Truck Driver Shortages and Landside Port Congestion

Addressing supply chain challenges one queue at a time

February 2022

Future Logistics, Technology & Environment Discussion Papers

Truck Driver Shortages and Landside Port Congestion: Addressing Supply Chain Challenges One Queue at a Time is part of a series of discussion papers produced by Foresion that aim to holistically explore contemporary supply chain issues and future directions, focusing on logistics, emerging technologies, and environmental sustainability. These papers are aimed at business practitioners, policymakers, and governments as a vehicle for improving integration and visibility along key supply chains.

Suggested Citation

Neagoe, M., Turner, P. (2022) "***Truck Driver Shortages and Landside Port Congestion: Addressing Supply Chain Challenges One Queue at a Time***". Future Logistics, Technology & Environment Discussion Papers, Foresion

Disclaimer

The information contained in this publication is based on knowledge and understanding at the time of writing (February 2022) and may not be accurate, current, or complete. Foresion take no responsibility, and will accept no liability, for the accuracy, currency, reliability, or correctness of any information included in the document (including material provided by third parties). Readers should make their own inquiries and rely on their own advice when making decisions related to material contained in this publication.

Cover photo credits: Prostar, Mike Kelly

Contents

Glossary

$CO_{2\text{-}e}$	CO_2 equivalent measure
OCR	Optical Character Recognition
SLA	Service Level Agreement

Credit: Tideworks

Executive Summary

Many of the world's biggest economies are experiencing major supply chain challenges because of the convergence of several factors: worker absenteeism due to the COVID-related restrictions, incidents like the Ever Given Suez Canal obstruction and growing electronic commerce have all impacted on timely delivery of many goods and services.

These disruptions, however, are only part of two broader longer-term challenges facing global supply chains. The first challenge is the significant projected shortage of qualified truck drivers that had already started to create goods, fuel and food supply disruptions for business and the general population in several countries [1–3]. The second is the global experience of landside port congestion that has emerged partly due to ever greater reliance on mega-ships and mega-ports and have directly contributed to significant landside transport inefficiencies.

Fundamentally, these vulnerabilities in global supply chains need to be addressed in a coherent manner over the short, medium, and long term. Recognising that finding ways to improve driver and transport efficiency by reducing congestion opens up opportunities to tackle driver shortages in the medium to long term by ensuring drivers are trained to better integrate their activities into the supply chains within which they work and to optimise the use of digital infrastructure to mitigate future congestion and optimise transport efficiency and sustainability as new types of fuel cell vehicles enter heavy vehicle transport.

Introduction

Global supply chains have been tested by several events in the past two years. Lockdowns, worker absenteeism due to self-isolation restrictions, the Suez Canal obstruction, have forced supply chains to reconfigure. Many economies and supply chains which were already suffering from truck driver shortages have been strained even further by these events. Governments' natural response to truck driver shortages has been to try to increase the supply of truck drivers. While a logical long-term solution, also in light of the rapid technological changes occurring in the transport sector, truck driver training or retention programs are relatively slow and expensive approach to reduce the driver shortage.

Truck driver shortages must be evaluated in relation to three factors driver supply, transport demand and transport efficiency. Congestion plays a major role in the truck driver shortage as it reduces transport efficiency – long waiting times in queues reduce the available working hours usable for transportation. The Los Angeles/Long Beach port complex has probably been the most visible example of truck congestion, although other ports are also facing major challenges [4–6]. Truck drivers can spend 8 or more hours queuing to pick up or deliver shipping containers and cargoes at major seaports[4]. In some cases, queuing can reduce transport productivity by more than 50%. Congestion also has major environmental consequences. A truck queuing or crawling in queues for 3 hours can emit 18 kg of $CO_{2\text{-}e}$ [1], roughly the same amount as a typical passenger vehicle every 100 kilometres travelled.

