though congestion can be significantly reduced
At peak hours, the combination TaxiBot and high capacity public transport-based system uses 65% fewer vehicles than today, and AutoVots without public transport would still remove 23% of cars used today at peak hours. This potentially enables a strong reallocation of street space to other public uses.

Reduced parking needs will free up significant public and private space

In all cases, self-driving fleets completely remove the need for on-street parking. This is a significant amount of space – in the city modelled it is equivalent to 210 football fields or nearly 20% of the kerb-to-kerb street area. Additionally, up to 80% of off-street parking could be removed generating new opportunities for alternative uses of this valuable real estate.

Ride-sharing vs. car-sharing: TaxiBots replace more cars than AutoVots

TaxiBots replace more cars than AutoVots since the latter require more vehicles and much more re-positioning travel to deliver the same level of service.

Public transport will have an impact on both self-driving fleet requirements and volume of travel.

Scenarios without HC public transport require 18% more TaxiBots and 26% more AutoVots than scenarios where shared self-driving vehicles are deployed alongside high capacity public transport. However, in the TaxiBot scenario, this translates into only 5000 additional cars that would completely compensate for the absence of public transport. This figure is higher, 12000, in the case of an AutoVot system. The overall number of car kilometres travelled, though, would increase in the absence of HC public transport – 13% and 24% more, respectively, for TaxiBots and AutoVots. This is due to car repositioning as well as to self-driving car trips replacing public transport trips.

Managing the transition will be challenging

If only 50% of car travel is carried out by shared self-driving vehicles and the remainder by traditional cars, vehicle travel increases with or without high-capacity public transport – between 30% more to nearly doubling at 90%. At peak hours, the overall number of cars required increases in all but one case (TaxiBots plus HC public transport).

Policy insights

The impact of self-driving shared fleets is significant but is sensitive to policy choices and deployment scenarios

Transport policies can influence the type and size of the fleet, the mix between public transport and shared vehicles and, ultimately, the amount of car travel, congestion and emissions in the city. For small and medium-sized cities it is conceivable that a shared fleet of self-driving vehicles could completely obviate the need for traditional public transport.

Actively managing freed capacity and space is still necessary to lock-in benefits

Shared vehicle fleets free up a significant amount of space in the city. However, prior experience indicates that this space must be pro-actively managed in order to lock-in benefits. Management strategies could include restricting access to this space by allocating it to commercial or recreational uses, delivery bays, bicycle tracks or enlarging sidewalks. For example, freed-up space in off-street parking could be used for logistics distribution centres.

Road safety will likely improve; environmental benefits will depend on vehicle technology

Despite increases in overall levels of car travel, the deployment of large-scale self-driving vehicle fleets will likely reduce crashes and crash severity. At the same time, environmental impacts are still tied to per-kilometre emissions and thus will be dependent on the penetration of more fuel efficient and less polluting technologies.

New car models and business models will be required

The drastic reduction in the number of cars would significantly impact car manufacturer business models. New service-based models will develop under these conditions but it is unclear who will manage them and how they will be monetised. The role of authorities, both on the regulatory and fiscal side, will be important in guiding developments or potentially maintaining impediments.

Under all of our scenarios, vehicles are used much more intensely than before – rising from approximately 50 minutes to 12 hours per day and daily travel will increase from approximately 30 kilometres to nearly 200 kilometres. This increase in use will require different car models than are currently on the market today, but also induce a shorter lifecycle and with it a quicker penetration of new, cleaner technologies. Shared use will also require different and much more robust interior fittings though weight savings could potentially accompany a reduction of crash risk. Innovative maintenance programmes could be part of the monetisation package developed for these services.

Public transport, taxi operations and urban transport governance will have to adapt

The deployment of self-driving and shared fleets in an urban context will directly compete with the way in which taxi and public transport services are currently organised. These fleets might effectively become a new form of low capacity / high quality public transport. Labour issues will be significant but there is no reason why public transport operators or taxi companies could not take an active role in delivering these services. Governance of transport services, including concession rules and arrangements, will have to adapt.

Mixing shared self-driving fleets with traditional cars will not deliver the same benefits as full fleet deployment, but remains attractive

Overall vehicle travel will be higher in all fleet-mixing scenarios and vehicle numbers increase in 3 out of 4 of our peak hour scenarios. It is likely that improved traffic flow could mitigate congestion up to a point. In the most extreme scenarios, however, it may be difficult to make a public policy case for self-driving fleets alone (without HC public transport) based solely on space and congestion benefits. Nonetheless, even in mixing scenarios, these fleets could represent a cost-effective alternative to traditional forms of public transport if the impacts of additional travel are mitigated. "All in" deployment of shared self-driving fleets may be easier in circumscribed areas such as business parks, campuses, islands, as well as in cities with low motorisation rates.

