Data Exchange

ACEEE Topic Brief

November 2021

Data is at the heart of freight planning, evaluation, and operations. With the evolution and proliferation of information and communications technology (ICT) tools to gather data and put it to work, shippers, carriers, and logistics companies are adopting those tools and practices to stay competitive. These developments bring the potential for major increases in efficiency, which can deliver not only cost reductions through time savings and improved reliability, but also reductions in environmental impacts—including reduced carbon emissions—through optimized loading and routing and greater use of energy-efficient modes.

Data-based efficiency opportunities

While new uses of data in planning and evaluation are often extensions of current capabilities, some data applications are qualitatively different from past uses. Big data, for instance, allows detailed observation of freight movement, which companies have traditionally modeled or projected using rules of thumb. The near-instantaneous communication of information about the status of individual vehicles and shipments can permit dynamic decision-making by rendering the entire transport system fully visible.

Strategies to increase efficiency

The pooling of shipper and carrier data and the ability to communicate and analyze that data support better utilization of vehicle capacity, increased supply chain visibility, and other strategies to streamline goods movement. Increased efficiency may follow from the flexibility to select the most energy-efficient mode for an individual trip or to locate a compatible load with which to share a trailer on the fly.

Explosive growth

One indication of the significance of these ICT-based opportunities is the growth rate of the services they enable. Trucking as a Service (TaaS), which is dominated by digital load matching, is projected to grow from $11.2 billion in 2019 to $79.4 billion in 2025,[1] a growth rate of 38.6% per year. In the $792 billion U.S. trucking industry,[2] this represents a more than 10% market share within a few years.

Sharing data

While freight data is often proprietary, the freight system's efficiency depends on strategic sharing of that data. For both the individual participants and the freight system as a whole, the ability to reap the benefits of these developments depends upon how widely available the newly generated and newly collected data will be. The more visible the entire freight network and its assets, the more choice—as well as the more flexibility and cost savings—available to shippers and carriers.

ENSURING CARBON REDUCTIONS

Fuller trucks, improved routing, and greater use of rail and water modes mean fewer truck miles for a given shipment and therefore reduced carbon emissions. Better data and more ICT tools do not guarantee these outcomes, however; absent incentives to reduce carbon emissions, companies may use these tools exclusively to speed delivery or create new service options.

We can decrease truck miles and carbon emissions for any given shipment using

Fuller trucks

Improved routing

Greater use of rail and water modes

Greater availability of data and analytical tools not only expands the potential for growth but also facilitates the estimation and tracking of emissions, which can support policies to ensure that emissions reductions are a priority. On-demand estimates of the carbon footprint for each shipping option available for a given load would allow both shippers and receivers to use carbon emissions as a criterion for selecting the mode and carrier at the time of booking.

Case study: Data exchange as a tool for zero-carbon freight in Europe

The European Union (EU) has long regarded better integration of logistics in the region as key both to maintaining economic prosperity and to reaching greenhouse gas reduction goals. Data and ICT tools are central to the EU strategy to achieve that integration. In 2015 the EU established the Digital Transport and Logistics Forum (DLTF) to promote policy and technical coordination among EU states and freight stakeholders regarding the digitalization of transportation and logistics. DLTF and other groups worked to create a legal framework for using electronic freight transport information, and the European Parliament adopted that framework in July 2020.[3] The rules allow companies to submit proof of compliance with any EU freight documentation requirements electronically rather than in hard copy.

The DTLF then turned to demonstrating a "near real-time" freight data exchange and structure for interconnecting digital freight platforms through the European Federated Network of Information Exchange in Logistix (FENIX) project.[4] FENIX aims to provide freight and logistics service providers, infrastructure operators, cities, and public authorities with "a set of integrated services that exploit real-time Big Data streams for real-time awareness and visibility, delivered from the cloud as a service."[5] These data services will facilitate horizontal collaboration across service providers, optimized and dynamic freight routing and mode choice, and increased supply chain visibility.

Structurally, FENIX is a virtual network whose nodes are digital platforms that provide commercial freight data and/or services. FENIX provides the framework allowing secure data exchange and platform interoperability, with each platform retaining control over its data and with whom it is shared.

FENIX is working to demonstrate the framework's feasibility through 3-year pilot implementations, initiated in 2019, in 9 of the 10 major freight corridors in the Trans-European Transport Network (TEN-T) (see figure 1). Projects at the pilot sites will show the cost and GHG reductions from the multimodal and synchromodal transport operations,* intelligent freight hubs, and network optimization enabled by the FENIX framework.