Recognising that improved congestion management can reduce short-term pressures on the existing workforce creates opportunities to focus on medium- and long-term decision-making on the future role of heavy vehicles in global and regional supply chains and the skills that truck drivers will require. Consequently, this report seeks to answer three key questions:

1. **How is port congestion affecting truck driver shortages?**
2. **How is truck congestion managed in ports?**
3. **How should truck congestion be managed to address the driver shortage?**

[1] Truck CO_2 emissions of 6,032 g/hr based on [33] and personal vehicle emissions of 182 g CO2-e/km for a gasoline vehicle with a fuel consumption of 8 litres/100 km


Credit: GoAuto

Truck Driver Shortages: Balancing Supply, Demand and Transport Efficiency

Truck driver shortages are affected by three main factors: truck driver supply, the demand for transport services and transport efficiency. When supply is lower than demand or when demand is higher than supply, shortages are expected. Importantly, the efficiency with which the supply satisfies demand plays a role in driver shortages.

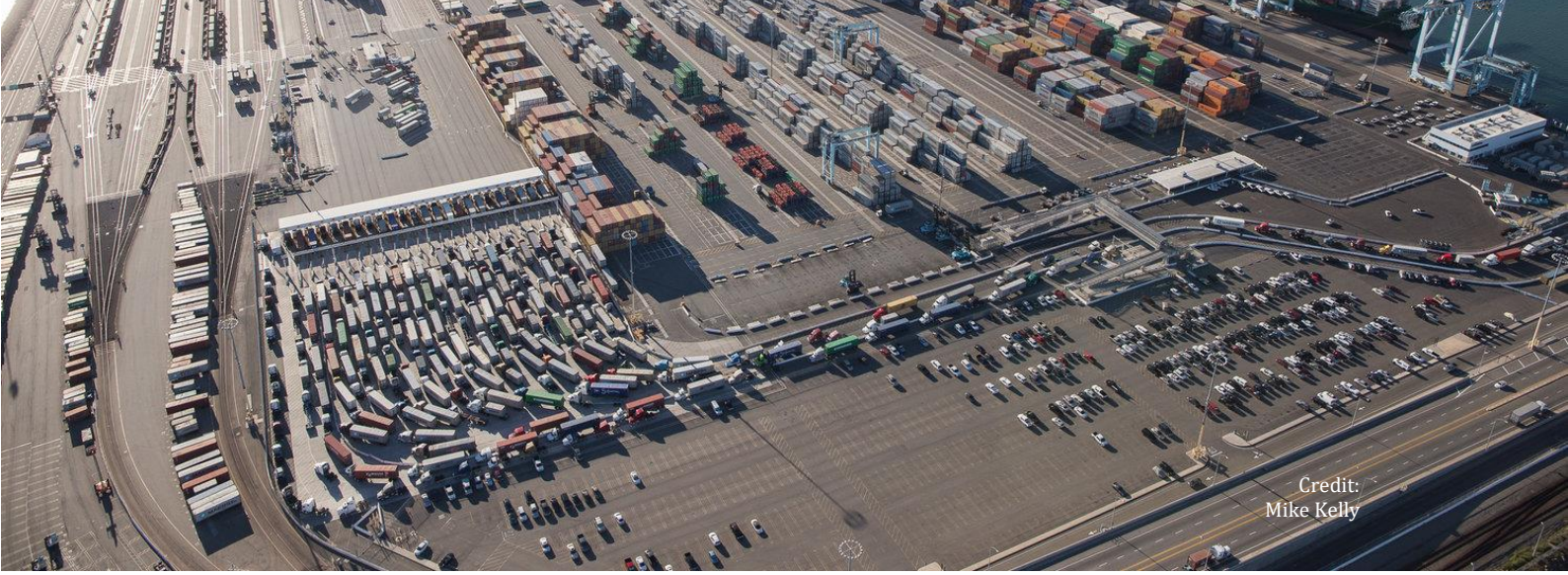
The **supply of truck drivers** is firstly affected by the number of registered drivers, the number of drivers willing to work for given pay and work conditions, drivers' geographical distribution, turnover, and replacement rates. Truck driver supply issues appear to be global, with some countries experiencing more severe shortages. The United States is reportedly missing between 60 and 80,000 drivers [1,2], while Canada is missing 25,000 drivers[2] and more than 150,000 truck driver positions were vacant across the European Union [3]. Much research has gone into exploring high driver turnover, dwindling driver replacement rates and the working conditions and lifestyle challenges associated with truck driving. The results are typically consistent across regions and countries: although enough people are qualified as truck drivers, fewer are actually willing to work as drivers[2], mainly due to the pay[7], long and irregular working hours[3], lack of adequate facilities and loneliness [3,8]. Consequently, driver retention and replacement rates are typically low, as the truck driver image is not necessarily appealing to younger generations.

