Logistics inspired by digital platforms: Towards a physical internet of merchandise

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Abstract:
At the end of the 1990s, e-commerce emerged out of networks of individuals and merchandise. This transformation of the retail trade modified flows of information and freight by extending supply chains to end customers in urban areas, which were neither designed nor organized to handle this change of logistics. This increase in traffic has marred urban areas by worsening congestion, pollution and greenhouse gas emissions. This organization is hardly tenable, and the logistics of freight must be redesigned. For this purpose, the idea of organizing the flow of merchandise by drawing from the ideas of packet-switching on the Internet opens a new perspective for handling economic and environmental problems and seeing to the sustainability of this new form of commerce. Logistic platforms would thus be "smart hubs" capable of processing flows of merchandise, independently of senders and receivers, so as to become a link in a physical internet, which alone will be capable of optimizing the flow of merchandise.

At the end of the 1990s, the networking of people and merchandise gave birth to a new form of business: e-commerce. This change not only modified flows of information and goods but also stretched supply chains out to end-customers in urban areas, which were neither designed nor organized to handle these flows. Since then, as these interconnected flows have swollen, the negative effects of increased traffic congestion, pollution and greenhouse gas emissions are being felt in urban areas. This hardly sustainable organization draws our attention to the need to redesign freight logistics. For this purpose, the idea of organizing freight flows by drawing on packet-switching (as used by the Internet) opens a new approach for addressing economic and environmental issues and seeing to the sustainability of this new form of commerce. If this approach is adopted, logistic platforms would become "smart hubs" capable of handling flows of merchandise independently of the senders and receivers. They would become links in a physical internet with the capacity for pooling and optimizing flows of physical goods.[1]

[1] This article has been translated from French by Noal Mellott (Omaha Beach, France). The translation into English has, with the editor's approval, completed a few bibliographical references. All websites have been consulted in October 2019.

Online commerce: Overhauling freight flows

The development of electronic commerce has pushed retailers, whether new online platforms or the historical players, to deliver goods to end-consumers at their place of residence or work. This new form of commerce has deeply modified logistics by forcing retailers to propose not just to put products up for sale but to deliver them to the point of consumption (and not just the point of sale). Retailers have thus been forced to offer delivery services. This extension of the supply chain is often described as the problem of the "last mile" of delivery.

Modern retail businesses moved farther out of downtown areas to reap the benefits of lower real estate costs and bigger floor spaces. As a counterpart for this access to merchandise at low prices, retailers passed the cost of last-mile delivery onto consumers — not just the monetary cost but also the opportunity cost (often measured in time). By introducing home delivery, e-commerce has upended this system for charging the cost of the last mile. This cost now falls on retailers. Apart from the question of how this delivery cost is charged, the organization of last-mile deliveries turns out to be different from what is needed for store deliveries. For home deliveries, several orders, most of them of one product, have to be delivered at several points, whereas deliveries used to be grouped and made to a few points of sale. Optimizing delivery rounds thus turns out to be a key economic variable for limiting the cost per unit delivered.

Furthermore, given uncertainty about whether the client will be present at the time of delivery, the rate of packages on hold is often high. These pending deliveries increase costs. The delivery of packages to pick-up points or automated "packstations" has proven feasible.

The organization of logistics has thus become a strategic issue in e-commerce since it conditions both customer satisfaction and a business's profit-earning capacity. Reorganizing logistics in order to deliver customers as soon as possible yields a competitive advantage. Intense competition between historical retail businesses and newcomers has sprung up around this question of time and timing. The historical players have adjusted their point-of-sale logistics to the new situation by offering pick-up delivery in stores and returns of products ordered on line. In this case, the point of sale becomes the logistics center for last-mile delivery. Using the store as a pick-up point for what has been ordered on line considerably alleviates the requirement that products have to be instantly available, and this tends to give an advantage to brick-and-mortar retailers. Meanwhile, online newcomers have considerably improved their logistics and are proposing the same-day delivery (or even within one or two hours) of a growing range of products.

Last-mile logistics has thus become the battlefield of competition. Logistics platforms with "short distribution channels" are necessary for rapid delivery service in urban areas. This strategy requires substantial investments and entails a shift in the way of looking at this problem. In their attempt to compete with the big e-commerce websites, historical retailers in France are licensing from Ocada, an English "pure player", the technology for managing warehouses and filling orders. Ocado built an automated infrastructure in Great Britain for delivering groceries ordered on line, thus competing directly with Amazon.

Far from being restricted to merchandise alone, businesses with last-mile services have extended into other fields, such as the home delivery of meals, a sector where specialized companies have sprung up worldwide (UberEats, JustEat, Deliveroo). Thanks to digital technology for aggregating and organizing the demand for local produce, short distribution channels can be set up for delivering food products from local sources in dense urban areas, as La Ruche Qui Dit Oui! has demonstrated (APUR 2018).

