THE FREIGHT HUB CONCEPT AND AN INFRASTRUCTURE ASSET MANAGER PERSPECTIVE ON IT

Author
O. ARENDSEN
Trainee at Rijkswaterstaat, Ministry of Infrastructure and Water Management, The Netherlands

Co-Author
F. NIEMAN
Senior Advisor on freight transportation at Rijkswaterstaat, Ministry of Infrastructure and Water Management, The Netherlands

Co-Author
A. Dijkstra
Senior Advisor on spatial developments at Rijkswaterstaat, Ministry of Infrastructure and Water Management, The Netherland

Co-Author
ir. T.C. STRIBOS
Senior Advisor on accessibility and urbanisation at Rijkswaterstaat, Ministry of Infrastructure and Water Management, The Netherlands

Abstract

This paper researches the concept of the freight hub and investigates the role of an infrastructure asset manager, in this case Rijkswaterstaat, by researching its current perspective on freight hubs. Freight hubs are credited for their potential in developments towards more sustainable and efficient usage of infrastructure. Despite difficulty to define the concept, this paper identified three potentials for which freight hubs can play a role: modal shift, upscaling, and last-mile deliveries. However, due to limitations such as lack of capacity and data, these potentials are still underutilized. This is in part due to a perspective on freight hub development as less relevant than other asset management tasks. The identified potentials and the data from interviews that have been taken show that a reconsideration of this perspective might be due.

Keywords: Multimodal Transport Equipment, Infrastructure And Spatial Planning, Freight Hubs, Infrastructure Asset Manager

1. Introduction

An important actor in the Netherlands on the stage of infrastructure is Rijkswaterstaat, an executive agency that is part of the Ministry of Infrastructure and Water Management. This organisation is involved with the development and maintenance of public works (such as bridges and tunnels), main roads (mainly highways) and water management. This role is shifting more and more from developer towards maintenance as a lot of infrastructure has already been constructed in the previous decades (Del Grosso, Inaudi & Pardi, 2002).

Rijkswaterstaat (RWS) is currently working on gathering knowledge on freight transport on their networks. For networks, quantity (amount of kilometres road constructed for example) is not the only thing that counts, the quality of the network is also important (Banister & Berechman, 2004). Quality, among other things, refers to the extent of the physical network. How well is the network linked to nodes and how are these nodes organised, as these places are often points of congestion. These nodes, which can also be referred to as hubs, are therefore an important part of the network. Yet what exactly constitutes a hub in terms of freight and logistics is somewhat vague. In its most basic way the concept of (freight) transport hubs stems from the hubs-and-spoke network, in which a hub is a central point for collection and distribution of goods and people (Rodrigue, 2013, p. 67). This, however, leaves a lot of space for interpretation when it comes to freight hubs. As freight by itself is very diverse, the hubs through which they will flow can also be very different. Bulk goods such as coal, for example, will flow through very different hubs than consumer electronics such as smartphones. Hubs can also have different geographical orientations, local city hubs serve a different area than international main ports, such as the port of Rotterdam.

Knowledge on freight hubs can be useful in planning for more efficient and more sustainable usage of infrastructure. Which is relevant as a lot of expensive infrastructure such as bridges and tunnels are coming up for replacement or expensive maintenance (Del Grosso et al., 2002). Furthermore, understanding the influence of freight hubs is also important as more and more municipalities are enforcing stricter vehicle restriction, which forces creation of freight hubs on the fringe of the city where a change of modality takes place. Such hubs could have an effect on the network as a whole (Stathopoulos, Valeri, & Marcucci, 2012).

Up until recently freight transport and logistics were underrepresented in planning literature. Most focus was on passengers and individual mobility issues (Hesse & Rodrigue, 2004). This consequently also means that research related to hubs also mainly focussed on hubs that served passengers (Rodrigue, 2006). Though this has been changing in the last 10-15 years, most focus is still concentrated around passenger transportation (Akgün, Monios, Rye, & Fonzone, 2019). For this reason this research aims to contribute to the literature freight transportation planning by exploring the concept of freight hubs, its potential impacts and what is could mean for Rijkswaterstaat as an infrastructure asset manager.

