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Logistics: Situating flows in a spatial context

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Abstract

The origins of logistics lie in military and imperial methods of expansion and control of geographical space. It is principally associated with the more recent contexts of business management and engineering. Logistics systems are now the conveyor belts of the global system of trade, commerce and production, and its associated techniques and strategies aim at optimizing flows and throughput within discrete units (such as firms), in economic networks and across geographical space. Because flows are important determinants for the development of places, logistics has the power to structure territories. Therefore, it has raised considerable interest in the field of geography, not only with regard to cities and their dense agglomeration of people, buildings, and infrastructure but also in geopolitical terms as it fosters the exploration, control, and surveillance of areas. The paper presents a critical account of logistics operations and their relevance for the making (and unmaking) of territories, related policy dimensions, and future challenges for research.

KEYWORDS

cities, electronic commerce, geography, geopolitics, goods distribution, logistics, urban policy

1 | INTRODUCTION

When logistics aims at the coordination of material flows with respect to time, space and commodities, it is geographical by nature. Places need the supply of goods and services in order to exist, and the quality of such provision can be an important prerequisite for, or constraint to, development (Beyers & Fowler, 2013). With more sophistication, logistics has the potential to foster connectivity and related growth, while being disconnected from major flows can cause stagnation or de-coupling. In the language of the real estate corporation, logistics contributes to

“structuring the territory” (Cushman & Wakefield, 2019). It did so when it was conceived as a military function, as forces had to be moved, supplied and re-organized across space and time (Moore, 2017; Yoho, Rietjens, & Tatham, 2013). And it did so, likewise, as a technology of imperialism, when logistics permitted the exploration and exploitation of foreign countries as colonies, for the purpose of resource extraction, supply of cheap labor, or in the context of geopolitical strategies (Williams 2013, quoted after Cowen, 2014, p. 8).

The concomitant principles of logistics—operating purposeful, agile and cost-effective materials supply and delivery—became a standard practice in the corporate world (Christopher, 2011). However, while business logistics aimed at the comprehensive improvement and management of corporate material flows, and thus understood itself as a “science of systems” (Cowen, 2014, p. 33ff.), its determination was primarily to increase operational and cost efficiency. Hence for decades, negative externalities such as environmental impact, social inequality, or labor issues did not feature much in debates on the subject. At the same time, logistics was neglected by geography and related disciplines, where it has long been, for the most part, a hidden subject. In several areas of the social sciences, logistics was taken for granted and did not receive the attention it arguably deserves (Hall, Hesse, & Jean-Paul, 2006)—it was considered a “missing link” (Coe, 2014), or a “forgotten space” (Sekula, Burch, & Tessi, 2010). Due to the almost ubiquitous provision of infrastructure and diminishing transport costs, such issues had lost momentum in postwar economic geography. Even seminal works from authors such as Vance (1970) on the geography of wholesale or the rich tradition of retail geography had rarely been associated with what they actually represent: understanding spatial development studies against the background of the demand for and supply of commodities—the key subject of logistics organization. Over the course of the last 20 years, this situation has altered significantly, primarily as a result of the profound changes that have shaped the logistics system (Bowen & Leinbach, 2011; Fields, 2004; Sigler, 2013). As a consequence, processes that are affected by these changes and the multiple underlying geographies are now receiving increasing attention (see e.g., Chua, Danyluk, Cowen, & Khalili, 2018; Cowen, 2010, 2014; Hesse & Rodrigue, 2004; Rodrigue & Notteboom, 2009).

A closer inspection of logistics offers a particular insight into the changing relationship between places and flows, which is also the lens of this review. Places and flows, or location and movement, are fundamentally linked to each other: localities need access to trade routes and industrial heartlands in order to be part of economic networks, while the concentration of population and workforce in cities in turn creates demand for (and supply of) goods merchandise. In the words of Mezzadra & Neilson (2019, pp. 135/136), logistics can be seen as “a key set of techniques and technologies for the orchestration and execution of contemporary capitalist operations, with consequences for the control of labor, the *production of space* (emphasis M.H.), and even the emergence of new imaginaries in culture and art”. Its spatial implications are as complex as they are substantial: Primary effects include the establishment of a dedicated logistics infrastructure (separate from what was once part of retail or manufacturing), and affect territories through negative externalities of many kinds. Secondary effects include the provision of development opportunities to a broader range of areas, on grounds of improved accessibility. Additionally, infrastructure alliances were set up in order to boost the sector. Inspired by the dialectics of spaces and flows, this paper will provide an overview of developments associated with logistics and distil some of the associated problems and conflicts; it will also address future challenges for research.