Truck driver supply and shortage must be evaluated in relation to the **demand for transport services**. Transport services demand can vary for multiple reasons. Variations can be seasonal or event-driven – the Christmas holidays in much of the Western world are a good example[9]. The pandemic has also shown that demand can increase due to perceived shortages of goods – see the great toilet paper shortage [10–12]. Demand can also increase due to structural changes – more online shopping leading to more returns[13] - or inventory replacement.

The United States is reportedly missing between 60 and 80,000 drivers [1,2], while Canada is missing 25,000 drivers[2] and more than 150,000 truck driver positions were vacant across the European Union[3].

Finally, the **efficiency** with which the existing driver supply satisfies transport demand contributes to driver shortages – the more trucks and drivers needed to deliver a given amount of goods, the more severe the shortage. Transport efficiency is perhaps one of the areas in logistics research that has received most attention – from optimising the distribution of containers from ports to distribution centres [14–16], scheduling log deliveries to sawmills[17], planning material deliveries to construction sites [18] or urban parcel logistics[19]. Researchers and practitioners alike have endeavoured to find the most efficient use of transport equipment and labor to satisfy transport demand. The key issue arises when optimal plans are confronted with on-the-ground realities - other road users, equipment breakdowns, roadworks – which interfere with optimal plans. One such interference is congestion.

Truck congestion often arises in supply chain bottlenecks and intersection points, most commonly in seaports and leads to waiting times which can surpass several hours. Congestion interferes with optimal transport plans because it reduces transport efficiency. If it takes more time to fulfill particular transport tasks, ultimately more drivers and trucks are required.



Truck Congestion Management in Ports

Truck congestion is generally nobody's responsibility. Unless port terminal operators have service level agreements (SLAs) with transporters, truck waiting times fall outside any organisation's remit. Many container and bulk terminals, unless vertically integrated, do not have any contractual relations with transporters. In the absence of contractual responsibility, congestion management is either government and regulatory agency-led or initiated by individual organisations – primarily terminal, facility operators.

Truck congestion is typically managed using digital technology, infrastructure capacity or access expansions, and policy and regulatory mechanisms. Digital technology tools are used for automating processes – such as documentation management to speed up truck processing [20] or optical character recognition (OCR)[21] and appointment systems for managing truck arrivals [22,23]. Infrastructure capacity or access expansions consist of either the addition of infrastructure or extensions of opening times for deliveries [24]. Regulatory and policy mechanisms include incentives – frequently payments or credits - or disincentives -fines, restrictions or bans - for operators to spread truck arrivals throughout any given day [25,26].

Truck congestion is nobody's responsibility. Unless port terminal operators have service level agreements (SLAs) with transporters, truck waiting times fall outside any organisation's remit

Despite the wide array of methods to manage congestion, their impact truck waiting times varies greatly from no impact to moderate reduction. Congestion pricing at the port of New York/New Jersey in the United States had limited impact on truck arrivals[26] as did congestion incentive payments in the Port of Haifa in Israel [25]. The PierPASS OffPeak congestion pricing program implemented in the Los Angeles/Long Beach (LA/LB) port complex, United States, in conjunction with appointment systems and extended terminal working hours have had some impact on congestion. Nonetheless, the LA/LB port complex continued to struggle with congestion in 2021[5]. In Port Botany, Sydney, Australia, following the implementation of an appointment system, truck service times decreased by approximately 30% and arrival punctuality increased from 72% to 95% in the first 12 months [27]. The transactions within the system are monitored by an *independent pricing tribunal* that oversees penalties for truck operators and terminals. Nonetheless, Port Botany operates a truck marshalling yard, where early arrivals queue prior to entering the port to avoid late arrival penalties. This suggests, in part, that congestion has been somewhat displaced but not eliminated.

