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A review of freight and the sharing economy

Future of Mobility: Evidence Review

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A review of freight and the sharing economy

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Executive Summary

The report has two principal aims. First, to provide a holistic review of freight and the shared economy and second, to provide evidence to help the UK Government think systematically about the future in this area, by providing consideration signposts for policymakers in tackling future challenges associated with the emergence of logistics practice in the sharing economy.

We take a wide interpretation of what 'freight sharing' means, adopting the following definition: 'Freight services provision performed by actors working together at the same level in the supply chain, often facilitated by an intermediary digital platform player, that provide added values for all participating entities.' Throughout the report, it is emphasised that the practice of freight sharing is not new in the provision of logistics. Indeed, the notion of sharing has underpinned many developments in logistics, notably over the last two decades or so, examples of which are referred to in the report. However, catalysed by recent developments in digital capabilities and enhancements in data access technologies, new manifestations of sharing in logistics are emerging, which have the potential of becoming increasingly mainstream. In this report the benefits of sharing in logistics are explored and examined, supported by the presentation of numerous examples of many different versions of these new sharing-based business models.

Reflection is provided also on the disincentives or barriers to freight sharing. Sharing has been promoted for many years as a panacea for addressing many of the challenges the logistics industry faces, but there have been false dawns, where what has been forecast has not materialised. With this in mind, consideration is given to how 'freight and the sharing economy' could evolve up to 2040 with a focus on the roles the public and private sectors may play in incentivising, facilitating and regulating this emerging area, so that the concept best benefits UK society as a whole.

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1 Introduction

1.1 Background

Sharing in an economic sense is not new. It has been recognised in business for a long time. Today, the sharing of assets in the conduct of business is normal practice in many industries, such as in the office space, air transport or container liner shipping sectors, where co-working, alliances and consortia in various forms have existed for many decades. In freight logistics too, the idea of sharing has long been considered part of the basic provision of logistics, with the role of logistics providers being, in part, facilitating the 'bringing together' and 'jointly addressing' the logistics requirements of actors across supply chains, feeding in any derived gains to provide extra value for the supply chain actors they serve.

In recent years, the emergence of new digital capabilities and enhanced data access technologies has led to a resurgence of interest in the fresh possibilities that sharing can bring about. Usually facilitated by a host, acting as a linking information platform or hub, a new business model phenomenon built around the idea of sharing the use of assets is emerging in many sectors and markets. These peer-to-peer rental marketplaces tap into the potential of extending the use of assets already owned by people, or organisations, through what is known as the 'sharing economy'.

The beauty of these businesses is that the facilitators do not have to 'own' assets themselves: they merely provide the link between those seeking use of capacity or use of redundant capacity in the assets they own and those that want to use this capacity. However, there are concerns emerging from the freight sharing idea, such as the nature of work involved, which will be examined in this report.

Thus, we are witnessing the emergence of an expanding set of 'peer economy' (Fraiberger and Sundarajan, 2017) examples in many industries and geographies. China, and the growth of ridesharing there, is a leading example of this development (WEF, 2016) – see box.

The Sharing Economy in China (WEF, 2016)

- China is arguably the leading sharing economy (SE) in the world
- SE in China was worth US$500 billion in 2015
- SE is forecast to grow to 20% of China's GDP by 2025
- For example, China's Didi Chuxing became the world's biggest ridesharing company in just five years – 1.4 billion rides in 2015
- Dense, populous cities, price-conscious consumers and fast mobile payments are all key factors.

1.2 Purpose of this review

These background changes also need thinking through in terms of what implications they have for decisions related to policy and regulation of the sector. For instance, will these changes impact positively or negatively on sustainability goals, how will these developments affect employment practices and what should the role of government be in catalysing the possibility of logistics sharing where there are seen to be societal benefits but no private leadership is forthcoming? We therefore aim in this review to appraise objectively the subject of the sharing economy in freight logistics, an industry that has a discernible history of sharing and also appears to be at the forefront of a renewed enthusiasm for sharing.

1.3 Report structure

We are aware that some reading this review will have little understanding of modern logistics. So, at the outset (section 2) we explain the concept of logistics, including a summary of key pressures that are shaping the way modern logistics is conducted. In section 3 we briefly explore and debate how the notion of the 'sharing economy' can be understood and defined. In section 4 we focus on the key developments in sharing in logistics, structuring the presentation around the two main physical processes in logistics: transport and warehousing. We also devote special attention to the so-called 'last mile', as this is a highly topical area with the rise of e-commerce, and also an area where a great number of freight sharing initiatives appear to be focused. Ideas such as crowdshipping and horizontal collaboration are also explored in this section. In section 5 we look at the concept of 'data sharing' in relation to logistics, examining the many opportunities that are emerging as this area develops. In section 6 the implications for consideration by Government surrounding freight sharing both now and up to 2040 are put forward, presented around three theme areas – the implications for the economy, environment and society – before conclusions are reached (section 7).

2 The Concept of Logistics, and Current Logistics UK Snapshot

2.1 Concept of logistics

Logistics might sound simple, defined as 'the commercial activity of transporting goods from one place to another', but in reality it is an extremely complex industry (Srinivasan and Leveque, 2016). Logistics, as a term, originated with the military, but today in the business sector, it is used to describe the efficient and effective flow of goods in supply chain processes. It includes transportation, shipping, receiving and storage as well as management of all these areas. Logistics activities can be divided up in terms of where they occur in the chain of supply:

Transport (including reverse flows) in turn can be split into:

- **Inbound logistics:** covers all logistics activities further up the supply chain, often referring to logistics services required for supply of raw materials to manufacturers or of finished products to retailer distribution centres;
- **Outbound logistics** refers to logistics services required to support onward supply, often to end customers or actors in the supply chain who immediately serve customers, such as retailers in supporting their retail outlets, etc.
- **Last-mile logistics** is rising in importance with the emergence of e-commerce: it is often raised as the most problematic and costly segment of logistics.

Warehousing is a nodal operation where inventory storing and handling (breaking down, or accumulating assortments) is undertaken, until it is called for onward shipment.

In all activities the concept of sharing could be and is applied.

Logistics provision is commonly outsourced to specialist providers. Three levels of providers can be envisaged (see Figure 1). Those providers that work immediately with shipper customers for logistics services are termed **logistics service providers (LSPs)**. They operate primarily in the business-to-business (B2B) marketplace and take full responsibility for delegated logistics work that has been contracted to them. Examples here include:

- **Third party logistics service providers (3PLs)**, who conduct much of the logistics work themselves supported on occasion by subcontractors;
- **Fourth party logistics providers (4PLs)**, who generally do not conduct logistics services themselves but provide an overseeing role from a platform, retaining

accountability for the logistics contract and aiming to optimise a logistics network while contracting other 3PLs and subcontractors to perform the actual logistics services on their behalf; and

- **Freight forwarders**, who arrange onward goods shipments, often overseas to international markets.

Carriers operate across all transport modes and while rarely having a direct relationship with the manufacturer or retail customer actually perform much of the physical practice of logistics. Finally, **couriers** provide specialist logistics services, such as express and parcel deliveries, often direct to public consumers as well as to businesses.

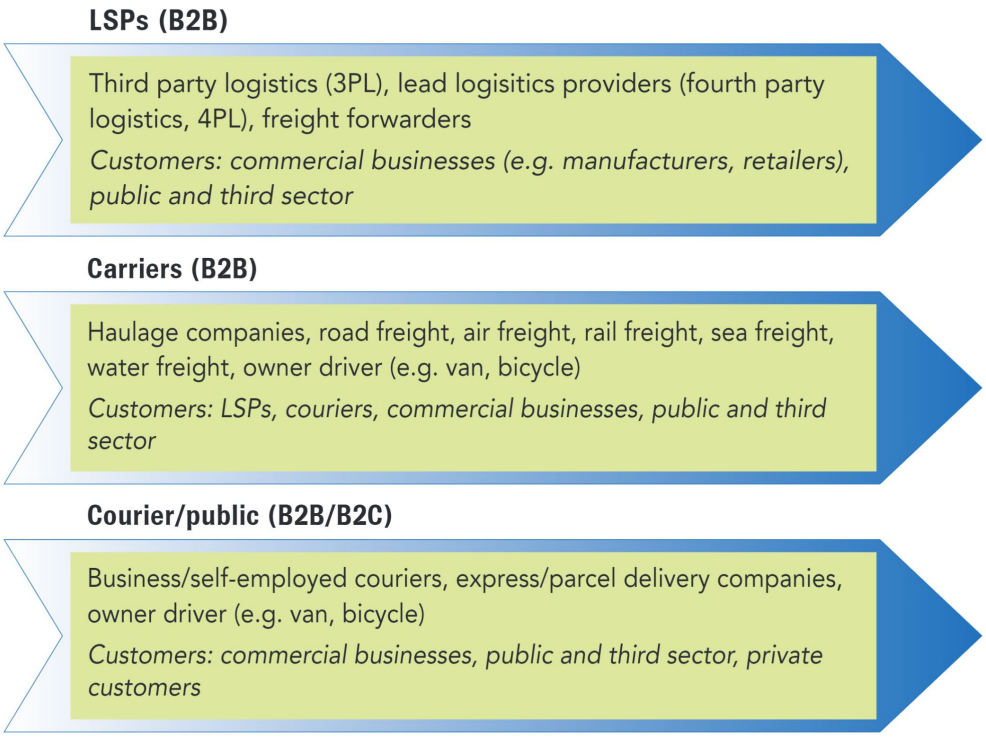


Figure 1: A high-level conceptualisation of logistics providers

All types of logistics providers are operating continually under immense commercial pressure. They must consistently meet exacting customer goals in support of their supply chain strategies while operating within exceedingly tight profit margins. In a sector characterised by a commoditisation of provision (many of the processes are highly repeatable and barriers to entry, especially in the Carriers category, are low), where competition is intense, improvements through sharing are potentially highly attractive.

A change of thinking and operating philosophy now pervades supply operations. This change, emerging over the last three decades or so, is characterised by a tendency for competition to be on a supply chain v supply chain basis, not firm v firm. This process-

based approach has meant that the delivery batch size has become smaller. Orders that had been aggregated to full loads are no longer tolerated. As inventory levels are managed down, logistics providers must cope with smaller, more frequent deliveries, to tighter delivery windows. Moreover, although these service demands have heightened, so too has the pressure on costs continued to intensify. Sharing has the potential to help tackle all these logistical challenges.

2.2 Current state of UK logistics

Road is the main mode of transporting freight in the UK. In 2015 it accounted for 76% of all goods moved (water 15% and rail 9%) (DfT, 2016). The road freight sector contributed £11.9 billion to the UK economy in 2015 (a 6% increase on 2014) with 44,565 practising enterprises (a 22% increase on 2014). Heavy goods vehicles (HGVs) traffic levels were unchanged between 2015 and 2016 at 26.8 billion vehicle-kilometres, with HGVs account for 18% of all greenhouse gas emissions from road transport, despite only representing 5% of the traffic flow. According to DfT (2017a), goods lifted (the weight of goods carried, measured in tonnes) and goods moved (the weight of goods carried, multiplied by the distance hauled, measured in tonne-kilometres) by GB-registered HGVs in the UK had reached record levels at the end of March 2017 (it had dipped following the 2007/8 recession and is only just surpassing those levels now). This equated to 1.97 billion tonnes of goods lifted, an increase of 17% compare to March 2016, and 174 billion tonne-kilometres of goods moved, an increase of 13%.

The empty running (vehicle-kilometres driven empty, defined as carrying zero tonnes) has increased as a percentage of total fill from 27% in 2006 to 30% in 2016. Considerable debate has surrounded this issue as it really needs to move in the other direction to contribute to an improvement in the logistics sector's greenhouse emission performance. However, the loading factor (the amount of goods that were moved, as a proportion of the total amount of goods that could have been moved, if HGVs were loaded), has improved in recent years (see Figure 2).