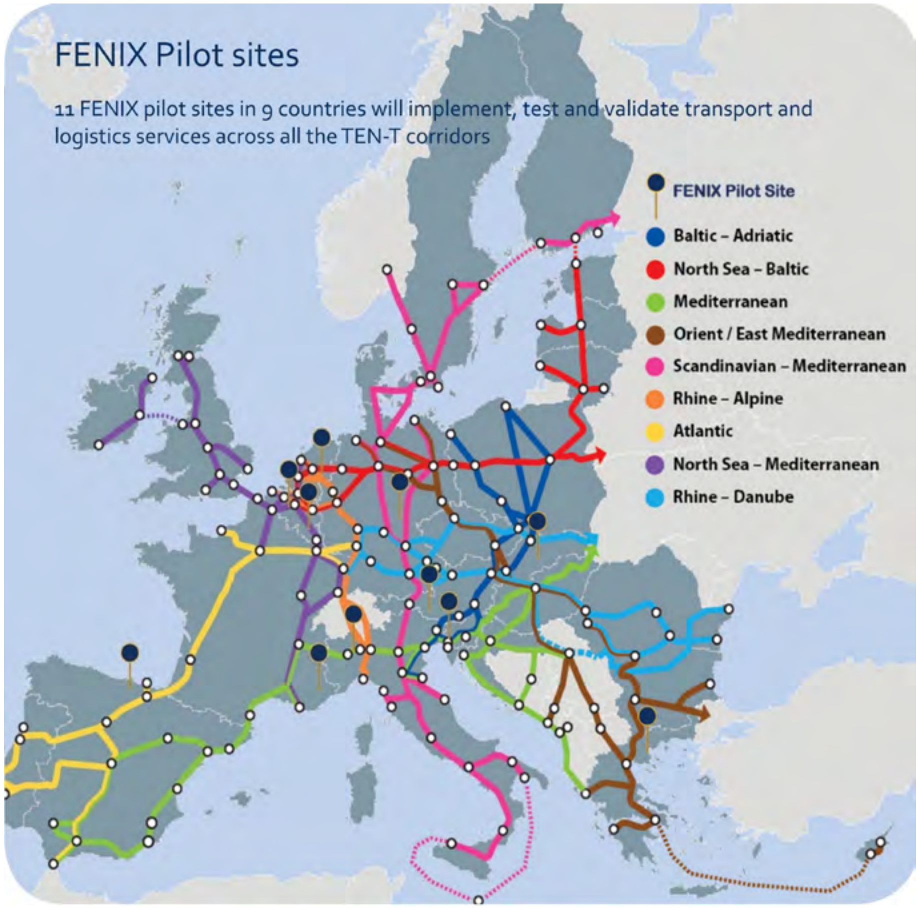

Figure 1. FENIX pilot sites in the Trans-European Transport Network (TEN-T). Source: FENIX Network.

* Synchromodal transport is transport achieved by assigning shipments to the multimodal network in real time.

Importance of collaboration

Freight transportation is a highly competitive industry with a complex array of stakeholders. Vertical integration—including close communication among shippers, logistics service providers, and distributors—is essential for successful freight transport. In contrast, horizontal collaboration among entities—often competitors—at the same level of the logistics chain is less common, and in fact, a service provider's success may depend on exclusive access to information. Yet with the emergence of Big Data and powerful tools for dynamic analysis, major new savings—both economic and environmental—are available only through a more collaborative approach.

Public sector role

Moving freight is largely a private sector function, but governmental entities are engaged in its planning and operations for a variety of reasons. Much of the infrastructure required for freight movement is publicly owned or funded, and the adequacy of that infrastructure is critical to regional and national economic health. Increasingly, essential freight infrastructure includes data systems.

The public role also includes evaluating and addressing the environmental, health, and safety impacts associated with the transportation system. Freight operations' adverse health impacts, which are concentrated in low-income communities and communities of color, are especially pronounced.[6] Resilience and security of critical supply chains are also priorities of the federal government,[7] a fact highlighted by the COVID pandemic. Addressing these issues depends on access to extensive data.

While many new tools and processes are emerging to improve freight efficiency, the benefits tend to accrue to companies that create or purchase the services provided by these technologies—typically larger and better-resourced shippers, carriers, and transportation logistics companies. In principle, broadly shared data can allow small and medium-sized enterprises (SMEs) to better compete with larger ones, but absent rules guiding data deployment, the opposite is likely to occur. Hence, the government's role includes promoting equitable data access for freight SMEs as well.

Freight digitalization requires a new level of sophistication in the collection, integration, dissemination, and use of freight data. The private sector, including tech companies, is well equipped to support the advance of digitalization, and the process is moving forward rapidly as a joint enterprise of the freight and tech sectors. Public sector engagement is also crucial, given the major issues of security, environmental protection, and fairness to SMEs.

