



Sector coupling: How to regulate convergence?

vol. 22 | n°3 | 2020

« au service de l'analyse » — since 1998

networkindustries
quarterly

Network Industries Quarterly, Vol. 22, issue 3, 2020 (September) “Sector coupling: How to regulate convergence?”

In this special issue we explore the links between infrastructure sectors, especially in terms of regulating interfaces between the different sectors and regulating more integrated and converging sectors.

Historically, most infrastructure has developed independently of other infrastructure and constitutes a self-contained socio-technical system. For example, this is the case of electricity, gas, telecommunications, air transport and railways. Consequently, regulation was also set up in a self-contained sector-specific manner.

However, this way of doing things cannot continue in the future as the different infrastructure sectors are converging. This is, first, because of technological and economic dynamics that have been triggered by liberalisation and which have led to new technologies often at the interface between different sectors (e.g. power-to-gas), along with corresponding cross-sectoral business strategies. Convergence also results from recent developments in digital networks (and in particular in the fifth generation of wireless technologies, 5G) which increasingly act as drivers of convergence between sectors, leading to cross-sectoral and much more integrated infrastructure services (e.g. ‘Mobility-as-a-Service,’ or MaaS). The take-off of the Internet of Things (IoT) based on 5G networks, which is considered the next industrial revolution, is expected to accelerate this trend. Finally, climate and other ecological challenges force a direct comparison among different sectors, as in the case of externalities caused by energy generation (by renewables or by fossil fuels) or by different transport models. For all three reasons, a more convergent view of the different network industries is rapidly emerging, but will it translate into converging regulation or even into the regulation of convergence?

This special issue of the Network Industries Quarterly is dedicated to **some of the best papers presented at the 9th Conference on the Regulation of Infrastructures** which was organised by the Florence School of Regulation in June 2020.

The first contribution, authored by **Nolden**, explores powering trains with renewable energy. Exploiting this huge transport decarbonisation potential depends on changes to policy and regulation, and the interpretation thereof, to procure and value the multiple benefits of sector coupling.

Knieps discovers data-driven sector coupling within smart sustainable cities. Smart sustainable cities provide vast potential for data-driven sector coupling due to the variety of smart network infrastructure and services involved. Digital twin technologies support city planning and city operation activities. However, virtual replicas cannot replace entrepreneurial solutions to governance problems through the organisation of market-driven activities.

Hoffmann discusses three entitlement problems in digital markets and the distributive nature of antitrust. Many conflicts that competition law faces in the digital economy can not only be understood as problems of competitive harm but also as issues of appropriation. Reviewing recent European case law, he identifies three typical disputes over the exercise of property entitlements and explores how competition law shapes legal regimes of appropriation in digital markets.

Paniccia analyses the implications for regulatory policies at the European level of patterns of competition and/or integration between traditional public transport and platform-based forms of mobility that are occurring in urban contexts, also considering the social and economic effects following the Covid-19 pandemic.

dossier

- 3 Powering trains with renewable energy
Colin Nolden
- 8 Data-driven sector coupling in smart sustainable cities
Günter Knieps
- 12 Three entitlement problems in digital markets and the distributive nature of antitrust
Linus J. Hoffmann
- 17 Substitution or Integration between Traditional Public Transport and Platform-Based Forms of Mobility. Implications for Economic Regulation
Ivana Paniccia
- 24 Announcements

Network Industries Quarterly | Published four times a year, contains information about postal, telecommunications, energy, water, transportation and network industries in general. It provides original analysis, information and opinions on current issues. Opinions are the sole responsibility of the author(s).

Subscription | The subscription is free. Please do register at fsr.transport@eui.eu to be alerted upon publication.

Letters | We do publish letters from readers. Please include a full postal address and a reference to the article under discussion. The letter will be published along with the name of the author and country of residence. Send your letter (maximum 450 words) to the editor-in-chief. Letters may be edited.

Publication director | Matthias Finger

Managing editor | Irina Lapenkova

Proof reader | David Frank Barnes

Publishing editor | Ozan Barış Süt

Founding editor | Matthias Finger

Cover image | Creative Designed By lily From LovePik.com

Publisher | Chair MIR, Matthias Finger, director, EPFL-CDM, Building Odyssea, Station 5, CH-1015 Lausanne, Switzerland (phone: +41.21.693.00.02; fax: +41.21.693.00.80; email: mir@epfl.ch; website: <http://mir.epfl.ch/>)

Powering trains with renewable energy

Colin Nolden*

In August 2019, Riding Sunbeams, a value-led business, demonstrated for the first time ever that it is possible to power railways directly with solar energy. Exploiting this huge transport decarbonisation potential depends on changes to policy and regulation, and interpretation thereof, to procure and value the multiple benefits of sector coupling.

Introduction

Sector convergence between transport providers and decentralised and decarbonised electricity suppliers at the grid edge is often assumed to involve big data, digital platforms and app-facilitated user-centricity. Such innovations, however, appear to be less significant for the electrification of railways. Despite over 100 years of experience, railway electrification remains difficult and costly, with few countries fully electrified and none fully decarbonised. Railway traction power currently relies on dispatchable (synchronous) energy resources. As these are mostly supplied by fossil fuels, such as gas and coal (but also biomass) or nuclear power, such electrification does not necessarily contribute to decarbonisation targets. This reflects the co-evolution of fossil energy systems and railways systems:

Both national electricity grids and the railway shadow electricity grids tend to be dominated by AC (Alternating Current) and 25kV lines to maintain the same frequency.

Both infrastructure systems support self-reinforcing carbon intensive practices which blind actors to innovations outside their siloes (Kuzemko et al. 2016).

Breaking this path-dependency requires radical innovation. Digital connectivity, however, which is driving electrification and sector convergence between decentralised and decarbonised electricity supply and individual mobility demand, plays only a minor role in this process. Converging this supply with centralised mobility demand requires more conventional technological demonstration, regulatory compliance and de-risking procurement.

Riding Sunbeams has technically proven that it is possible to match intermittent direct-wire solar energy (asynchronous) supply with the regular (synchronous) demand required for the reliable operation of railways (Nolden et al. 2020). Using the case study of Riding Sunbeams, this pa-

per explores the changes to policy and regulation required to procure and value the multiple benefits of converging decentralised and decarbonised renewable energy supply with railway traction demand.

Solar-powered trains

This section includes a sub-section providing background information on railway electrification in the UK before introducing the case study. This is followed by sub-sections exploring barriers, opportunities and solutions. The final section concludes with some regulatory implications.

Network Rail and UK railway electrification

Network Rail is a regulated public enterprise which owns and operates British railway infrastructure. It is the UK's largest single electricity purchaser (on behalf of train operating companies) with current (2018) demand of around 3.5TWh/a, representing around 1% of total UK electricity demand. It also procures around 700m litres of diesel/a as 42% of UK railway tracks are not electrified and 29% of the UK's current fleet is run solely on diesel. As a result, Network Rail is responsible for around 2.5% of transport related carbon emissions, which in turn comprise around 26% of total UK emissions (Mayers and Bamford 2019).

4,000-4,250 route km will need to be electrified using low-carbon sources to help reach the UK's zero-carbon target. Conventional electrification in the UK using grid supply points and overhead AC gantries, however, costs around two and a half times the European average (Smith 2019). To complicate matters, incremental improvements adopted in the current policy, financial and operational environment are not deemed sufficient to deliver decarbonisation "anywhere near fast enough," especially given the expected increases in demand and electrified track (RIDT 2019: 8).

* Colin Nolden, Vice-Chancellor's Fellow at University of Bristol Law School and Researcher at the Environmental Change Institute, University of Oxford, colin.nolden@bristol.ac.uk, colin.nolden@ouce.ox.ac.uk

This issue has been recognised by the UK's Department for Transport. It has consequently provided several rounds of Small Business Research Initiative (SBRI) First of a Kind (FOAK) funding to support alternative decarbonisation and electrification options which support the 4Cs of Cost reduction, Carbon reduction, Capacity increase and Customer satisfaction. Supported technologies include hydrogen, batteries and direct-wire supply. While hydrogen is dependent on the development of new infrastructure and batteries still lack the energy density to power trains, direct-wire supply combines repurposed off-the-shelf technology with a high technology readiness level.