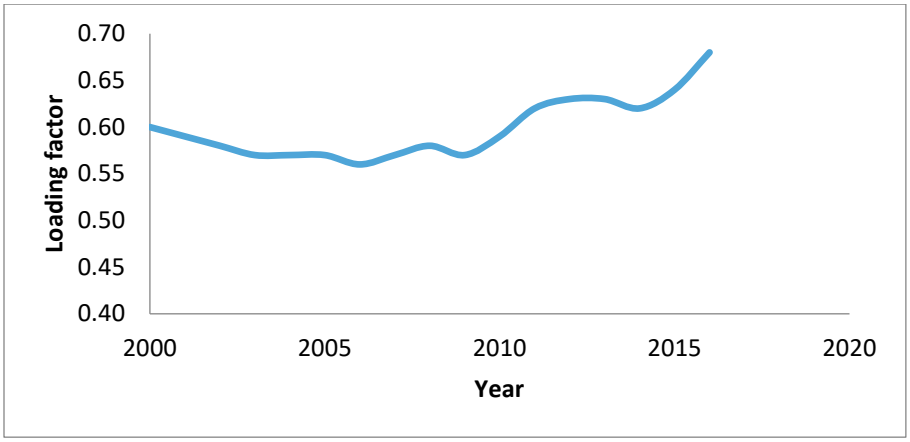


Figure 2: Loading factor for all vehicles (rigid and articulated) (DfT, 2017b)

In terms of commercial vehicles, the registration of new vans is considerably higher than for HGVs (larger heavier vehicles): in 2016 there were around 380,000 new van registrations compared to around 55,000 for HGVs (FTA, 2017). HGVs have a gross vehicle weight ranging from 3.5 to 44 tonnes, with articulated LHVs (longer heavier vehicles) carrying the bulk of road freight. In 2016, 75% of goods moved were carried by articulated HGVs (this proportion has remained slightly above three quarters ever since 1996). The number of HGVs was 397,000 in 2015 – still 8% below the 2007 figure (FTA, 2017). In terms of operating licences, this rose to 77,000 in 2015/16, but is still well below the peak of 110,067 in 1999/2000 (FTA, 2017).

In broad terms the UK logistics industry has gone through a period of consolidation in ownership and centralisation in spatial terms, notably with hub networks around the Midlands 'Golden Triangle' over the first two decades of this century (CILT, 2016). Many believe that these trends may reverse between now and 2040, with the notable force of growing e-commerce and shorter lead times being a significant catalyst in this regard. What will be interesting to observe is what role sharing in freight will play if this decentralisation does come to fruition.

3 The Sharing Economy and Freight Sharing

3.1 Introducing the sharing economy

The concept of having temporary access to goods or services, rather than permanent access, is becoming more accepted (Matzler et al., 2015), as sharing is seen by many as being:

- **more accessible**, as the cost of searching and conducting transactions has reduced due to developments in technology;
- **more attractive**, as it is able to provide efficiencies and deliver the extra convenience customers increasingly demand; and
- **better for the planet**, as assets are utilised more intensively.

In a PWC (2015) survey of US adults, 44% said they were familiar with the sharing economy concept, 19% had participated in the shared economy as a user, and 7% said they had participated as a provider. It is thus promoted as a fast-growing area of commerce that is leading to companies and consumers re-imagining how they operate, especially how they better utilise previously under-utilised assets. Many argue that the emergence of this sharing economy represents ‘a paradigm shift’ from the traditional way of conducting commerce (e.g. Gesing, 2017). Illustrative examples of relatively new start-ups can be found across many economic sectors (Table 1).

Table 1: Examples of US start-up peer-to-peer companies operating in the new 'sharing economy' (adapted from Fraiberger and Sundararajan, 2017)

Peer-to-peer marketplace examples	Description of activity
Getaround, Turo, Drivy	Short-term rentals of owners' cars
Airbnb, onefinestay	Living space rentals for short periods
FatLama	Household item rentals
KitSplit	Professional photography equipment rental
Didi Chuxing, Lyft, Uber	Urban transport services
VizEat, Kitchit, EatWith	Dining
BlaBlaCar	Inter-city transport
TaskRabbit, Handy, Thumbtack	Odd-jobs providers
Lending Club, Funding Circle	Loans
Instacart, Postmates, Doordash	Local delivery

However, the sharing economy is not a new theoretical concept. The core idea of 'collaborative consumption' was first proposed by Felson and Spaeth (1978) on the basis of the willingness of people, especially in families or neighbourhoods, to help by sharing items with each other in order to exchange non-material form goods. Today, the 'sharing economy' idea goes by many names: as well as 'collaborative consumption' it is known as the 'peer-peer economy', 'on-demand', the 'gig economy', and 'access over ownership'. This raises the need to define exactly what the 'sharing economy' is.

Simply it can be defined as 'the accessing and reusing of products or service to better optimize resource allocation' (Kathan, et al. 2015), or as 'the economic activity of digital platforms that facilitate transactions where users are given temporary access to a service provider's otherwise underutilised asset' (Gesing, 2017). Fraiberger and Sundararajan (2017) argue that what makes the examples they have identified (see Table 1) different from rental services that have traditionally been practised (for example, via traditional hotels, or car rental companies) is that 'the trade they facilitate is largely between individuals'. The authors go on to argue that potentially this group can be further divided into those that facilitate the sharing of otherwise idle assets, which were originally purchased, and those that use them.

Beyond this, the reality is that the landscape of this emerging sharing economy concept is complex, with a great diversity of exponent players. To unravel some of the complexity Cohen (2016) has drawn up a 'Sharing Business Model Compass' which

reveals many of the alternative dimensions that are being adopted. Dimensions include whether transactions are free or market based, who is the sharing between, what is the governance model, etc. Examples of peer-to-peer companies can be mapped on to this compass to get a fuller understanding of how different they all are.

In conclusion, we take a broad interpretation of what freight sharing is, which allows us to include many notable B2B developments in the horizontal coordination of logistics that have emerged over the last 20 years or so, as well as the newer, much talked about, 'sharing economy' ideas, which have especially built up around the thinking that the public can become more involved in better utilising idle or redundant assets. Our definition is:

> *Freight services provision performed by actors working together at the same level in the supply chain, often facilitated by an intermediary digital platform player, that provides added values for all participating entities.*

To facilitate many Sharing economy business models, a platform is usually created through which the necessary facilitating connections with the User and Service Provider can be channelled (Figure 3).

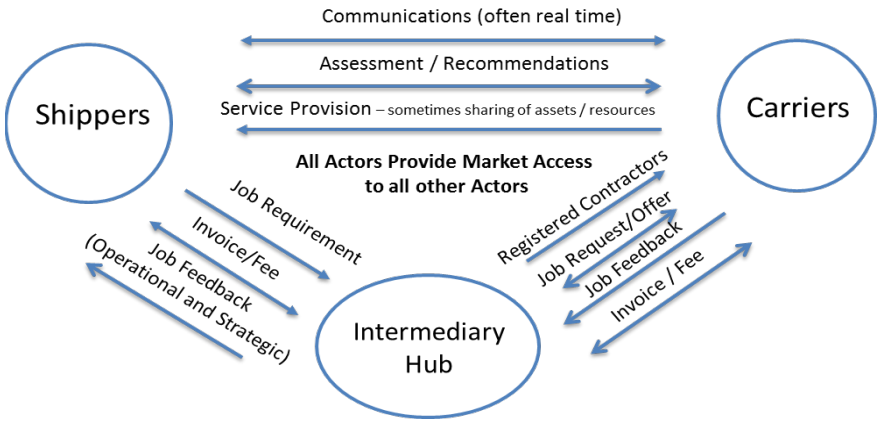


Figure 3: The sharing economy business model

Finally, it should be added that while businesses are increasingly appreciating the benefits from sharing it needs to be very carefully handled so that it does not fall foul of competition law. Horizontal cooperation and agreements between companies are carefully regulated, as it is viewed in many jurisdictions that the opposite of cooperation, competition, 'encourages companies to offer consumers goods and services at the most favourable terms' (EU 2018). 'Competition encourages efficiency and innovation and reduces prices but to be effective, competition requires companies to act independently of each other, but subject to the competitive pressure exerted by the others' (*ibid*). In Europe this is enshrined in the European Anti-Trust Policy (see box).

European Anti-Trust Policy (EU, 2018)	
Two central rules, set out in the Treaty on the Functioning of the EU, underpin EU anti-trust policy to ensure that competition is not distorted or restricted. Article 101 of the Treaty prohibits agreements between two or more independent market operators which restrict competition (this covers both horizontal agreements (between actual or potential competitors operating at the same level of the supply chain) and vertical agreements (between firms operating at different levels, i.e. agreement between a manufacturer and its distributor)). Article 102 of the Treaty prohibits firms that hold a dominant position on a given market to abuse that position. The European Commission and national competition authorities have a number of investigative powers to apply the rules (e.g. inspection at premises, written requests for information, etc.).	

3.2 What is freight sharing?

The sharing economy idea can be applied to many industries but has proven to be particularly taken up in sectors that possess big assets, such as mobility and hospitality (Gesing, 2017). Logistics, with its heavy privately owned assets, such as transport vehicles and distribution centres, is an industry where on the face of it the principles of sharing could be applied. There are a number of other driving factors that suggest sharing could be well suited to be increasingly incorporated into the logistics industry.

First, the demands placed on logistics providers to reduce costs could be partially met with increased freight sharing, which could drive improved efficiencies and productivity gains (Cruijssen et al., 2007 and Mason et al., 2007). Better sharing of assets would spread asset costs, meaning that size economies are generated, for instance. Cruijssen et al. (2007) refer to all sharing economies as 'relational rents': 'a supernormal profit jointly generated in an exchange relationship that cannot be generated by either firm in isolation' (Dyer and Singh, 1997). Efficiencies can also be gained through employment terms, where providers are treated as self-employed and hence the cost to employ can be lower than a traditional employment arrangement (this is discussed in detail in section 6.3 of this report). In addition, sharing can result in purchasing economies: the pooling together of a purchase order leading to potential size-based discounts.

Second, the increasingly important role logistics plays in supporting supply chain strategies means that service levels have to be of the highest standards. Sharing, for instance, through facilitating more consolidation centres, can result in higher levels of delivery service with minimal extra costs. For instance, through sharing, suppliers can afford to locate inventory closer to their customers, permitting more frequent and/or faster deliveries to be provided.

Third, on environmental grounds, sharing could help the logistics industry achieve better emission rates for work provided, by facilitating better fill rates and thus using assets more intensively, ameliorating empty running and supporting greater use of more environmentally friendly transport modes (sharing makes a more environmentally friendly transport mode more viable, for example the use of rail, inland waterway and short-sea shipping which could not be justified for one customer of freight alone), to name but a few advantages.

Of course, any supply benefits of extra competitiveness from sharing that are not passed on to the customer need to be divided up between the provider and the platform facilitator. The exact arrangement will be determined by the contingent conditions that prevail in each case – an area that needs to be watched and regulated if sharing becomes more of a dominant business model in logistics.

A key to understanding the concept of sharing in freight is to delineate sharing involving companies providing value in terms of services for businesses (predominantly through B2B sharing, but also including other arrangements such as public/private sector

sharing, and B2C sharing) and sharing that provides value in terms of service for end-consumers (often consumer to consumer (C2C) sharing, but also some B2C sharing).

In B2B sharing, coordination of freight activities between companies can be defined as the concerted practice of sharing logistics activities by companies operating at the same level of the supply chain. However, there can be twists on this basic definition, as coordination of logistics can occur across supply chains between suppliers and customers of goods and logistics service providers, so not necessarily operators at the same level (Sanchez-Rodrigues et al., 2015). Sharing for the benefit of business customers can also take place with other partners, such as sharing between public and private sector. Section 4 of this report focuses on B2B freight sharing practice.

In recent years, there has also been growing interest in sharing at the C2C level. The 'last mile' is particularly problematic in terms of achieving great service levels at minimal costs. Sharing concepts are proving particularly well suited to addressing some of the challenges in this aspect of logistics.

A wider span of sharing can also be envisaged in freight and will be expanded on in this report. Hubs can potentially link with other hubs too to further open up sharing possibilities. A high-level conceptualisation of how these sharing platforms can interface with all levels of logistics players and/or other hubs is shown in Figure 4.

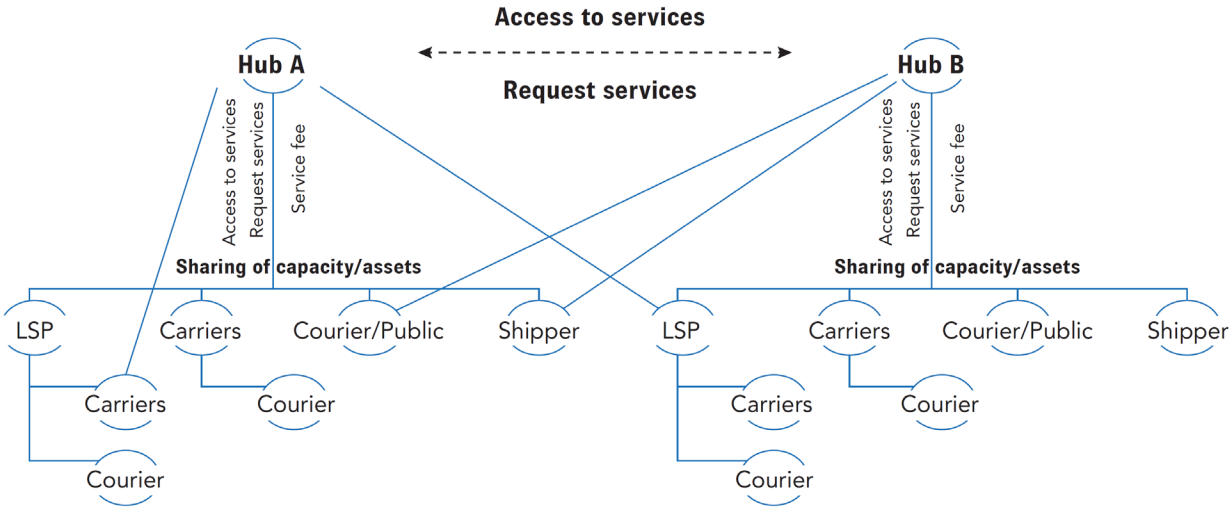


Figure 4: A conceptualisation of different options of logistics sharing business models

To conclude, the 'sharing economy' in our view has had and will have great appeal in freight services for the logistics sector. Therefore, this report will explore how freight sharing is already occurring and examine where it could also develop in the future.

