Chapter 3
Logistics Developments Impacting Horizontal Collaboration

In the previous chapter we have introduced four major trends that are observed in virtually all countries and industries. In this section we zoom in on recent developments specifically within the logistics industry that impact the formation and success of horizontal collaborative initiatives. The holistic supply chain point of view we take in this report implies that we also investigate how logistics processes are (or perhaps should) be impacted by urbanization, security concerns, automation, the sharing economy, etc. And we will study how these developments impact logistics collaboration.

A valuable resource when discussing recent developments in logistics is the latest DHL trend radar report (2019). Figure 3.1 summarizes the main trends observed, categorized by the time they are expected to become relevant to the wide logistics industry and their expected impact.

In the next subsections, we discuss some of these trends of which we believe that they are of special importance to the development of 4Cs, as well as a few developments that are not represented in the figure. In any case, it is clear from the picture that logistics is a dynamic field where a lot will change even in the next 5 years already. The topics that we will discuss next are: (1) Standardization, (2) Labor market developments, (3) Urbanization and City Logistics, (4) Security, (5) E-commerce, (6) Autonomous vehicles, (7) Physical Internet, (8) Logistics Marketplaces, and (9) The Sharing Economy.

3.1 Standardization

One impediment to horizontal collaboration at large or for 4Cs in particular is that it is very difficult to combine goods from various industries into the same vehicle, vessel, or train, because of specific characteristics of the products and the load

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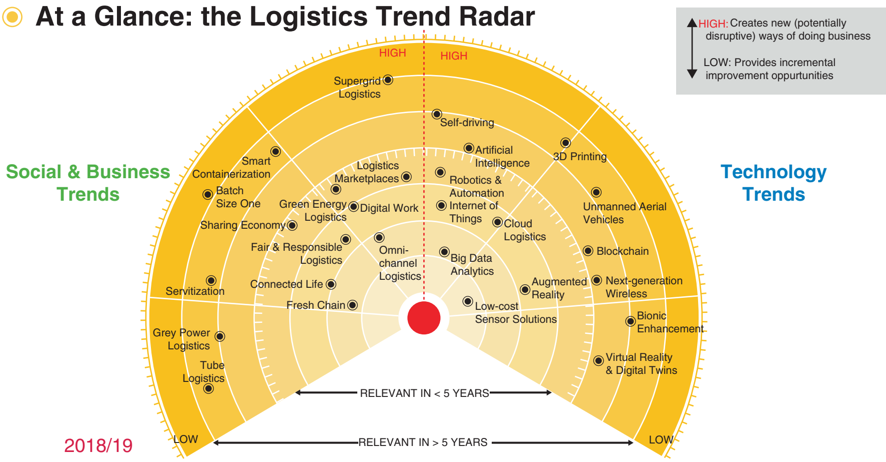

Fig. 3.1 DHL logistics trend radar (2019)

carriers used (see Sect. 7.1). Whereas this issue is mostly solved for collaboration within specific industry sectors (ref. ISO pallets, (refrigerated) containers, etc.), absence of logistics standardization is still a large hurdle for collaboration across industries.

DHL Trend Research (2019) mentions smart containerization as an important upcoming innovation. They argue that the adoption of the standard container revolutionized global cargo shipping, bringing vast improvements in efficiency and ease of trade. However, the growing need for flexibility and increasing time and cost pressures will require new container formats and processes, especially in the context of shared logistics networks and urban delivery. New packaging formats are also essential to handle the rise of single shipment volumes from e-commerce.

The EU funded project Modulushka focused on the development of standardized containers and boxes to enable freight bundling and horizontal collaboration. The goal of the project was to develop iso-modular logistics units of sizes adequate for intermodal and co-modal flows of fast-moving consumer goods (FMCG), providing a basis for an interconnected and orchestrated logistics system for 2030.

Another aspect that hinders the regular exchange of shipments either via a control tower is brand-related: companies with a strong brand image often have difficulties with giving up their brand visibility on trucks. This could hopefully be resolved by multiple or projected logo's on shared trucks, accompanied by logos of neutral certification entities like Smartway in the USA, EcoStars in the UK, or the Dutch Lean and Green program.

3.2 Labor Market

A recent report by Eurostat (2019) concluded that European road transport firms will soon be facing a driver shortage of 150,000 unfilled jobs. In only six countries (the UK, Germany, France, Denmark, Sweden, and Norway) the shortage of drivers adds up to 127,500. The UK has the highest shortage (52,000 drivers) but is closely followed by Germany at 45,000 vacancies. In Germany, the DSLV transport union reports that in the next 15 years, two-thirds of drivers will retire.