The central question this paper tries to answer is: what are freight hubs and how are they perceived by Rijkswaterstaat? To answer this question this paper will first try to define freight hubs and potential effects that are associated with such defined freight hubs using existing literature. The other part of the paper will look into the perception of Rijkswaterstaat on freight hubs by doing four case studies on local involvement in local freight hub developments.

2. Freight hubs

As stated, no clear definition of freight hubs exists. However, in policy, hubs are associated with its potential to avoid trips by consolidation flows of freight, which leads to a reduction in vehicles needed to transport the same amount of flows. It could potentially also ease congestion by shifting to more preferable modes of transport (Klauenberg, Elsner, & Knischewski, 2020). This fits well within the intermodal transport chain framework that Rodrigue (2013) describes.

2.1 Freight hub characteristics

Rodrigue (2013, pp. 110-112) describes the nature of intermodal transport as consisting of four characteristics:

- Composition: Here freight is assembled and consolidated from local/regional distribution systems that links it to (inter)national distribution systems. An example could be an inland (river) harbour.
- Connection: This involves a consolidated modal flow between two terminals, such as barges from an inland terminal to a larger port.
- Interchange: This is where major intermodal exchange takes place, mostly at a national or international level. Most prominent examples are major ports (such as the port of Rotterdam).
- Decomposition: This is where freight is fragmented and transferred to the local/regional freight distribution system. This part is also known as the 'last mile'.

Such characteristics could apply to a multitude of things, though they all relate to logistic activities and its related industry (warehousing, multi-modal terminals, etc.). Within this logistics industry a trend has been observed that is referred to as logistical sprawl (Onstein, Visser, Tavasszy, & van Ham, 2016). This is the process in which logistic centres are moving towards the peripheries of urban centres as demand for floor space per facility keeps growing and space on the cities periphery is cheap, leading to so-called XXL-distribution centres. Cheap land prices are, however, not the only reason for logistical companies to relocate. Research by Klauenberg, Elsner, and Knischewski (2020) cite multiple reasons for relocation. Besides the fact that land is cheaper, it is also less dispersed. Larger plot sizes reduce the need for internal transhipments and therefore reduce cost. Other cited reasons are the proximity to high quality connections in the periphery, mainly referring to highway connections, the lack of disruptive forces (such as congestion), distance to residential areas that regulate working hours due to noise disturbance, and, though not considered as a decisive factor, government incentives (such as subsidies). Such a sprawl could be unwanted if it leads to a fragmented landscape (NOS, 2019). In the Netherlands there has also been research investigating possible logistical sprawl. Onstein et a. (2016,) research potential logistical sprawl for the Netherlands as a whole and found, while growth of peripheral areas was observed, that no significant sprawl could be observed.

2.2 Freight hub potential

As hubs can be considered to be the nodes within what Rodrigue (2013, pp. 110-112) refers to as the intermodal transport chain, hubs could help support modal shift (as multi-modal nodes), upscaling or intensifying freight flows (as nodes of consolidation), and play a role in making the last mile more efficient (as places of decomposition).

Modal shift

This relates to another concept related to modal shift: modal split. Modal split is simply the share of each mode of transport in the total amount of transport movements that are made in a defined urban area. For example, in American cities the car would probably be the most dominant mode of transport. Modal shift refers to a change in modal split. In most cases this means a shift away from the dominance of the road towards other forms of mobility, such as active mobility (walking and cycling for example). For freight transportation in Western Europe this is also the case. As roads are becoming ever more congested it harms the competitiveness of European economies (Blauwens, et al., 2006). However, while there is a willingness to promote modal shift, actually achieving it may prove to be difficult. Not all types of cargo can easily be transported on other more (politically) preferable modes of transport. Depending on the location, some modes of transport will simply not be available. For instance, even if rail infrastructure is within range, this is only useful if there is also a terminal to load goods onto a train. This in turn will only be done if it is financially viable to do that.