In developing this review we have debated how the various sharing initiatives involving logistics could be categorised and hence how they could be presented. Below is a list of various dimensions of this categorisation we considered:

- Where in the physical supply chain (inbound, outbound, warehousing, last mile)
- Physical asset or information asset sharing (e.g. sharing idle logistics space or data)
- Pooling or sharing (does working collectively accumulate resource/data or facilitate deployment of spare capacity)
- Sharing pre-operation, in-operation, post-operation
- Degree of sharing: one–one, one–many, many–many
- Within industry / across industry
- Economy 1.0 level / economy 2.0 level
- B2B, B2C, C2C etc.
- Technology enabled / or not
- Involving facilitator or not
- Motivation for sharing: where on spectrum from market (financial) to free
- Payment means in sharing: money – credit – exchange in-kind, etc.

It is interesting to reflect briefly on the difference between Economy 1.0 and 2.0, as discussed in Bussman (2017). Economy 1.0 can be envisaged as what exists today with facilitating platforms coordinating sharing and hence taking a profit margin out of sharing activities they have helped bring about. In the Economy 2.0 scenario, concepts such as blockchain and smart contracts make these middle players redundant so participants in sharing are able to retain the value themselves (Bussman, 2017).

We concluded that it would be most logical to categorise our presentation around the core logistics activities of freight transport, including a special category focusing on the ‘last mile’, warehousing and data sharing. The first three categories, which in essence cover the physical side of logistics, are covered in section 4, but a summary of the key challenges each activity area is currently facing is given in Table 2. Most are defined by the specific area of activity, although it should be noted that some challenges are applicable to more than one activity area. The subject of data sharing is covered in section 5.

Table 2: Summary of physical logistics freight sharing initiatives

	Freight transport	Last mile	Warehouse
Main challenges currently facing activity area	Small, frequent shipments; Delivery reliability; Higher utilisation; Cost control	Small, frequent shipments, incl. batch size 1; Higher schedule reliability; Short lead times; Real-time communication; Omni-channel integration	Demand fluctuations Using capacity intensively and consistently; Lower inventory levels; Cost control
Examples of Sharing*	Consolidation centres	Urban consolidation centres	1 to 1 sharing
	4PLs / Lead Logistics Providers	Crowdshipping last-mile delivery	Multi-user sharing
	Pallet networks Spare capacity filling	Piggy-backing Shipments.	Flex warehouses
	Agricultural Cooperatives	Horizontal Collaboration	On-demand warehouse
	Joint venture collaboration	Other innovative last-mile freight sharing ideas, e.g. drop-off lockers	Self storage
	Reducing wasted miles		
	Spare truck capacity filling		
	Synchromodality		

4 Sharing and Physical Freight Logistics

4.1 Freight transport and sharing

Sharing in freight transport has been a characteristic of many business model developments that have been recorded in logistics practice, notably since the turn of this century. A number of the most notable examples are discussed below, with examples predominantly taken from the UK.

4.1.1 Consolidation centres

A challenge that logistics providers have had to face up to has been the requirement to move to smaller volume/more frequent orders, as players have 'leaned' up their operations, reducing inventory levels at, for instance, assembly factories and warehouses. With the prospect of running light-loaded vehicles due to the smaller shipment volumes, logistics providers have had to create solutions to meet the service levels required, while still ensuring low costs of transport. One answer has been to introduce consolidation centres (CCs) so that less-than-truck-load supplies can be consolidated early in their journey, allowing for what is termed the 'trunk leg' to be performed as a full vehicle (Figure 5).

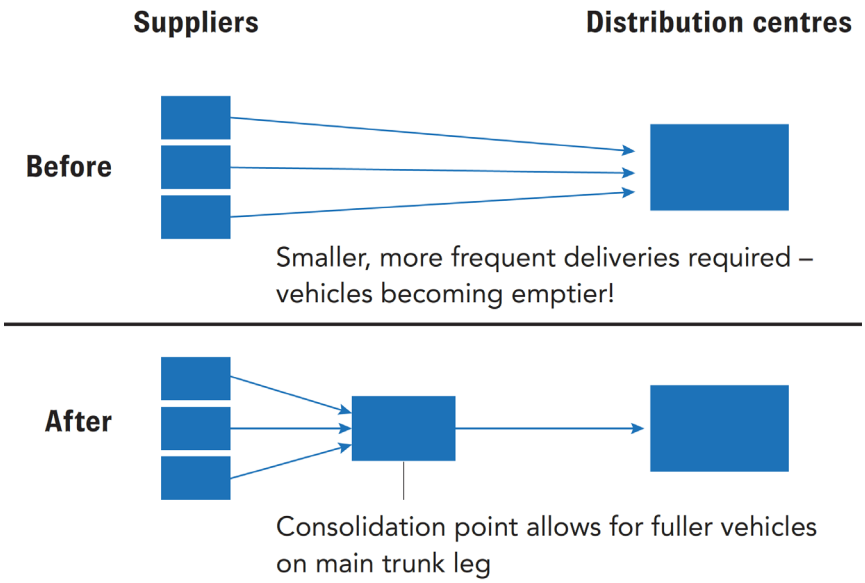


Figure 5: The consolidation centre concept

The question has emerged, though, who should run the CCs? Early versions of CCs (which do still exist) involved one-to-one 'sharing': two suppliers collaborating, setting up and running the CC jointly. This often evolved to include more neighbouring suppliers too. However, some suppliers may be excluded or the location of the consolidation centre may not be sited ideally for the inbound customer, so there were questions

around how optimal the arrangements were. This was the situation Tesco faced at the beginning of the 2000s, which resulted in their Factory Gate Pricing (FGP) initiative. This involved Tesco taking complete control of their inbound supply chain logistics from their suppliers Factory Gates, including an optimally located CC network (Potter et al, 2007). In essence Tesco became a platform controller of a 'shared' logistics operation, acting as a 4PL for inbound transport and CCs operations.

4.1.2 4PL – lead logistics providers – facilitating freight sharing

Tesco, in the example above, provides a good illustration of what has become known as the 4PL, or 'lead logistics provider' concept, another facilitator of 'freight sharing'. 4PLs are asset-light players who take on the responsibility for logistics while not actually carrying out any of the physical logistics duties themselves. In its original form, the concept envisaged that the lead logistics provider would integrate the actors along the vertical supply chain through a control tower (not horizontal sharing at all). However, many logistics companies that became involved with this idea restricted it to one activity, such as transport, and looked to optimise activities across parallel supply chains (horizontal optimisation).

Advanced information systems that permit the concept of the lead logistics provider have meant that this once-theoretical idea is now a model of logistics that is quite commonly employed. An example of an industry in the UK where this idea was introduced over a decade ago and has been sustained since is the steel sector. In 2006 TDG became one of the pioneer 4PLs in making the concept work for Corus Steel. TDG have since been taken over by, first, Norbert Dentressangle, who in turn were bought up by XPO Logistics, and Corus have been acquired by Tata Steel, while the 4PL business is now known as KeyPL. However, the core 4PL idea still works and in fact has become bigger and more successful (Hobson, 2013 and XPO, 2018).

4.1.3 Pallet networks

Another successful answer to the need to transport frequent, small shipments between businesses – a feature of today's leaner supply chains – has been the UK pallet network (today, many networks cover all of Ireland too). The pallet network concept developed in the UK particularly from the mid-1990s onwards, and is still expanding today: in the first nine months of 2017 full pallets on the network grew by 6.3% to 19 million, and half pallets by 8% to 5.4 million shipped according to the Association of Pallet Networks (Millet, 2017). It comprises a hub facilitator, which brings together regional haulage partners to be able to offer, often next-day, pick-up and delivery of goods by pallet services across the UK.

So, for example, if a supplier in Bristol received an order for two pallets worth of its products from a customer in Newcastle, to be delivered next day, it clearly would not be viable to run a delivery vehicle. Instead, the Bristol-based logistics service provider partner would collect the pallets that afternoon, consolidate the pallets with other onward shipment of pallets from suppliers in the same area collected through the day,

and then early in the evening transport them to the Midlands hub. Once there, the truck would be emptied, the pallets cross-docked, and then loaded to the return leg of the Newcastle truck, merging with other pallets destined for the same area. After travelling through the night, the delivery of the two pallets arrives in Newcastle, where delivery is made and any pallets for return shipment to anywhere in the UK for the next day are collected.

Examples of lead pallet network players in the UK are Pall-Ex, Palletways, United Pallet Network and The Pallet Network (TPN). TPN for example has 105 member companies, who are all top regional transport companies in their own right, and 121 depots across the UK. Some networks also connect up with Europe. A sophisticated IT system links up all partners through the hub platform run by the pallet network provider. The Association of Pallet Networks claim that their operations contribute to reducing the number of road vehicles on the road a day by 800, and achieve average vehicle fill rates of 73% (compared to a UK average of 51%), thus substantially reducing congestion, boosting UK productivity and contributing to environmental goals as well (APN, 2018).

4.1.4 Agricultural cooperatives

A more traditional example of sharing that has a long history is the cooperative idea. This is probably most well known in the agricultural sector where sharing occurs across a range of activities. In the UK today there are 436,000 farming coops owned by 153,000 farmers. Large expensive machinery is pooled, produce destined for onward shipment is stored and consolidated, onward transport to customers is collectively performed on behalf of the cooperative members, and marketing and selling activities can also be run by a specialist on behalf of the supplying farmers. An example of this kind of set-up is Openfield, one of the UK's largest agricultural coops (Openfield, 2018).

4.1.5 Joint venture collaboration

Another form of horizontal partnership in logistics transport is where a joint venture is formed among logistics service providers. A leading example over the last decade or so where medium-sized logistics providers in the UK have formed a joint venture to compete with the larger players in terms of bidding for national contracts is Jigsaw, which was set up in 2002. Jigsaw today has evolved into a 4PL consortium of 11 hauliers and is owned by its largest partner C.M. Downton. It bids for and wins national contracts which the regional logistics providers would otherwise be unable to compete for, but by pooling their capabilities they are able to offer comprehensive yet flexible UK freight transport solutions for customers. The shared user traffic efficiencies allow for transport assets to be deployed by regional hauliers on other work when not required to work for Jigsaw customers (Hobson, 2017).

Horizontal collaboration
Horizontal collaboration (HC) is an important component for many sharing concepts. However, research in this area is in its infancy compared to the level of research on vertical supply chain collaboration (Pomponi et al., 2015). HC in logistics covers the 'voluntarily initiated, long term relationships among autonomous logistics service providers that operate on the same stage of the supply chain as close or distant competitors and that strive for benefits that could not be achieved by individual companies alone' (Schmoltzi and Wallenburg, 2011). It is a well-established working practice in air- and sea-based logistics, but is not, as yet, a common characteristic of road freight logistics (Cruijssen et al., 2007). Internal firm barriers such as a concern over sharing data can inhibit collaborative distribution efforts (ECR, 2007 and Hingley et al., 2011). Other areas where the concept in logistics has been examined in more detail in research include looking at the key enablers that are required to make it successful. For example, Sanchez-Rodrigues et al. (2015) found that synergies between prospective partners are often vital. Synergies included workable directional cargo flows and common supplier and delivery bases at the operational level, compatible and interoperable protocols and cargo containers at the tactical level and strategy alignment and similar service standards at the strategic level.
Often, potential horizontal collaborative partners advocate the facilitating role an 'orchestrator' can play to bring together parties acting at the same level of the supply chain for their common good. This is where the idea of a 4PL, lead logistics provider or control tower logistic platform would come in. They primarily advocated this as often the concept of 'gain share' (the fair allocation of benefits in relation to inputs) was an invariably problem in horizontal sharing. A finding from the CO3 project in Europe was exactly that: 'as such it is recommended that gainsharing is managed by a third party or a neutral referee…often referred to as "neutral trustee"' (Vestrepen and Van den Bossche, 2014).