2 | THE EMERGENCE AND “MAKING” OF LOGISTICS IN BUSINESS MANAGEMENT

Logistics has emerged as a device for improving business operations (Johannessen & Solem, 2002). It brings to light what was once considered to be the “dark continent” (Drucker, 1962) of corporate management. At that time, it was called physical distribution, and for quite a while it was left out of strategies that were introduced to make corporate practices more effective and efficient. Drucker’s observations provide an inspiring read even from today’s perspective, more than half a century later. When pointing at the “mob in the shipping room” (Drucker, 1962, p. 266), he

was struck by the rather disorganized handling of goods distribution within the firm and between corporations; the associated circulation in the public realms was rather random. Rhetorically, the phrase “dark continent” provokes reflection on the significant role logistics once played, and probably still plays, in colonial and imperial contexts. “From its history as a military art in service of the national state, logistics became a technology of supranational firms operating in relational geo-economic space. In contrast to the absolute territory of geopolitical calculation associated with colonial rule, geo-economics relies on the unimpeded flows of goods, capital and information across territorial boundaries.” (Cowen, 2014, pp. 50/51).

While manufacturing became the target of rationalization processes (achieving a popular peak with the adoption of the Japanese modes of “lean production” by European and North American firms in the 1980s/1990s), the recent development of logistics and physical distribution is an outcome of a broad set of economic structural changes and related corporate strategies (Christopher, 2011). Main drivers were the rise of service economies, the introduction of new information and communication technologies and globalization in particular (Castells, 1996). The emergence of global trade, commerce and production is a powerful external momentum, which has solidified these changes quite comprehensively (Dicken, 2015; Dicken, Kelly, Olds, & Wai-Chung Yeung, 2001). They triggered a fundamental reorganization of the production and distribution of commodities and services. Arguably the key process in most recent changes of logistics was the invention of supply chain management (SCM): the comprehensive, integrated management of all components and activities that are dedicated to the manufacturing, processing, marketing and finally consumption of commodities (Christopher, 2011; Gattorna, Trost, & Kerr, 1990, p. 8; Handfield & Nichols, 1999).

SCM is distinct from earlier practices as it is an integrated approach, in which materials management and freight distribution of firms and networks are closely interwoven (Stevens, 1989; Stevens & Johnson, 2016). With the introduction of global production networks (GPNs), this integration became practiced at global scales (Coe, Hess, Yeung, Dicken, & Henderson, 2004; Yeung, 2015). GPNs would not have emerged without a properly working logistics system, pursuing the best possible integration of the different stages of manufacturing with the efficient provision of raw materials and commodities on the one hand, and the timely distribution of end-products to the customers on the other hand (Coe, 2014; Ducruet & Lee, 2006).

The increasing degree of logistics integration provided by SCM was only possible through the application of new information and communication technologies (Holma & Salo, 2010). Data-driven modelling technologies were also the predominant way of framing logistics in scientific terms, whose emphasis was on optimizing flows within, between and beyond firms. Implementing the principle of flow permitted the reduction of inventories in time-sensitive manufacturing and cost-sensitive wholesale or retail operations (McKinnon, 2001). The switch from storage to distribution means mobilizing inventory that triggers more circulation, an outcome that is actually reinforced against the backdrop of expanding markets. This helped creating a new economic geography of flows (Aoyama, Ratick, & Schwarz, 2006).