Upscaling

Upscaling refers to increasing the amount of goods that are consolidated at a hub and send over the network. One example is increasing the size of container vessels (post-panamax) to be able to haul more containers per trip. On the road, such freight consolidations efforts also exist, and can have different forms. A couple of examples are: truck platooning, ride sharing, and so called 'SuperEcoCombi's' (Bhoopalam, Agatz, & Zuidwijk, 2018; Verweij et al., 2020). Such efforts of upscaling make freight transportation more efficient and sustainable as less fuel is used to haul the same amount of goods. It, however, could also cause more damage to existing infrastructure (ITF, 2018)

Last-mile

The last mile is often considered to be the most difficult part of the supply chain (Kin, Verlinde, Sterckx & Macharis, 2020). There are a multitude of reasons for this: a lack of unloading space, vehicle restrictions and congestion. In large and dense cities this problem is even more evident. What makes it even more complex is the large variety of stakeholders involved in urban freight planning (Stathopoulos, Valeri, & Marcucci, 2012). Related to general upscaling, freight hubs could help reduce the amount of vehicles needed to supply certain areas of the city by consolidating loads in so called 'urban consolidation centres, also knowns as UCCs (Allen, Browne, Woodburn, & Leonardi, 2012). However, while credited for their potential to reduce the amount of traffic and related environmental impact, it still questioned whether such UCCs are financially viable.

2.4 Spatial impact of freight hubs

Besides potential, a freight hub as a spatial entity also has an impact on the surrounding environment. Two concepts have been identified that could help assess such impacts: the functional urban area and the freight landscape.

Functional Urban Area

Vital Nodes (2018) defines the functional urban area as a concept that can be used to describe the 'potential emerging spatiality' of an urban node (Vital Nodes, 2018). This, however, is just one of the different definitions that is given to the concept. The OECD uses, in contrast to Vital Nodes, a step-by-step model to define a FUA (Dijkstra, Poelman, & Veneri, 2019). This definition puts more emphasis on the daily commutes and therefore seems to have something in common with the daily urban systems concept. This definition is further explored by Sýkora and Mulíček

(2009) who argues for an extended definition called the complex micro regions. This definition is broader than the functional urban area as it also incorporates peripheral nodes within the demarcation of the concept, something that is not the case when the FUA definition of the OECD. However, these definitions seem to focus more on the transportation and flows of people moving to and from work. This contrasts with the purpose of the Vital Nodes interpretation of FUAs, which is more focussed on freight transportation. This emphasis becomes clear with the fingerprint method applied to analyse functional urban areas (van der Linden, & Linssen, 2019). This method contains a framework for data collection (fact and figures) and a framework to assess the collected data (impacts).

Goal of the functional urban area is to have policymakers start looking beyond their own administrative boundary to solve certain spatial planning problems. For instance, one could try to invest in more road infrastructure in the port of Rotterdam to increase the throughput, but this money might be better allocated in other parts of the country (or even in neighbouring countries) as the extra capacity is not utilized due to bottlenecks that exist elsewhere. This concept is relevant in de context of freight hub development as it could help support the decision to develop such hubs by putting the development in a network perspective and thereby relating them to other relevant places.

Freight landscape

One problem the functional urban area cannot solve is estimating the potential congestion and pressure on the network that could be generated by development of hubs (such as container terminals or distribution centres). This is in part caused by the lack of data on freight flows, and in particular the lack of data on truck traffic. A concept that tries to work around this lack of data is the freight landscape (Rodrigue, Dablanc, & Giuliano 2017). The concept of the freight landscape is meant to be a representative of the spatial distribution of freight activity and intensity in large urban areas (metropoles).

The concept hypothesizes the relation between urban density (of employment and population) and truck intensity. Meaning that more dense urban areas, such as the city centre, have more intense truck activity than more rural areas. This hypothesis has been successfully tested in Los Angeles and Paris (Giuliano, Kang, & Yuan, 2017; Sakai, Beziat, Heitz, & Dablanc, 2018). This means that density of population and employment could serve as a proxy to estimate the intensity of truck activity. Sakai et al. (2018) also found that proximity to intermodal facilities (rail-road facilities) has an significant effect on truck traffic demand. Giuliano et al. (2017) could not find such a relation in Los Angeles for trucks and intermodal facilities, but did find the overall traffic intensity (cars and trucks) to be correlated to such facilities. Though intermodal facilities have a significant role in estimating truck traffic demand, distance to highways is the most important accessibility variable in estimating truck traffic demand.

While pointed out that it is still in early development, the concept and methodology of the freight landscape could be a useful tool in making rough estimations of truck traffic. This is especially helpful if more direct data on truck flows in not available.