4.1.6 Reducing wasted miles

Examples of 'one to one' sharing come from the sharing of trucks and facilities, the sharing of data and systems, and back/front haul sharing that have been used to drive down 'wasted miles' in the grocery sector over the last decade or so. Facilitated by the IGD (Institute of Grocery Distribution) on behalf of ECR (Efficient Consumer Response) since 2008 the strategy has resulted in the catalysing of numerous partnerships to share logistics services. This has involved link ups with various retailers, suppliers and logistics service providers, sometimes even between competitors; for example, ASDA, Nestlé, Mars, United Biscuits, Tesco, Kimberley Clark and Kellogg's. In 2008 alone they announced that this had generated a forecast saving of 900 fewer lorries on the UK Roads, resulting in 53 million fewer road miles, 26 million less litres of fuel used and a £30 million cost reduction. One of the key issues was to deal with how improvements were allocated. A gain share mechanism based on the gain from sharing vehicles

allocated to partners according to their share of the volume was presented from the experience of Nestlé and PepsiCo's shared loads collaboration (IGD, 2015). The IGD/ECR's vision is for the grocery sector to evolve from this basis of sharing trucks and facilities, through shared data and systems and ultimately to collaborative network optimisation. To achieve this one of the keys they highlight is compatibility, network management/freight exchanges and smart scheduling based on live updates (Smilie, 2015). Another example is in the healthcare sector where DHL Supply Chain reports up to 20% reduction through delivery consolidation where clusters of common postcodes are frequently served as part of the distribution service (DHL Supply Chain, 2018). It is interesting to note that the majority of examples were found in the grocery sector, which highlights the potential for this to be exploited in other sectors.

4.1.7 Spare truck capacity filling

The potential to use sharing to reduce partly filled vehicles and/or to reduce the empty running of trucks is one of the real prizes that many observers of the freight transport sector seek. In reality, of course, this quest is easier to propose than to actually achieve.

Evidence to support this came from our interview of the Managing Director (Derek Beevor) of Road Tech, a market leader for providing IT services for the haulage and logistics sectors in the UK. The company trialled a marketplace hub for matching requirements for haulage work with spare capacity with the Road Haulage Association for a number of years. In the end they concluded it did not work as what was always left were either jobs that no one wanted or ones that were priced at too low a rate. It was also argued that many activities in logistics actually rely on a relationship of trust between the logistics provider and their customer and often include a certain degree of uniqueness so that a commoditised sharing notion, although on the surface an attractive option, in reality is difficult to actually achieve.

However, the gains that could be achieved from better matching demand and supply for road haulage is something that is constantly being trialled. In geographies where transport is over longer distances than is common in the UK there has perhaps been more traction in the idea. In the United States, for example, Penske Logistics have developed software called Clear Chain that aims to match up empty-running trucks with jobs they could undertake. Real-time visibility of trucks, driver hours and work allows backhaul loading opportunities to constantly be updated and matches to be facilitated when appropriate (Penske, 2018).

Another example of backhauling is provided by Tradeteam, which is part of DHL. Specialising in drinks distribution, they aim to link their core distribution activities with reverse flows from other DHL contracts. If this cannot be achieved, then it makes it more likely that they will subcontract the work (Sutton, 2013).

In the UK a new project backed by Innovate UK, 'FreightShareLab', is aiming to reduce this empty running and improve partly loaded vehicle percentages. They are developing an open data software platform to coordinate the sharing of assets. In a similar way to

what it appears Clear Chain, discussed above, is looking to achieve, they aim that the software will act as a strategic planning tool, integrating job and vehicle data from shippers, fleets and carriers (Cork, 2017).

4.1.8 Synchromodality

Synchromodality is a fairly new idea which is concerned with fully integrating the flows of goods across all modes of transport. Built on the back of the multimodal approach, often based on the use of containers, it envisages the seamless transportation of goods from origin to destination with each mode being deployed in a fully integrated manner into the flow of distribution whenever best needed to meet the specific demands of the shipper customers. This fleet connectivity should allow for more cost and energy efficient shipments, it is argued. It requires sharing in a broad sense, as some of the modes that need scale of shipment require the 'bringing together' of volumes across supply chain customers to make their use viable. In Europe, with the large land-based hinterland feeding ports like Rotterdam and Hamburg, this synchromodality concept is beginning to take root. Supply of transport is being matched with demand requirements, such as time for shipment, costs, and even, for the environmentally conscious customer, emissions rates budgets (TU Automotive, 2015). These are early days, but mainland Europe is leading the way. This is due to the high price of fuel, large geographical area and the driving influence of ports, such as Rotterdam, which envisage that their hinterland transport networks optimisation can contribute to customer port choice considering costs, environmental sustainability, time and other aspects of the total journey (TU Automotive, 2015). There is a claim that a reduction of 15,700 ton CO_2 emissions has been achieved through 18 synchromodal projects in the Netherlands, with maritime projects having the highest impact (Smart Freight Centre, 2018).

4.1.9 Conclusion on sharing in freight transport

In conclusion, shared freight transport ideas have become more and more possible as barriers to the thinking have broken down, technology advances have more fully developed and, perhaps most importantly, more logistics companies or users of logistics have become more ready to accept the ideas.

The key is being able to give up sole control to enjoy the benefits that sharing can provide. Sanchez-Rodrigues et al. (2015) made the point, however, that sharing initiatives must ultimately add value to the supply chains the logistics providers serve, to be of use. It is no good efficiencies being achieved if service measures such as availability of product or delivery on time rates suffer as these latter measures are often the primary measures that determine decision-making and behaviours in the modern supply chain.

4.2 Last-mile and freight sharing

4.2.1 E-commerce and logistics

In recent years, one of the biggest developments that has impacted on logistics has been the rise of e-commerce. 'The online world of e-Commerce is altering all aspects of what is expected from logistics. The criteria of what fast, efficient, convenient, personalised and customer empowered all mean have been and are being transformed by the new always on, anytime, anywhere culture that characterises this new commercial world which has emerged in recent years … e-Commerce is summed up by the phrase, quicker, faster, sooner and freer' … [e-Commerce] has opened up profound new challenges that are demanding even more out of modern logistics practice.' (Mason and Evans, 2017).

So e-commerce consumers demand time-efficient, cost-efficient, convenient searching, delivery and return options all supported by real-time communication. This rapidly changing evolution in customer expectations is redefining the delivery process (EyeforTransport, 2018), posing many questions for logistics providers.

However, various freight sharing initiatives are delivering some answers in this demanding environment. Below, a range of these new 'Sharing' initiatives are presented.

4.2.2 Urban consolidation centres

Urban consolidation of deliveries is one strategy that changes the network infrastructure, aims to address last-mile logistics challenges and links up traditional with new sharing models. Urban consolidation centres (UCCs), or child hubs, can serve as decoupling points in the logistics process, receiving trunk leg flows and preparing goods for the 'last mile' delivery.

Allen et al. (2014) evaluated six UCC schemes and discussed the role of UCCs in reducing the environmental impact of goods vehicle deliveries. Among consolidation and delivery activities, UCCs can offer a range of value-added services: stockholding services, stock room management, pre-retail services, recalls and returns, providing staff training facilities and a range of benefits (Table 3). On the other hand, they can weaken shippers' and logistics companies' link with their receiving customers.

Table 3: Urban consolidation centres: potential benefits (Allen et al., 2014)

Supply Chain Partners	Potential benefits of UCC
Shippers and logistics companies: dropping loads at the UCC	Savings related to vehicle time and costs: no need to enter congested urban areas and queue to make deliveries.
Goods receivers from UCC	Delivery reliability, product availability, reductions in the need for on-site storage space, opportunities to enhance productivity and sales in core activities through the freeing up of space and personnel.
Developers and site owners	New business opportunity or the potential for business expansion; can reduce the delivery bay requirements and free up this space for other, more profitable activities.
The residents of the urban area	Reduction in goods vehicle traffic and reduction in vehicle pollution, noise, and greater pedestrian safety.

The idea of delivering to a hub point and then leaving the last-mile delivery to onward last-mile specialists has spurred the development of many 'last-mile' initiatives often involving the concept of Crowdshipping.

UCCs are commonly used in European 'heritage' cities. In the UK, UCCs serve shopping areas in Bath and Bristol, Heathrow Airport, London's Regents Street and Sheffield's Meadowhall Shopping Centre. There is a lack of evidence, however, as to how a UCC would work for more complex urban areas in the UK (PTEG, 2015).

4.2.3 Crowdshipping logistics

Crowdshipping works as follows: a sender has a package to be delivered which is held at a distribution hub, potentially a UCC. It passes the details of the package to a platform that 'crowdsources' it to a group of approved local distributors (drivers who are not employed by the platform company). One distributor is selected (this may be by price – but can also be influenced by the nature of the package/geography of delivery and/or distributor's service rating).

According to Botsman, 2014, shippers tend to fall into three categories:

1. The subcontractors of mainstream brands such as Allied Express, Startruck, DHL (who at best earn 30% of the delivery job costs – but often it's far less than that).

2. Professional drivers employed by courier companies who have downtime spare between jobs, empty space in their vans and idle return trips after a drop off.

3. University students, retirees or freelancers.

Crowdshipping advantages

'The power of crowdshipping is it does not require the asset-heavy infrastructure such as warehouses, vehicle fleets, fuel costs and employed drivers that traditional logistics companies have to pay for and manage' (Botsman, 2014). Botsman goes on to say: 'instead, they use technology to create access to an abundant source of underutilized assets to create a powerful new cost-effective logistics system. It's an asset-light model, akin to the likes of Uber and Airbnb, with low overheads meaning it can scale relatively fast depending on demand.'

'The key advantage to drivers is that they can control when they work, how long they work for at each time and how much they earn' (Botsman, 2014).

'Pick your own parcel'

Wang (2016) proposes a variation of this model for parcel delivery using crowdsourcing. Each region in a city is allocated a 'pick your own parcel' station. Delivery to these stations is much easier for hub to hub carriers who then do not need to bother with the 'last-mile' delivery. From the parcel station ordinary people can accept responsibility for deliveries on their own phone in connection with a journey they were going to undertake anyway. Technology links will keep providers and customers of this local logistics informed. The result is customised delivery, quickly executed at much lower costs, customised exactly to customers' requirements.

A good examples of these crowdsourcing delivery models currently emerging around the world is MeeMeep in Melbourne. Rob Emmett, the CEO and founder of MeeMeep, argued that his business model worked like this. A $70 dryer delivery cost would cost $3.80. However, this is based on this being the only delivery they make in an hour. With crowdshipping the deliverer can charge a lower delivery fee by completing more jobs per hour. When comparison website are viewed, crowdshipping models like MeeMeep are 55% cheaper than traditional logistics delivery. As the delivery is cheaper it opens up a whole new wave of door-to-door delivery possibilities from homes and businesses, which is estimated to be worth $80 million in Australia alone (Botsman, 2014). So, for example, this can lead to new distribution options that can be linked to restaurants or dry cleaners, etc. Deliveroo is an example of such a service, which is linking up with many restaurants creating new business opportunities for restaurant owners by linking deliveries to many potential new customers.

DHL's trial, 'MyWays', is another example of a crowdsourcing platform in Stockholm (DHL My Ways, 2018). It is operated by members of the public who frequently pass a DHL service point, who then can deliver packages and earn extra income.

4.2.4 Delivery mechanisms

One of the key challenges in last-mile is to be able to complete the delivery even when the customer is 'out'. A range of innovations based on a drop-off concept when the customer is absent is helping to make these 'last-mile' delivery options become more viable. Examples below may not be direct components of freight sharing but can be thought of as enabling the shared delivery process:

- Drop-off lockers
    - Lockers that deliveries can be dropped off at and customers can pick up their packages when convenient to them. For example, DropLocker (DropLocker, 2018).
- In-house deliveries
    - Amazon have developed smart locks and keys which would enable their delivery drivers to gain access to houses (Field, 2017)
- In-car deliveries
    - Services that allow deliveries to be made directly into a parked car (e.g. Volvo, 2018 and Swisspost, 2018)

4.2.5 Piggy-backing on rail journeys

The idea of moving freight via people who are on a journey anyway is an idea that is at the heart of some of these urban last-mile delivery solutions. This thinking can also be applied to longer journeys, but also result in final destination delivery too.

An example of this concept is 'Living Packets'. It is another crowdsourcing start-up specialising in this kind of niche market. They serve customers who require packet delivery between London and Paris as well as Paris to London. The delivery model operates through travellers – in less than four hours customers can get door-to-door delivery at a price considerably cheaper than express companies (Livingpackets, 2017)[1]. In essence they are turning journeys to work into delivery opportunities.

[1] 'The LivingPacket is equipped with a LED light and detector cell that sounds if opened without authorisation. An intelligent tracking system lets you locate your item in real-time' (Living Packets.com, 2018).

Figure 6: Living Packets smart packaging bag transports packages in a secure way and allows transit to be tracked

Freight sharing with rail offers potential for time-sensitive cargoes to be delivered fast, with potential cost and environmental benefits.

