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Brief

Analysis of the spatial logics of Amazon warehouses following a multiscalar and temporal approach. For a geography of Amazon's logistics system in the United States.

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Introduction

The company Amazon embodies all of these developments in retail and e-commerce,being a dominant player in the e-commerce sector: in 2017, Amazon accounted for 37% of the total e-commerce market in the United States, reaching 39.8% in 2020. This share should exceed 40% in 2021. In the United States, Amazon's supremacy is clear: 40.4% of the e-commerce market in 2021, 7.1% for Walmart (2nd), 4.3% for eBay (3rd), 3.7% for Apple (4th), 2.2% for Best Buy (5th)[1]. In the overall retail sector, Amazon is the second largest market player behind Walmart. The Covid-19 crisis has had an accelerating effect on Amazon's already spectacular growth with sales growth of 44.1% in 2020 - sales are expected to grow more than 15% in 2021 - and revenue growth of 38% in 2020 to $386 billion. This performance is based on a particularly successful vertical integration and a recognized efficiency in supply chain management, particularly in the last mile[2]. This management is based on a logistics system organized around an interlocking network of warehouses and logistics equipment of different sizes and types, proprietary 3PL and 4PL services and proprietary transport services (air, trucking). At the beginning of 2021, Amazon purchasedeleven Boeing 767 aircraft converted to cargo planes to expect a fleet of 85 cargo planes by the end of 2022. For several years, Amazon has been shifting its strategy towards direct ownership and control of most aspects of the supply chain, to be less dependenton third-party service providers (UPS, FedEx). This has enabled it to reduce its *click todoor time* in 2020 from 3.4 days to 2.2 days on average (industry average: 5.1 days)[3].This research therefore focuses on the evolution of Amazon's logistics system and in particular the geography of Amazon's warehouses, marked by an expansion of the spatial coverage of the warehouses and by a functional specialization of this logistics system. The research has three objectives: to map these evolutions with a temporal dimension; to identify the logics of spatial coverage of the company in particular in relation to markets of different sizes; to distinguish these logics according to the type of warehouse; to analyze the strategy of the company and these spatial logics on a regional scale starting from the three largest consumer markets (New York region, Los Angeles region, Chicago region).

Methodology

The analysis of Amazon's warehouses in the United States was made possible thanks to an inventory of logistics facilities maintained by MWPVL International, a logistics and *supply chain* consulting firm. This inventory is regularly updated: here is the latest available inventory updated in September 2021. This inventory is available onthe company's dedicated website and is protected but authorized to be used for research purposes[4]. This inventory is the most complete available but it is possible that some projects are not referenced or that information is fragmentedfor smaller logistics facilities (especially *Prime Now Hubs*).

This research took place from April to July 2021, and is based on the May 2021 inventory - so some information (particularly in terms of warehouse projects) may have changed between May and November 2021. In order to represent the spatial processes in 2021 as simply as possible, the choice was made to take into account for the 2021 maps all the facilities including

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[1] https://www.emarketer.com/content/amazon-dominates-us-ecommerce-though-its-market-share-varies-by-category [accessed on 12/11/2021].
[2]https://www.forbes.com/sites/shelleykohan/2021/02/02/amazons-net-profit-soars-84-with-sales-hitting 386-billion/?sh=69d546a41334 [accessed on 12/11/2021].
[3] *Ibid*.
[4] https://www.mwpvl.com/html/amazon_com.html [accessed on 12/11/2021].

all the projects indicated as opening until December 2021. This database contains a geo-coding with for each facility: a specificcode (3 letters and 1 number most of the time), the location by American state and thenby address (precise or approximate especially for projects), the function and the type ofwarehouse, the surface area (expressed in *square feet*), the year of opening (estimated opening for projects), the status of the warehouse (open, closed, planned), the co-presence, if any, of another logistic or transport facility. Other information may appear in the warehouse function that is subject to cartographic processing, for example warehouse extensions or their total or partial robotization.