Demonstrating solar-powered trains

To this end, Riding Sunbeams' First Light project was awarded £350,000 of SBRI First of a kind funding in 2018 for the period between March and November 2019. This funding supported the installation of a 37.5kWp solar PV demonstration system at Aldershot, on a busy commuter route southwest of London, to connect solar energy directly into the traction power supply network. Several technological issues relating to signalling and harmonics needed to be overcome before the site was finally completed. In August 2019, Riding Sunbeams demonstrated the technical viability of connecting solar electricity directly into 750v DC (Direct Current) third rails found across some rail systems in the UK, Spain, South Africa and India and most metro rail systems (Murray and Bottrell 2017; Murray and Pendered 2019).

As part of the First Light project, data from data loggers was used to build digital twins using a Real Time Data Simulator at the University of Birmingham. This allowed the findings from the demonstrator site to be scaled up to prove the viability of >2MWp solar farms, using different inverters in the process. On busy Kent, Sussex and Wessex routes, around 540 substations provide connection points for trackside renewable energy developments, each of which are capable of accommodating at least a 1MWp solar farm. Due to the intermittency of both load and supply, a maximum of 15% of the total traction demand of these routes (1.38TWh/a) can be supplied by solar power without significant upgrades. This represents a £17.1m/a market at current prices (Murray and Bottrell 2017; Murray and Pendered 2019).

Commercially, Riding Sunbeams has proven that this innovation can help the UK's rail infrastructure operator Network Rail meet its business, social and environmental objectives through energy procurement and through capital sourced from outside the company. Legally, it has

identified the means for Network Rail to procure this innovation through an Innovation Partnership (Nolden et al. 2020). Both demonstration and simulation enabled Riding Sunbeams to provide evidence regarding its contribution to the SBRI First of a kind 4C business objectives:

Cost reduction: direct-wire solar traction power can be supplied at the same or at a lower price than Network Rail's current grid electricity procurement contract and without capital investment by Network Rail.

Carbon reduction: direct-wire solar traction power is the lowest carbon option available to Network Rail.

Capacity increase: direct-wire solar traction power can be provided in grid-constrained areas where bottlenecks limit the amount of electricity that can be supplied through transmission and distribution networks.

Customer satisfaction: the possibility of community and commuter co-ownership of direct-wire solar traction power supply assets provides the basis for public buy-in and democratic control of supply assets.

By enabling Network Rail to take solar traction power innovation through compliance, Riding Sunbeams' First Light project provides an opportunity for Network Rail to future-proof its business model and consolidate a bottom-up self-regulatory approach pre-empting more stringent regulation. Close collaboration with commercial and legal experts provides the basis for Network Rail to procure this innovation and facilitate convergence between decentralised renewable energy generation and traction energy demand (Nolden et al. 2020).

Barriers

Despite successful technical demonstration, simulated up-scaling and contribution to the 4C objectives, several commercial and legal barriers need to be overcome to reduce the risk and transaction costs of procuring direct-wire electricity through a Power Purchase Agreement (PPA). Compared to other sectors where PPAs have rapidly diffused as a means to procure electricity, the abovementioned path-dependency of railway systems manifests itself in distinctive regulatory institutions and shared norms, identities and missions (Kuzemko et al. 2016).

Prioritisation of safety and security of supply, together with high specificity and legacy infrastructure, do not lend themselves to innovation. Preference for single supply contracts represent a barrier to entry for innovative decentralised grid-edge solutions. These issues, together with opaque decision-making structures within Network Rail and perceived regulatory constraints, result in high (per-

ceived) risk and transaction costs. Opportunity costs result from Network Rail's long-term supply contract with EDF (Energie de France). This contract matches traction energy demand with electricity generated from EDF's eight nuclear power stations, which implies that trains mostly run on nuclear power.

While this is low carbon in principle, Network Rail recognises that direct-wire solar traction supply provides more diverse, flexible and adaptable decarbonisation and electrification opportunities. However, the EDF contract, according to Network Rail, is "put in place for the whole of Network Rail to obtain economies of scale and reduce the number of contractual meetings" (Network Rail 2017). Demonstrating this innovation at scale is considered necessary to address Network Rail's concerns regarding the consequences of large amounts of asynchronous supply for the reliable operation of railways. Overall, more evidence of the benefits of this innovation is required for Network Rail to consider procurement of this innovation alongside its electricity supply contract with EDF.

Opportunities

Aside from the benefits relating to the 4C business objectives, further social benefits of this innovation have been identified through the development of a social impact framework. This framework, which was also supported by the SBRI First of a kind funding, identified benefits which can help Network Rail fulfil the requirements of the UK Public Services (Social Value) Act 2012 (UK Government 2012). Relevant to this innovation are requirements to diversify supply chains, especially towards small and medium-size enterprises (SMEs), social enterprises and not-for-profit organisations. As Riding Sunbeams falls under the first category, and its parent companies Possible and Community Energy South fall under all three categories, procuring their direct wire solar traction power can contribute to the fulfilment of these requirements, again without capital investment by Network Rail.

The Utilities Contracts Regulation 2016 provides Network Rail with a framework to engage in alternative procurement arrangements (UK Government 2016). Rather than a strict dichotomy between pre-commercial R&D procurement and commercial procurement, it enables the establishment of Innovation Partnerships. Such partnerships provide utilities such as Network Rail with the mechanism to award contracts based on the assessment of qualitative, environmental and social aspects alongside price and cost (Regulations 82, 83 and 86 of the Utilities Contracts Regulation 2016). To enable procurement that

takes such values into consideration, the governance of Network Rail's business model needs to evolve accordingly.

Network Rail's business model is primarily regulated through the Office of Rail and Road (ORR), the Department for Transport (DfT), the Minister for Rail and the UK's devolved governments. ORR is responsible for ensuring a punctual and reliable service and the delivery of enhancement projects according to budget. For the current financial and regulatory Control Period 6 (CP6 – 2019-2014), ORR has devolved budget and responsibility towards Network Rail's eight geographical routes. This enables the routes to buy goods and services locally rather than centrally if they offer better value for money. Although this devolution does not explicitly include the possibility of procuring energy locally, ORR stresses that "routes have a choice over their own procurement, unless there is evidence this is inconsistent with Network Rail's other obligations in the network licence" (ORR 2018: 36).

Discussion

Combined, the Public Services (Social Value) Act 2012, the Utilities Contracts Regulation 2016 and the devolution of procurement responsibilities provide the means for Network Rail to directly procure solar traction power through one or multiple PPAs without challenging or breaching the long-term nuclear traction power supply contract with EDF. Innovation Partnerships at the scale of routes, rather than the whole of Network Rail, provide 'incubation space' to experiment and provide evidence as a blueprint to scale up and embed social and environmental criteria in open-market tendering once Innovation Partnerships have been terminated.

This provides the basis for long-term engagement with innovators with non-traditional business models, unfamiliar constitutions and unconventional trading histories, such as social enterprises and value-led businesses like Riding Sunbeams. Such changes help plant the seeds of change which are necessary for structural transformation through sector coupling to achieve net-zero carbon emissions. They also provide railway system with innovative solutions for more efficient public services which create public value beyond the single bottom line of cost efficiency. Rather than just technological diffusion, the procurement of direct-wire solar traction power can therefore set a precedent for recognising the inherent public value that can be created and supported through the procurement of sector-coupling grid-edge innovation. Innovation finance has been crucial in demonstrating the viability of this innovation. Another £400,000 of at-risk finance has been made available through the third round of SBRI First of a kind fund-

ing for Riding Sunbeams' Daybreak project in 2020. This project seeks to demonstrate a direct connection between renewable energy generation and more widely diffused AC overhead line powered rail traction systems. It presents a much greater electrification, decarbonisation and market opportunity compared to First Light's DC solution. A further £2.5m have been provided through the UK government's Getting Building Fund to demonstrate the DC solutions at scale. Both the tested DC solution and the emerging AC solution require procurement at scale to encourage their diffusion. It also needs to be recognised that innovations of this kind are likely to emerge through further and continual engagement with nimble SMEs, social enterprises and value-led businesses with unfamiliar trading histories.

Conclusion

Catalysing solar-powered trains through innovation procurement provides an opportunity for Network Rail to electrify and decarbonise UK rail services through capital sourced from outside the company. By facilitating the inclusion of public value requirements relating to the 4Cs and societal and environmental objectives, together with the diversification of supply chains in open-market tendering procedures, regulators have the capacity to contribute to a just energy transition through transport electrification and decarbonisation. To enable rapid and nationwide roll-out of this sector-coupling innovation in line with Ofgem's Decarbonisation Action Plan and the UK government's net-zero emissions target, grid code, distribution code and railway electrical connection compliance should be revisited to help overcome the complication of integrating renewable energy into distribution networks through railway power infrastructure supply points.