A pilot project was undertaken by InterCity RailFreight in partnership with Great Western Railway (GWR), WEGO Carbon Neutral Couriers and Cornish fishermen to transport live lobsters and other shellfish from Cornwall to restaurants in London. 'We have proven that using rail in this way can cut both costs and emissions by up to 60% while saving time', said Jeff Screeton, Managing Director of InterCity RailFreight. 'Having access to frequent high speed rail services opens up new markets for regional small and medium businesses and enables them to sustainably tap into the huge potential from e-commerce' (Railway Gazette, 2015).

4.2.6 Drop-shipping

Drop-shipping is another new idea aimed at improving the fulfilment of customer orders. In this case the 'store' selling the product does not actually keep the products it retails. Instead, the store accesses the ordered product directly from a third party stockist and then arranges for the logistics, delivering the ordered item directly to the consumer (Shopify, 2018). There are many advantages, notably the low capital outlay involved as no inventory, or storing capability, is required. There are disadvantages as obviously margins are low and it is potentially quite a complex operation to handle. It will be interesting to observe how 'mainstream' this kind of idea becomes as technology develops. It is a form of freight sharing for warehousing inventory in the same way that facilitators such as Uber are providing a freight sharing for transport. This business model is framed around a similar triadic model, with interaction between customer, seller and intermediary drop-shipper. The seller is the facilitator bringing together the customer and drop-shipper who holds the inventory. It is perhaps debatable whether this is a true example of freight sharing but it has many commonalities with freight sharing examples discussed across this report.

4.2.7 Horizontal collaboration – example of shared fulfilment centres and home delivery operations

On a bigger scale there are now examples of larger companies working together to achieve online delivery logistics synergies. An illustration of this is the tie-up between Ocado and Morrisons which began in 2014.

This partnership has resulted in substantive benefits to both parties:

- Ocado have derived considerable economies of scope to make their operations more viable and also to prove its e-fulfilment model (a model that would be subsequently sold to other retailers around the world hoping to move into online shopping).

- Morrisons have been quickly able to add on an online option for many of their customers, completely supplied by Ocado.

However, this collaboration reveals how fraught and complex 'freight sharing' through horizontal link-ups can be, as the parties are both competitors as well as partners in the same industry. They cannot stray into colluding in any commercially sensitive areas. After clearing everything about the operations link-up with competition authorities, they are able to share the running of the fulfilment centre and many aspects of the delivery operations. However, they are not able to ask suppliers to share deliveries requested by both companies to their site, even though this would result in benefits to society such as a reduction in emissions, etc. Perhaps this is an area for competition rule makers to consider if they are to encourage more such link-ups.

4.2.8 Conclusion on 'last-mile' sharing in freight transport

'Last-mile' is arguably the most problematic aspect of modern logistics. The reasons for this include the dispersed nature of deliveries and hence lack of scale to dilute costs, an emphasis on time criticality and service levels, often urban and rural settings, which have their own unique problems and the need for integrated solutions between deliveries which require dynamic ongoing planning. The demand is clearly growing fast as online shopping becomes increasingly demanded and popular, and the standards required are also becoming more exacting. For example, it could be argued that time competition (where competition is fought around the competence of being able to provide logistics services to defined, often very tight, lead time windows – in retail now it can be one hour from order to delivery) is replacing price competition (where competition is solely based on how efficient the logistics operation is). Freight sharing is providing opportunities to reduce/control costs while providing the enhanced levels of service that are required in 'last-mile' delivery. Numerous innovative examples are being put forward and offered commercially. It is not clear which ones will become mainstream

yet, but all seek to offer better-value equations for customers and suppliers alike who need to make their last-mile operations work effectively yet efficiently.

4.3 Warehouse sharing

The evolution of the logistics industry from a centralised to a more decentralised model means that a potential strategic network of warehouses located closer to the market is available for sharing. There are numerous examples of one-to-one and multi-customer space sharing. PROLOGIS RFI DIRFT is an example of a fully managed logistics park with rail connectivity and geographical location. It is located at the heart of the UK adjacent to the M1 and customers include Tesco, Sainsbury's and Eddie Stobart (PROLOGIS RFI DIRFT, 2018). The location offers a pathway to deep-sea ports that account for 90% of UK container traffic. Notably, according to the provider, the container traffic is expecting to rise by 182% by 2030.

The traditional multi-customer warehouse is usually managed by 3PLs with the aim of achieving economies of scale. Dedicated operations in one location can be generally described as inflexible in terms of time and fixed allocation of space (Gesing, 2017). A multi-user facility provides flexibility in space allocation enabling 'truly shared' warehousing (Gesing, 2017). Rental space can be in pallets or other standardised module designs. The digital sharing platform allows utilisation of the vacant warehousing space where mixing diverse sectors with different seasonality peaks supports flexibility (e.g. construction is slower in the winter; whereas retail is booming). This addresses challenges faced by companies that do not have the infrastructure or only have seasonal trades, also where visibility and real-time information is critical, especially for fast-moving industries.

It is important to note that flexibility can be achieved by independent logistics companies (e.g. 3PLs) where they can offer bespoke software packages and flexible terms to suit clients' requirements, as illustrated by C.M. Downton Ltd (Downton Deliveries, 2018). Downton's operates 1.2 million square feet of state-of-the-art warehouse facilities strategically located across the UK, with the majority of facilities owned by the company – giving them greater flexibility. Wincanton operates 30 strategically located shared user warehouses across the UK. Available on a pay-as-you-go basis with a minimum store of 1,500 pallets, all are supported by a warehouse management system that can be tailored to each client (Wincanton, 2018).

Online warehouse marketplaces (also known as 'AirBnB of warehousing', 'AirBnB for logistics', 'on-demand warehouse'), such as Flexe can offer sellers next-day delivery options and include 750 warehouses in over 45 markets across North America (Flexe, 2018). The network is said to provide a better geographical coverage than the Amazon delivery network (Bloomberg News, 2017). The cloud-based platform connects appropriate warehouse operators with extra space, manages inventory data, and

schedules inbound and outbound deliveries with real-time alerts and analytics. The implications for participating warehouse operators are to be able to accommodate new customers on short-term arrangements without disrupting their own operations (Bloomberg News, 2017). Other examples in a UK setting are presented in section 5, where flexible warehousing is offered among other services, e.g. exchange haulage work.

In the urban environment, urban discrete warehousing aims to address storage issues through a usage-based, per-item or membership-based fee structure and includes sharing space in a variety of locations, such as homes, offices, garages and rental locations (Gesing, 2017). For consumers, the concept extends from self-storage rooms/spaces to pickup and delivery, durable storage bins, and wardrobe boxes with protection plan (MakeSpace, 2018). Omni (2018) is an example of convenient on-demand storage that extends to premises pick-up and delivery and renting unused items. Other developments relate to community sharing platforms that enable users to earn money by sharing household items (e.g. BorroClub, 2018; RentMyItems, 2018).

5 Data Sharing

Data sharing platforms among companies in general, related to logistics processes, are on the increase. The ultimate goal of data sharing is to allow 'optimisation' of the whole system rather than just focusing on a particular entity. This section reviews the various forms this can take, with case examples selected to illustrate the potential they could each deliver, if more widely adopted. Particular emphasis is placed on an assessment of the development of 'holistic' platforms where data is being collected across numerous fields in a geographic region. These holistic platforms aim to accumulate data from both public and private sources, for a city for instance, and to stimulate connections, to make efficiencies in logistics, enhance service levels and/or contribute to the delivery of sustainability goals, such as carbon emission reduction.

The data used by organisations can be classified into three broad categories (Figure 7): 1) closed data only can be accessed internally, e.g. employment contracts, personal, sales and sensitive data; 2) shared data allows named, group-based and public access; and 3) open data that is free to use, reuse and redistribute by everyone (businesses and individuals) and include social media, open licences publications, train/bus timetables (ODI, 2018a). The data spectrum and contract conditions influence the way companies involved in freight movements undertake data sharing and how the data is used to support logistics strategies such as collaboration, managing return loads and freight exchange.

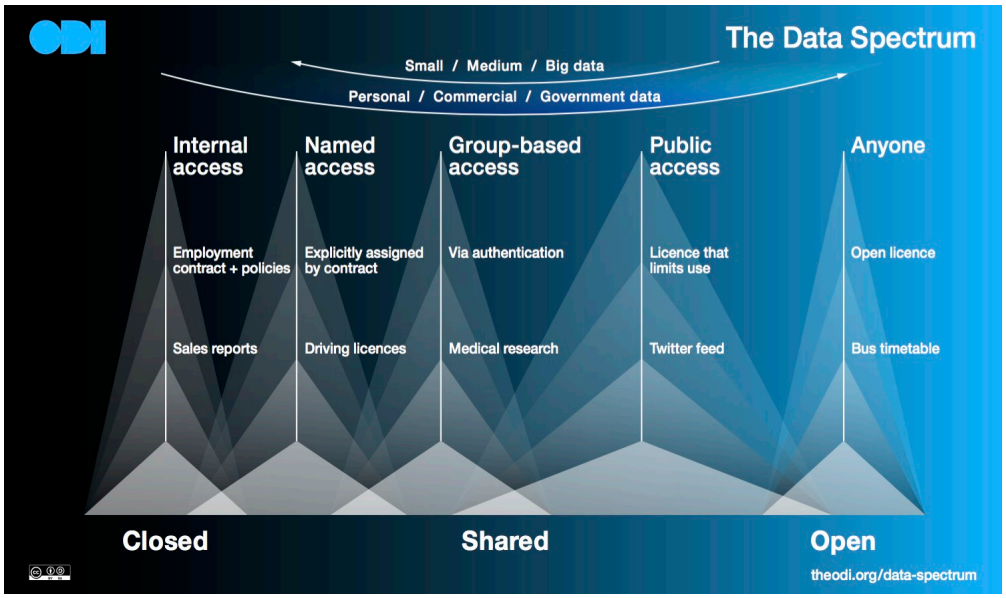


Figure 7: The data spectrum (ODI, 2018a)

The shipper side of the logistics industry can be described as having high-volume or low-volume shippers. The shippers with recurring loads would have established relationships with their carriers whereas shippers with infrequent or ad hoc shipments would have to search for carriers and logistics services. Carriers operate in a fast-moving environment and it can be a challenge to find suitable carriers that have the required capacity and are marketing excess capacity. The difference between needs and availability can be linked to extreme price fluctuations in addition to shippers having to search for suitable carriers and competitive prices (Koch, 2010).

Therefore, electronic marketplaces, such as online freight exchange marketplaces, are leading the way in data sharing to address ongoing freight challenges, such as reduction of empty running and capacity underutilisation of the transportation network. Table 4 presents a wide range of classifications and relationships that can be present. A key is matching logistics environment with the appropriate data spectrum and data sharing characteristics. For example, the open marketplace allows carriers and shippers to use their services with no entry barriers, whereas a closed system focuses on the actual needs of shippers/carriers (Wang et.al., 2011).

Table 4: Categories of the electronic marketplaces (Grieger, 2003, Skjøtt-Larsen et al., 2003)

Classifications	Type of Relationship
Orientation	Buyer-oriented Seller-oriented Neutral
Categorisation	Vertical Horizontal
Pricing mechanism (fixed/variable pricing)	Auction Exchange Catalogues
Purchasing process 'What' & 'How'	Manufacturing vs. Operating inputs Spot vs. System sourcing
Type	Open Closed
Transaction phases	Information exchange Negotiate Settlement After-sales
Market mechanism	Aggregation Matching

There are also other motivations for using such portals. Benefits range from traditional factors linked to efficiency, improving resource utilisation and service level, in addition to environmental, industry-wide and society wellbeing factors, e.g. CO_2 reduction, access to the latest technology (Table 5). It is important to note that shippers and carriers may have different motivation factors and potentially it can be linked to different sectors and types of marketplace (e.g. open/closed). For example, in the collaborative marketplace (form of closed system), shippers emphasise economy, service and visibility, while carriers may have a narrow range of motivations with an emphasis on maintaining good relationship with shippers, and improving service level and responsiveness (Wang et al., 2011).

Table 5: Examples of motivation factors for sharing economy[2]

Motivation type	Benefits
Economic	Control of order-to-delivery process Productivity and efficiency improvement Cost reduction
	Resource utilisation including reduction of empty miles and under-utilised capacity Pool of complementary resources Information richness leads to continuous improvement
Service	Delivery performance Lead time reduction
Visibility	Information visibility Real-time communication
Relationship	Coordination and collaboration
Flexibility	Eliminate communication complexities Reliability and responsiveness
Agility	Reduction in uncertainty
Resilience	Robust operations
Industry-wide	Service visibility Knowledge sharing Access to latest technology Market intelligence Promote industry standards
Environment	CO_2 reduction
Society wellbeing	Employment opportunities

The unique feature of the sharing economy e-marketplaces is that they bring together a number of users, e.g. shippers, freight forwarders, haulage companies, including self-employed couriers and vehicle owners into collective hubs. The logistics exchange marketplaces create opportunities to find exchange haulage work and courier jobs that span from active loads, return loads to warehouse exchanges across UK and Europe/Asia. Having access to such data brings further opportunities for self-employed

[2] Developed from motivation factors for collaborative logistics e-marketplaces (Wang et al., 2011))

carriers and vehicle owners to use such portals to search for suitable general work or return loads. Table 6 presents examples of marketplaces which range from hubs that are dedicated to freight exchange haulage work to portals for individual/business customers to post their requests, for example, for moving personal goods as part of house moves.

