Much of the improvements in transportation and logistics since the onset of containerization have involved physical infrastructures. Transport and logistics flows were occurring at a velocity slow enough that much of the inefficiencies related to transactions and compliance (e.g. customs) were not particularly apparent. The growth and diffusion of containerization and larger containerships, coupled with a global network of container terminals, were all drivers that increased the modal and particularly the intermodal velocity of freight. Coupled with trade liberalization and facilitation, significant additional demands for shipping and logistics occurred, placing transactional and managerial pressures. It thus became apparent that the transactional dimension of freight distribution was taking a higher toll on its velocity in relation to the physical dimension.

With digitalization, the industry is moving towards a great freight synchronization, where the physical and transactional velocities are better matched. This synchronization is not planned but represents a convergence of interests based upon new technologies being available and their opportunistic applications to segments of the transport system.

**THE FOUR DIMENSIONS OF DIGITALIZATION**

The digitalization of freight and its transactional and physical synchronism takes four major forms (Figure 1) these are:

1. The goods being carried can be equipped with various tracking and reporting devices. This can range from a simple bar of QR code that can be scanned, to RFID tags that can be queried all the way to an array of sensors that can provide real time information about location (GPS) and conditions (e.g. temperature, humidity). This revolution is particularly relevant for the container, which is a unit that needs to be monitored along complex intermodal transport chains.

2. Conveyances are transportation modes subject to digitalization. Vehicles such as trucks, delivery vans, trains and ships are also equipped with sensors reporting a wide array of attributes related to their operations (location, speed, engine condition). Routing and navigation are notable forms of
digitalization as they enable much improved operations considering existing constraints such as congestion and the availability of a slot at a terminal. The next and much more complex step in digitalization involves vehicle automation.

3. Infrastructure include the physical support of transportation activities such as roadways, terminals and distribution centers. They can be equipped with sensors to monitor their use and condition, which allows for more effective traffic management systems to optimize their scarce capacity. Terminal automation, such as for ports and distribution centers, is an ongoing digitalization paradigm.

4. Business processes support the transaction rich environment related to freight distribution. Many internal business processes have been digitalized (e.g. inventory management), leading to productivity improvements along a supply chain. The fast growth of the amount of data handled lend to the setting of electronic data exchange protocols, within the branches of corporate entities, but the requirements to more efficiently convey information between the actors involved led to more open standards such as EDI. Blockchains are an evolution of this concept by enabling the setting of digital ledger systems.

TERMINAL AUTOMATION: SLOW AND STEADY
Terminal automation is likely to be one of the most consequential but least visible form of digitalization. It is a key driver since terminals are a crucial node in global shipping and logistics. Terminal automation roughly accounts for 9% of the world’s container terminals and the growth rate is slow but consistent. Although the rate of automation for container terminals appears low, there is wide array of dimensions to which it can be applied. Yard management systems have for long be the low hanging fruit of terminal automation, particularly over stowage and yard planning. Further developments involve automated gates, yard cranes, horizontal transport and eventually quay cranes. Distribution centers are symbolically a transport terminal as well and their automation has been ongoing, particularly considering e-commerce. It mostly involves automating the storage and retrieval of items in large distribution centers and has evolved to include the assembly and packaging of orders of various sizes, from a store requiring a customized truckload to a single item purchased online by an individual.

The slow and steady rate of terminal automation continues and is becoming a crucial element of the great freight synchronization as entities linked to the terminal are adopting their own digitalization strategies.

VEHICLE AUTOMATION: ON THE CUSP OF A PARADIGM SHIFT
Freight vehicle automation is reaching a paradigm shift. Automated horizontal transport is already part of several container yards in the form of automated guided vehicles, including straddle carriers. This form of vehicle automation will obviously continue since the technology is proven. Ongoing developments in automated trucks are reaching a point where there is a move from experimentation towards its first commercial implementations. Haulage between terminals and distribution centers is the most salient application of road vehicle automation. Deliveries between stable origins and destinations along well-defined road corridors offers significant opportunities. In later stages, automated delivery vehicles to stores and homes could be implemented but the last mile is a ‘liability rich’ environment and prone to high risks such as accidents. Drones also have a niche role to fulfill, but are likely to remain marginal.

BLOCKCHAIN: CONVERGENCE TOWARDS ONE STANDARD
Processing and managing international trade documents can account for up to 20% of the transportation costs and one third of the transport time, such as waiting for documentation. Shareable electronic ledgers, known as Blockchains, are particularly relevant to shipping

Figure 1 Forms of Digitalization in Freight Transportation
and logistics since they share many similarities. Supply chains are transaction intensive entities where multiple actors and stakeholders are interacting where each physical flow is related to supporting information flows.

The risk is to see the emergence of several competing blockchain platforms, leading to duplications. An analogy can be drawn with containerization which was developed around a standard that was available to all stakeholders. Recent developments are, however, positive since Maersk was able to push towards its TradeLens platform, jointly developed with IBM. When (in spring 2019) CMA CGM and MSC announced that they were joining the Blockchain platform, this meant that about 50% of the world’s container shipping capacity is committed to this standard.

Other actors along the supply chain are likely to follow. A critical mass has therefore been reached and that matter is now one of implementation and testing.

DIGITAL FREIGHT PLATFORMS: FREIGHT TO BE UBERIZED?

Online commercial brokerage platforms are an emerging opportunity for the freight sector by enabling providers of freight transport services such as shipping lines or trucking companies to auction services or bid for an offered transport demand. Supply is therefore better synchronized with demand. In 2019, the giant e-commerce retailer Amazon started a digital freight brokerage platform for trucking, which was able to reduce spot market prices by at least 25%.

It remains to be seen about which segments of the shipping market can be made available on such platforms since it impacts a pricing power based on asymmetrical access to information. In maritime shipping where there is an enduring overcapacity, freight platforms can result in better asset utilization (more bookings) but soften the pricing power. They are thus positive for the demander of freight services but much less so for the providers of such services.

ARE WE FINALLY BEYOND THE HYPE?

It is not surprising to see wide variations in the digitalization of the industry considering its heterogeneity of terms of ownership, regulation, capital intensiveness, lifecycles of infrastructures and conveyances. The same digitalization technology can have different outcomes across shipping segments. The momentum that digitalization is assuming indicates that we may be beyond the hype phase and that true implementations are emerging. At some point, the great freight synchronization will be played out, implying that transactional and physical velocities will match. In such a context, supply chains will be managed based upon risk assessment and the willingness to maintain inventory and transport capabilities to face uncertainties.

ABOUT THE AUTHOR

Dr Jean-Paul Rodrigue is a Professor at Hofstra University, New York. His research interests mainly cover the fields of transportation and economics as they relate to logistics and global freight distribution. Specific topics over which he has published extensively cover maritime transport systems and logistics, global supply chains, gateways and transport corridors.

ABOUT THE ORGANIZATION

PortEconomics is a web-based initiative aiming at generating and disseminating knowledge about seaports. It is developed and empowered by the members of the PortEconomics group, who are actively involved in academic and contract research in port economics, management, and policy. Since October 2012, Port Technology International and PortEconomics have been engaged in a partnership. www.porteconomics.eu.

ENQUIRIES

Dr Jean-Paul Rodrigue
Dept. of Global Studies & Geography-Hofstra University
Hempstead, New York, United States
jean-paul.rodrigue@hofstra.edu