This alarming situation can, ceteris paribus, only be solved by automation (see Sect. 3.6 on autonomous vehicles) or by dramatic efficiency increases in transport. When widely adopted, horizontal collaboration is an innovation that can establish this efficiency increase.

3.3 Urbanization and City Logistics

Globally, urban areas are growing and the fraction of the global population in rural areas is shrinking. Large cities are becoming very densely populated, and the associated congestion is escalating. Since 2007 more than half of the world's population lives in urbanized regions, in several western countries this percentage is already well above 70%.

At the same time, e-commerce is growing quickly especially in these cities and consumers expect shorter and shorter delivery times. This places considerable importance on the design of smart, sustainable, and secure supply chains into the cities, and it increases the need for advanced and innovative technologies to plan and execute logistics, with a high level of collaboration and automation. We will come back to this when discussing the Physical Internet in Sect. 3.7. As Ferrell et al. (2019) state: the current paradigm of accepting inefficiencies to avoid collaboration with competitors for freight movement is a luxury that will no longer be workable. Concepts of 4C and horizontal collaboration can be expected to evolve from a nicety to a necessity in urban areas first.

In their recent report the World Economic Forum (WEF 2020) states that there has never been a time of greater change for the "last mile" than today. Consumers order more things online, expecting more control and faster deliveries. Disruptive technologies such as droids and drones are shaking up entire delivery chains. Emerging tech players such as Uber Freight and Postmates are changing the dynamics of the competitive landscape. However, these developments have a downside: Inner cities are struggling with traffic congestion and air pollution due to the increasing number of delivery vehicles, their emissions, and second-lane parking. Some cities predict that if no interventions are made, inner-city traffic will be seriously disturbed in the next three years.

Femke Halsema, Mayor of Amsterdam
"The city of Amsterdam is expected to have 1 million citizens in 2032, a growth of 20% compared to today. The number of jobs is expected to grow by 30% until 2040. The additional volume of traffic will lead to severe bottlenecks on the road and in public transport. Especially urban deliveries – mostly linked to the soaring e-commerce growth rates recently – cause structural problems to the city of Amsterdam. Currently, one in eight vehicles in the inner city is a truck or a van. Many old bridges and quays are not designed for the heavy loads and intensive use these days. Also, delivery vans cause gridlock, as these vehicles park on the street or in busy inner-city areas. Also, they present a safety risk to our many bike users and pedestrians. To combat this development and achieve our decarbonization targets, we have put a plan in place according to which the inner city will be free of fossil-fueled trucks and vans by 2025, causing a 77% reduction in NO2, and a 42% reduction in CO_2 from all of the traffic in the city, including passenger cars."

Figure 3.2 from WEF (2020) provides an overview of the most prominent city logistics measures that can be taken. Especially the interventions of multi-brand parcel shops, load pooling, and Urban Consolidation Centers (UCC) require intense collaboration, even with competitors.

Muñoz-Villamizar et al. (2017) assess the implementation of an electric fleet of vehicles in collaborative urban distribution of goods, in order to reduce environmental impacts while maintaining the usual service level. They test their approach in a real-life setting in the city of Bogotá, Colombia.

Finally, Cleophas et al. (2019) discuss the important role of horizontal collaboration and supply coordination in urban logistics. In their work, they collect and discuss contributions to collaborative freight transport in urban areas from recent publications (i.e., those published during the past ten years). They particularly analyze vertical and horizontal approaches of collaboration from an operations research perspective and point out strategic, tactical, and operational planning problems and solution approaches. To highlight research gaps and future research opportunities, they present innovative examples of collaborative urban transport and analyze factors of failure and success.

3.4 Security

With the digitization of transport logistics comes increased (digital) vulnerability. For example, many incidents in Europe emphasize how freight systems can be manipulated, data hijacked by ransomware, or information stolen. Cyberattacks

Fig. 3.2 Overview of 24 prioritized last-mile interventions (WEF 2020)

threaten the availability and validity of data and can seriously harm a supply chain. Current transport management systems and some onboard technology were not designed with security as a primary factor. The ability to use sensors that indicate the occurrence of security events during transport would be invaluable for risk awareness. After all, cargo on the move is much more vulnerable to theft than goods stored in a warehouse. Indeed, most cargo theft (85%) involves trucks, and those thefts cost businesses more than $10 billion annually worldwide (Ferrell et al. 2019).