Conclusion and discussions

From the analysis of Amazon's logistics system, we understand how strong the spatial footprint of e-commerce is and we can confirm some of the major processes affecting the e-commerce sector and more broadly the retail sector:

- The process of specializing logistics facilities to support the company's vertical integration strategy (distribution centers and local delivery points for products that can be packaged and for products that cannot be packaged, robotic warehouses, multi-story warehouses, Amazon's own airport hubs, small logistics spaces for the *Prime Now* service or to ensure the last mile);
- The process of diversification of facilities both in terms of the size of the warehouse and its location characteristics (location in the dense urban area or in the dense peri-urban area, location in peripheral territories or even in themetropolitan fringes);
- The process of dualization of logistics markets and the warehousing sector, with the largest peripheral warehouses (*fulfillment centers*, *inbound cross docks*, *regional sortation centers*) on the one hand, and intermediate or small urban logistics areas (*last mile delivery stations*, *Prime Now hubs*) on theother;
- The process of taking direct control of the various links in the global logistics chain, allowing control of flows and distribution routes and less dependence onthird-party carriers or shippers, particularly for long and medium-distance operations.

This cartographic analysis makes it possible to identify several spatial logics for the establishment and extension of Amazon's logistics system:

- A dual spatial rationale of networking and concentration of logistics warehouses, with the development of clusters of warehouses around major transport infrastructures (motorway interchanges, regional or international airports, ports, rail freight network) and the creation of a more or less finemesh of warehouses, particularly urban logistics areas. This dual logic makesit possible to obtain broad market coverage even in secondary markets and to reduce processing and delivery times, while at the same time achieving economies of density. This dual logic can be found both at the national level (concentration in the main megaregions and progressive networking in new market areas) and at the metropolitan level (concentration in clusters of peripheral warehouses and deployment of a network of urban logistics spaces);
- A dual spatial rationale that focuses both on the outskirts of metropolitan areasand on dense urban centers. This work confirms the emergence of a dual logistics real estate market with, on the one hand, large peri-urban or even ex-urbanized warehouses that structure logistics chains on an international, national and regional scale (Heitz *et al*., 2017) and, on the other hand, small urban warehouses or urban logistics spaces designed to serve metropolitan areas and the last mile and final delivery chain. In this last mile chain, new logistics spaces are built to support the development of new market segments, in particular "instantaneous deliveries" (Dablanc *et al*., 2017). The growth of e-commerce and the increase in goods flows

that it brings with it have led to an interest in developingurban logistics space. E-commerce *pure players* are among the drivers of the logistics real estate sector, seeking to meet their growing needs for logistics space by turning to new asset classes, ranging from XXL warehouses of one hundred to two hundred thousand sqm to small urban warehouses of a few hundred or thousand sqm. This dual entry into the logistics real estate market is well illustrated by developments in Amazon's US locations.