Logistics is also relevant in terms of communication and discourse. The notable shift from the mere materials management and physical distribution of the 1960s/1970s to the epistemologies of “logistics” more recently is also a linguistic turn (Solem, 2003). At the meta-level of analysis, it can be understood as a semantic upgrading of an activity whose virtual world—of information processing, tracing and tracking of consignments, freight forwarding, routing and scheduling, automated warehouse operations, satellite navigation and the like—might look increasingly sophisticated. Its material appearance however is pretty different: it is about running ocean ships and container cranes, moving cargo aircraft and in its large majority lorries and parcel vans, handling goods in flat warehouses and the like. This creates a contradiction between the tech-modern logistics' imaginary and its mere imprint on geography, the environment and society (Cidell, 2006; Cidell, 2011; Warnaby, 2009; Watkins, 2015).

3 | LOGISTICS IN SPATIAL CONTEXTS

Logistics is essentially driven by, and also reinforces, the relationship between spaces and flows (Hall & Hesse, 2013). However, assuming that the mobilizing forces of logistics lead to a “decline” of territory (Cowen, 2014, p. 10)

is only one side of the coin, as, at the same time, logistics can also open up new trajectories for development. Traditionally, flows followed the spatial rationale of places, connecting the location of production with that of consumption. The main spatial implication of SCM is to pull out the inventory function from places of manufacturing and of retail, and to concentrate its management in distribution hubs. As a result, a completely new system of infrastructure had to be established for operating these systems. Moreover, the spatial relationship has changed, as places now follow the rationale or dynamics of flows, in contrast to the previous situation.

At a global scale, shifts in logistics were a function of the relocation of production to the emerging mega-locals in Asia such as Shanghai, Hong Kong or Singapore, and also by the massive concentration of international freight flows in hubs and gateways, such as major seaports, container ports, and large freight airports (Comtois & Rimmer, 1997; O'Connor, 2010; Ng et al, 2014). The maritime industry is particularly relevant here, as these gateways' role changed from control of the hinterlands (Burghardt, 1971), to facilitating the physical freight flows in a larger spatial-organizational context (Drewe & Janssen, 1998; Olivier & Slack, 2006). This was associated with supply-chain power shifting away from ports to key corporations (Bowen, 2012; Frémont, 2007) and liner shipping alliances (Brooks, 2000).

Rupture and change accelerated in the wake of the financial crisis of 2008/09 (Ng & Liu, 2010). When hubs were under pressure to maximize throughput, by expanding infrastructure, enlarging port or transshipment areas or by dredging rivers, they now had to deal with fluctuating market demand as well (Notteboom, Parola, & Satta, 2019). Long-term strategies of expansion, which were governed by the economies of scale, were complemented by efforts to create new business opportunities and market niches. However, the imperative of catering to ever larger mega-carriers remained on the ports' agendas, having an important impact on port cities (OECD/ITF, 2015). Some ports have reclaimed land from the sea, as the Dutch did in the case of the *Maasvlakte* in Rotterdam (Hesse & McDonough, 2018); others built sea-based ports off-shore or a network of satellite terminals (Goetz & Rodrigue, 1999); others created brand new coastal ports, like the deep-sea *Jade Weser Port* in Wilhelmshaven, Germany. A second major spatial shift occurred at city-regional scales. When port distribution and logistics facilities expanded into the ports' hinterlands, the related geographical signifier was "port regionalization" (Notteboom & Rodrigue, 2005; Raimbault, Jacobs, & Dongen, 2015). These developments were also accompanied by more port-centric developments observed recently that focus on a more efficient use of port land and resources (Monios, Bergqvist, & Woxenius, 2018). In both cases, tensions emerged between and among cities and regions on the one hand, and the maritime industries on the other hand (Hall, 2007; Hayuth, 1982; Hoyle, 2001; Daamen & Vries, 2013; Merk, 2013; Wang, 2014; Pallis, 2015).