Negative externalities in this new situation

Centered around control over the logistics of last-mile delivery, this fierce competition for urban markets has an impact there where it is being played out.

Initial studies of the effects of e-commerce suggested that it reduced road traffic, but it has now been ascertained that this is not so. The hypotheses made about the loads on delivery trucks were not very realistic, since, in fact, the trucks were seldom full but often empty. Furthermore, the models used in these studies overlooked the reverse flow of products returned by dissatisfied customers. For some categories, such as ready-to-wear clothing, returns are frequent, and this negatively affects traffic and congestion. According to the National Retail Federation, 8% of online orders in the United States were returned in 2016. This rate averages about 20% in France. In 2015, 25% of French respondents stated that they had returned a product ordered on line, as compared with 41% in Germany. These return flows increase greenhouse gas emissions and deteriorate environmental conditions in urban areas. Switching to electric delivery vehicles would partly reduce these negative externalities (greenhouse gas emissions).

Urban congestion is made even worse by the traffic flows generated by the online platforms that propose vehicles for hire. As several studies have shown, the ceaseless circulation of the drivers of these vehicles, far from reducing traffic, increases it and worsens congestion (ERHARDT *et al*. 2019). Between 2010 and 2016 for example, Uber and Lyft were responsible for 60% of the increase in congestion in San Francisco (SCHALLER 2018).

Congested cities are trying to organize freight traffic to limit its environmental and societal impact. To control and organize freight flows more efficiently, they are installing urban distribution centers, where packages are pooled before being delivered in organized rounds in the urban area, thus reducing the number of vehicles entering the city and circulating on the streets. Located a few kilometers from the downtown area, these urban distribution centers are platforms that pool packages and then ventilate them for delivery. Their primary objective is to manage flows of merchandise to dense urban zones. In addition to these centers, there might be small centers of vicinity logistics. With reserved lanes for delivery vehicles, these small centers monitor operations and offer services for, in particular, subcontracting the last few yards of delivery to modes of transport with a low environmental impact. These vicinity centers, even if they are not obliged to do so, positively affect the logistics of their business partners by improving delivery services in dense urban zones. To optimize delivery rounds, depositories or boxes might be installed at street level or in a building for the temporary storage of merchandise.

These urban logistics centers should be developed to help optimize traffic in urban areas. However pooling seems insufficient and is too financially complicated to handle the heavy freight traffic generated by e-commerce (GONZALEZ-FELIU 2013). Besides, few cities are adopting such solutions.

So, a radically different approach is needed, one that reconsiders all flows of merchandise. Inspiration for redesigning freight traffic can be drawn from the Internet and its protocols for routing the traffic of network packets.

A sustainable logistics for e-commerce: A physical internet of merchandise

Given the many inefficiencies in freight logistics, ever more stakeholders are wanting to globally redesign supply chains by using the concepts and protocols that the Internet has rolled out on so many devices and networks. For those who advocate this approach, logistics should shift paradigms as telecommunications did when it moved from circuit- to packet-switching. This shift would solve the problems of urban congestion resulting from e-commerce deliveries and reduce the negative effects (pollution, noise) by pooling all merchandise in an interoperable network of hubs running on a principle similar to the Internet protocol.

Since its invention, the Internet protocol (IP) has been deployed on different sorts of networks thanks to the encapsulation of the contents to be conveyed. This could also be done with merchandise. Instead of directly managing merchandise, the containers would be managed via a physical internet. In other words, various hubs would handle standardized containers just like a router handles e-mail (To dispatch the message to its destination, only the header is read).

A preliminary to this sort of organization in logistics is to standardize messages. GS1 has already proposed a standard for pooling tracking information and sharing event data (EPCIS).[2] Container formats, too, must be standardized, as was done for containers and pallets in Europe. Containers answering to the same standard would carry radio-frequency identification (RFID) chips for tracking them all along the supply chain.

Logistics platforms, the actual routers of freight, would dispatch merchandise by end destination while optimizing truck loads so as to reduce the number of vehicles and freight-related traffic. A “clearing house” will be needed to manage an organization of this sort. It would follow rules similar to those for peer-to-peer operations on the Internet so that the various parties in the supply chain are paid.

In line with this conception of traffic flows, the pooling of different logistics networks and delivery points (depositories, lockers) would optimize the number both of vehicles running and of rounds in downtown areas, thus reducing traffic and greenhouse gas emissions. In France, the first installation of this sort has proven efficient: CO_2 emissions fell 10%, the truck load coefficient rose 15%, and the cost of transportation dropped 7%.[3] As climate-related issues take on more importance, public policies must urgently follow up on, and facilitate, the deployment of these solutions, especially in metropolitan areas, so that e-commerce no longer saturate urban traffic. This solution calls for redesigning traffic management by drawing on the principles underlying these services, namely the Internet.

[2] https://www.gs1.org/standards/epcis

[3] https://www.youtube.com/watch?v=nsu6S8KB2OA

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