3. Methodology

Summarizing the previous discussed literature, it can be observed that hubs touch upon a wide variety of subjects. Knowledge on the impact of hubs could therefore be relevant for an infrastructure asset management organisation such as Rijkswaterstaat as, for example, consolidated freight efforts, which leads to heavier loads, could potentially cause more wear

and damage to roads (ITF, 2018). However, not all things related to freight hubs are equally important to an infrastructure asset manager. The remainder of this paper will therefore explore the role of Rijkswaterstaat within the concept of freight hubs. The strategy (case study) on how to do this is outlined in 3.1. The selection of the cases is outlined in 3.2 and the methods of obtaining the data are described in 3.3. Chapter four discusses the analyses the data.

3.1 Research strategy

According to Van Thiel (2014, p. 58) there are several considerations that play a role in selecting a research strategy. The main consideration is the subject of the study. Some subjects are extensively covered in literature while others are not. The subject also gives an indication about how many units of study will be available. In this case the subject of study are hubs, and more specifically freight hubs in the Netherlands. The main aim of this research is to create a better understanding of freight hubs. As little previously known research on freight hubs has been done, this research would be of a more exploratory nature. A case study (or studies) on freight hubs in the Netherlands would therefore be best suited to answer the central question.
While case studies generally are conducted through qualitive methods it, however, does not rule out quantitative methods from this research. Understanding impact on modal shift, upscaling and last mile deliveries also requires quantitative (traffic) data. This, however, is a problem, as it has become clear that usable data about traffic flows on the level of the chosen case studies is not available for trucks. Data for the case studies will therefore be provided through a literature review and interviews with Rijkswaterstaat employees involved in the case areas.

3.2 The cases

Selection of the cases

The selection of the cases was based upon a four of decisions. First, they had to be within the Netherlands in order for them to be related to Rijkswaterstaat. Second, a maximum of four cases would be selected as more would not be feasible within the time frame. Third, they had to be known as logistically relevant. Meaning that logistics companies consider it an interesting location from which to operate. Reasoning is that freight hubs are related to the logistics industry, since the definition of them in this paper closely resembles the definition of logistics hubs (Klauenberg et al., 2020). In order to assess this the map of logistical hotspots in the Netherlands was used (Dijkhuizen, 2021). The fourth criteria was based upon diversification. As freight transportation is a diverse activity, it would be preferable to have different freight contexts be represented within the limited amount of cases. This eventually led to four cases.

The cases

Logistiek Cluster Flevoland is a combination of three municipalities in the province[1] of Flevoland: Almere, Lelystad and Zeewolde. Its considered to be an interesting logistical location due to its central position within the Netherlands, and its proximity to Amsterdam. The diversification argument for this case was its popularity as a location, despite being located outside the freight corridors the Dutch government outlined (Topcorridors, 2020).

Veghel is a municipality in the province of Noord-Brabant and part of the logistical hotspot of Oss – Veghel – ‘s-Hertogenbosch. What makes this case interesting is de large presence of agricultural and food related industry, which was the diversification argument.

[1] A province is a regional government in the Netherlands that is situated between the national government and the local municipality.

Sittard-Geleen is located in the province of Limburg in the southeast of the Netherlands. And consists of the municipalities of Sittard and Geleen. The region is known for the large presence of chemical industry and its car manufacturing plant, which both attract and emit large amounts of freight. The diversification argument in this case was based upon plans of the chemical industry to move towards more circular production, which would lead to changes in its current supply chain (Chemelot Circular Hub, 2020).

The city of Utrecht is located in the province that bears the same name. Utrecht is located in the centre of the Netherlands on the crossroads of different highways. It is therefore a popular location for logistical companies. As one of the largest cities in the Netherlands, it is also interesting to see how they deal with freight activities within their borders because of the high concentration of population and employment, which could lead to conflicts between freight and passenger transportation (Rodrigue et al., 2017). These two arguments eventually led to this case to be chosen.

3.3 Methods

Literature review
The literature review (chapter two) will be used as input for both the interview topics as well as analysis of the interview.