The digital threat to transport logistics cannot be solved by one company or one solution. The transport system is a complex network and nowhere is this more true than in a collaborative logistics setting, where every link in the network contributes to the risk or the security of the system. After all, a collaborative network logically includes more actors and more information sharing than traditional singular supply chains. Clearly, efforts aimed at increasing the prevalence of collaborative arrangements are likely to increase this risk, see, for example, our discussion on the legal framework for collaboration in Sect. 5.7. It is fair to say that networked models such as 4Cs are as strong as their weakest link. The demand for constant online communication creates opportunities for hackers to exploit weak security practices on the account of a single actor in a network. Moreover, while a cyberattack aimed at stealing employee or customer data remains the most talked-about risk, attacks designed to deny or disrupt service are also gaining popularity. These attacks can seriously jeopardize production and delivery schedules and cause delays that can have rippling impacts on customers and their customers' customers (Ferrell et al. 2019). Security therefore is a topic that must be paid special attention to when designing a 4C.

3.5 E-Commerce

A further important logistics development that has already been touched upon in the previous sections is the rapid rise of e-commerce, and the resulting pressure on logistics systems. Supply chains need to take the development of e-commerce opportunities into account, but at the same time (and perhaps even more strongly) e-commerce itself will also influence the logistics networks that perform the physical activities related to e-commerce. This challenge is felt more and more, not only in logistics operations, but also on the side of government regulation. The large e-tailers become bigger and bigger and their influence on both supply chains and cities is also growing rapidly. In a recent interview by Link2Logistics Alex van Breedam in a recent interview warns for this development, which he calls *Amazonization.* The few gigantic e-tailers will take their logistics execution more and more in their own hands and before long they might have the scale to implement their own Physical Internet, but based on their own terms and their own commercial logic (see Sect. 3.7 on the Physical Internet).

Amazon has a clear strategy to vertically integrate logistics activities into their own company. For example, they have an airplane fleet that is planned to reach 70 own airplanes already in 2021, while their airline was only started in 2016. In one year, Amazon ordered 20,000 big Mercedes delivery vans, 2000 special vans at Spartan, and no less than 100,000 electric vans at Rivian. Within a few years it is expected that Amazon will own more delivery vans than UPS or FedEx. In addition, Amazon also started its own ocean shipping line, long haul transport company, and a freight brokerage firm (see Fig. 3.3). Overall, Rakuten Intelligence estimates that Amazon now ships about 50% of their parcels without using any external LSP. In 2017, this percentage was only 15%. Amazon denies these figures, but its strategy to take over control of the entire journey of their parcels to the final customers is clear.

Fig. 3.3 Amazon as logistics executor

Amazonization in a way is an alternative for collaborative logistics and 4Cs: bundling of flows and efficiency of transport is reached by the sheer size of a dominant company. Although this might be beneficial for some macro logistics KPIs, this comes with several threats. First, one single commercial entity will control transport, see buying behavior and own loads of consumer data. This renders this company enormously powerful and difficult to regulate for governments. The fragmented transport industry may gradually develop into an oligopoly or in the end a monopoly which is not in the best interest of consumers. It also makes it impossible for SME transport entrepreneurs to compete against the dominant player. Under a 4C concept these disadvantages are not there, but as experience shows collaboration in tough to organize quickly. And if it takes too long, the likes of Amazon may have gained a deciding advantage.

3.6 Autonomous Vehicles and Platooning

The development of autonomous vehicles is progressing rapidly, also with an increasing focus on commercial transport vehicles. Amazon is a leading player here as well. While these autonomous vehicles could be used to replace trucks in existing systems and networks, and managed and controlled in traditional ways, Ferrell et al. (2019) argue that they also present novel opportunities to strengthen logistics collaboration. The availability of vehicle-to-vehicle communications offers information to transport planners that will enable them to better predict traffic conditions and arrival times, and provide opportunities for resource synchronization, thus making control tower concepts with fewer human planners per operated truck more viable.

Autonomous vehicles will likely be operated for longer periods of time, will be routed and re-routed more effectively and dynamically, and will be cheaper to operate. For example, there is no need anymore to return to the home base of the driver on a regular basis. In principle, the truck could embark on an endless pickup and delivery journey until it needs maintenance. This brings an interesting research opportunity for researchers as it changes the classical vehicle routing problem where typically a truck must return to its depot at some point in time.

All these characteristics have the potential to enable collaboration through 4Cs, and indeed they may help to address some of the potential roadblocks and challenges inhibiting horizontal collaboration in some settings. TNO (2020a), however, warns that autonomous vehicles still have quite some hurdles to take before they will be allowed on the road. One obvious consideration is the interaction with vulnerable road users such as pedestrians and cyclists. But also, it is still unclear how the vehicles will and should cope with incomplete information such as reduced sight because of other (moving) objects around them (Fig. 3.4).

