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New models in freight transport: sustainable supply chains, the physical internet and irreducible complexity

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The freight transport and logistics industry has entered a period of transformation. Digital technologies are transforming global supply chains, market structures and logistics business models. At the same time, the environmental impacts of logistics have become a central theme. ALICE (2017) places a push to low carbon, low energy and circular economy as a first major trend, with rapid technology developments in "Industry 4.0 and 3D printing, automation, robotics, IoT, Big Data, Future Internet, machine learning and connectivity" (ALICE 2017 p. 18). DHL (2020) argues that innovation in logistics had rapidly increased in the two years since their previous trend report. Some major developments are: omni-channel logistics for extended customer services, a move towards zero emissions logistics, digital technologies (Blockchain, AI, IoT), robotics and automation in logistics systems. WEF (2016) identify: e-commerce giving consumers more possibilities, logistics control towers, data analytics as a service, digital international logistics platforms, autonomous vehicles and drones for delivery, 3D printing and crowdsourcing for production and logistics processes, the circular economy and shared logistics assets as themes of the digital transformation of logistics, with an estimated potential of $1.5 trillion in value for the logistics industry. New logistics concepts such as synchro-modality (Giusti et al. 2019), logistics control towers (Alias et al. 2015) and the physical internet (Montreuil 2011) are being developed to implement these changes.

The capability to analyse and model the systemic nature of these changes is lacking. Meersman and van der Voorde (2019) point out that current transport models have not been successful in predicting the effect of structural, organisational and behavioural changes on transport demand and this is one reason why there has been limited success in reducing negative externalities from freight transport. Tavasszy (2020) identifies three challenges for descriptive and predictive transport models. The new structures have to be represented, improved analyses of decision making in logistics are needed, and enhanced capabilities for analysis of dynamics in freight models should be developed. Tavasszy (2020) also argues that there is no literature that explores the new policy questions that these changes generate.

And now Covid has arrived. The pandemic is changing travel and retail behaviours, while raising new questions of resilience of supply chains. What really happens when a country goes into lockdown and key workers have to self isolate? Will there be a permanent increased demand for cold supply chains for vaccines, which could generate new investments?

Current transport models have not been designed to address such a far reaching combination of shocks and accelerating system change. Köhler et al. (2018) argue that modelling such interlinked and complex changes (apllied to sustainability transitions) cannot just proceed from established approaches. It is necessary to specify the system to be analysed and the changes it faces and then consider the modelling approach to be used.

This presentation is intended to suggest som einitial ideas and stimulate debate on modelling to address these questions. In the case of road freight as a part of the logistics system, perhaps the first question is: what are possible scenarios for digitalisation of logistics? From this, how can the physical internet generate and make available (Big) data for coordination and sustainability

assessment of complete supply chains? How can AI methods generate new business models and logistics market structures?

The next question will be: can this all be made sustainable? How can the environmental impact of the physical internet and the new structures be managed? What will the operational profiles of low carbon vehicles be? What new physical infrastructures will be developed - in fuel, load management, warehousing, intermodal nodes?

This leads to issues of policy and governance. Climate change politics have demonstrated the limitations of conventional, nation-based policy making in addressing greenhouse gas mitigation, especially in global transport networks. So maybe new governance structures are required. At the the same time, there is an increasing possibility of legal claims against governments over climate policy and recent activity by institutional investors in the oil industry to force multinationals to address their GHG impacts show how new governance – or mechanisms of influence – are emerging.

Some initial ideas on these themes will be presented: How can Big Data in logistics be accessed and analysed? How can complete logistics systems be modelled? Is Agent Based Modelling the answer to everything??? Are new methods of bringing models into decision making processes possible?

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