For more information on the findings of this projects, please click here

Mobility Data:
Changes and Opportunities

Why

The 21st century is awash with data from sensors, vehicles, smartphones, parking systems, inventory tracking systems, ticketing systems, geographic applications, buildings, energy distribution networks and multiple other digital and analog sources including video streams. There are tremendous upsides from the use and fusion of these data streams to better manage and optimise transport services and improve safety. There are also associated risks since much of this data is highly personal in nature. It looks at the considerations authorities should have regarding the creation, processing, conditions of use and access to data that could help them carry out their mandates.

How

We undertook this study on the basis of meetings and discussions amongst project partners, desktop research and invited the contribution of an external expert group – Carlo Ratti Associati in conjunction with the MIT SENSEable City Laboratory.

What we found

The volume and speeds at which data today is generated, processed and stored is unprecedented and will fundamentally alter the transport sector
The convergence of ubiquitous and low-cost sensing – much of it involving personal devices – the steep drop in data storage costs and new data processing algorithms improves our ability to capture and analyse more detailed representations of reality. These representations augment traditional sources of transport data collection today. In the future, they will likely replace them.

Embarked sensors and data storage/transmission capacity in vehicles provide new opportunities for enhanced safety for both conventional and increasingly automated vehicles
Work is underway to harmonise standards regarding these technologies and communications protocols in order to accelerate safety improvements and lower implementation costs.

Multi-platform sensing technologies are able to precisely locate and track people, vehicles and objects in a way that has never before been possible

Locating and tracking individuals at precisions up to a few centimetres in both outdoor and indoor environments is currently feasible and will likely become standard – at least in urban areas – as current location-sensing technologies become omnipresent. The widespread penetration of mobile (especially smartphone) technology makes this possible. The same location technologies deployed in the current generation of mobile telephones is also migrating to vehicles enabling precise and persistent tracking.

The fusion of purposely-sensed, opportunistically-sensed and crowd-sourced data generates new knowledge regarding transport activity and flows. It also creates unique privacy risks

When combined, these data reveal hitherto unsuspected or un-observed patterns in our daily lives which can be used to benefit both individuals and society. There is also the risk that insights derived from these patterns may open new avenues for misuse and potential manipulation of individuals and their behaviour. The knowledge derived from this fusion may not have been anticipated by data collectors at the time of collection, nor may the use of these insights have been anticipated or communicated to people who are the object of that data.

Location and trajectory data is inherently personal in nature and difficult to anonymise effectively

Tracking and co-locating people with other people and places exposes a daily pattern of activity and relationships that serve as powerful quasi-identifiers. These trajectories are as unique as fingerprints and though many techniques exist to de-identify this data, doing so effectively while retaining sufficient granularity for useful analysis is not a straightforward exercise.

Data protection policies are lagging behind new modes of data collection and uses – this is especially true for location data

Rules governing the collection and use of personal data –e.g. data that cannot be de-identified – are outdated in two ways. Data is now collected in ways that were not anticipated by regulation and authorities have not accounted for the new knowledge that emerges from data fusion. A split has emerged among those who would seek to retain prior notification and consent frameworks for data collection and those who would abandon these in order to focus on only specifying allowable uses of that data.

Policy insights

Road safety improvements can be accelerated through the specification and harmonisation of a limited set of safety-related vehicle data elements

E-call, E-911 and vehicle data black boxes provide post-crash data best suited for emergency services and forensic investigation. Much more vehicle-related data is available and, if shared in a common format, could prevent crashes. Further work is needed to identify a core set of safety-related data elements to be publicly shared and to ensure the encryption protocols necessary to secure data elements that could otherwise compromise privacy.

Transport authorities will need to audit the data they use in order to understand what it says and does not say and how it can best be used
Big data in transport is not immune from small data problems – especially those relating to statistical validity, bias and incorrectly imputed causality. Transport authorities will need to ensure an adequate level of data literacy for handling new streams of data and novel data types. Ensuring robust, persistent and harmonised provenance metadata will facilitate data usability audits. Big data is often not clean – issues with data quality may entail significant upfront costs to render it useable and this should be considered early in the decision-making processes.

More effective protection of location data will have to be designed upfront into technologies, algorithms and processes
Adapting data protection frameworks to increasingly pervasive and precise location data is difficult largely because data privacy has not served as a design element from the outset. Both voluntary and regulatory initiatives should employ a 'Privacy by Design' approach which ensures that strong data protection and controls are front-loaded into data collection processes. Technological advances including the arrival of 'system on a chip' sensors can aid by allowing on-the-fly data encryption. Other advances could include protocols allowing for citizens to control and allocate rights regarding their data. Failing to ensure strong privacy protection may result in a regulatory backlash against the collection and processing of location data. This would hamper innovation, reduce consumer welfare and curb the economic benefits the use of such data delivers.