Table 6: Examples of online logistics exchange marketplaces

Logistics exchange marketplace	Services (Examples)	Users (Examples)	Tools (Examples)
www.returnloads.net 'Online haulage marketplace for transport companies and the return loads freight exchange averages 3,000 active loads, backloads and return loads every day' As of 28/11/17, 1,779 verified live empty vehicles, 252 warehouses, 33,158,868 sq. ft. of space. Free two weeks trial.	Exchange haulage work and courier work: full loads, backloads, courier jobs, general van work. Warehouse exchange: search for available UK space or make a space enquiry.	From self-employed couriers to international haulage companies; Connects them to freight forwarders; Connects them to manufacturers and commercial businesses.	Access to all loads; all vehicles; Place unlimited loads and your vehicle availability; Real-time load alerts; Real-time vehicle alerts; Mobile app.
https://haulageexchange.co.uk 'Trade-only' online platform for operators working in the express freight and same-day delivery industry (UK & Europe).' As of 28/11/17 – load matching (over 4,500 professional members, excess of 713,000 movements a year).	Freight exchange for haulage work: return loads, back loads or transport contracts	Owner operators; Haulage companies; Freight Forwarders.	Post loads, Real-time loads; Matching load notification; Telematics & mobile app; Diary and Accounting Module, Feedback, accreditation & rating.

Different pricing for UK/ UK & Europe and for different users.			
http://www.truckspace.co.uk 'Dedicated online market place to link companies and individuals who have goods to move with haulage companies and couriers looking for load' UK/Europe Free to use	Road Haulage Services: e.g. regular haulage, return loads; International removals and relocations Storage and warehousing (e.g. self-storage, short-term warehouse, storage container).	Individual Shippers; Couriers; Owner Driver; Freight Forwarders.	List empty vehicles; List a load; Items for sale; Map of storage available/ required and logistics services.
www.lkw-walter.co.uk/en/carrier 'With more than 5,500 loads a day in Europe, Russia, North Africa, Central Asia, the Middle East and the Caucasus.' Free access	Permanent work in round trips; Ideal combination options as a one-way partner; As a trucking partner.	Register as a transport partner.	Register empty trucks; Mobile app.
https://trucksonthemap.com 'TrucksOnTheMap is the trusted logistics partners' community, where You decide with whom you connect and collaborate.' 570 available trucks, 150 registered beta users (30/01/2018) Free trial.	Connect to trusted logistics partners; Build your private network of A+ partners; Visualises all your own & your partner's free trucks; Request quotes from	Freight Forwarders; Non-asset based carrier; Asset based carriers.	Truck availability map

	the available trucks around the loading address.		
https://freight.uber.com 'A free app that matches carriers with shippers.' Free/ Texas at present (4/12/2017)	Book loads	Drivers; Carriers; Shippers; At present 53 dry van and reefer.	Free mobile app; Clear pricing; Fast payment, no fees.
https://www.loadup.co.uk 'Get cheaper goods deliveries and removals using empty return trips of transport companies' 'More than 95,000 customers and transporters have had more than 1.2 million loads delivered since we began operating.' UK/Europe Subscription for transporters (?)	House removal; Personal goods; eBay items; Haulage freight, including return load Freight forwarders bulk load posting.	Shippers; Hauliers; Couriers; Removal Companies.	Examples: Post loads; View loads.
https://www.uship.com/uk/find 'We make transporting big stuff cheap and easy by helping customers directly connect with transporters who have extra truck space.' 3.5 million shipping customers, 788,000 service providers, 5.7 shipment listings (4/12/2017)	e.g. freight services; Self services; Part load freight and packaging; Ocean freight container.	Shippers; Carriers.	'Safer' profile importer; Message centre; Find shipments; Shipment alerts; Mobile app, Share your location (nearby shipment alerts); Bidding tools (automatic

			underbidding, bid alerts, group bidding); Manage multiple drivers, terrapass (US only), PC miler routing and mileage.
www.shiply.com 'Hassle free courier services. Save time and money when customer rated courier companies compete for your work.' 'Utilises spare capacity of vehicles running on the road: 99,262,820 kg/CO_2 saved' (4/12/2017)	Heavy and bulky items (e.g. individual items, house removal).	Shipper, Transport Providers.	Search deliveries.
www.getvan.co.uk	Moving house, bulky items, freight, office relocation, vehicle transportation, Passenger, plant and heavy equipment.	Business/ individual shippers; Van owner.	Post a job; eBay compatible; Mobile app.

The open data in general, related to logistics, has benefits to the industry, entrepreneurial development and individuals. Sources and datasets related to strategic road networks, live traffic information (e.g. current alerts and incidents from Highways England), have been available to users for some time. Nevertheless, the integration of those sources, such as real-time alerts into business processes, requires specialised skill. Links are also available as an additional feature of some online portals presented in Table 6 or through specialised technology providers (e.g. telematics) where subscription charges can apply.

Having access to open data allows for a better understanding of local services and challenges, including travel planning, and it is said to be 'technology that can be used by everyone' (ODI, 2018b). Local councils have started developing open data portals that have a range of datasets that help to 'understand the city' and support the development of solutions to local challenges. For examples, the Greater London Authority established London Data Store, where datasets can be linked with Transport for London (TfL) and it created opportunities to develop third party mobile applications and used as part of the research. Table 7 provides examples of available open data hubs, and it can be seen that some councils are leading and actively developing open data portals across the UK. The data richness will depend on the portal. There seems to be a drive for every local authority to join this 'revolution' and share collected data openly with everyone in society. The challenge of converting data collected by authorities into suitable open datasets may require internal data collection and management process redesign to reduce additional burdens. The Open Data Institute provides a 'Finding Open Data' guide that has starting points for locating open data (see Table 7).

Table 7: Examples of open data sources

Finding Open Data Guide (ODI) (https://github.com/theodi/shared/wiki/Finding-Open-Data)
Examples of open data sources related to transport Open data published by government departments, agencies, public bodies and local authorities (https://data.gov.uk) Open Street Map (https://www.openstreetmap.org) Ordnance Survey (https://www.ordnancesurvey.co.uk) Highways England (www.highways.gov.uk/traffic-information/, http://tris.highwaysengland.co.uk) Department for Transport street-level traffic data (http://www.dft.gov.uk/traffic-counts/index.php) Department for Transport input and impact indicators: other data (https://www.gov.uk/government/publications/input-and-impact-indicators-other-data)
Local Authorities open data (some incl. transport) **UK and Northern Ireland:** Aberdeen (Open Data Statistics) www.aberdeencity.gov.uk/open_data/statistics.asp Belfast City Council: http://www.belfastcity.gov.uk/council/Openandlinkeddata/opendatasets.aspx Birmingham Data Factory (Birmingham City Council): https://data.birmingham.gov.uk Bristol: https://opendata.bristol.gov.uk/pages/home/

Cambridge Open Data: https://data.cambridgema.gov/browse

Camden Open Data: https://opendata.camden.gov.uk

Coventry: www.coventry.gov.uk/info/145/websites_and_social_media/650/open_data

Data Mill North: datamillnorth.org

Edinburgh Open Data Portal: http://edinburghopendata.info

Glasgow: data.glasgow.gov.uk/dataset

Greater Manchester Public Data, DataGM: https://www.datagm.org.uk

Leicester Council: directory.leicester.gov.uk/transparency-directory/

Liverpool (Open Data): www.opendataliverpool.org.uk

London Datastore: data.london.gov.uk

Manchester City Council: open.manchester.gov.uk

Newcastle Open Data: https://www.newcastle.gov.uk/your-council-and-democracy/open-data-and-access-to-information/local-transparency

Nottingham: www.opendatanottingham.org.uk/catalogue.aspx

Oxfordshire Open Data: https://www2.oxopendata.uk

Plymouth: www.dataplymouth.co.uk

Salford Open Data: https://salforddataquay.uk

Sheffield City Council Open Data: https://data.sheffield.gov.uk

International:

European Data Portal: https://www.europeandataportal.eu

Los Angeles Open Data: https://data.lacity.org

New York State Data: https://data.ny.gov

Open Data Swiss: https://opendata.swiss/en/

City Data Exchange Marketplace

Copenhagen City Data Exchange: www.citydataexchange.com

Examples of developments using open data

Transport Apps https://data.london.gov.uk/apps_and_analysis/transport-apps/

http://geolytix.co.uk (create novel datasets using Open Data as inputs, to help with your network strategy and location-based decisions)

https://www.elgin.org.uk/products/data-services (Elgin: Data APIs – data is gathered exclusively from official sources including the national highways agencies of England, Wales and Scotland, metropolitan traffic management centres, over 95% of Local Highway Authorities of England and Wales and organisations responsible for major public events that disrupt traffic)

6 Developments up to 2040

The logistics sector is a vibrant industry, which has grown considerably in the UK and around the world, especially over the last two to three decades. Notably, the challenges of meeting the demands of the supply chain customer, and more recently the online customer, have encouraged huge changes in practice. However, many providers are operating on very thin margins and some logistics service providers have had a reputation for not being as innovative as they could have been, stuck in just meeting the demands of the contract they are working on and not investing in tomorrow. Traditionally, only registered transport companies were allowed to carry other companies' goods, but the phenomenon of 'modern' sharing extends the pool of participants to individuals and provides both opportunities and threats. It is important to note that any changes impact on different levels of logistics decision-making, e.g. strategic (optimum number of warehouses and customer allocation), tactical and operational (e.g. resource and transport planning). The discussion below, in assessing the impact of the rise of freight sharing to 2040, also makes a wider, longer-term assessment of the impact that a growth in sharing logistics could have on sustainability goals and on the jobs sector, where the emergence of the 'Gig' economy in recent years has been correlated to this kind of more flexible, asset-light business model. Implications for regulation and policy will be considered and proposed. Our discussion is split into four areas: economy, social, environment and regulation/legislation.

6.1 Economy

A recent report tried to ascertain the size of the sharing economy. It calculated that the total GDP impact of the sharing economy was still fairly small at around 0.25% of GDP (Feubli and Horlacher, 2015). Here, we reflect on the impact that freight sharing is having and could have on the UK economy, looking at the more traditional areas of logistics such as freight transport and warehousing and then at newer 'freight sharing' concepts.

First, we have asserted throughout this report that despite a great deal of recent heightened discussion, freight sharing is not new. Notably, in its B2B form it has been a defining feature of the way logistics provision has developed, especially over the last couple of decades or so. This means that the impact that freight sharing can bring about is already being manifested in the economy, to a certain extent.

So, for instance, we highlighted in our report (section 4) how the pallet network idea has grown since its inception in the UK back in the mid-1990s to today when around 25 million full and half pallet loads are moved annually (Millet, 2017). On load sharing, the GD's Initiative to combine part loads and seek out new collaborative backhauls is now over 10 years old. Jigsaw, the joint venture linking regional logistics providers is now over 15 years old, as is Tesco's 'Factory Gate Pricing' concept that was built on the idea of holistically running all the consolidation centres in its network. Finally the 4PL concept

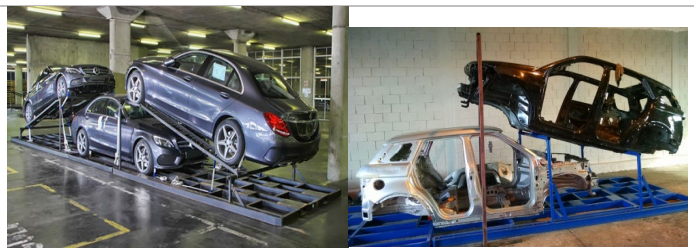
is also not new – the example in steel logistics we cited is over a decade old now. All of these freight sharing ideas have matured and expanded since their inception and their economic success is borne out by the fact that they are all still running.

Where further economic progress can be imagined in this segment of freight sharing is through the further maturity and acceptance of these concepts. For example, the pallet network is growing at 6.3% (full pallets) and 8% (half pallets) a year (first nine months of 2017 (APN, 2018)) currently – substantially above the UK GDP growth rate (1.8% in 2017, 1.9% in 2016).

A key ingredient for freight sharing are modular forms, both on the physical and information sides of logistics, that are structured in such a way that operators can easily bolt on their operations. Here standardisation, accepted across industries, is critical. Transport modules, such as the advent of the standard pallet and container, have been good examples of standardisation that have been instrumental in facilitating link-ups not just between transport modes vertically up and down the supply chain but also horizontally between players operating at the same supply chain level. Still more progress needs to be achieved here – could cars be transported more on containers for instance, which would mean empty car trailers could be avoided (see inset box). Also, on the information side further work could be completed on standardising protocols to facilitate better interoperability. Organisations such as GS1 (GS1, 2018) have been critical here in the development of internationally recognised cross-industry standards, but much more progress needs to be made if the fullest freight sharing possibilities are going to be realised.