Community and commuter co-ownership of solar power supply assets increases the legitimacy of converging decentralised and decarbonised renewable energy supply with railway traction demand while facilitating local revenue recycling. Procurement in this context needs to be reframed as value-added. This allows railway infrastructure providers such as Network Rail to shift from regulatory compliance towards innovation procurement to create public value and maximise multiple benefits while creating a route to market for non-traditional electricity suppliers and their innovative sector-coupling solutions.

References

Kuzemko, C., Lockwood, M., Mitchell, C. and Hogggett, R. (2016), 'Governing for sustainable energy system change: Politics, contexts and contingency,' *Energy Research & Social Science*, 12: 96-105.

Mayers, M. and Bamford, D. (2019), Decarbonising Britain's railways demands urgent action – here's how it could be done, *The Conversation*, <https://theconversation.com/decarbonising-britains-railways-demands-urgent-action-heres-how-it-could-be-done-124905>, accessed, 13 August 2020.

Murray, L. and Bottrell, N. (2017), *Riding Sunbeams: Powering our railways with solar PV* (London: 10:10 Climate Action, Imperial College London, Community Energy South, Turbo Power Systems, Innovate UK).

Murray, L. and Pendered, O. (2019), *Riding Sunbeams – Before Dawn* (London: 10:10 Climate Action, Community Energy South, The Rural Community Energy Fund).

Network Rail (2017), *Safety Central – Energy Purchasing*, <https://safety.networkrail.co.uk/home-2/environment-and-sustainable-development/energy-and-carbon-management/energy-purchasing/>, accessed 13 August 2020.

ORR (2018), *2018 periodic review final determination – Overview of approach and decisions* (London: Office of Rail and Road).

Nolden, C., Sanchez-Graells, A., Murray, L., Pendered, O., Stone, I. and Wilkins, J. (2020), Riding Sunbeams: Powering our trains with solar PV. *PolicyBristol*, Policy Briefing 79: December 2019.

RIDT (2019), *Final Report to the Minister for Rail* (London: Rail Safety and Standards Board).

Smith, A. (2019), On track for carbon-free rail traction, *Ricardo Quarterly*, Q2 2019, <https://d1v9sz08rbysvx.cloudfront.net/rail/media/resources-downloads/carbon-free-rail-traction-june-2019.pdf>, accessed 10 August 2020.

UK Government (2012), *The Public Services (Social Value) Act 2012*, <http://www.legislation.gov.uk/ukpga/2012/3/enacted>, accessed 13 August 2020.

UK Government (2016), *The Utilities Contracts Regulation 2016*, http://www.legislation.gov.uk/uksi/2016/274/pdfs/uksi_20160274_en.pdf, accessed 13 August 2020.

Data-driven sector coupling in smart sustainable cities¹

Günter Knieps*

Smart sustainable cities provide a vast potential for data-driven sector coupling due to the variety of smart network infrastructure and services involved. Digital twin technologies support city planning and city operation activities. However, virtual replicas cannot replace entrepreneurial solutions to governance problems through the organisation of market-driven activities.

Data-driven innovations as drivers of smart sustainable cities

The evolution from dumb to smart networks is data-driven and characterised by real-time adaptive production and consumption decisions based on real-time and geolocational scarcity signals. Smart sustainable cities are emerging as data hubs with a vast potential for big data-driven innovations. Sensor-generated data is increasingly replacing data generated by infrastructure. Data value chains are becoming increasingly relevant in the planning, delivery and management of transport services and infrastructure due to the rapidly decreasing cost of sensors and of the collection, storage and processing of data (OECD, 2015, Chapter 9; OECD/ITE, 2015, 2016).

In recent years, big data combined with modern information and communication technology (ICT) has assumed a pivotal role in the development of smart sustainable cities (ITU 2015; Al Nuami et al., 2015). The Internet of Things (IoT) is becoming increasingly relevant, combining physical network service such as water, electricity, transportation and waste management with complementary virtual networks and thereby exploiting the full potential of ICT with tools such as smart metering, sensor networks, actuators and remote control. Virtual networks incorporate data value chains combining quality of service (QoS) differentiated data transmission with latency guarantees, position accuracy, continuous sharing of position data and big data processing of sensor data in order to fulfil the requirements of IoT applications and related physical network services (Knieps, 2017a, 2019, p. 176).

Different forms of sector coupling in smart sustainable cities building innovative sustainable value chains to provide physical network services may be distinguished. Sector coupling may arise between different sectors. Synergies of urban system integration can be exploited in transport, energy and waste systems, such as by coupling biogas produced in recycling wastewater plants with buses and

taxis designed to utilise this fuel (OECD, 2015, p. 384). Sector coupling may also create new intermodal markets, shifting intramodal transportation markets towards mobility-as-a-service markets and shared mobility projects. Sector coupling is also challenging the conventional value chain of electricity markets. The coupling of generation and consumption in microgrids can be organised via operator platforms. Renewable energy generation can also be coupled with electric vehicle mobility.

Many possibilities of data-driven sector coupling in cities are still unexploited. Physical features may be improved in order to make cities more walkable, focusing on intermodal mobility service platforms. Data-driven routes in cities can be developed, thus improving urban navigation for pedestrians. Embedding smart city solutions will require more data and better algorithms (Castro, 2020).

The complementarity of physical and virtual networks in smart sustainable cities

Various physical network services are of relevance in smart cities, such as smart transportation management, networked vehicle services, microgrids, smart garbage collection, smart water distribution, shared mobility services and city safety (ITU-T 2015a). Smart cities utilise multiple technologies to improve performance in the areas of health, transportation, energy, education and water services. The potential to enhance smart city services is based on big data analytics (Cathelat, 2019). Of particular relevance in the transition of conventional cities into smart sustainable cities is the creation of data value chains enabling the design of virtual networks complementary to the necessities of physical networks in cities. The need for a multiplicity of different virtual networks in smart sustainable cities results from the heterogeneous requirements of different physical networks. The network logistics of heterogeneous virtual networks for smart cities are based on common elements of ICT architecture, particularly sensor networks,

¹ Helpful comments by the participants at the 9th Conference on the Regulation of Infrastructures – particularly Matthias Finger, Juan José Montero and Pier Luigi Parcu, as well as Volker Stocker – are gratefully acknowledged.

* Prof. Dr. Günter Knieps, University of Freiburg, guenter.knieps@vwl.uni-freiburg.de

geopositioning services and the aggregation and processing of big data (Knieps, 2017a).

Different forms of data-driven sector coupling in smart sustainable cities

Data-driven innovations create a vast potential for big data-driven sector coupling in smart network industries, with particular relevance in smart sustainable cities. Cities are not only considered data hubs collecting large volumes of data and offering many chances for data-driven innovation but they also provide a wide range of market coupling opportunities due to the variety of smart network infrastructure and services involved.

Traditional separately organised markets are now converging, resulting in a tremendous potential for sector coupling due to the increasingly blurred boundaries between traditional network industries. Big data-driven market coupling is of particular relevance in the electricity and transportation sectors (OECD, 2015, p. 50). Microgrids can combine the low-voltage generation and consumption of electricity with a focus on renewable energy and coupling customised energy generation and storage with energy consumption (Knieps, 2017b). Multipurpose home networks are coupling the broadband capacities of sensor networks for energy prosumage with communication and entertainment applications such as voice over IP and IPTV (ITU-T, 2016).

Examples of cross-functional applications of ZigBee IP sensor networks in smart sustainable cities are infrastructure maintenance, garbage management and street parking. Electronic devices endowed with smart metering capabilities enable the real-time digital collection of consumption data on network services in urban infrastructure. The remote accessibility of data concerning electricity, heat, gas and water consumption enables not only real-time smart metering and concomitant adaptive energy consumption but also billing, leak detection and peak-load pricing (ITU-T, 2015). ‘Mobility-as-a-Service’ platforms can evolve for intermodal physical transportation services, enabling seamless app-based mobility-as-a-service combining the advantages of sector coupling with different complementary rail- and road-based transportation options (Knieps, 2018). ICT and the digitalisation of urban flows are gaining importance, thus increasing the ability to monitor and manage urban infrastructure in real time (Engin et al., 2019). Smart sustainable cities may also benefit from cross-sector data sharing enabled by ZigBee IP sensor networks and smart metering. Examples can be drawn from electrical, water and waste systems and transport with re-

al-time peak load demand and supply (OECD, 2015, pp. 50, 379-403).