Massive changes also occurred in distribution over land. Centralization of warehousing achieved a certain peak by the end of the 2000s, with operations bundled either at one single location or in premises that were destined to support large territories. Distribution centers (DCs), which were mainly designed for throughput rather than storage were key to these operations (Bowen, 2008; Cidell, 2010; Hesse, 2008; Hesse & Rodrigue, 2004; Orenstein, 2019; Riemers, 1998; McKinnon, 2009; Sakai, Kawamura, & Hyodo, 2017). DC clusters were assembled in accessible locations not too close to major metropolitan regions, with cheap land and motorway access that allowed for serving the consumer markets within a reasonable amount of time (Hesse, 2006; Hesse, 2004). These agglomerations of DCs emerged as inland hubs, gathering together warehousing, transshipment, trucking, and air freight, often conceived of as freight clusters (Chhetri, Butcher, & Corbitt, 2014; Gouveral, Lavaux-Letilleul, & Slack, 2011; Hesse, 2014; Sheffi, 2012; Van den Heuvel, Langen, Donselaar, & Fransoo, 2014). Prominent cases have emerged for example in the Inland Empire in Southern California or in the Midwest of the U.S., such as Louisville, Kentucky, which Negrey, Osgood, and Goetzke (2011) called the "distributive world city"; in the British midlands halfway to London and in the North; in the Netherlands or in Flanders, Belgium. From these inland hubs, millions of customers can be reached within a 4–5 hour-long truck drive.

The new rise of services hubs has raised the interest of urban-regional development policy-makers to add logistics and physical distribution activities to their portfolio (Bowen & Leinbach, 2011; Ferrari, Merk, Botasso, Conti, & Tei, 2012; Hesse, 2014; Musso, Benacchio, & Ferrari, 2000). Now, local entities seek to actively participate in the growing circulatory economy, by fostering logistics investments and the required improvements in infrastructure

(Danyluk, 2019; Hesse, 2015; Jaffee, 2019; Levelt, 2010; Ziadah, 2018a). This policy and governance dimension of logistics and freight distribution has gained more interest recently, as the restructuring of the industry has helped in mobilizing the related growth dynamics away from the old gateways, thus creating new logistics centers and secondary hubs. It was epitomized in the creation of signifiers such as the “Logistics City”, as for example in Dubai (Fernandes & Rodrigues, 2007; Ziadah, 2018b). This bundling of flows offers development potentials even to places that have been previously considered as peripheral (Cabus & Vanhaverbeke, 2003; De Ligt & Wever, 1998). The same applies to regions which were hit hard by de-industrialization, where it is now hoped that logistics might compensate for job losses in the old industries and provide new opportunities for growth (see below). However, when organization space (Easterling, 2001) turns into a logistics landscape (Waldheim & Berger, 2008), the built environment looks merely like a carpet of distribution centers scattered across space.

Related developments accelerated further with the rise of E-commerce and the related establishment of new fulfilment or distribution centers, often considered a potential for local labour markets (Blix, 2017; Jordhus-Lier, Underthun, & Zampoukos, 2019). Probably the most important case in this respect, and also most extensively discussed, is the online retailer Amazon.com. It is currently the second largest online retailer worldwide, with a market share of about 50% of all online sales in countries such as the US, the UK or Germany, and meanwhile employs almost 650,000 people (temp-staff not counted). Amazon.com is now a big player in the development of new DC locations, thus becoming actually one of the most important single forces in shaping the geographies of logistics. As of 2019, the company operates about 400 distribution facilities in the US and another 440 in the rest of the world (MWPVL International, 2019), mostly all of them newly-built on greenfield sites in the vicinity of major urban centers or situated in between metropolitan regions.

The regional development imprint of Amazon.com is massive (Hesse, 2018). New DCs hire a handful of IT and middle management experts, as well as many fulfilment associates who are in charge of assembling and shipping the consignments. Such investments can easily reach 1,000 or more employees at a single site, which makes the company an ideal target of economic development agents. The smaller the places are where DCs are to be landed, the higher the hopes will be in terms of growth and job creation. However, such hopes may often be outweighed against the rigid (Darwinian) corporate culture, employees' surveillance and the tracking of their productivity; not to forget the emptying out of existing retail businesses. O'Connor (2013, p. 2) reported on the small town of Rugeley, a former coal mining town in Staffordshire/UK, which was chosen in 2011 to host the site of a 700,000 square feet fulfilment center by Amazon.com: “It seemed like this was the town's chance to reinvent itself after decades of economic decline. But as they have had a taste of its ‘jobs of the future’, their excitement has died down”. The ambivalent role of “Amazon everywhere” for local communities finds increasing media coverage (see e.g., Shane, 2019; Streitfeld, 2019).