Cars in containers

A recent development is adapting containers for transporting cars. One company, 'Kar-tainer', is developing cassette systems for finished cars and for semi-knockdown shipments. For every 10–15 loaded shipments, one container is returned with the cassette equipment.



This is a good example of expanding the use of a modular component to a new use. Once achieved it would allow cars to be mixed with other goods on freight transport flows and also has the benefit of allowing the container to be used for other goods on backhaul flows. The inefficient and unsustainable empty car transporter returning to base may become a relic of the past!

It is also worth reflecting here on some of the other barriers to freight sharing and whether they could be removed. A significant barrier relates to the issue of fair 'gainsharing'. This is a major inhibitor but intermediary platforms are proving useful in managing this issue. This expanded use of 'platforms' is likely to continue for this reason in freight sharing.

The second barrier we identified was reduced control. Undoubtedly freight sharing at the B2B level can produce value benefits, but it also can have drawbacks where value can be lost through lack of direct control. We have found that many supply chains are operating to exacting standards dictated by suppliers and customers who value certainty and consistency above all. Freight sharing may give customers cheaper logistics or quicker logistics but if this is at the expense of certainty it is very often not even contemplated by suppliers. This is a major issue which may be overcome in time as modular forms, new technologies and the sheer force of competition encourage suppliers to give up direct control and go further down the sharing route – but we found that there is still a great deal of resistance here.

The final key barrier we have identified relates to a fear of competition/anti-trust legislation. This is covered further in the section on legislation below. However, in brief we have found examples where freight sharing opportunities are not fully explored or taken up as companies are afraid that they could stray, or be perceived to stray, into collusion rather than genuine collaboration with companies they otherwise could combine with. Examples include the freight forwarders who were fined €169 million for alleged price fixing on air transport in 2012, or UK grocery retailers who were fined £116 million in 2007 for allegedly fixing the price of dairy products such as milk or cheese, loom large in the psyche of companies. Being risk averse, it steers them away from any potentially questionable activity such as working with a competitor to arrange for consolidated deliveries from a supplier(s), even where there would be no pricing advantage and potential environmental gain through reduced emissions from fuller vehicles.

Another couple of barriers mentioned in academic research are the uneven adoption of ICT solutions among logistics companies and unequal negotiating position of the partners (Cruijssen et al., 2007; Krajewska et al., 2008).

The main barriers in relation to horizontal collaboration/freight sharing are listed below:

- Lack of standards, both of physical modules and ICT protocols;
- Difficulty in fair gainsharing;
- The fear of losing control and maintaining required service level;
- A fear of anti-trust legislation;

- Uneven adoption of ICT solutions among logistics companies;
- Unequal negotiating position of the partners.

In newer 'freight sharing' concepts our research has identified great energy and potential – although as yet they are not to be fully regarded as mainstream concepts. From an economic perspective they could be divided into three groups:

- Those ideas that are genuinely driving the economy onwards, producing new types of business that did not exist before, or extra growth potential;
- Those ideas that are merely facilitating swapping from one supply chain concept or transport mode to another – i.e. not generating any new growth per se;
- Those ideas that are serving growing areas of business such as e-commerce, making this growth more viable

A final point on the economy centres on what impact 'sharing' could have on economy measurement, taxation and pricing. The traditional notion of sharing refers to swapping, borrowing; informal arrangements that do not involve monitory exchange. Therefore if discounts, freebies, special offers and payments in 'special currency' (e.g. tokens) are offered to participants in flexible deliveries, how does that contribution overall add to GDP measurement and to what extent do those activities need to be regulated? The transformation of those credits into actual payment (money) will have further implications in relation to tax and this needs to be taken into account to move away from 'underground trading', especially as the sharing economy environment expands. There is also the prospect of the dynamic pricing model spreading and being applied to aspects of logistics that they have not been applied to before. Sharing converts the product of logistics more into a service – like travel for example. As this occurs it may be that new pricing models based around the dynamic pricing concept become more prevalent in logistics. If products are moving from goods to services then there may be a trend towards more dynamic pricing.

6.2 Environment

Many of the impacts that freight sharing is having, or could have, on the environment are similar to those discussed in section 6.1 on the economy.

Indeed, for many of the more traditional forms of freight sharing involving freight transport, such as the IGD Reducing Wasted Miles initiative, although economic

advantages have been a driver, environmental performance gains have actually been the main catalyst that has brought interested parties together.

What seems to be clear is that for the most part the so-called 'Green/Gold' agenda appears to have dominated environmental progress, so freight sharing that contributes to improved commercial performance as well as environmental performance seems to be the pattern followed. We found very few examples where freight sharing was pursued on environmental grounds but at the expense of the commercial agenda.

There is no doubt that freight sharing initiatives have made a substantive contribution to reducing emissions, however. For example, a 25% saving on CO_2 emissions has been quoted as being saved by pooled networks (Ballot and Fontane, 2010). The pallet network, quoted above, cites a saving with fill rate of 74% compared to 51%, which is the industry average (APN, 2018). It is interesting to reflect, however, on why empty running has remained so stubbornly high – actually worsening slightly over the past decade – if freight sharing is meant to be providing opportunities for this kind of 'waste' to be reduced.

The Chartered Institute of Logistics report (CILT, 2016) on the state of UK logistics at the middle of this decade postulated that while centralisation had been a theme that characterised the evolution of logistics over the last couple of decades the next period, potentially up to 2040, would be characterised by a trend of decentralisation fuelled by customers requiring time-efficient deliveries and the rise of e-commerce in particular. It is interesting to consider to what extent freight sharing initiatives could ameliorate the worsening emissions that could have resulted from this decentralisation process. The numerous initiatives in the 'last-mile' section (4.2) point to the possibility that they could help considerably in this endeavour.

Also there are many new forms of freight sharing around the world and incumbent freight sharing initiatives across industries and between public and private parties using big data and data sharing initiatives that could be productive in reducing emission rates.

Finally, by 2040 the landscape will have changed considerably with electric vehicles taking over much of the freight distribution by then. This evolution will have to be fully considered alongside the development of freight sharing parties, etc.

6.3 Social

We reflect here on the impact freight sharing is having and could have on society, especially focusing on employment patterns where the notion of the 'gig economy' is very much associated with the freight sharing concept.

Balaram et al. (2017) estimate that there are 1.1 million 'gig' workers in UK. They relate that the 'gig economy' refers to the trend of using online platforms to find small on-demand jobs, which is clearly also part of the sharing economy. These new business

models and practices are bringing about working flexibility which is valued by contractors and to a certain extent by employees in certain situations. This can be important for the labour market, but many argue that this kind of new flexible working model should not be exploited by employers just to reduce costs. There is a concern that this is beginning to occur and, moreover, is moving the risk of employment too much over to the employee, who faces uncertainties in relation to work offered or understanding if there is an entitlement to related sick and holiday pay (Taylor et al., 2017).

In the freight transport/retail sector, there are further concerns related to meeting employment legislation, including minimum wage compliance, employee training and health & safety. For instance, agency companies often supply drivers for the sharing economy workforce, so that the main company does not have to directly employ dedicated drivers. These 'self-employed' workers, while working directly for an employer, could be required to pay a daily fee for vehicle hire and additional administration fees while receiving a flat daily rate based on output (successful deliveries) without any guaranteed hours, so that by the end of the week the driver could earn less than minimum wage.

There are also tax advantages for the employer, apart from saving on holiday/sickness payments. As a full employee the employing company would have to pay its share of National Insurance for the worker. Employing self-employed workers avoids this obligation, thus giving employers who go down this route a potential competitive advantage compared to employers who do not.

There is, therefore, a growing call for government to clarify the law regarding workers in the 'gig economy' and 'to close loopholes that incentivise exploitative behaviour by a minority of companies, not least because bogus self-employment passes the burden of safety net support to the welfare state at the same time as reducing tax revenue' (House of Commons Work and Pensions Committee, 2017).

Balaram et al. (2017) also note that 'classifying workers appropriately under the law is also limited in its potential to transform workers' experiences of the labour market. The law will not guarantee that work is fair in other ways that matter; for example, the law cannot guarantee "gig" workers more power over decisions that affect them or a larger share of the value that they've created.' Taylor et al. (2017) emphasise that complexity in legislation makes it very hard for individuals (and for that matter employing companies) to easily and clearly determine if they are an employee, a worker or genuinely self-employed. This has impacted on individuals' understanding of their employment status and rights and what the responsibilities of the businesses are.

So while there are advantages for both businesses and employees in the 'gig' economy way of working that is becoming a key part of the modern sharing economy phenomenon there are growing calls for a tightening up of legislation to make sure it works well for all parties involved. Awareness of the debate around employees in the 'gig' employment labour market is growing, and in particular over whether the benefits

are too one-sided and potentially exploiting workers with ‘bogus self-employment contracts’ (Butler, 2017). The Work and Pensions Committee intend to close loopholes allowing businesses to potentially underpay their workers (Butler, 2017), which will be an important development for the future of the freight sharing idea.

Beyond consideration of employment type, freight sharing is having and will have various impacts on jobs. On the one hand freight sharing will lead to new job opportunities, such as new start-up enterprises, epitomised by companies such as Deliveroo and Uber Freight. The pallet network is another example where new jobs have been created. On the other hand freight sharing could lead to efficiencies and job losses. All this needs to be considered in the context of other, wider changes such as the move to robotics, autonomous vehicles, etc., which are having an impact on employment patterns in logistics, and will continue to do so.

6.4 Legislation/Government/Local Authority

The UK law and local authorities’ regulations can support and enable the formation of new collaborative networks and can also be seen as an obstruction to sharing economy. A range of related areas discussed previously in this report are touched on in turn briefly here. Table 8 presents a summary of related points made with suggested actions.

Table 8: Legislative and governmental issues affecting freight and the sharing economy, with suggested actions

Area	Suggested actions
Anti-trust legislation	Re-establish guidelines/legal best practice to clarify legally permitted sharing collaborations, especially for activities in the so-called 'grey' area.
Local Authorities	Consider encouraging LAs to be less 'piecemeal' in developing local area plans for logistics provision. For example: • approach to support establishment of urban consolidation centres; • review restrictions in relation to commercial delivery vehicles in urban areas; and, • consideration of possible use of bus lanes for local deliveries. The LA decisions should consider the local logistics needs, but should also be in line with UK logistics strategies.
Integration of passenger transport and multi-modal options	Re-imagining possibilities for sharing using current infrastructure and supporting the development of those projects.
Big Data	The emphasis on pooling resources to be supported and generated by local governments in collaboration with local stakeholders.
Vehicle regulations	With an expected increase of the following in the sharing economy, it is important to ensure regulation keeps pace with technological change in: • Vans below 3.5 tonnes; • Motorbikes, scooters and learners for deliveries.
Open data hubs/ marketplaces	The rope of government at various levels in relation to open data hubs/marketplaces should be reviewed, especially in relation to data management and centralisation.
Mobile phone coverage and internet	Consider what are minimum expectations and investment required to support the freight sharing economy.

Anti-trust legislation: The legislation should be reviewed due to a danger that current EU anti-trust legislation can impede potential collaborative opportunities from being established. We have found that there are missed opportunities in freight sharing that would benefit the economy and the environment. This stems from a feeling of 'uneasiness' that we found to be evident among potential participants when collaboration, especially involving potential competitors on a larger scale is considered. Among risk-averse companies this could lead to 'safer' practices that are legally permitted being preferred and any activities in the 'grey' area not being explored – leading to innovation being stifled. There is a thin line between perceptions of the law and how the law is handled.

For example, on inbound deliveries, load consolidations could be initiated by suppliers or their customers. In the environment where, for example, customers are participating in the sharing economy, written regulations can imply that planning inbound deliveries is 'outside' of the collaborative partnership, but if the supplier delivers to the same location on a different day it is up to supplier to 'spot' similarities and negotiate suitable delivery days for consolidated loads. At the same time, the customer involved in the collaboration could not ask the supplier directly to consolidate their own and their collaborator's deliveries as those decisions are in the 'grey' area, even though the customer manages all of their collaborators' internal processes.

Therefore, legally permitted collaborations that are outside direct scope of sharing opportunities need to be established and explored at the initial stage and further reviewed as collaboration evolves. The establishment of guidelines and the development of legal best practices need to be considered to support anti-trust legislation.