Two key issues emerge:

- First, the selection process for congestion management approaches appears arbitrary and somewhat disconnected from the factors that cause congestion in the first place [28] leading to limited reductions in truck waiting times. It is unclear how terminals operators decide whether additional infrastructure, extended working hours or appointment systems are necessary to reduce waiting times. In one research article on truck congestion in Japanese ports, the researchers found that most congestion was caused by incomplete or incorrect documentation which led to queuing while issues were sorted out[29]. It is unlikely that infrastructure or extended working hours would have tackled congestion otherwise.
- Second, once penalties are levied through congestion management tools, managing congestion becomes a revenue stream dependent on the existence of congestion [30]. Incentives between truck and terminal operators are misaligned. Truck operators – who can gain significant efficiency benefits from reduced congestion – experience limited improvements in waiting times and face cost increases due to access fees or delay penalties levied through tools aimed at reducing congestion. Terminal operators may not be incentivised to address congestion or may like to maintain a certain level of queuing.

Credit:
CNBC, Jetta Productions

Mitigating Truck Congestion to Address Driver Shortages

Clearly, ignoring the factors that cause congestion when choosing the truck congestion management approach is likely to decrease the effectiveness of these initiatives. 24/7 operations in ports have less than the expected impact on congestion if the remainder of the supply chain does not work 24/7. Fines or appointment systems' costs become part of the cost of doing business and are typically passed to final customers or consumers. The marginal impact of infrastructure investment decreases with scale. However, new coordination problems arise with increases in scale. Appointment systems can easily become marketplaces for driver waiting times as well as revenue streams, especially for terminal operators. What all congestion management measures have in common is that they typically do not consider the supply chain in which these measures are implemented.

Aligning Congestion Mitigation to Congestion Factors

Congestion management should first start with identifying the factors along and within supply chains. Our research[31] identified several supply chain-related congestion factors including misaligned incentives, lack of coordination, excessive interdependence of operations, lack of supply chain flexibility, inadequate infrastructure, operational disruptions and performance expectations. Understanding to extent to which these factors play a role in port congestion is a necessary initial step to designing effective congestion management mechanisms.

Targeted Waiting Time Reduction

It is nearly impossible to completely eliminate truck congestion in ports. Some researchers argue that congestion is inevitable in ports due to their scarcity and value in supply chains [32]. However, it may not be necessary to aim for a complete elimination of congestion to address the truck driver shortage. Instead, congestion

should be reduced just enough to improve truck driver productivity.

A simplified example illustrates this point. During a 12-hour shift, a driver can potentially realise 2 full pick-up and delivery cycles (drive to port – queue – load container – drive to warehouse and unload) if the port waiting time is 1.5 hours for each container. If port waiting times are reduced to 1 hour, the same driver can realise 3 full delivery cycles. In this example, a half-hour targeted reduction in waiting times can increase this truck driver's productivity by up to 50%.

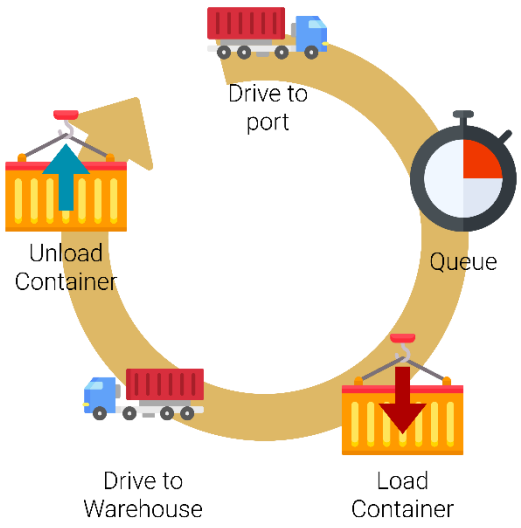


Figure 1 A simplified truck pick-up and delivery cycle (Source: Foresion, 2022)