This case illustrates that it is by no means clear that cities and regions always benefit from attracting logistics investments (Cidell, 2014; Loewen, 2018; Newsome, 2010). A range of difficulties and problems may arise when pursuing such goals, for reasons that are imminent to this industry: Freight and logistics services are essentially based on flows and thus seem to be much more mobile, volatile and less embedded than for example they were in manufacturing. Capturing local value from the management of global flows remains a huge challenge. The related locational dynamics depend upon the demand from shippers or receivers, and they have shifted according to their respective mobilities. Logistics processes are still, by and large, a derived factor. Its performance depends on demand triggered by production or consumption, and the effects this generates can hardly be considered structural or generic.

4 | THE CITY AS A PLATFORM AND LABORATORY FOR LOGISTICS INNOVATIONS

When turning our attention to the urban, one needs to take into account that cities are traditionally considered the key sites of the demand for, and supply of, logistics services (Dablanç & Fremont, 2015). Cities are essentially

logistical subjects, as on the one hand, the concentration of customers in urban regions implies that a significant part of logistics services and flows in consumer societies is directed there (Chinitz, 1960; Hesse, 2010; Hesse, 2013; Odgen, 1992). Classical works on the city by theorists such as Weber (1921), Christaller (1933), or Vance (1970) highlighted the significance of cities as market places. On the other hand, agglomeration poses major functional challenges (or friction) to logistics operations, as urban densities, transport bottlenecks, and the scarcity of space to maneuver hinders the free flow of vehicles (Hesse & Rodrigue, 2004, p. 178ff.). Mobilities can both *make* and *break* cities (Clark, 1958; Graham, 2002). As urban residential populations are sensitive against disturbing land uses and activities, the physical impact of motorized vehicles or airplanes is a source of long-standing concern and contestation (De Lara, 2013; Flämig, 2013; Oosterlync & Swyngedouw, 2010; TRB, 2003)—even though freight distribution might not compare to the externalities that were exposed to the city in the age of the smoke pipe industries.

Roughly a third of the total number of vehicle trips per workday derive from the movement of goods, not people (Woudsma, 2001). In terms of employment, warehousing, wholesale and freight transport account for about 4–8% of local workforce (cf. Allen et al., 2018). Apart from its quantitative dimensions, specific problems are assigned to heavy goods vehicles, both regarding their imprint on the built environment (road design, deterioration of road surfaces and bridges) and also the consequences of traffic accidents, which often turn fatal for pedestrians and bikers (Behrends, Lindholm, & Woxenius, 2008). In terms of location, waves of decentralization of warehousing, storage and distribution land uses are indicative: first, they were directed to urban fringes (1970s to the early 1990s, cf. McKinnon, 1983), then, second, heading further away to strategic places linked to the motorway network, or in dedicated freight centers (Hesse, 2008). The changing spatial patterns have been extensively studied in recent times (see e.g., Dablanc & Browne, 2019; Dablanc, Ogilvie, & Goodchild, 2014; Dubie, Kuo, Giron-Valderrama, & Goodchild, 2019; Heitz, Dablanc, & Tavasszy, 2017; Rodrigue, Dablanc, & Giuliano, 2017; Aljohani & Thompson, 2016).

However, the concrete consequences of such movements for cities are less obvious, the urban impact of these waves being rather mixed (Andreoli, Goodchild, & Vitasek, 2010; Aljohani & Thompson, 2016; Ugarte, Golden, & Dooley, 2016). On the one hand, entry level jobs got lost due to the urban exodus of wholesale and warehousing (also to nonunionized districts), while truck and parcel mileages have increased when urban outlets are being supplied from ex-urban DCs. On the other hand, vacant land in what were once called light industrial and warehousing zones of transition (Park, Burgess, & McKenzie, 1925) or transport places (Harris & Ullman, 1945) offered opportunities for urban policy to create attractive places for office, retail and housing. The rise of the urban waterfront was actually triggered by changes in logistics. Projects such as *Canary Wharf* at the London Docklands, UK, *Kop van Zuid* in Rotterdam, the Netherlands or the revitalization of the river bank in Bilbao, northern Spain, have already gained template status for urban regeneration (Brownill, 2013; Doucet, 2013; Hall & Clark, 2010).