Digital twins and their role for smart sustainable cities

Al Nuami et al. (2015, p. 15) identify the need to develop simulation systems to reduce implementation and testing costs during the various stages of smart city development as an open issue. Based on recent innovations in the fifth generation of mobile technology, 5G, a state-of-the-art simulation and planning tool known as ‘digital twins’ has become relevant. 5G-driven artificial intelligence (AI) along with augmented and virtual reality (AR/VR) technologies enable the construction of virtual replicas through a software representation of the physical city. Digital twins combine virtual replicas of urban infrastructure with real-time sensor-based information about the physical city (Castro, 2019). Members of the Open Mobility Foundation, consisting of 13 U.S. cities (including New York City, Philadelphia, San Francisco and Washington, D.C.), collaborate on creating digital data models of urban mobility (Westrope, 2019). The Open Mobility Foundation White Paper is widely based on the ‘digital twin’ model, specifying that municipalities own and control a digital data model of urban mobility (Open Mobility Foundation, 2019). Virtual Singapore is considered a forerunner project. Singapore’s three-dimensional (3D) city model merges simulations of large-scale automotive IoT deployment (National Research Foundation Singapore, 2018). Cities that have deployed digital twins in the meantime include Newcastle, Rotterdam, Boston, New York, Singapore, Stockholm, Helsinki and Jaipur (Onag, 2019). The planners of the new capital city of Amaravathi in India are using digital twins to help design this greenfield smart city (Jansen, 2019). The number of digital twins is expected to increase significantly in the next decade (Blackman, 2019).

Digital twins versus virtual networks

Digital twin technology is a planning tool enabling users to simulate the impact of exogenous changes to infrastructure, e.g. building an additional bridge, reorganising traffic, extending car-free zones, etc. Digital twins can also be applied to support smart city operation systems. For example, Rotterdam’s digital twin tracks both road and waterway traffic intensity to optimise bridge opening and closing, enhance urban waste collection and link real-time usage data to the digital twin keeping residents informed (EIP-SCC Marketplace, 2019). A digital twin provides a virtual replica of a city without solving the challenging governance problems of contractual relationships among the different actors involved. In contrast, the IoT

requires physical and complementary virtual networks to enable adaptive, real-time and location-differentiated network configurations for smart sustainable cities (Knieps, 2017b). In order to meet the diverse requirements of different physical network infrastructure and network services, different combinations of sensors, cameras, location-based data generation and processing and QoS requirements of data transmission are required.

Although data value chains are pivotal in developing IoT applications in smart sustainable cities, solving the entrepreneurial governance problems in the IoT requires physical networks and complementary virtual networks. The presence of both enables adaptive, real-time and location-differentiated network configurations. Although digital twin technologies may become very beneficial in city planning and city operation activities, virtual replicas cannot replace entrepreneurial solutions to governance problems through the organisation of market-driven activities by the different actors involved, such as platform operators, virtual network providers and all-IP broadband network providers.

References

- Al Nuami, E.A., Al Neyadi, H.A, Mohamed, N., Al-Jaroodi, J. (2015), Applications of big data to smart cities, *Journal of Internet Services and Applications*, 6:25 DOI 10.1186/s13174-015-0041-5.
- Blackman, J. (2019), Digital twins of 500 smart cities by 2025, says report, September 19, <https://enterpriseiotinsights.com/20190919/channels/news/500-smart-cities-will-have-digital-twins-by-2025>, accessed 6 August 2020.
- Castro, D. (2019), Digital Twin Technology can make smart cities even smarter, October/November 2019, <https://www.govtech.com/smart-cities/Digital-Twin-Technology-Can-Make-Smart-Cities-Even-Smarter.html>, accessed 6 August 2020.
- Castro, D. (2020), Making cities more walkable with better data and technology, <https://www.govtech.com/analytics/Making-Cities-More-Walkable-with-Better-Data-and-Technology>, accessed 6 August 2020.
- Cathelat, B. (2019), Smart Cities, Shaping the society of 2030, UNESCO and NETEXPLO, Paris, <https://unesdoc.unesco.org/ark:/48223/pf0000367762>, accessed 6 August 2020.
- EIP-SCC Marketplace (2019), Rotterdam's Digital Twin Redefines Our Physical, Digital & Social Worlds, <https://eu-smartcities.eu/news/rotterdams-digital-twin-redefines-our-physical-digital-social-world>, accessed 6 August 2020.
- Engin, Z., van Dijk, J, Lan, T., Longley, P.A., Treleaven, P., Batty, M., Penn, A. (2019), Data-driven urban Management: Mapping the landscape, *Journal of Urban Management*, <https://doi.org/10.1016/j.jum.2019.12.001>.
- ITU-T (2015), *Overview of smart sustainable cities infrastructure*, Focus Group Technical Report, ITU-T FG-SSC.
- ITU-T (2016) *Unified high-speed wire-line based home networking transceivers – System architecture and physical layer specification*, Recommendation ITU-T G.9960 (2015) – Amendment 2.
- Jansen, M. (2019), Digital Twins for Greenfield Smart Cities – The New Capital City of Amaaravathi, India: A Digital Twin from Day 1, <https://newcities.org/the-big-picture-digital-twins-for-greenfield-smart-cities>, accessed 6 August 2020.
- Knieps, G. (2017a), Internet of Things and the economics of smart sustainable cities, *Competition and Regulation in Network Industries*, 18 (1-2), 115-131.
- Knieps, G. (2017b) “Internet of Things and the economics of microgrids.” In F. Sioshansi (Ed.), *Innovation and Disruption at the Grid's Edge*. Amsterdam et al., Academic Press/Elsevier (pp. 241-258).
- Knieps, G. (2018), Network Economics of Shared Mobility, *Network Industries Quarterly*, 20(3), 9-12.
- Knieps, G. (2019), Internet of Things, big data and the economics of networked vehicles, *Telecommunications Policy*, 43(2), 171-181.
- National Research Foundation Singapore (2018), Virtual Singapore, <https://www.nrf.gov.sg/programmes/virtual-singapore>, accessed 6 August 2020.
- OECD (2015), *Data-driven Innovation – Big Data for Growth and Well-Being*, Paris, <https://www.oecd.org/sti/data-driven-innovation-9789264229358-en.htm>, accessed 6 August 2020.
- OECD/ITF (2015), *Big Data and Transport – Understanding and assessing options*, Paris, <https://www.itf-oecd.org/big-data-and-transport>, accessed 6 August 2020.
- OECD/ITF (2016), *Data-Driven Transport Policy*, International Transport Forum, Paris, <https://www.itf-oecd.org/data-driven-transport-policy>, accessed 6 August 2020.
- Onag, G. (2019), Digital twin concept spreads into smart city environments, September 11, <https://futureiot.tech/digital-twin-concept-spreads-into-smart-city-environments>, accessed 6 August 2020.
- Open Mobility Foundation (2019), *Open Mobility Foundation White Paper*. From Appendix A: Open Mobility Foundation Open Mobility Design Principles V1.27. Digital Twins, a Technology Solution: <https://members.openmobilityfoundation.org/wp-content/uploads/2019/06/OMF-White-Paper.pdf>, accessed 6 August 2020.
- Westrope, A. (2019), Cities and Industry Launch New Foundation to Manage Mobility, GovTechBiz, June 25, <https://www.digi.city/what-were-reading-1/2019/7/5/cities-and-industry-launch-new-foundation-to-manage-mobility>, accessed 6 August 2020.

Three entitlement problems in digital markets and the distributive nature of antitrust

Linus J. Hoffmann*

Many conflicts that competition law faces in the digital economy can not only be understood as problems of competitive harm but also as issues of appropriation. Reviewing recent European case law, I identify three typical disputes over the exercise of property entitlements and explore how competition law shapes legal regimes of appropriation in digital markets.

Digital market disputes as problems of entitlement allocation

In order to draw the parallelism between the problem of competition and the problem of appropriation, this paper discusses cross-cutting entitlement conflicts in digital markets from selected case studies. Each conflict can be understood as a situation in which the current entitlement distribution is unclear or unsustainable. Like Coase's cattle and crops (and actually any conflict that law deals with), each issue can therefore be reduced to a simple question: to which party should the legal entitlement in dispute be allocated?

Competition law plays a role in the normative resolution of all three entitlement problems. The goals and reasoning of property law are therefore as relevant for each entitlement conflict as competition law's proper goals and reasoning. And in effect, perhaps more than purpose, competition law can be conceived as a system of entitlement allocation. Indeed, it is no news that during a period of technological advancement new markets require a definition of the initial allocation of entitlements, i.e. the emergence of new property rights or at least the tuning of existent ones to the new reality (Demsetz 1967: 350).