Interviews
Van Thiel (2014, pp. 93-100) makes a distinction between open and semi-structured interviews. Open interviews are generally more suitable for inductive research. As this research is deductive a semi-structured interview is preferred as this gives the researcher more control on what topics will be discussed during the interview. This is important, as the topics that will be discussed should be about the hypotheses that are being tested in the study. The topic list of the interviews will contain concepts from the literature review. The target respondents of the interviews are employees of Rijkswaterstaat that are involved in spatial developments in the selected cases. These respondents can give useful insight into what aspects of freight hubs they consider to be most relevant for Rijkswaterstaat.

4. Interview results

The topics discussed in the interviews with the different employees of RWS can roughly be summed up into two central topics: knowledge on freight transportation and hubs and local involvement in municipal and provincial developments.

4.1 Knowledge on freight transportation and hubs

The results on questions whether there was knowledge on freight hubs and freight transportation were quite diverse. Some respondents could directly point towards places they consider to be freight hubs, and even the potential bottlenecks hampering its potential. Other respondents would have no overview of freight hubs within their case or even about freight transportation in general. The lack of knowledge was largely due to a lack of capacity to gather knowledge on freight transportation in general. This also pointed towards another thing. Because what also became clear was the subordinate position of freight in spatial planning in general. This is largely due to the complex nature of spatial developments in which a lot of different stakes have to be taken into account (housing, nature preservation, noise pollution, the position of different

stakeholders, etc.). Mobility is just one among the many different stakes that have to be taken into account. And within mobility passenger transportation is often the most dominant determinant for policy. Which can also be observed back in the projects in which RWS is involved in. Because, while knowledge on freight transportation might be fragmented among the different actors in the different cases, all actors were in some way involved in infrastructure projects mainly targeted for passenger transport. This lack of knowledge is not unique to RWS, but is can be observed on more policymaking levels, such as the municipality (Dablanc, 2007). The lack of knowledge is also partly due to the fact that essential data on truck traffic flows is not always available, or its only available on an aggregate level that is not useful for analyses on a municipal level or lower.

4.2 Local involvement

Besides questions on knowledge, there was also an inquiry about how RWS is being involved in current and previous spatial development related towards freight transportation. What became clear with these questions was that involvement was strongly dependent on the position of RWS as an stakeholder. In case RWS was a land owner they were invited at the beginning of a spatial development program by either the local municipality or the province. One respondent pointed out that despite early involvement it was still hard to steer the process as no real knowledge or RWS wide policy on freight transportation was in place to guide the process. This, however, did not mean that input in freight hub related development projects was marginal. As one responded explained a case in which a local municipality wanted to develop a new harbour along an existing canal, for which Rijkswaterstaat was responsible. In this case, the harbour could not be realised as the new development would create too much of an obstacle for all the other traffic on the canal. If the spatial project required a permit from RWS they were also more involved in the process. This also was the case if RWS as a (potential) financer of the project.

In all other cases RWS would only be involved if the spatial project would be developed near land that they owned. In such cases RWS would be involved at the end of a process in which little or no real input in the process could be realised. Or RWS would have to halt the process due to unrealistic expectations of certain mobility developments (such as developing a new harbour along a canal).

5. Conclusion

This paper explored the concept of freight hubs, firstly by juxtaposing the definition and potential impacts of freight hubs using a literature review, secondly by assessing the current role Rijkswaterstaat takes regarding freight hubs as infrastructure asset manager, doing qualitative interviews in several case studies. It can be concluded that freight hubs can play a role in developments towards more sustainable and efficient usage of infrastructure. This is related to three identified potentials that can be related to freight hubs. First is the potential for modal shift, which could help alleviate congestion problems on the roads by switching to other modes of transport (Blauwens, et al., 2006). Second is the potential for upscaling (by consolidating freight) which could lead to more fuel efficiency . Last is its potential for helping to solve last mile delivery problems (Allen et a., 2012).

However, it can also be concluded that this potential is currently underutilized for a number of reasons. First is the difficulty to define a freight hub. This has to do with the complexity of freight transport in general. In contrast to passenger transportation, freight transportation is a

very heterogenous business with many different types of freight that all require different modes of transport and all follow different routes towards final consumption. Despite this difficulty there are attributes that all the different types of freight hubs have in common. They are connecting nodes within a network where freight can be either consolidated or decomposed and from which freight can switch to other modalities (Rodrigue, 2013). Such a definition gives an indication on what kind of potential could be expected from freight hubs.