- The process of expansion of the spatial coverage of warehouses, which contributes to the phenomenon of logistics sprawl that relies on the multiplication of warehouses in peri-urban spaces and more broadly in low- density spaces (Giuliano *et al*., 2013; Dablanc *et al*., 2018). The lack of regulation of metropolitan margins has favored the development of warehouses in peri- urban spaces. Several location-related relationships already identified (Dablanc *et al*., 2018) are confirmed by this empirical study on the case of Amazon: logistical sprawl is positively related to the availability of large parcelsin peripheral areas and the intensity of logistical sprawl varies with the type of warehouse (higher for large distribution and processing centers, more limited for courier terminals). Amazon therefore contributes to logistics sprawl in the United States, both through the location of large distribution warehouses in suburban areas and even on the outskirts of cities, and through an increasingly dense network of warehouses that accentuate Amazon's land andproperty footprint, which is quite far from urban centers. Moreover, despite the dualization of the logistics real estate market and the renewed interest in central and peri-urban areas, this has not been to the benefit of limiting or mitigating logistics sprawl. The case of Amazon is interesting in confirming thispoint: the strong growth in the number of peri-urban warehouses is coupled with a strong growth in urban logistics spaces, thereby increasing Amazon's urban footprint. One could therefore speak of a contradictory process of logistics sprawl, both centrifugal and centripetal, or of a process of contradictory logistics sprawl that doubles as a process of expansion of the urban footprint of the logistics sector. If warehouses of various sizes were to multiply in central and peri-urban areas in parallel with the peri-urban logistics system, this would contribute to increasing the urban footprint of warehouses. This raises regulatory, land, real estate and environmental issues in terms of urban planning and development, as well as vehicle flow management and management of the negative externalities of urban logistics.
- The logistics sprawl to which Amazon's logistics system contributes can be explained firstly by a change of scale in Amazon's level of activity (explosion of e-commerce and strengthening of this trend during the Covid-19 crisis (Dablanc, 2019), Amazon's dominant position on the US market) and secondly, by the overall evolution of the global supply chain (Hesse, 2008). Indeed, Amazon's logistics real estate strategies follow the major trends observed in this global logistics real estate market: development of a logistics real estate offer that meets the needs of logistics operations (mutability, automation, need for space and large single plots, modern equipment); consideration of the logistics building as a financial and real estateasset (Fender *et al*, 2016); a process of vertical integration that relies on direct control of several links in the *supply chain* to be less dependent on third-party actors (3PLs, shippers, carriers) and on the development of a real system that takes advantage of this dual but potentially complementary logistics real estate market and generates economies of scale and density.
- Finally, Amazon's warehouse location strategies need to be observed on a finerscale in order to fully understand their spatial logic. After analyzing the three case studies, it appears that regionalized logistics strategies are being deployed, with several important common characteristics (concentration of large warehouses on the outskirts of metropolitan areas, deployment of a fine network of urban logistics spaces, development of intermediate logistics links, particularly *regional sortation centers*, importance of accessibility and location near

transport infrastructures). Nevertheless, it also appears that these regionalized strategies reveal differentiated systems, apparently taking into account territorial arrangements and socio-economic and urban dynamics: the case of the Chicago metropolitan area shows a logistics system built according to a classic model of distinct radio-concentric areas (large warehouses on the outskirts, urban logistics spaces in the city center, with the exception of a few rare urban logistics spaces in peri-urban areas). The case of Los Angeles, onthe other hand, reveals a polycentric logistics system reflecting the polycentric organization of the metropolitan area, with several major clusters of peri-urban warehouses far from the city center, another cluster near the port infrastructuresof Los Angeles/Long Beach, and a scattering of urban logistics spaces in the main and secondary residential and employment centers which are structuring this vast metropolitan area. Finally, the case of the southern part of the Northeast region, from the New York metropolitan area to the Baltimore and Washington D.C. shows a new form of spatial organization, linear this time, following the long urban and infrastructurecorridor that structures the megalopolis, with, for example, several clusters of peri-urban and ex-urbanized warehouses on the outskirts of the major cities,but also in the secondary centers and in the interstitial spaces. Moreover, this linearity is beginning to split further north with a second arc of warehouses beginning to form in the hinterland. These initial findings require further study, particularly in other US urban regions, to understand whether the spatial logic of Amazon's location adapts to pre-existing territorial arrangements and legacies in addition to (or in parallel with) market logic (land availability, costs, etc.).

This work could be complemented by further research in a context of strong development of Amazon's logistics system and continued growth of the e-commerce sector, particularly during the Covid-19 crisis. Other analyses of Amazon's locations inother urban regions and large agglomerations could be conducted in order to refine theinitial findings on the regionalization of Amazon's logistics system and to identifyother regionalized logics. In addition, two lines of research could be pursued: first, a multifactorial analysis (transport, land, traffic flows and congestion, socio- demographic and economic factors, environment, etc.) on the location logic of Amazon warehouses in order to understand its urban footprint and negative impacts;second, an analysis of land and real estate costs in order to understand the impact ofthese costs on the location of warehouses and the extension of the warehouse network and to deepen the understanding of the differential relation between warehouse location (in urban areas and in peripheral areas) and real estate and land costs (Oliveira, Schorung, Dablanc, 2021).