A promising semi-autonomous arrangement is the concept of platooning, small convoys of trucks that drive automatically. One or two trucks follow the actions of the first driver at 0.3 seconds from the vehicle ahead: accelerating, steering, braking. These actions are automated using vehicle mounted sensors, such as radar, sonar,

Fig. 3.4 Volvo's electric autonomous vehicle Vera. Note: Together with Vera Volvo also develops a system design for collaborative networks of autonomous vehicles that shows some similarities with the 4C concept

and cameras. The advantages of platooning are fuel savings, lower CO_2 emissions, improved road safety, and better traffic flow. Janssen et al. (2015) expect that in a few years' time, market introduction will be possible.

3.7 Physical Internet

One of the recently proposed logistics innovations is the concept of the Physical Internet. This was first introduced in a book by Ballot et al. (2012). The Physical Internet (PI) works based on horizontal collaboration and consolidation. It is called the Physical Internet because of its similarities with the Digital Internet. In the Digital Internet, providers are only responsible for links between servers, instead of the whole routes. PI applies this idea to physical flows. A supplier is connected to the PI, sends its freight to the network, and the PI will get it to its destination. This is quite different from the current situation, where usually each firm has its own (customized) supply chain network, whether it is inhouse or subcontracted to an LSP.

The PI network consists of open warehouses and/or open cross-docking hubs (so-called PI-hubs). In principle, these are available for every LSP and every type of shipment. Open warehouses have the capacity to store goods, while at cross-docking hubs this space is limited. The latter will mainly be used as transit points where goods will be only be stored temporarily (usually a couple of hours). An important aspect of the PI is standardization. As it should be able to transport and cross-dock all kinds of goods, these should be packed in a standardized manner so that they can be transported together. Some effort has already been done to come up with designs of these modular packages, the so-called π-containers. Open warehouses and PI-hubs do not widely exist yet, but several papers study possible designs for these terminals, e.g. Ballot et al. (2012), Meller et al. (2012), Montreuil and Thivierge (2013).

Several simulation studies have been carried out to investigate the potential benefits of the Physical Internet. Hakimi et al. (2012) show a significant decrease in the total distance driven. Another study, by Sarraj et al. (2014), finds a reduction in total costs (5–30%), lower CO_2-emissions (13–58%), and a higher weight fill rate (from 59% up to 65–76%), depending on the different scenarios and designs of the network. Furtado et al. (2013) also show social benefits, as truck drivers, for example, spend more nights at home under a PI transport model. As more intermediate cross docks will be used in the PI, drivers will commonly shuttle between two hubs instead of driving the whole route.

Since the presentation of the PI concept by Montreuil et al. (2012), the European Union has embraced it as the central vision for future supply chains towards 2050. Concerning 4C, ALICE (2015) states that the PI represents the technological and informational basis for future coordination and collaboration in supply chains. ALICE proposed a road map to arrive at the PI towards 2030, with an ambitioned large-scale adoption in 2040. This road map is shown in Fig. 3.5.

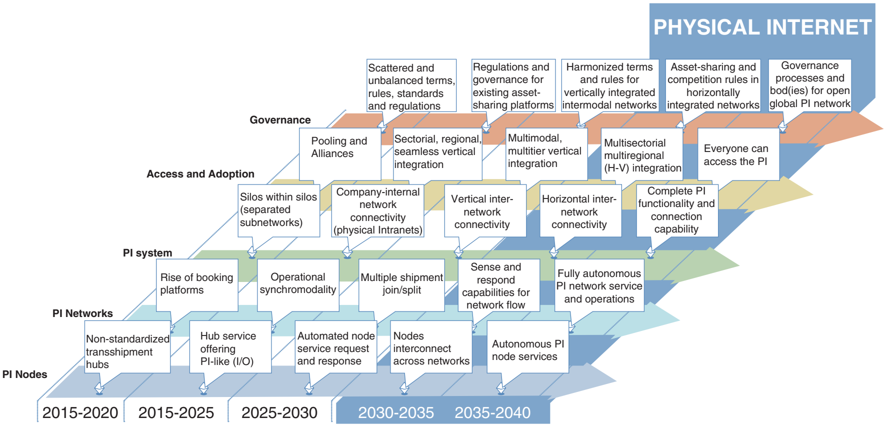

Fig. 3.5 ALICE PI roadmap 2015–2050

As the roadmap shows, the PI will not materialize overnight. Various steps need to be taken to move into the direction of the PI in one form or another in the future, one of which is intensified collaboration. Although the PI is one network, it is not envisaged that there will be only one operator. Multiple operators will exist next to each other, each responsible for a piece of the network. Here the analogy to the Digital Internet also comes into play, as these operators will have a similar role to that of Internet service providers.