1. Access to software affected by network externalities

Some pieces of software, like operating systems, app stores or internet search engines, benefit from network externalities. Unlike a physical infrastructure network, software affected by network externalities is an exclusively intangible good. This means that these pieces of software are hard to replicate for competitors not so much because of supply-side costs or technological advantages but because of demand side properties like the uncertainty of the emergence of network externalities in multi-sided markets, tipping and winner-takes-all effects.

Competition law enforcement has identified some of these pieces of software. Indeed, there is a genuine run

towards its appropriation by digital firms, which is monitored by competition agencies. Our example is the *Google Android* case (Case 40099, *Google Android*, European Commission decision of 18 July 2018).

The *Google Android* case is about three different types of abusive conduct. We are interested in the set of questions around Google's anti-fragmentation agreements and the modified versions of the Android smartphone operating system (Android OS), the so-called Android forks. For the context, since Google acquired the developer of Android OS in 2005, it handles Android OS as an open-source project. Beyond creating its own versions of it, Google gives third party developers free access to the source code and allows them to create their own versions. However, through so-called anti-fragmentation agreements, Google obliged all the equipment manufacturers who wanted to pre-install on their mobile device certain Google proprietary apps, namely the Play Store and Google Search, to commit to not develop or sell any devices running on Android forks. This made Google's own version of the Android OS the only viable OS for hardware manufacturers, because smartphone users strongly value access to Google's proprietary apps. This is the critical point in the case.

The European Commission (EC), after having set out that Google has a dominant position in the market for general internet search services, licensable smart mobile operating systems and app stores for the Android mobile OS, decided that Google abused its dominant position by effectively hindering the development of Android forks that could become a competitive threat to its own versions. By preventing the installation of its proprietary apps on Android forks, Google impeded from prospering alternative Android OSs that could have promoted alternatives to the Play Store and to the Google Search engine. Google was fined and ordered to stop impeding hardware manufacturers from selling devices based on Android forks.

* Linus J. Hoffmann, PhD researcher, EUI Law department, Via della Badia dei Roccettini, 9, 50014 Fiesole FI, (+33)0640529824, linus.hoffmann@eui.eu

The parties in the conflict are Google on the one side, the main developer of the Android ecosystem, and hardware manufacturers on the other side, which need to install an OS on their devices in order to sell functional smartphones. As Android is a widespread product that benefits from network efficiencies, hardware manufacturers could either install the Google version of Android and accept not to develop forks or create their own fork and accept not to get the Play Store and other Google proprietary apps. The entitlement in dispute concerns the control over forks and could be either distributed to Google or to the hardware manufacturers.

In the language of property, entitlement to be distributed concerns the capacity of a party to exclude the other from interacting with the common object. This means, independently of how it is distributed, the solution of the conflict will necessarily give one party the “power to control, to varying degrees, [other people’s] behavior in connection with the thing” (Perzanowski & Schultz 2016: Chapter 2, “Property and the Exhaustion Principle”, para. 22). This is precisely the exercise of a property right and it is why we can interpret the situation as a problem of appropriation. Under the hood of the competition case, the situation reveals itself as a dispute over Android OS access and modification rights.

It becomes clear that the exercise of property rights has been shaped after the intervention of competition law, although not explicitly. The outcome of the EC case is that hardware manufacturers are granted access and modification rights and the right to sell modified versions of an OS that was and is still formally owned by Google. The *Google Android* decision shifted Google’s ownership position of Android OS a bit towards the more precarious end.

2. Limits to the appropriability of user data with network externalities

A certain amount of data collection and appropriation is inherent to the business model of many digital firms. For example, the data that Facebook collects from users ultimately permit the firm to provide their social network service for free. At the same time, much of firms’ output that emerges from data collection can also be conceived as a by-product of the data subject’s behaviour. Should collected data belong in the first place to the data subject?

As network externalities can also affect user data, the appropriation of user data can sometimes stand as a proxy for the capture of supplementary network externalities. In general, “a good exhibits network effects if the value to a new user from adopting the good is increasing in the num-

ber of users who have already adopted it.” (Varian 2017: 1).

One could be tempted to argue that network externalities are not a good, i.e. that there is nothing to appropriate or capture. But network externalities are more than a mere descriptive economic model. In digital markets, firms carefully design multi-sided markets with complex pricing structures in order to make network externalities come into existence. And firms have sometimes great struggles in doing so (Hagiu 2014: 5). The second entitlement problem is about the question of the extent to which they should be able to do so in the particular context of user data appropriation, especially when markets have tipped. Our example is the ongoing tale of the 2014 Facebook/WhatsApp merger, and in particular the question of whether automatic profile matching between Facebook and WhatsApp users should be allowed.

The EC authorised Facebook to acquire WhatsApp for USD 19 billion in 2014. At that moment, 70-90 % of WhatsApp’s active users were also using Facebook (Case M.7217 - *Facebook/WhatsApp*, Commission decision of 3 October 2014, paras. 165-166). Although Facebook submitted to the EC that matching the user profiles of WhatsApp and Facebook would be technically impossible, it did so in 2016 and in 2017 was fined by the EC. However, the merger approval was not revoked (Case M.8228 - *Facebook/WhatsApp*, Commission decision of 17 May 2017).

In 2019, the German Bundeskartellamt took up the same conflict, but on slightly different grounds. Its argumentation was based on a combination of competition law elements and data protection rights of users, arguing that users had no choice other than to accept profile matching when using the services, which led to a lower standard of privacy protection. Consequently, the Bundeskartellamt prohibited automatic profile matching (B6-22-16, Fallbericht vom 15. Februar 2019). Later, the Düsseldorf Higher Regional Court blamed the authority for the methodological mixture between competition and privacy aspects and cancelled the authority’s interim measures (Beschluss VI-Kart 1/19 (V), *Facebook v Bundeskartellamt*, 2019). Finally, the Bundesgerichtshof upheld the initial decision on provisional measures (Bundesgerichtshof, Beschluss des Kartellsenats vom 23.6.2020 - KVR 69/19). The decision on the merits of the case is pending.

The underlying entitlement dispute revolves around the exploitation of supplementary network externalities arising from matching two user bases. It is safe to say that if the Facebook and WhatsApp services are allowed to

integrate and to match profiles, additional positive data network externalities will arise, and Facebook would have even more accurate preference profiles of the users. What Facebook wanted to appropriate in 2014 was probably not WhatsApp as a business itself, nor its mere userbase, but the very possibility of capturing these supplementary network externalities. When it comes to the users, the dispute arises primarily from a privacy concern, i.e. a concern about the loss of control over personal data. This touches on the fundamental debate over whether personal data should only be protected by fundamental rights such as privacy rights or whether they should be instead protected by property rights. Indeed, some argue that personal data should become a tradable good owned by the data subject (Zech 2015). This, however, has brought up concerns about competitive harm, as it would probably foster the dominant position of data collecting firms on tipped markets (Petit 2020: 203).

3. Claims over digital content

Content arises when parties interact on a digital platform. It can also be affected by network externalities, but contrary to user data content is not only a by-product of human behaviour but a product of human work. Therefore, a special regime of appropriation is necessary.

Our example is a decision by the French Autorité de la concurrence (the Autorité) concerning a dispute between a group of press publishers and Google (*Décision n° 20-MC-01 du 9 avril 2020*). The case concerns the introduction of the so-called ‘neighbouring rights’ of press publishers of snippets of their work that are displayed on different Google websites.

For the context, Google and other search engines display snippets of online press articles. A snippet is a preview of the article that contains a hyperlink to the publisher’s website, the title of the article, the date, a few sentences and a thumbnail of the article’s photography.

EU Directive 2019/790 on copyright and related rights in the Digital Single Market created *sui generis* property rights for press publishers. Publishers of copyright-protected press publications are granted exclusive reproduction rights and rights to make the publications accessible to the public (art.15). These are the ‘neighbouring rights.’ The directive insists on the fact that “online content-sharing service providers” (read: Google) must secure an authorisation of the right holders in order to make the press publications available to the public (art.17). There is no further indication on the negotiation process or fair compensation. The legislator seemed to believe that it was sufficient to cre-

ate a property right and let free bargaining between press publishers and ‘online-sharing service providers’ play out.