Second, based on the literature and the interviews it has become clear that the role of Rijkswaterstaat regarding freight hubs is currently marginal. The cause for this marginal role is twofold. First is largely due to the lack of capacity. Second, related to this lack of capacity, is the view that other infrastructure management tasks are considered to be more pressing. This marginal role leads to underutilized potential, as the network perspective of an infrastructure asset manager could help freight hub development. Potential for a more prominent role within development of such freight hubs is however possible. For instance, modal shift potential is not solely determined by developing multi-modal hubs, but also but the supporting network and its capacity known as the quality of the network (Banister & Berechman, 2004). Something that could become more clear through the usage of concepts such as the functional urban area and de freight landscape (Vital Nodes, 2019; Rodrigue et al., 2020). Therefore, infrastructure (asset) managers are essential in the planning process of freight hubs if there is a desire to steer the process. This importance is also observed in the interviews, in which it becomes clear that RWS employees are often involved in later stages of spatial development related to freight hubs, at which point they either have to 'pull the brake' by making clear certain developments can simply not be supported by the network, or no real input can be given anymore.

Being involved in the process might however prove to be complex, as development of freight hubs involves a range of different actors that all have different goals in mind when it comes to freight hubs. Municipalities, for instance, look at a broader picture of economic development and potential mitigation of environmental impacts caused by freight traffic in dense urban centres. Rijkswaterstaat on the other hand, will be more concerned with the maintenance, safety and robustness of the larger network that is influenced by freight hub developments.

The role of Rijkswaterstaat in developments of (urban) consolidation centres is somewhat harder to define. On one hand is its potential to mitigate the environmental impact of freight transportation through a reduction of the amount of vehicles needed to transport freight. This however, would cause trucks to be more heavy on average, which could increase road deterioration (ITF, 2018). To what extent this holds true is hard to determine, as there is very little data available on truck traffic. Something also pointed out by the interviewees. The concept of the freight landscape has been identified in the research as one of the possible solutions to this lack of data.

Discussion

In summary, freight hubs are hard to define, which make it difficult to formulate policies around it. Yet, somewhat paradoxically, at the same time the freight hub concept could be useful as a way to make more uniform policies on the very heterogenous landscape of freight transportation. Because while many goods follow different supply chains and pass different modes of transport and terminals the concept of freight hubs groups them within a common denominator: connecting nodes within a network where freight can be either consolidated or decomposed and from which freight can switch to other modalities. Rijkswaterstaat, as infrastructure asset manager, could play an important role in supporting such developments as they could share knowledge from a network perspective, in part using concepts such as the

functional urban area. This could help better realise potentials that freight hubs promise to deliver. However, lack of capacity, data, and knowledge are barriers that need to be overcome in order to better understand the what is means to develop freight hubs. Lack of capacity should however, not be an excuse to leave freight hubs for what they are. As they can have real impacts on they networks and can help move towards more sustainable and efficient network development. Furthermore, as the example of the canal harbour (see 4.2) exemplifies, freight hub development by other parties can also impact the network. Developing a policy towards such (local) initiatives could help steer such initiatives to be more sustainable from a network perspective.

Though freight hubs can be generalised, it should be noted that every good that is transported is different, and follows another path. So generalization of the results onto all the different freight markets should be met with caution. Another thing that should be pointed out is the fact that the case study results stem from their own unique context. Other areas might yield different results as a consequence of a different context. More research targeted at different types of freight could be a next step in unfolding the freight hub concept.