According to ALICE (2015) the two most important strategic drivers towards the PI are:

- Increasing the service level to the consumer of products and services in the most efficient and sustainable way.
- Lowering the barriers to enter new geographical markets and for consumers to have access to new products.

Full realization of the PI concept means that logistics assets and services cease to be a differentiator, as they will be fully standardized, integrated, and shared on a global level. In other words, supply networks will become a commodity that is available to any sender and receiver. In a fully developed PI, competition will be no longer based on owned and individually optimized supply chains. Instead, higher-level logistic functions, such as network planning, after-sales services, and advanced stock allocation, will drive the competition among supply chain leaders.

PI is still a concept, not a reality. But if PI will become the new standard in future logistics (and not the vertically integrating e-tailers discussed in Sect. 3.5) it most likely will be realized in a gradual process where global supply networks evolve through three subsequent stages:

1. Fully owned supply chains, where the assets and services are key constituents of the company products/services, as differentiators for the customer. This is the current situation.

2. Horizontal collaboration and vertical coordination in a limited network of companies, sharing what are considered “commodity” assets and services.
3. Physical Internet for most goods, in a collaborative network involving many parties who are implicitly collaborating, with the lowest costs and maximum availability and service level.

From step 2 onwards, the PI has many commonalities with the 4C concept. Whereas the PI originates from a mostly technical idea, 4C focusses more on the organizational or business model questions around collaborative and integrated logistics processes. In a way, the PI is the automation of a 4C, and 4C a business model within the PI.

3.8 Logistics Marketplaces

Another development in logistics that is gaining traction and facilitates transport flow bundling is the growth of the so-called logistics marketplaces, or freight marketplaces. Freight marketplaces match companies looking to ship freight using one or multiple modes of transport (road, air, ocean, and/or rail) with suppliers or brokers of logistics capacity. Customers benefit from better comparability and transparency of proposals, optimized price/performance ratios, and high security through member certification and rating systems. LSPs can use these platforms to digitalize internal processes as well as maximize capacity utilization.

The integration of logistics marketplaces with 4C control towers through central planning, reporting, dispatching, and tracking tools will further enhance its impact. Karaenke et al. (2019) explore mechanisms for freight auctions and discuss computational and strategic problems that need to be solved to coordinate carriers optimally in freight marketplaces. They show that such mechanisms can, for example, decrease waiting times significantly. The goal of these auctions is to maximize efficiency. They study congestion at loading docks of retail warehouses as a substantial problem in retail transport logistics and as example of a coordination problem. The difficulty is that carriers optimize locally, leading to globally suboptimal outcomes. Still, logistics marketplaces are a relevant building block of collaborative logistics. Mutually benefitting from each other’s capacities brings more structural coordination through a 4C one step closer.

3.9 Sharing Economy

The final logistics development in the light of the 4C concept that we discuss is the sharing economy. Sharing is especially important in dense urban areas, where space is scarce, and optimal utilization of resources is essential. The success of companies like Airbnb and Uber has been made possible by evolving technologies, enabling consumers to share information fast and in a secure way. Traditional business models must be adapted, and firms must learn how to compete in a world of shared idle capacities (Gansterer and Hartl 2020).

The concept of shared transport resources is a hot topic in transport and logistics (Speranza 2018). This can be explained by the growth of the e-commerce sector, which boosts competition and brings down prices. Customers have small order sizes but often expect same-day delivery services within very tight time-windows. Therefore, economically and ecologically efficient delivery is challenging. Empty truck miles in the EU are estimated to range between 15 and 20%. Collaborative (sharing) frameworks provide opportunities to reduce these inefficiencies considerably (Karaenke et al. 2019; Vanovermeire et al. 2014).

Also DHL Trend Research (2019) observe that B2B and B2C sharing of resources, logistics assets, and infrastructure can increase capacity utilization while reducing costs and the carbon footprint of transport. LSPs can participate and share their own underutilized assets such as delivery vehicles and forklifts as well as warehousing space with an on-demand approach.

The difference between the sharing economy and true horizontal collaboration is that with the sharing economy typically the collaboration or exchange is a short-term or one-off exercise, whereas horizontal collaboration and 4C aim to structurally combine assets to improve efficiency. In that sense, the sharing economy is fully decentralized, whereas 4C assume centralized coordination of some kind.