This did not go well for the press publishers. Search engines represent most of the traffic that is redirected to the press publishers’ webpages. Therefore, Google has a strong bargaining position when it comes to obtaining the publishers’ authorisation to make the press publications available to the public. Google decided to no longer display snippets of the news content unless the press publishers granted Google the authorisation to do so free of charge, which most of them did (Autorité de la concurrence, 2020).

The case was brought to the Autorité by a group of French press publishers. Besides their complaints on the merits of the case, they requested interim measures to enjoin Google to renegotiate the compensation scheme in good faith. In the decision on interim measures, the Autorité stated that Google is susceptible to having a dominant position on general internet search services, given that it handles 90% of general search requests in France. By denying negotiations on the compensation for the licences, Google could have abused its dominant position. Interestingly, this is how the Autorité interprets the goal of the directive and the French transposition law: “the Autorité notes that, in the state of the investigation, [Google’s conduct] seems difficult to reconcile with the purpose and scope of the law, which aimed to redefine the sharing of value in favour of press publishers vis-à-vis platforms” (Autorité de la concurrence 2020). The Autorité, insisting on the financial difficulties of the press publishing sector, decided to enjoin Google to renegotiate in good faith the compensation for the license with the press publishers. The case on the merits is pending.

The entitlement in dispute between Google and the press publishers is the compensation for displaying. The case is not about the existence of the so-called neighbouring rights; these are positive property rights that the legislator has already created. Instead, the case turns on the exercise of this right. This entitlement dispute is about the very effectiveness of an already existing positive property right. If the Autorité decides in favour of the press publishers, and this seems likely, then it creates a positive market value for neighbouring rights. This would strengthen the ownership position of press publishers.

Raising awareness of the distributive nature of competition law

Although competition law has not been conceived as a tool to resolve individual entitlement disputes, it is a reli-

able instrument to localise them. Thanks to its sensitivity to the functioning of markets and to the distribution of economic power, competition law excels in identifying the assets that firms try to capture and to exploit in digital markets. This paper has found three of them: software, user data and digital content, all of which are affected by network externalities.

As the case studies show, the intervention of competition law in property rights is not unilateral. When it configures the conditions for access and exploitation of digital assets, it shapes strong and precarious regimes of appropriation. This flexibility is necessary. Markets can be crippled when unnecessary property entitlements are introduced or granted for too long (Hovenkamp 2013: 60), and also when necessary property entitlements are not introduced (Epstein 2009: 11). In addition, granting property entitlements can have no effect at all, as we saw in the third case study.

The definite response to the question of what should be regarded as an optimal initial allocation of entitlements remains a policy choice. According to Melamed and Calabresi, any entitlement dispute can be solved either in order to increase efficiency or in order to make a desired distributive outcome happen. The desired distributive outcome can tend to more equality, but also to more inequality between the parties of the dispute (Melamed & Calabresi 1972).

Competition deciders are therefore advised to take into account the long-term distributional implications of their choices. By shaping the capacity of companies to appropriate central digital goods, they also decide how the tremendous value arising from digital technology is shared throughout society.

References

Autorité de la concurrence. (2020, April 9). *Press release, Neighbouring rights: The Autorité has granted requests for urgent interim measures presented by press publishers and the news agency AFP (Agence France Presse)*. <https://www.autoritedelaconcurrence.fr/en/press-release/neighbouring-rights-autorite-has-granted-requests-urgent-interim-measures-presented>

Demsetz, H. (1967). Toward a Theory of Property Rights. *The American Economic Review*, 57(2), 347–359.

Epstein, R. A. (2009). Property Rights, State of Nature Theory, and Environmental Protection. *New York University Journal of Law and Liberty*, 4, 1–35.

Hagiu, A. (2014). Strategic Decisions for Multisided Platforms. *MIT Sloan Management Review, Special Collection “Top 10 Lessons on Strategy.”*

Hovenkamp, H. J. (2013). Consumer Welfare in Competition and Intellectual Property Law. *SSRN Electronic Journal*. <http://www.ssrn.com/abstract=2329150>

Melamed, D. & Calabresi, G. (1972). Property Rules, Liability Rules and Inalienability: One View of the Cathedral. *Harvard Law Review*, 85(6), 1089–1128.

Perzanowski, A., & Schultz, J. (2016). *The end of ownership: Personal property in the digital economy*. The MIT Press.

Petit, N. (2020). *Big Tech and the Digital Economy. The Mologopoly Scenario*. Oxford University Press.

Varian, H. (2017). Use and abuse of network effects. *SSRN Electronic Journal*. <https://ssrn.com/abstract=3215488>

Zech, H. (2015). Daten als Wirtschaftsgut – Überlegungen zu einem „Recht des Datenerzeugers.“ *Computer und Recht. Zeitschrift für die Praxis des Rechts der Informationstechnologien*, 3, 137–146.

Substitution or Integration between Traditional Public Transport and Platform-Based Forms of Mobility. Implications for Economic Regulation¹

Ivana Paniccia*

Following the Covid-19 pandemic, stricter integration between public transport and platform-based forms of mobility may occur in urban contexts. This will imply a spur to digitalisation in the mobility industry with an incisive role of independent regulation, also concerning new ways to finance public service obligations, passengers' rights and pricing.

This paper analyses the implications for regulatory policies at the European level of patterns of competition and/or integration between traditional public transport (PT) and platform-based forms of mobility that are occurring in urban contexts, also considering social and economic effects following the Covid-19 pandemic.

New forms of mobility and PT. Substitutes or complements?

First, a general distinction is made in this paper between conventional PT or mass transit on the one hand and non-fixed routes and unscheduled transport services on the other. In this latter group, traditional services, such as taxis and private hire vehicles, can be distinguished from new Flexible Transport Services (FTSs) based on digital online platforms.

Where services offered by platforms are shared, a distinction is made between vehicle-sharing services and ride-sharing services. The latter can be distinguished (referring to a US taxonomy) into:

- Transportation Network Companies or TNCs (e.g. Uber, Lyft, Kapten) and
- Micro-transit (minibuses with app-based booking operating on fixed routes) and demand responsive transport (DRT) (e.g. Via).

According to recent (pre-pandemic) studies, ridesharing, which accounts for a limited but dynamic share of movement, generally exerts a subtractive impact on PT, although it depends on the 'quality' or effectiveness of the specific urban context considered (Schaller, 2018; Chewlow *et al.*, 2017). TNCs mainly compete with PT, taxis, walking and biking, drawing customers from these non-auto modes based on speed of travel, convenience and comfort. Evidence from Europe is scantier and anecdotal with mixed results (Orb/Uber, 2018).

Specifically regarding DRTs, they prove to be effective complements of public transits to serve very dispersed small to medium-size settlements where PT hubs are too far or when demand is very small either during periods of the day/week/year or in certain areas (Schaller, 2018). Experiences of integrating on-demand services in urban transport are in their early days in European countries, with very (context-specific) positive results (BMVI, 2020; Civitas, 2017).

New forms of mobility and PT after the pandemic

Evidence available for many countries shows a dramatic drop in travel demand, concerning either PT or ridesharing, during the pandemic and lockdown periods. The extent of post-crisis recovery will depend on the many different factors which will be summarised below, which also affect the features of the relationship between PT and FTSs, as related to ongoing structural global trends concerning digitalisation, demographics (population ageing) and societal trends affecting consumer behaviour, global climate change and urban transformations (DFT, 2019; Pankratz *et al.*, 2018).

First, the component of 'systematic' demand for mobility related to commuting may scale down in relation to the reorganisation of work and studying activities, with a reduction and reconversion of productive activities, continuity in the adoption of teleworking by public administrations and private companies generalised to a large number of workers, bachelor and doctoral courses online and, in general terms, a diffusion of remote learning and formation, and increases in part-time work and self-employment. This tendency was already ongoing in many European countries due to structural changes in the economy and in connection with population ageing, considering that commuting presently represents a small proportion (15-30%) of total travel/trips according to recent statistics (DFT, 2020; ISFORT, 2019). As a countervailing trend, recreational and leisure travel has generally increased in the last decade

¹ The views expressed are purely those of the author and may not in any circumstances be regarded as stating an official position of her institution.

* Ivana Paniccia, PhD in economics - University of Reading, 1999. Director of Retail Services and Markets at the Italian Regulatory Authority for Transport, Turin, Italy, ipaniccia@hotmail.com.

in many countries, but its growth may slow down in the post-pandemic phase if population income worsens.

Similarly, people movements for big leisure or business events will be less frequent, while the observed decrease in 'shopping trips' over the past decade is more uncertain, as it is related to online shopping, which may be mitigated by a shortening of global production chains and a return to proximity trade.