Given the broad economic, environmental, and equity benefits of an efficiently operating freight system, public entities have an interest in expanding data sharing. Indeed, public sector engagement provides benefits for all involved. Government can serve as a neutral party in developing and deploying data protocols and a platform interoperability framework, and it typically has experience with convening the relevant stakeholders as well.

Public role in freight data exchange and utilization

- Serve as a neutral party in development of data protocols and platforms
- Ensure data security
- Protect small and medium-sized enterprises (SMEs)
- Advance public benefit

U.S. developments

In the United States, agencies' work in freight planning, assessment, and demonstrations requires good data and generates much valuable data as well. Examples include the U.S. Environmental Protection Agency (EPA) SmartWay program, the California Sustainable Freight Action Plan,[8] and a variety of programs at ports and metropolitan planning organizations across the country. Yet at present, there is no coordinated effort across governmental agencies concerned with freight movement to assemble the available data, establish standards to ensure data quality and compatibility, and investigate tools that could make the best use of this data to improve freight system efficiency and advance social and environmental objectives.

The U.S. Department of Transportation (DOT) has been the federal lead on developing Intelligent Transportation Systems (ITS) since the 1991 passage of the Intermodal Surface Transportation Efficiency Act (ISTEA). DOT maintains the National ITS Architecture providing a framework for ITS interoperability. Historically, ITS have focused on improving safety and the flow of vehicles, both personal and commercial. In terms of data science, technical specifications and protocols, and relevant frameworks and institutional issues, DOT's ITS experience would be valuable in establishing a freight data exchange as well. In fact, some ongoing projects have promoted freight data integration as well as improved truck capacity utilization and reduced emissions.[9] DOT's 10-year targets for applications of its Freight Advanced Traveler Information System (FRATIS) include a 15% reduction in empty trips, a 10% reduction in fuel consumption, and a 17% reduction in truck travel times. Further, a system pilot in Memphis achieved a 13% reduction in dray truck empty miles,[10] and a FRATIS application for container movement at the Ports of Los Angeles and Long Beach demonstrated a 35% drop in the average miles driven per order.[11] A successor project in Los Angeles involves some of the strategies on display in the EU's FENIX project, especially with respect to modal integration.[12]

The United States could benefit greatly from further strategic integration of public and private data to optimize freight movement. National Academies reports provide guidance, particularly on developing a freight data architecture (2010) and freight data exchange (2013).[13]

Challenges

Resistance to data exchange

Increasing freight data exchange and platform interoperability to improve freight system efficiency may encounter resistance arising from several factors:

- Contractual obligations to protect client data
- Concerns about the security of data exchange
- Concerns about the loss of competitive advantage from data that are not currently available to other companies
- Potential impact on existing private sector data collection efforts

These issues will require extensive, ongoing work to address them in ways that satisfy the community, and government agencies could be helpful here. The industry will need time to acquire confidence in any new data systems, and participation in any exchange of data should be voluntary, at least in the near term.

Perceived threat to the logistics industry

Providers of tools and services such as load-matching platforms that take advantage of the wealth of new freight data may resist efforts to facilitate more open access to that data. However, an open data exchange and a framework to promote platform interoperability would not supplant the private sector role of creating and operating those platforms. In fact, this data infrastructure should enhance the value of private platforms by greatly expanding the universe of trips, loads, and users that they can serve.

National benchmarks for freight efficiency and sustainability

The United States does not yet have targets for freight system efficiency or environmental performance, such as truck load factor, freight modal shares, or carbon emissions. Absent such targets, it may be difficult to gain sustained agency commitment and industry buy-in for developing systems and processes to drive advances in these areas.

Next steps and conclusions

This is a crucial moment for the federal government—with the support of the freight industry, states and cities, technology providers, and the research community—to establish the data and technology infrastructure needed to realize potential improvements in freight system efficiency and emissions reductions. DOT could spearhead this effort, beginning with these four steps:

1. Within or in parallel with the national ITS program plan, create a plan to develop a freight data architecture and data exchange that would optimize freight shipment movement by expanding the use of the multimodal freight system, collaborative shipping, and other efficiency strategies.
2. Establish a freight digitalization forum for members of the freight industry and other freight stakeholders to provide input to the national freight data architecture and data exchange and to participate in demonstration projects for these systems.
3. Consult with the U.S. Department of Energy on the Energy Efficient Mobility Systems program research to identify the most important opportunities to apply freight data sharing to save energy.
4. Consult with the EPA on using the Smartway program community and experience to guide the implementation and testing of a new data exchange.

Government can make key contributions to ensuring that the new wealth of freight data fulfills its promise to both improve efficiency and reduce freight movement impacts, but facilitating freight data sharing need not be a governmental function in perpetuity. If the societal costs of carbon emissions, local pollution, congestion, and other transportation impacts were better reflected in freight costs, a data sharing framework would have strong economic appeal and eventually could be hosted commercially. Some government oversight and regulation will likely be necessary on a long-term basis, however, to assure and protect system participants.