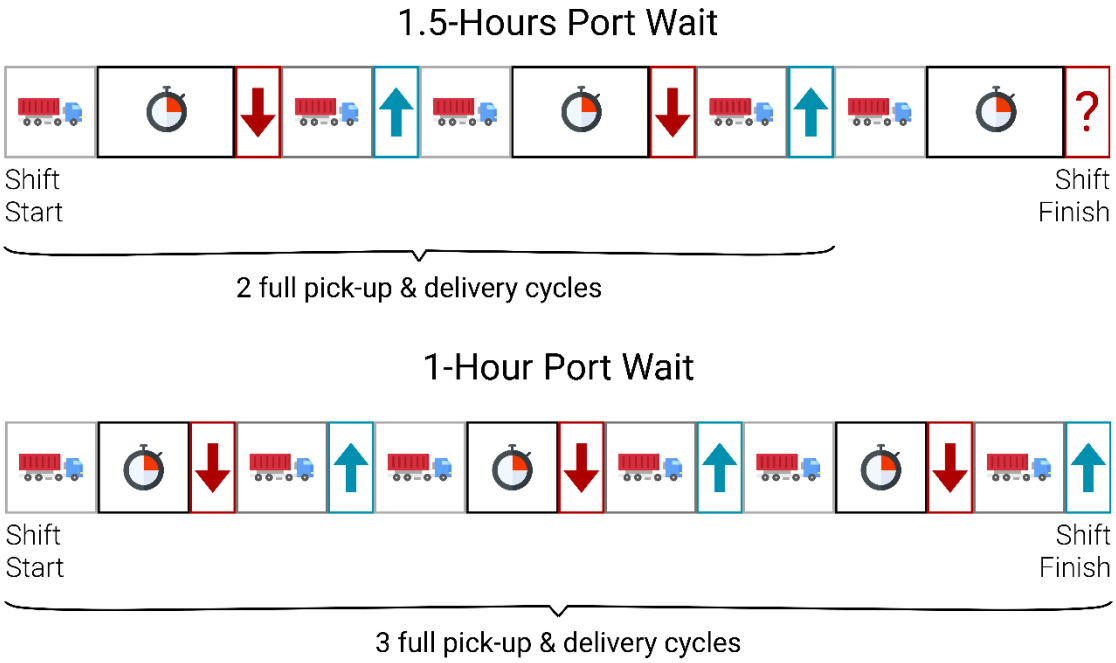


Figure 2 The efficiency difference a reduction of 30 minutes in waiting times can make (Source: Foresion, 2022)

References

1. Yurkevich, V. Wanted: 80,000 truck drivers to help fix the supply chain. *CNN* https://edition.cnn.com/2021/10/19/economy/trucking-short-drivers/index.html (2021).

2. MacMillan, C. The Truck Driver Shortage – The Dirty Truth No One Talks About. https://www.smart-trucking.com/truck-driver-shortage/ (2021).

3. Ji-Hyland, C. & Allen, D. What do professional drivers think about their profession? An examination of factors contributing to the driver shortage. *Int. J. Logist. Res. Appl.* **0**, 1–16 (2020).

4. Kay, G. Truckers at backlogged ports say they've waited in miles-long lines for up to 8 hours without pay. https://www.businessinsider.com.au/truckers-wait-outside-backlogged-ports-8-hours-without-pay-2021-11 (2021).

5. Associated Press. Ports of LA, Long Beach to fine firms over container backlog. https://abcnews.go.com/US/wireStory/ports-la-long-beach-fine-firms-container-backlog-80781805 (2021).

6. Castle, S. Truckers Shun U.K. Ports to Avoid Brexit Red Tape. https://www.nytimes.com/2021/01/27/world/europe/truckers-uk-ports-brexit.html (2021).

7. American Trucking Association. ATAs Driver Shortage Report 2017. 13 (2017).

8. Staats, U., Lohaus, D., Christmann, A. & Woitschek, M. Fighting against a shortage of truck drivers in logistics: Measures that employers can take to promote drivers' work ability and health. *Work* **58**, 383–397 (2017).

9. Schulz, J. D. LTL carriers bullish on demand, pricing dynamics for 2021. *Logistics Management,* https://www.logisticsmgmt.com/article/ltl_carriers_bullish_on_demand_pricing_dynamics_for_2021 (2021).

10. Moore, A. How the Coronavirus Created a Toilet Paper Shortage. https://cnr.ncsu.edu/news/2020/05/coronavirus-toilet-paper-shortage/ (2020).

11. Frances Mao. Coronavirus panic: Why are people stockpiling toilet paper? *BBC News,* https://www.bbc.com/news/world-australia-51731422 (2020).

12. Snell, A. Why Are There Toilet Paper Shortages around the World? *Fee Stories,* https://fee.org/articles/why-are-there-toilet-paper-shortages-around-the-world/ (2020).

13. Parcel Pending. Package Delivery Statistics. https://www.parcelpending.com/blog/package-delivery-statistics/ (2021).

14. van Riessen, B., Negenborn, R. R. & Dekker, R. Real-time container transport planning with decision trees based on offline obtained optimal solutions. *Decis. Support Syst.* **89**, 1–16 (2016).