If ridership commuting decreases because of the socio-economic changes mentioned above, the average operating cost of PT in urban networks will rise (because of diminishing economies of density) while unit revenue from fares will drop. Moreover, people may be willing to live further from the site of their employers, dispersed across city suburbs in the urban fringes and rural areas (or in Italian *borghi*) once they are adequately connected to the digital broad-band network. In this scenario, mobility needs in non-urban settlements may move to private (small and probably sustainable) cars or micro-mobility, while the need to connect with urban hubs may be satisfied with non-fixed lines or flexible services.

A resurgence of private mobility (including micro-mobility and active on-foot mobility, at least to cover short or last mile distances) and, generally, a more intense use of single-occupancy vehicles are also a very likely result in the post-pandemic picture because of a lasting/enduring mistrust of collective forms of mobility. While pollution effects may be contained, provided non-fossil fuels are used in motorised vehicles, the occupancy of streets and curb sides may require stricter (also economic) regulation to avoid congestion (and lower commercial speed, especially for PT), also considering the infrastructure needed for electric vehicle recharging.

These tendencies undermine the economic rationale and effectiveness of PT as the most cost-efficient option in dense urban areas (at least for its high capacity) with an added pressure on PT budgets, while a potential higher demand for alternative forms of mobility, when they prove to be more competitive than individual cars, may be constrained by their higher price, which may not be affordable by a larger audience of non-affluent users. Given the mixed effects on the demand volumes for FTS, they may not overcome scale issues even in metropolitan contexts, while ridesharing headquarters, especially those operating in the automotive industry, may move towards more focused investments.

Although anecdotal, evidence shows more shared mobility mergers and acquisitions, a general downsizing of

fleets and mass layoffs among their workforces, while some have pivoted to delivering goods, enterprise mobility or even to selling their ride-hailing software to transit agencies. At the same time, ride-hailing companies have offered on-demand services to public transport agencies in Europe and the US, with rising claims that they represent complements to rather than substitutes for PT.

In this perspective, there will be coordination of different urban mobility and infrastructure operators following a necessary reshaping of PT planning, financing and funding. Whether the coordinator will be a PT agency at the municipal or regional/federal level or a private company, either a PT operator or an independent (from the mobility industry) commercial one, will depend on the industry structure of each country and on its institutional framework. Digital competencies to manage data on demand changes and flexible operational and organisational models of organisation (concerning scheduling, shifts, industrial relations, etc.) will be critical resources for assuming such a role, which may lead to Mobility as a Service (MaaS) packages for different trips supported by contactless ticketing systems and forms of payment.

Once established, (MaaS) coordinator identity will have a great influence on the prospects for development and competition in the mobility industry, in terms of the risks of operators, mode of transport discrimination, market closure, underinvestment and equity issues that need to be addressed by regulatory tools.

Policy and regulatory implications

Investing in digitalisation will maintain continuity with the main trends in the industry before the pandemic outbreak.

From a policy perspective, the correct targeting of public financing and funding needs to be considered in terms of resilient technologies and infrastructure, and also considering the identity of MaaS coordinators. A more intense use of digital technologies by transport operators in the management of demand, planning, service production and customer relationships is conceived here as a resilient investment policy able to spur economic recovery and to reduce national public debts once the emergency is overcome.

Investments may rely on the European Recovery Fund (RFF) to the extent that single interventions adopted are included in strategic plans for selected industries with a growth potential, and may turn out to be able to repay their initial cost or to maintain their economic value also

after the emergency phase, promoting a long-lasting process of industry modernisation. Revised guidelines for 'Sustainable Urban Mobility Plans' (SUMPs) might be an appropriate policy intervention tool, among others.

A centralised policy also makes easier coordination with other departments, such as that for the environment, because of the negative impact on congestion and pollution by private cars, or economic development, in order to coherently support the value chain of transport, including manufacturers of vehicles at the top of the vertical chain of PT, through targeted charging/incentives for negative/positive externalities. This issue shows the inadequacy of any sector-specific approach (Finger *et al.*, 2020), also considering the need for new sources of financing for PT budgets. Similarly unsuitable is an approach neglecting interdependencies between digital infrastructure and the providers of different modes and types of transport based on common operational standards, which requires a convergence of sectoral regulations.

The new perspective may need a rejuvenation of concepts already common in European regulation of the (land) transport industry (EC Regulation no. 1370/2007; EC Regulation no. 1371/2007; EU Regulation no. 181/2011), in particular concerning public service obligations (PSOs) and passengers' rights, or just a different use of existing tools, such as concerning the pricing of PT and FTSs, quality of service, consumer protection and the inclusiveness of new platform-based forms of mobility.

Regarding tariffs or charges, consideration of the willingness-to-pay (WTP) of travellers may make them more cost-reflective. Indeed, a single regulated charge for PT in a geographical franchised area might indeed include services which, despite being characterised by PSO, are also used by groups with higher WTP as they have higher income levels and, in some cases, are able to travel at different times to commuters. Therefore, higher rates should be applied to these users or they should be offered different types of travel passes, including differentiated ones, to those provided to commuters.

The amount of data that may be collected through digital devices may also permit WTP parameters to be derived (and data may also be 'monetised' in order to finance PSOs). In this respect, even traditional PT will (must) learn to apply more flexible tariff schemes, reflecting either WTP or the degree of congestion of networks and vehicles.

The broader prospect of integration between traditional PT and FTSs also includes the question of whether the latter services should be subject to PSOs coherent with EC regulations. This is a conceptual issue that may be solved

following a sequential process of PSO determination based on the analysis of appropriate (not historical) data on travel demand and the WTP of (potential) customers, which may result in the exclusion of any PSO and/or any financial compensation in a public service contract (PSC) either because market forces provide for an affordable service (for targeted customers who may have a WTP higher than that implied in regulated tariffs in a PSC) or a regime of simple authorisation (including 'horizontal PSOs' as in maritime cabotage regulation compliant with EC Regulation no 3577/1992), assisted by consumer rights regulation, may be sufficient. A methodology sequentially describing the process to identify PSOs according to proportionality and efficiency criteria for the use of public resources compliant with EC regulations can be found in ART (2017).

When consumer rights regulation applied to FTSs is not able to ensure the required level of service standards or when FTS operators are not in a condition to comply with the market's required/expected level of quality or tariffs (demand side), when "considering their own commercial interests" a PSC scheme and related rules on awarding, defined according to non-discriminatory and level-playing-field criteria, may apply.

Another solution, which is probably compatible with EU regulations is direct compensation of transport users. Citizen's essential mobility needs can be met even outside PSCs through services that do not imply any compensation or assignment of exclusive rights, while a direct user's compensation may fully replace the direct compensation of the operator or be complementary to it.

The financing arrangement at issue may consist of dedicated vouchers, rebates on payment of the ticket price or a reimbursement of part of the ticket price after purchase, given by the difference between the full cost of service and the preferential charge or season ticket in relation to pre-determined income conditions, non-working conditions or disability. Vouchers work as a discount or reduction of the ticket price which is granted to persons with the necessary requirements as established by the competent authority with respect to the social policy and transport objectives it intends to pursue.

There may be a risk that all or some of the above digital solutions for transport will be not accessible to persons with disabilities, the elderly or low-income individuals.

One way to ensure equity and inclusivity in transport services is to specify minimum requirements (or recommendations) to market (non-PSO) operators. These may be included in general laws or in the act authorising operation of the service (or dispatching it in a MaaS model) and

may range from obligations to offer booking and payment options that do not require smartphones (digital devices) or specific pricing plans for users with low incomes and distributing vehicles more equitably across the area to be served (i.e. a peripheral borough).

Another tool to guarantee the inclusiveness of new platform-based forms of mobility is a specification of minimum requirements to market operators in terms of a package of minimum digital services to be ensured to all consumers in their territories (universal broadband service). Pursuant to art. 84 of (EU) Directive 2018/1972 of 11 December 2018 (Recast) establishing the European Electronic Communications Code, everyone is entitled to have access to an adequate broadband internet service capable of supporting a minimum set of services.

The short review of structural changes in the mobility industry in this paper, also considering effects of the pandemic, has highlighted a scenario of 'convergence' between different types (and modes) of transport. Operational and business models of PT are becoming more flexible and interdependent with digital infrastructure and assets, including travel and traffic data, while related to these digital transformations a sharpening of policy and regulatory tools becomes necessary, which is also being inspired by other network regulated industries.