Recent changes of the logistics of retail have altered the picture again, particularly in regards to the Internet and E-commerce (Couclelis, 2004; Currah, 2002; Kellerman & Paradiso, 2007). These changes have probably contributed to a fading away of urban retail from the main street and traditional mall; however, they triggered the rise of small-scale consignments that disrupted local supply chains and rendered urban distribution dysfunctional and less profitable (Allen et al., 2018; Björklund & Johansson, 2018; Boyer, Prud'homme, & Chung, 2009; Heitz & Beziat, 2016). Local deliveries account only for a small amount of the overall freight volume, but they are the most expensive element of the delivery chain, easily accounting for half of the total cost (Horvath & Partner, 1999). For that reason, urban or city logistics are on the screen of cost-cutting policies and have been reorganized in urban areas (Russo & Comi, 2010; The Mayor of London, 2019; TRB, 2013; Wolpert & Reuter, 2012). Parcel services such as *DHL* or online providers such as *Amazon.com* are currently introducing a second layer of distribution centers close to, or even within, inner city areas (e.g., placed in vacant shop floors or department stores). Urban consolidation centers add to the existing big boxes on the periphery and can provide an advantage in terms of increasing the density and velocity of delivery tours (Allen, Browne, Woodburn, & Leonardi, 2012), which allows for to experiment with a more environmentally friendly distribution on the so-called last mile to the customer, including the use of mini storage and pick-up points, cargo bikes, or smaller electric delivery vehicles (Allen et al.,

2018; Boyer et al., 2009). Among others, the city of Paris, France, for example, has recently become a testbed for innovations in city logistics (Dablanc, 2019). To some extent, the trend towards urban consolidation reverses the locational reorganization that had shaped logistics only two decades before—bringing a new facet to the relationship between places and flows.

While such innovations have spread the hopes for greening urban logistics (McKinnon, Browne, Piecyk, & Whiteing, 2015), they obviously include only a small part of a city's metabolism at work; they aim at steering freight distribution primarily in pedestrian zones or shopping areas, and to the private household, respectively. A much larger part of freight flows in the urban realms comprises raw materials and components supply and distribution for commerce or industry (FHWA, 2012). An important sector here, even though often overlooked, is construction (Sullivan, Barthorpe, & Robbins, 2011). Given the constant demand for building, renovation and development, this sector may account for a big share of urban freight movements. A specific approach in fine-tuned construction logistics had been enforced in the mid-1990s at the Potsdamer Platz in Berlin, Germany, including raw materials supply via rail and the strict regulation of truck access to major construction sites (Flämig, 2000). However, dedicated construction logistics did not become a blueprint model for urban policy, mainly due to anxieties of regulation and the associated costs. Logistical challenges are also associated with temporary activities such as urban fairs or mega-events. These incidents require a fine-tuned system of delivery of goods, components and services, which need to be wisely planned in advance. The city of Paris, which will be hosting the 2024 Olympics, is currently preparing related adjustments—not only in regards to buildings and infrastructures that are foreseen but also with respect to the whole logistical organization (APUR, 2018; Jaller, Wang, & Holguin-Veras, 2015).

5 | APPLYING A CRITICAL LENS—SOCIETAL CONTEXT AND THE DARK SIDE OF DISTRIBUTION

In the context of logistics restructuring and spatial reorganization, critical issues have emerged such as resources consumption, environmental and health problems, labor conflicts, power issues within the supply chain, and the technologies of surveillance, bordering and control. For quite a while, these were overlooked—somehow hidden within the hidden subject. If one assumes that “the logistical coordination of capital's valorization and accumulation provides a framework not only for enterprises of transport and communication but also, more generally, for the reorganization of production and the social relations that enable production” (Mezzadra & Neilson, 2019, p. 134), then there is good reason to focus on the political economy of logistics as well.