Local Authorities (LAs): LAs propose local plans in relation to polluting vehicles in their areas. For example, Oxford city council and Oxfordshire county council proposed a ban of petrol and diesel cars from the city centre so that Oxford will become the world's first zero emission zone (Jones, 2017). The ban will include light commercial vehicles and the zero-emissions zone will extend to cover all non-electric vehicles, including HGVs, in the whole city centre by 2035. Any changes to the road infrastructure and vehicle restrictions have an impact on logistics provision. A 'piecemeal' approach to legislation where different councils ban different vehicle types in specific areas would have to be financially absorbed by logistics providers, for whom it might not make economic sense to change all trucks to electric vehicles. This also could lead to changes in the network infrastructure and establishment of new 'consolidation centre' clubs where the collaboration among LAs and the private sector is essential to support smooth transition of deliveries at different phases.

Changes proposed by LAs also create further sharing opportunities where passenger transport options should be explored further (see section below on 'Integration of passenger transport and multimodal options', and section 5). One example is the possibility of using bus lanes for urban deliveries post consolidation centres. Therefore it is important to undertake a holistic approach to decision-making and review the role of

Government and LA in decisions that impact on freight movements and how the decision-making is aligned with national transport strategies.

Integration of passenger transport and multi-modal options: The sharing economy encourages exploration of further sustainable options for freight movements, where collaborations needs to be encouraged among different providers that already have established infrastructure and assets, for example passenger transport service providers (buses, taxicabs, delivery sharing), bikes, waterway options and rail passenger networks. According to Passenger Transport (2018), the public transport sector is entering a new era: it quotes Alain Flausch, the secretary general of the International Association of Public Transport as saying 'it used to be a "very dusty and conservative industry", neglected by public authorities, highly unionised and insensitive to customer needs. However, the arrival of new agile mobility players means that transport authorities and operators simply cannot afford to be complacent.'

The role of multi-modal options (e.g. barge, rail) in sharing needs to be re-examined and 're-invented' where the sharing becomes a part of the core business, bringing the environmental agenda forward.

Big data: The use of big data can transform and create new services and business models in the sharing economy. The development of data-driven decision making proposals with the emphasis on pooling resources needs to be supported and generated by local governments in collaboration with local stakeholders. Following from the government's Total Transport initiative in 2015, there is a natural expansion of the scope to engage local transport authorities, logistics service providers, port authorities and rail networks in sharing freight economy projects.

Vehicle regulations: Current UK regulation for van drivers state that they can work up to a maximum of 11 hours a day (10 hours of which is driving). The sharing economy will increase the use of self-employed/agency/occasional vehicle 'owners' where online shopping drives this trend. The question is how regulators can monitor to ensure that van drivers do not exceed allowed working hours where tachograph is not required for vehicles below 3.5 tonnes.

Additional consideration needs to be given to regulations around motorbikes and scooters where learners potentially can do commercial deliveries on routes or as part of the separate journeys. Is there a need to create a driving licence for bikes that are used for commercial use?

Open data hubs/ marketplaces: The open data hubs encourage innovation and in relation to transport data this development is mainly driven by individual LAs where businesses utilise open data sources. It is very encouraging to see how it has been embraced by LAs, but in some areas it is still in the early stages of development and level of aggregation of available datasets may not be suitable for required purposes. The role of government in open data hubs and marketplaces should be further questioned, especially in relation to data management and centralisation, which both

need to be discussed further. The transformation of open data into 'useful things' will depend on building in expertise and will require skills and understanding of how to get maximum value from the data.

It would also be beneficial to understand why some LAs are leading in open data innovation and how other LAs can follow these early innovators. There are many open data hubs, but what are the challenges related to different data representation for similar sets? Moving further from city-level to national-level depositories, and extending to marketplaces, could potentially generate additional revenues for LAs. Should charging for useful datasets/information be a new revenue source for authorities?

Mobile phone coverage and internet: If freight sharing becomes more widespread and more of a feature of the modern way of life, questions emerge around the quality of internet coverage – which freight sharing depends upon. Is it acceptable from a freight sharing perspective that one area of the country could benefit from freight sharing innovative practice but others do not, for example.

6.5 Reflection on future state of sharing economy

Freight sharing is clearly an increasing feature of modern logistics and we envisage that it will expand in prominence in the coming years. We draw this conclusion on the basis that there are a range of contributing factors that are developing to make the supply of freight sharing easier for service providers to either create or access. These contributing components are summarised in Figure 8 and are briefly explored below.

Clearly a major driver of freight sharing potential is derived from advances in **technology**. Notably, this is leading to the possibility of shared systems thinking to help support the enhanced management of freight sharing opportunities. We are seeing numerous examples, some of which are described in this report, of online hubs and marketplaces that aim to facilitate the bringing together of suppliers and customers to access freight sharing services. Further developments can be derived from the cloud-based nature of these hubs/marketplaces. This access to relevant **data** and services can be conceived of as being managed on a spectrum from fully open (like the internet-based system) to fully closed (for instance on an intranet, only accessible to a defined community). Indeed the ability to share data, often from apparently unrelated activities, to create useful information that may aid freight sharing in some way, is a fascinating area of potential development – this what is known as the 'big data' idea. In summary, technology advances and improved access to relevant data are key drivers of freight sharing, which will only increase in future years as innovation comes to fruition.

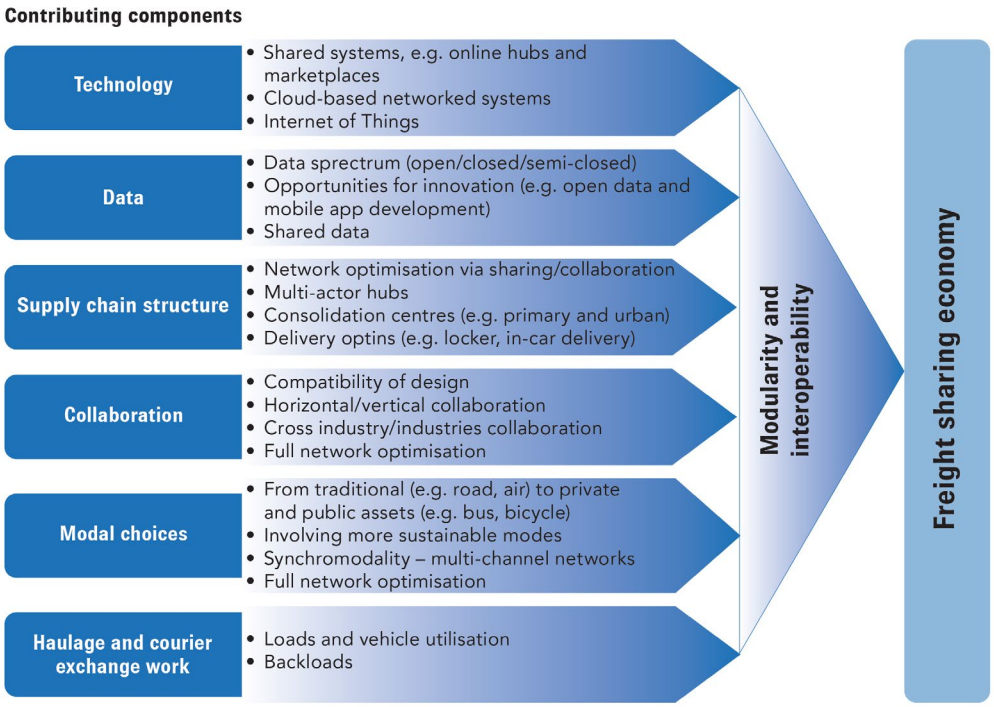


Figure 8: The future state of the sharing economy

However, it is not just on the information systems side where freight sharing opportunities are becoming more attractive to consider. On the physical side of supply chain activities, too, there are discernible changes occurring that are driving interest in freight sharing. For instance, cost pressures on asset ownership in logistics are being accentuated by globalisation (which has increased the intensity of competition) and customers' access to the internet, which means there are no hiding places any more for inefficient supply chain activities in many industry sectors (customers will just move elsewhere). Freight sharing is conceived by many as a way in which costs can be reduced through generating economies of scope. And it is clearly not just on the costs side that supply chain actors are under scrutiny, with customers also demanding enhanced service levels in terms of reliability and /or faster deliveries. Again freight sharing offers the possibility to better meet these demands. So new **supply chain structures** are being explored and taken up that revolve around network optimisation, via sharing, with possible multi-actor hubs such as consolidation centres or special access delivery options being tried out.

A key to sharing is the ability of actors at the same level of the supply chain to work together effectively. **Collaboration** can be conceived of at various levels: one to one, one to many, many to many, even industry to industry or full network optimisation. Facilitators, as we have discussed in the report, can be key to enabling this cross-player coordination and this helps sort out the issue of gainsharing, which has proved to be a problematic issue for potential horizontal collaborators to operate sustainably. A key

question here is how the facilitating hub is created – should it always be left to the private sector or should government play a role in its inception and operation. If the latter, numerous questions can be tabled and considered:

- what level of government should be involved (national, regional or local);
- what monetary form should it take (financial or non-financial);
- what time period should there be an involvement;
- what time horizon should be considered for the business model investment period;
- how long should a publicly run facility actually exist before it is either closed down or handed over to the private sector to run;
- what level of subsidisation should exist?

The edge of city consolidation centre for freight, based in Bristol, is a classic case against which many of these questions can be asked. Around the world we have identified examples where public governing authorities are playing influential and active roles to try and catalyse more freight sharing activity potential. In the UK this is an ongoing area for the governing authorities to consider.

Finally, the physical nature of freight movement needs to be considered. Much of the waste and/or undesirable externalities from freight movement derive from **mode choices**, for instance in under-utilised freight movement modes or excessive use of less environmentally friendly transport modes. Freight sharing has tremendous potential to improve the environmental performance of freight movement by generating economies of scope to allow more sustainable modes to become more viable (for example, increasing the use of inland waterway or rail rather than road transport), or in urban environments through, for instance, facilitating the consolidating of loads for customers so fewer vans are required or improving the better load-fill or reduced backhauls of road lorries. A counter-driver here is the huge pressure that supply chain actions face in ensuring their supply chain performance is optimised (reliability of delivery cannot be compromised in today's highly integrated supply chains and excessive costs cannot be excused). Sharing can be seen as a loss of supply chain control that coordinating actors such as logistics providers do not feel they can afford to give up. However, there remains much potential to improve the environmental performance of freight movement operations (for example enhancing **haulage and courier exchange work)**.

To conclude this consideration of Figure 8, for freight sharing to develop further we argue that two fundamental aspects need to be encouraged: improved **modularity** and enhanced **interoperability**. It is worth briefly exploring these two ideas to gain further insights into why they are so critical.

Modularity: a module is a set of standardised parts that can be combined to produce more complex structures. This concept is known as modularity, which is a systems concept idea that describes how the components in a system can be inter-linked (Rajahonka, 2013). It has a long history, notably in its application to manufacturing. When applied to services, there is still some vagueness in relation to definition, but for the purposes of this report, we refer to service modularity as the conceptualisation of the possible connectivity and interoperability of smaller subsystems in service provision. For example, it can be related to information system architecture, protocols, packaging and/or transport structures to support sharing in unit load movement. Modules have multiple benefits in relation to freight sharing. They can act as:

- critical platforms around which greater sharing possibilities can exist;
- a supporter of rapid development of solutions in freight sharing;
- easier duplication of a freight service in another setting;
- the customisation of services to improve the variety of solutions for customers to suit their needs.

Interoperability: interoperability has traditionally been seen in logistics as an enabler of various transport modes in the vertical supply chain in working seamlessly together to create multi-modal transport solutions for customers. Interoperability is also important to allow freight sharing to occur between players at the same level of the supply chain. The degree of interoperability in freight sharing is the measure of how easy/ convenient it is for players of the same level of the supply chain to communicate, exchange data, use information, and act together to provide freight services solutions. Modularity is a big supporter of interoperability, where good feedback mechanisms and widely accepted standards, as well as synergistic operating cultures can also play important roles.

In summary, we argue that modularity and interoperability can be contributing components for increased freight sharing.

7 Conclusions

There is a view that the logistics industry is living in the past both technologically and from a mind-set perspective (Winchmann, 2017), but this report has provided considerable evidence that in the area of freight sharing this is not the case. A great deal of innovation, in some cases driven by technology, allows for the development of new business models and practices (see IFSTTAR, 2018).

We have structured the report around four areas of logistics: transport, warehousing, last-mile and data sharing. In the transport and warehousing aspects of logistics, freight sharing practice has been a defining feature of logistics for many years now. In last-mile and data sharing, new forms of sharing are emerging and there are also new forms of sharing in transport and warehousing. In combination, this is leading to many possibilities in logistics practice that have implications for the economy, environment and society, that need to be reflected by legislators.

We envisage that there are a range of contributing components: technology, data, supply chain structures, collaboration, modal choices and haulage and courier exchange work that all need to be taken into account where a tendency towards freight sharing can be identified. We observe that the concept of modularity, making it easier for players at the same level of the supply chain to interoperate with each other in the provision of freight sharing, is leading to an increased prevalence in its use.

We anticipate that freight sharing will increasingly become a feature of business logistics practice in the UK over the coming decades.

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