References

ART (2017), Decision no 48/2017, *Regulatory measures on the definition of the methodology to identify the scope of public service and the most efficient financing arrangements, pursuant to article 37 (3) (a) of decree-law no. 201/2011 and article 37 (1) of decree-law no. 1/2012*, (Turin, <https://www.autorita-trasporti.it/delibere/decision-no-48-2017/?lang=en>).

BMVI: Federal Ministry of Transport and Digital Infrastructure (2020), *Shift effects and environmental effects of changed mobility concepts in passenger transport* (Bonn: BMVI).

Civitas (2017), *Smart choices for cities. Cities towards Mobility 2.0: connect, share and go!* (Bruxelles: Civitas).

Clewlou, R. and Mishra, G.S. (2017), *Disruptive Transportation: The Adoption, Utilization, and Impacts of Ride-Hailing in the United States* (Davis: UC Davis Institute of Transportation Studies).

DFT: Crown Department for Transport (2019), *Future of Mobility: Urban Strategy*, March 2019 (London: Department for Transport).

Finger, M., Montero, J., Serafimova, T. (2020), *Manifesto for the next five years of EU regulation of transport*, Policy Briefs (2019/20) (Florence: Florence School of Regulation).

ISFORT (2019), 16° Rapporto sulla mobilità degli italiani "Audimob" (Roma: ISFORT).

ORB/UBER (2017), *Attitudes To Car Ownership Across European Cities*, September 2017, available at <https://orb-international.com/2017/09/05/orbuber-attitudes-car-ownership-across-european-cities-september-2017/>

Pankratz, D.M., Nuttall, K., Eggers, W., Turley, M. (2018), *Regulating the future of mobility*, (New York: Deloitte Insights).

Schaller, B. (2018), *The New Automobility: Lyft, Uber and the Future of American Cities* (New York: Schaller Consulting).



Handbook on Railway Regulation Concepts and Practice

Edited by Matthias Finger, Ecole Polytechnique Fédérale Lausanne, Switzerland, European University Institute, Italy and Istanbul Technical University, Turkey and Juan Montero, National University of Distance Education, Spain and European University Institute, Italy

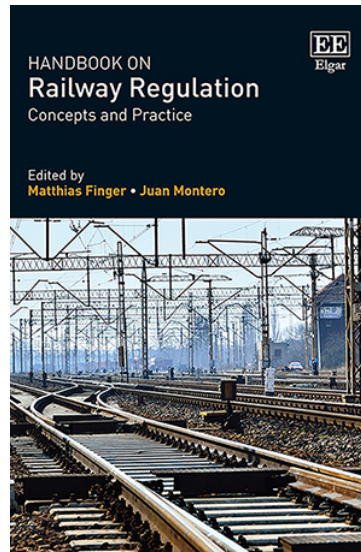
Taking a global approach, this insightful Handbook brings together leading researchers to provide a comprehensive overview of the state-of-the-art in railway regulation with a particular focus on countries that rely heavily on railways for transportation links. The Handbook also considers the most pressing issues for those working in and with railway systems, and outlines future trends in the development of rail globally.

'This collection of original papers takes a genuinely international look at the economic regulation of railways. It covers all forms of rail operations (freight, passenger, and local) and a diversity of regulatory regimes, as well as having a substantial geographical coverage. The editors have managed to entice a cornucopia of experts from around the world to contribute. The volume is timely. Railways over the last 50 years have seen economic regulatory adjustments that have affected their ownership, operations, methods of finance, and investment priorities. While one can easily find a common thread in many of these changes, the overriding emphasis has been on more reliance on market forces and lighter interventions by governments, there are considerable national variations in the instruments deployed and the outcomes that have emerged. This volume allows experts to keep abreast of events and thinking in the rail regulatory world and offers newcomers an almost encyclopedic account of the practical and intellectual challenges involved.'

– Kenneth Button, George Mason University, US

'A great resource for politicians, managers, competition lawyers and economists, seeking an overview of the implemented regulatory frameworks within the railway sector in Europe and beyond.'

– Frank Miram, Deutsche Bahn AG



2020 416 pp Hardback 978 1 78990 177 1 ~~£180.00~~ £162.00 ~~\$270.00~~ \$243.00
Elgaronline 978 1 78990 178 8

Edward Elgar Publishing Ltd. is registered in the UK at: The Lypiatts, 15 Lansdown Road, Cheltenham, Glos GL50 2JA. Registered number: 2041703

How To Order

Online

www.e-elgar.com

Get up to 20% discount when you order online

By Email

UK/ROW: sales@e-elgar.co.uk

N/S America: elgarsales@e-elgar.com

By Phone

UK/ROW: +44 (0) 1243 843291

N/S America: (800) 390-3149

Connect With Us

Find us on Facebook

facebook.com/EdwardElgarPublishing

Follow us on Twitter

For news, views and offers

[@ElgarPublishing](https://twitter.com/ElgarPublishing)

Read our Blog

For news, views and debate from our authors and readers.

<https://www.elgar.blog>

For More Information

UK/ROW: info@e-elgar.co.uk

N/S America: elgarinfo@e-elgar.com

networkindustries

quarterly

Network Industries Quarterly, Vol. 22, issue 4, 2020 (December)

“Digitalising infrastructures”

Presentation of the next issue

In this issue we would like to focus on the digitalisation of infrastructures. Digitalisation is transforming all kinds of industries. Content industries (music, newspapers, audiovisual and so on) were the first to be digitalised and then disrupted by digital platforms. Network industries are also in the process of being digitalised.

Digitalisation can reduce the cost of construction and operation of infrastructures. As sensors are installed in infrastructures producing massive data, infrastructure managers can also reduce the maintenance cost. Furthermore, big data can help infrastructure managers to better control the traffic flow. Machine learning algorithms can be used to predict peaks in the use of the infrastructure, and then use different tools to manage demand (dynamic pricing) and even supply (software-defined networks).

In this special issue, different infrastructure industries will be analysed. The common challenges will be identified, as well as the specificities in each infrastructure.

OPEN CALL FOR PAPERS

Implementation of the liberalization process has brought various challenges to incumbent firms operating in sectors such as air transport, telecommunications, energy, postal services, water and railways, as well as to new entrants, to regulators and to the public authorities.

Therefore, the Network Industries Quarterly is aimed at covering research findings regarding these challenges, to monitor the emerging trends, as well as to analyze the strategic implications of these changes in terms of regulation, risks management, governance and innovation in all, but also across, the different regulated sectors.

The Network Industries Quarterly, published by the Chair MIR (Management of Network Industry, EPFL) in collaboration with the Transport Area of the Florence School of Regulation (European University Institute), is an open access journal funded in 1998 and, since then, directed by Prof Matthias Finger.

ARTICLE PREPARATION

The Network Industries Quarterly is a multidisciplinary international publication. Each issue is coordinated by a guest editor, who chooses four to six different articles all related to the topic chosen. Articles must be high-quality, written in clear, plain language. They should be original papers that will contribute to furthering the knowledge base of network industries policy matters. Articles can refer to theories and, when appropriate, deduce practical applications. Additionally, they can make policy recommendations and deduce management implications.

Detailed guidelines on how to submit the articles and coordinate the issue will be provided to the selected guest editor.

ADDITIONAL INFORMATION

MORE INFORMATION

- network-industries.org
- mir.epfl.ch
- florence-school.eu
- ic4r.net

QUESTIONS / COMMENTS?

Irina Lapenkova, Managing Editor:
irina.lapenkova@eui.eu
Ozan Barış Süt, Designer:
ozanbarissut@gmail.com



LATEST ISSUES

- Vol 22 - No. 2 (2020)*
Transport in the European Green Deal
.....
- Vol 22 - No. 1 (2020)*
Water Utilities – governance and performance
.....
- Vol 21 - No. 4 (2019)*
Regulating Digital Platforms
.....
- Vol 21 - No. 3 (2019)*
Digital Platforms – The New Network Industries? How to regulate them?
.....
- Vol 21 - No. 2 (2019)*
Current Issues in Turkish Network Industries
.....
- Vol 21 - No. 1 (2019)*
Regulation of the Railway Industry
.....
- Vol 20 - No. 4 (2018)*
The path towards digitalisation in road infrastructure
.....

Published four times a year, the **Network Industries Quarterly** contains short analytical articles about postal, telecommunications, energy, water, transportation and network industries in general. It provides original analysis, information and opinions on current issues. Articles address a broad readership made of university researchers, policy makers, infrastructure operators and businessmen. Opinions are the sole responsibility of the author(s). Contact fsr.transport@eui.eu to subscribe. Subscription is free.