5. References

- Akgün, E. Z., Monios, J., Rye, T., & Fonzone, A. (2019). Influences on urban freight transport policy choice by local authorities. Transport Policy, 75, 88–98.
- Allen, J., Browne, M., Woodburn, A., & Leonardi, J. (2012). The Role of Urban Consolidation Centres in Sustainable Freight Transport. Transport Reviews, 32(4), 473–490.
- Banister, D., & Berechman, Y. (2001). Transport investment and the promotion of economic growth. Journal of Transport Geography, 9(3), 209–218.
- Blauwens, G., Vandaele, N., Van de Voorde, E., Vernimmen, B., & Witlox, F. (2006). Towards a Modal Shift in Freight Transport? A Business Logistics Analysis of Some Policy Measures. Transport Reviews, 26(2), 239–251.
- Bhoopalam, A. K., Agatz, N., & Zuidwijk, R. (2018). Planning of truck platoons: A literature review and directions for future research. Transportation Research Part B: Methodological, 107, 212–228.
- Chemelot Circular Hub. (2020). Chemelot Circular Hub. https://www.chemelotcircularhub.com/
- Dablanc, L. (2007). Goods transport in large European cities: Difficult to organize, difficult to modernize. Transportation Research Part A: Policy and Practice, 41(3), 280–285.
- Del Grosso, A., Inaudi D., & Pardi, L. (2002). "Overview of european activities in the health monitoring of bridges," First International conference on Bridge Maintenance, Safety and Management, IABMAS, vol. 2,.
- Dijkhuizen, B. (2021, June 9). Logistieke hotspot verkiezing 2021: Tilburg-Waalwijk pakt de triple. Logistiek. https://www.logistiek.nl/vastgoed/nieuws/2021/05/logistieke-hotspot-verkiezing-2021-tilburg-waalwijk-pakt-de-triple-101178623
- Dijkstra, L., H. Poelman and P. Veneri (2019), "The EU-OECD definition of a functional urban area", OECD Regional Development Working Papers, No. 2019/11, OECD Publishing, Paris,
- Giuliano, G., Kang, S., & Yuan, Q. (2017). Using proxies to describe the metropolitan freight landscape. Urban Studies, 55(6), 1346–1363.
- Hesse, M., & Rodrigue, J. P. (2004). The transport geography of logistics and freight distribution. Journal of Transport Geography, 12(3), 171–184.
- ITF. (2018). Policies to Extend the Life of Road Assets. itf-oecd.
- Klauenberg, J., Elsner, L. A., & Knischewski, C. (2020). Dynamics of the spatial distribution of hubs in groupage networks – The case of Berlin. Journal of Transport Geography, 88, 102280.
- Kin, B., Verlinde, S., Sterckx, K., & Macharis, C. (2020). Last-mile transport of fragmented deliveries: delivery preferences of nanostoreowners. Urban Freight Transportation Systems, 115–133.
- NOS. (2019, March 10). Het bedreigde landschap: de verdozing van Nederland. https://nos.nl/nieuwsuur/artikel/2275408-het-bedreigde-landschap-de-verdozing-van-nederland
- Onstein, S., Visser, J. G. S. N., Tavasszy, L., & van Ham, H. (2016). Trends in distribution centres and their locations: sprawl and polarization. In Vervoerslogistieke Werkdagen 2016
- Rodrigue, J. P. (2013). The Geography of Transport Systems (3rd ed.). Routledge.
- Rodrigue, J.-P., Dablanc, L., & Giuliano, G. (2017). The freight landscape: Convergence and divergence in urban freight distribution. Journal of Transport and Land Use, 10(1).
- Sakai, T., Beziat, A., Heitz, A., & Dablanc, L. (2018). Testing the “Freight Landscape” Concept for Paris. Transportation Research Record: Journal of the Transportation Research Board, 2672(9), 216–228.
- Stathopoulos, A., Valeri, E., & Marcucci, E. (2012). Stakeholder reactions to urban freight policy innovation. Journal of Transport Geography, 22, 34–45.
- Sýkora, L., & Mulíček, O. (2009). The micro-regional nature of functional urban areas (FUAs): lessons from the analysis of the Czech urban and regional system. Urban Research & Practice, 2(3), 287–307.

- Topcorridors. (2020). Programma Goederenvervoercorridors. https://www.topcorridors.com/default.aspx
- van der Linden, K., & Linssen, R. (2019, June). Vital Nodes Toolbox. Vital Nodes. https://vitalnodes.eu/wp-content/uploads/2020/01/Vital-Nodes_D3.5-Vital-Nodes-Toolbox_PU_20190628.pdf
- van Thiel, S. (2014). Research Methods in Public Administration and Public Management: An introduction (1st ed.). Routledge.
- Verweij, K., van Luik, C., Bekamp, B., Schroten, A., & van Wijngaarden, L. (2020, July). Super EcoCombi: Verkenning van kansen en verwachte effecten. Topsector Logistiek.
- Vital Nodes. (2018). Vital Nodes Brochure. https://vitalnodes.eu/wp-content/uploads/2020/01/Vital-Nodes-Results-brochure.pdf