As a consequence, an increasing research interest is directed at these challenges, reflecting upon externalities, violence and the power issues that determine the political regulation of logistics (Cowen, 2010, 2014). In their introduction to a recent special issue that lays down a future agenda for related research, Chua et al. (2018) call for a broader understanding of logistics as a force that transforms not only the movement of materials, but the “very rationality by which space is organized” (p. 617). The notion of turbulence, friction or disarticulation that is emphasized here provides a fuller understanding of logistics (Gregson, Crang, & Antonopoulos, 2017). This discourse seems to confirm that “extraction, logistics, and finance provide some of the most important conduits for tracking and understanding transitions of capitalism and operations of capital that are currently reshaping the world” (Mezzadra & Neilson, 2019, p. 134); it thus underlines the power of logistics, yes indeed, to structure territory. According to Chua et al. (2018, p. 617ff.), dealing critically with logistics would mean to accept the following axioms:

“(1) a rejection of the field's self-depiction as an apolitical science of management, along with a commitment to highlighting the relations of power and acts of violence that underpin it; (2) an interest in exposing the flaws, irrationalities, and vulnerabilities of logistical regimes; and (3) an orientation toward contestation and struggle within logistical networks.”

Recent works have started this undertaking, for example, by exploring the struggle of communities that are exposed to the toxic emissions from port and truck operations (De Lara, 2018a), the neighborhood impact of mega-

DCs (Yuan, 2018), or Amazon.com fulfilment staff who are on strike for higher salaries and better working conditions (Huws, 2019, p. 77). Given the advanced mix of information technology, big data surveillance and rigid corporate culture, it could be argued that the labor issue in most general terms provides substantial reason for concerns (Gregson, 2017; Gutelius, 2015; Hall, 2009; Jaffee & Bensman, 2016).

It is also remarkable to see that logistics and freight issues have recently been added to the “mobilities” agenda, which was initially confined to passenger mobility and its social and cultural meanings. With a good sense of branding the subject, some have begun exploring “Cargo Mobilities” (Birtchnell, Savitzky, & Urry, 2015; Birtchnell & Urry, 2015), and issues were as variegated as the “distributed” geographies of distribution centers (Cidell, 2015), the role of the standard shipping container for urban development, or the potential changes triggered by 3D printing and an associated relocation of manufacturing (Gress & Kalafsky, 2015). Maritime shipping has also gained prominence here, as concerns port-city issues, regional development policies, the environmental challenge of ship breaking in Pakistan or Bangladesh, and the cost of empty container transshipments (Antonopoulos, 2016; Monios & Wilmsmeier, 2018). Logistics also plays a role in applying power and control, which renders it crucial from a geopolitics perspective. The use of logistics technologies for exploiting territories and operating borders in colonial times has since accelerated in the course of the securitization of flows and thus spaces, for example in enforcing border control or operating export processing zones (Martin, 2012). The particular purchase for geography here is that logistics becomes even more evident for shaping the relationship between places and flows (Cidell & Prytherch 2015).

Local strategies to mitigate logistics externalities are facing some fundamental dilemmas, resulting from the extension of supply chains and logistics networks. Once more, geography comes into play here, as the place where a problem occurs (often an urban area) tends to be rather remote from the place where decisions are being made, often in both spatial and institutional terms. Power within supply chains (Cox, 1999) and beyond is unequally distributed. Corporate players have more steering capacity compared to local planners or economic development managers. The *modus operandi* of the circulation of goods seems to be determined by the logistics systems' imperative, growth and corporate competition, leaving little space for intervention or strategic response. This provides good reason for understanding logistics not only as technology but “as power” (Neilson, 2012). In this context, policies that promote logistics as a means of development are notably contested. They are therefore increasingly accompanied by a discourse of modernity, growth, and prosperity (Danyluk, 2019; De Lara, 2018b; Jaffee, 2015, 2019). Because of the apparent benefits promised by logistics acquisitions, governments and local communities are tempted to sell themselves as hubs, for example by highlighting their overall centrality even in cases where regions are in fact peripheral—sometimes it fits with the demand for placing logistics facilities. The World Bank's Logistics Performance Indicator (World Bank, 2014) provides a benchmarking tool that is welcomed by development agents at both national and local levels. Thus, logistics becomes a vital part of boosterist (urban) policies (Healey, 1999; McCann, 2013) and infrastructure alliances (Wachsmuth, 2017). The resulting communicative orchestration and thus social construction of logistics seems evident.