New models of public-private partnership involving data-sharing may be necessary to leverage both public and private benefits
An increasing amount of the actionable data pertaining to road safety, traffic management and travel behaviour is held by the private sector. On the other hand, public authorities are still - and will likely continue to be - mandated to provide essential services that the public prefers private actors not to provide. Should data access by public authorities continue to be modelled strictly on a supplier-client relationship or can new, more creative partnerships be developed that enable both the private sector to innovate and the public sector to carry out its mandates? Innovative data-sharing partnerships will likely develop though these should not obviate the need for market power tests, benefit-cost assessment and public utility objectives.

Data visualisation will play an increasingly important role in policy dialogue
Effective data visualisations can quickly communicate key aspects of data analysis and reveal new patterns to decision-makers and the public. Public agencies will have to be able to handle the visual language of data as well as effectively as they handle written and spreadsheet-based analysis.

For more information on the findings of this projects, please click here

Drivers of Logistics Performance: Case Study

Why

Understanding and breaking down the elements of trade and logistics performance can help countries improve freight transport efficiency and highlight where international cooperation is helpful to overcome barriers.

How

We use an international benchmarking tool - the World Bank's Logistics Performance Index (LPI) - to identify factors that have a critical impact on competitiveness, and to understand which policies may reduce persistent bottlenecks. In this context, we undertook a case study looking at the logistics performance of Turkey. To do this we completed extensive desk research and quantitative analysis concerning the country's logistics performance. We also conducted a series of in-country meetings with experts, policy makers, associations, and selected companies involved in trade and logistics services. These meetings were held under the guidance and participation of Prof. Lauri Ojala, University of Turku, Finland.

What we found

Turkey's customs clearance has improved as a result of a decrease in the variability of clearance times
Simplification and automation of customs procedures, increased productivity gains due to improved IT capability, and investment in improved management and human resources capability have all contributed to this improvement.

Massive road investment plays a crucial role in increasing Turkey's infrastructure performance in the LPI…
International freight forwarders are the direct assessors of logistics performance in the LPI methodology and since they constitute almost 60% of the road freight industry, any improvement in road infrastructure is likely to be reflected directly in the LPI.

…on the other hand, Turkey's heavily road-dominated transport system results in high transport costs
High energy costs represent one of the greatest obstacles for road transport and trade networks. Particularly for long-distance trips, diesel accounts for over 60% of total freight costs.

Port hinterlands are limited
Freight handling capacity at Turkish ports is still constrained by underdeveloped hinterland transport facilities.

Turkey's logistics performance is primarily bolstered by the development of the private sector
Chambers of Commerce and industry associations also take active roles in the development of the sector and the improvement of service quality.

External factors and political risks increase shipment costs and decrease on-time performance
The need to reroute due to political instability and war in neighbouring countries has been a major source of delays. In addition, the current practice of differentiated access rules for infrastructure and markets leads to the use of sub-optimal routes, some of which are limited by capacity restrictions. This results in increased delivery times and shipment costs.

Policy insights

Variability is one of the main factors of efficiency of customs and border clearance
There is ample evidence that appropriately designed policies can improve the efficiency of customs procedures and reduce variability. Even though objectives, implementation capacities, and resource availability differ greatly across countries, there is a core set of policies which can improve customs performance. These include simplification and automation of customs procedures, efficient risk management, optimal use of information and communications technology, effective partnership with the private sector, and increased cooperation and transparency.

Capacity management plays a vital role in infrastructure efficiency
Most transport facilities operate with low utilisation rates, yet, they still suffer from capacity constraints due to high demand variability. In this context, there are other strategies that may be less costly and more efficient than capacity extension. Cost savings and quality improvements in the handling systems are therefore vital instruments for enhancing the competitiveness of intermodal transport. Among these are flexible transport systems, better resource allocation and higher utilisation of existing infrastucture.

Intermodal transport systems, including good access to roads, terminals and seaport channels ensure a high-quality transport infrastructure
A public policy focus on modal equality should ensure that each mode competes based upon its inherent characteristics. Cost savings and quality improvements in intermodal connections and handling are therefore vital instruments for enhancing the competitiveness of intermodal transport.

Along with efficient port operations, well-functioning hinterland connections to other modes are essential in maintaining competitive transport networks.

A successful and powerful private sector is the leading factor in providing high quality logistics services

Numerous government actions help the private sector to develop logistics competencies. For example, promoting competition, increasing managerial capacity, setting quality standards, supporting professional organisations, regulating business certification and ensuring standardisation of operations all contribute to better logistics services.

Resilience-improving policies and investments are necessary

The private sector deploys risk-management strategies to maximise resilience and minimise disruption of external events. Governments should play a role also in ensuring increased resilience of the logistics networks to external and extreme shocks. The public and private sectors should work together and share data and information. This enables both to better understand and quantify logistics risks. This will improve network risk visibility, and in turn, will facilitate the development of proactive and effective actions.

For more information on the findings of this projects, please click here