15. Crainic, T. G. & Hewitt, M. Operations research and intermodal transport. in *Intermodal Freight Transport and Logistics* 239–253 (CRC Press, 2017).

16. Jachimowski, R. Review of horizontal transport decision problems in the marine intermodal terminal. *Arch. Transp.* **44**, 35–45 (2017).

17. Andersson, G., Flisberg, P., Nordström, M., Rönnqvist, M. & Wilhelmsson, L. A model approach to include wood properties in log sorting and transportation planning. *INFOR* **54**, 282–303 (2016).

18. Choudhari, S. & Tindwani, A. Logistics optimisation in road construction project. *Constr. Innov.* **17**, 158–179 (2017).

19. Boysen, N., Fedtke, S. & Schwerdfeger, S. *Last-mile delivery concepts: a survey from an operational research perspective*. *OR Spectrum* vol. 43 (Springer Berlin Heidelberg, 2021).

20. Koliousis, I. A conceptual framework that monitors port facility access through integrated Port Community Systems and improves port and terminal security performance. *Int. J. Shipp. Transp. Logist.* **12**, 251–283 (2020).

21. Heilig, L. & Voß, S. Information systems in seaports: a categorization and overview. *Inf. Technol. Manag.* **18**, 179–201 (2017).

22. Ramírez-Nafarrate, A., González-Ramírez, R. G., Smith, N. R., Guerra-Olivares, R. & Voß, S. Impact on yard efficiency of a truck appointment system for a port terminal. *Ann. Oper. Res.* **258**, 195–216 (2017).

23. Huynh, N., Smith, D. & Harder, F. Truck Appointment Systems. *Transp. Res. Rec. J. Transp. Res. Board* **2548**, 1–9 (2016).

24. Maguire, a, Ivey, S., Golias, M. M. & Lipinski, M. E. Relieving Congestion at Intermodal Marine Container Terminals: Review of Tactical/Operational Strategies. *Proc. 51st Annu. Transp. Res. Forum* **1**, 631–645 (2010).

25. Bentolila, D. J., Ziedenveber, R. K., Hayuth, Y. & Notteboom, T. Off-peak truck deliveries at container terminals: the "Good Night" program in Israel. *Marit. Bus. Rev.* **1**, 2–20 (2016).

26. Holguín-Veras, J. *et al.* Overall Impacts of Off-Hour Delivery Programs in New York City Metropolitan Area. *Transp. Res. Rec. J. Transp. Res. Board* **2238**, 68–76 (2011).

27. Davies, P. Container terminal reservation systems design and performance. *METRANS Int. Urban Freight Conf. Long Beach CA* 1–24 (2013).

28. Neagoe, M., Hvolby, H. H., Taskhiri, M. S. & Turner, P. Using discrete-event simulation to compare congestion management initiatives at a port terminal. *Simul. Model. Pract. Theory* **112**, 102362 (2021).

29. Motono, I., Furuichi, M., Ninomiya, T., Suzuki, S. & Fuse, M. Insightful observations on trailer queues at landside container terminal gates: What generates congestion at the gates? *Res. Transp. Bus. Manag.* **19**, 118–131 (2016).

30. Neagoe, M., Taskhiri, M. S., Nguyen, H.-O., Hvolby, H.-H. & Turner, P. Exploring congestion impact beyond the bulk cargo terminal gate. in *Logistics 4.0 and Sustainable Supply Chain Management, Proceedings of HICL 2018* 63–82 (2018).

31. Neagoe, M., Hvolby, H.-H. & Turner, P. Why are we still queuing? Exploring landside congestion factors in Australian bulk cargo port terminals. *Marit. Transp. Res.* **2**, 100036 (2021).

32. Meersman, H., Voorde, E. Van de & Vanelslander, T. Port Congestion and Implications to Maritime Logistics. in *Maritime Logistics* (eds. Song, D. & Panayides, P.) 49–68 (Emerald Group Publishing Limited, 2012). doi:http://dx.doi.org/10.1108/MRR-09-2015-0216.

33. Starcrest Consulting Group. *Port of Los Angeles Inventory of Air Emissions*. (2021).