6 | CHALLENGES FOR FUTURE RESEARCH

Based on the association between places and flows, logistics is a vital component of the making (and sometimes hollowing out) of territories in a networked economy. The affected territories are increasingly influenced by accessibility, flows, and the quality of service provision. Given the high pace of development in both technology and infrastructure regards, a number of topics associated with the geographies of logistics provide relevant axes for future research. Some of them appear as a continuation of ongoing trends, such as the growth of goods movement in overall terms and the quest for sustainability (as long as GDP is growing), or the shift between more central and more decentralized patterns of location. If globalization would slow down or come to an end, however, this would have a massive impact on global shipping industries, turning the tide of decades of growth into uncertainty. What would that mean those for places that have invested heavily in the associated infrastructures? How about the

communities that seem to depend on a small number of big logistics players such as Amazon.com, when supply chains are going to be disrupted?

Even more pressing questions apply to climate change, given that the logistics industry not only makes a major contribution to greenhouse gas emissions, but also that extreme weather events such as flooding or heat waves render arteries and infrastructure extremely vulnerable. Energy and climate change issues are among the top future challenges for logistics systems, given that circulation has been largely dependent on fossil fuels until now. This certainly applies to sea and air transport, to most land transport systems (depending on distance and modal share), and to inner urban deliveries. Such concerns have already been the subject of research, experimentation and political regulation for some time. In this context, it is notable that even the freight industry became part of a greenish policy paradigm, if one follows corporate and lobby rhetoric. However, until now, logistics and freight distribution systems have been lagging considerably behind carbon policy goals—as does the transport sector generally—and catching up with emission reductions, which other sectors have already achieved seems a real challenge (McKinnon, 2019). This applies especially to hitherto understudied aspects, such as the huge demand for energy displayed by the military-logistics complex (Belcher, Bigger, Neimark, & Kennelly, 2019). If carbon reduction is taken seriously, would not this require to restructure the whole logistics industry and the extensive space–time patterns it has allowed for to practice?

Logistics has proven not only to convey spatial imaginaries, imbued with meanings of modernity, growth, and prosperity, but also to trigger further (geo-)political dynamics, supported by huge infrastructure investments. The most striking case in this respect is of course the Chinese Belt & Road Initiative (BRI), a project that combines trade relations, infrastructure, finance, and foreign policy into a package that impinges upon numerous jurisdictions (Frankopan, 2015). Regions in the sphere of the BRI hope to accrue benefits from the implication in this new infrastructure. What could become a comparable case is the route passing through the Arctic Sea. Due to climate change, it is predicted that the season that allows for marine navigation through the Northwest passage, and the Northeast passage, respectively, could become significantly expanded during the course of the 21st century (Khon, Mokhov, Latif, Semenov, & Park, 2010). This could shorten trade routes and provide much cheaper links between Asia and North America. Even if changes in trade routes take time to materialize, this could bring new development opportunities for the Arctic Sea, such as oil drilling etc. What would these opportunities be about, and who would profit from them?

Other issues offer more reason to speculate about their potential impact, as they are rather recent and their influence is extremely difficult to predict. Among these are the collection and use of big data, the enforcement of automated vehicle operations (such as drones or robots), and *Artificial Intelligence* more generally. These issues may bring about a new stage in the control or orchestration of any moving object. Digital means are also essential for advancing the platform economy (Srnicsek, 2017), within which logistics necessarily plays an important role. However, while all these innovations still have to find their niche in society and economy, they are brought to us with huge expectations as to their potentials for solving problems and for making the world better, greener and more comfortable. It remains to be seen whether sophisticated logistics systems, if not becoming part of a solution, will make things at least better and more sustainable, or whether logistics remains a part of the problem. The systems imperative that is at work here is driving toward more efficiency, exerting power, and control in geographical spaces (Wilmsmeier & Monios, 2017). Situating flows in a spatial context reveals a fuzzy picture: Continuation or disruption; geographical centralization or dispersal; the making, controlling or hollowing out of space—all these phenomena are not mutually exclusive, but seem to be different sides of the same coin.

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