In terms of structure and technology, the future of dynamic freight data sharing is visible in emerging technologies such as blockchain, which has already found applications in logistics.[14] Indeed, the ultimate outcome of universal access to freight data and the ability to act upon it, if properly managed, is enticingly captured by the Physical Internet, a concept that has been championed by some logistics experts for more than a decade.

The Physical Internet is envisioned as an open global logistics system in which goods move in modular containers through shared transportation and distribution systems using universal data protocols.[15] It has been estimated to have the potential to increase freight sector efficiency by a factor of nearly three.

While it is regarded largely as an abstract notion in the United States, the Physical Internet is central to Europe's Zero Emissions Logistics 2050 Roadmap.[16]

ENDNOTES

[1] R. Granato, "The Rise of Digital Freight Matching and How It Works," SupplyChain247, July 25, 2019. www.supplychain247.com/article/the_rise_of_digital_freight_matching.

[2] ATA (American Trucking Associations), "Trucking Moved 11.84 Billion Tons of Freight in 2019" (2020). www.trucking.org/news-insights/trucking-moved-1184-billion-tons-freight-2019.

[3] EU (European Parliament and the Council of the European Union), "Regulation 2020/1056 of the European Parliament and of the Council of 15 July 2020 on Electronic Freight Transport Information," Official Journal of the European Union L 249/33 July 31, 2020. eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32020R1056&from=EN.

[4] FENIX (European Federated Network of Information eXchange in LogistiX) Network, "FENIX Network" (2019). fenix-network.eu/.

[5] Eusebiu Catana, FENIX: A European federated network of information exchange in future logistics (Presentation to the Virtual ITS European Congress 9-10 November 2020). https://fenix-network.eu/wp-content/uploads/2020/11/FENIX_ITS-Virtual-Congress-Nov2020.pdf.

[6] P. Allen, D. Lowell, L. Hellgren, J. Culkin, D. Seamonds, and G. Van Horn, Newark Community Impacts of Mobile Source Emissions: A Community-Based Participatory Research Analysis (Concord, MA: M.J. Bradley & Associates, 2020). www.njeja.org/wp-content/uploads/2021/04/NewarkCommunityImpacts_MJBA.pdf.

[7] The White House, "Securing America's Critical Supply Chains" (2021).www.whitehouse.gov/briefing-room/statements-releases/2021/02/24/fact-sheet-securing-americas-critical-supply-chains/.

[8] E. Brown, The California Sustainable Freight Action Plan (Office of the Governor of California, 2016). ww2.arb.ca.gov/sites/default/files/2019-10/CSFAP_FINAL_07272016.pdf.

[9] DOT (Department of Transportation), "Dynamic Mobility Applications Program: Freight Advanced Traveler Information System (FRATIS)" (Accessed September 2021). www.its.dot.gov/research_archives/dma/bundle/fratis_plan.htm.

[10] R. Butler, Using Freight Advanced Traveler Information Systems to Promote Urban Freight Mobility (Washington, DC: DOT, 2014). www.fhwa.dot.gov/planning/freight_planning/talking_freight/july_2014/talkingfreight07_16_14rb.pdf.

[11] G. Guiliano, Freight Efficiency Strategies: Information Technology (Davis: University of California, Davis National Center for Sustainable Transportation, 2016). escholarship.org/uc/item/8ng5j9wj.

[12] K. Cartwright, Port of Los Angeles Intelligent Transportations Systems (Alexandria, VA: AAPA (American Associaion of Port Authorities), 2019). www.aapa-ports.org/files/PDFs/ITS POLA 4.24.2019.pdf

[13] C. Quiroga, N. Koncz, E. Kraus, J. Villa, J. Warner, Y. Li, D. Winterich, T. Trego, J. Short, and E. Ogard, Guidance for Developing a Freight Transportation Data Architecture (Washington, DC: The National Academies Press, 2010). doi.org/10.17226/14466; National Academies of Sciences, Engineering, and Medicine, Freight Data Sharing Guidebook (Washington, DC: The National Academies Press, 2013). doi.org/10.17226/22569.

[14] R. Tan, Naviporta Propels Seamless Global Trade (Rotterdam: Naviporta, 2021). www.etp-logistics.eu/wp-content/uploads/2021/04/BLOCKC1.pdf.

[15] B. Montreuil, Physical Internet Manifesto, Version 1.11.1 (2012).

[16] ALICE (Alliance for Logistics Innovation through Collaboration in Europe), Roadmap to the Physical Internet (Brussels: ALICE, 2020). www.etp-logistics.eu/alice-physical-internet-roadmap-released/.