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Defining and characterizing Urban Logistics Spaces: insights from a port city and generalization issues

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Abstract. This paper presents a preliminary analysis of Urban Logistics Spaces (ULS) in Barranquilla, Colombia, with the aim of defining a typology in port cities in developing countries and examining the relevance of using a specific typology for those cities or having a unique and general typology, for any city in the world. Firstly, the background to the research is presented. Then, the methodology for the characterization of urban facilities and the definition of the typology is presented. A qualitative characterization was carried out through semi-structured interviews, in order to understand the specificities of the ULS located in Barranquilla, and to analyse how the logistic spaces that are not yet in that context could improve the city's logistic system. The data collection was carried out with the participation of nine (9) actors belonging to the logistic system of the city of Barranquilla. The results show that the "standard" typology chosen, typical of the European context, is partially recognized by the professionals of Barranquilla, and therefore the identification of other types of ULS currently operating in the Colombian context was obtained. Consequently, it is necessary to standardize the typology of urban logistic spaces and to deepen the analyses to define a general typology, which would be reduced in relation to the type of city, but which would have a unified general base capable of being later adapted to any city.

Keywords: City logistics, Urban Logistic Spaces (ULS), Typology, Case Study.

1. Introduction

Freight transport in cities is essential to their economic life, while at the same time it is a source of certain nuisances, in particular urban road congestion and pollution. The movement of goods represents approximately 10 to 20% of all journeys in a conurbation[;Error! No se encuentra el origen de la referencia.], so various urban stakeholders deal with proposing solutions to reduce environmental nuisances and cost of urban freight distribution. One strategy is the implementation of ULS, which can be seen as the interface between interurban and urban supply chains, linking producers and urban consumers [2]. ULS are interfaces used to facilitate the relations between dispatches and receptions, between the roads and the point of operation, between the city and its distant surroundings. Their purpose is to reconfigure the flows through the city for the benefit of all or some of the parties affected by economic exchanges. Currently, work on ULS typologies is mainly carried out in Europe (and other developed countries), but its deployment in emerging economies remains less explored [2]. It seems therefore interesting in these

contexts to examine the suitability of ULS, mainly in logistics cities such as those related to ports with large industrial and logistics structures. The aim of this paper is to identify existing solutions with respect to ULS in the city of Barranquilla, Colombia and to analyze which logistic spaces (present or not) could improve the city's logistic system. In fact, an important effort has been made in developed countries to evaluate and implement urban logistics solutions for last mile delivery in cities. However, efforts in low- and middle-income countries are not well documented in the scientific literature. Therefore, we also propose a typology of ULS that can be generalized in different contexts and types of cities according to the results obtained of the case study and a review of the existing ULS. The paper is organized as follows. First, background information on the current state of knowledge and practice regarding urban logistics spaces is presented, followed by a description of the research methodology. The results of the study are then discussed and a general typology of ULS was proposed. The paper ends with some conclusions and opportunities for future research.

2. Background

An Urban Logistics Space (ULS) can be defined as an interface used to facilitate the relationship between shipments and receipts, between roads and the point of operation, between the city and its surroundings, with the purpose of reconfiguring the flows through the city for the benefit of all or some of the affected parties (actors) by the economic exchanges [2]. According to [4], in Colombia, logistics facilities are commonly known as logistics centers, with the understanding as strategically located facilities in highly productive regions with the purpose of concentrating and supplying services which are complementary to their main activities and to work in function of the physical integration of the territory and conforming a social factory that propends for the well-being, the strengthening of productive activities and the consolidation of political-administrative bonds to promote territorial competitiveness.

The selection of a specific land use strategy by a private party often depends on the basic operations it will host, the structure and size of the customer orders, the logistics units managed, the material handling costs, the availability of storage space and labor resources, among others, i.e. mainly the technical aspects and the needs of the company. Regarding the conditions for the development of logistics functions in urban areas, and although the most appropriate solution would be to establish large facility complexes in metropolitan areas, large cities tend to have expansion policies not entirely following this logic [6], leading to logistics sprawl phenomena [7]. In this way, the impacts of locating logistics centers in metropolitan centers or peripheral areas have been widely discussed by various researchers [7][8][9]. In relation to immediate port hinterlands, which remain relatively captive, distant hinterlands are highly contested. In cases where road is the dominant mode, transport costs are a function of distance and therefore often the determining factor in the choice of port [9].

The concept of an interface designed to orient flows in direction to urban areas is relatively old. The first approaches date back to about sixty years ago, with the development of the first urban logistics facilities (in the form of urban consolidation platforms), although the systematic proposal of urban consolidation and distribution centers has been deployed in the 90's [10]. In practice, those facilities, initially deployed on an economic viewpoint [11], turned out to be difficult to implement due to the diversity of the application cases encountered, in contrast to the transport of passengers, except for the geography of the movements, which takes forms that are generally similar. Those obstacles have certainly prevented the emergence of systems for centralizing consignments. However, the solutions have been refined over time and we have seen the appearance of new and different categories of facilities. Moreover, in cities of emerging countries, and mainly in those with a high logistics activity (like port or intermodal platform cities), this typology merits precision and a more in-depth analysis, to evidence the suitability of that classification and the eventual needs of revising it. For those reasons, we propose below, via a case study, a methodology to adapt and evolve this typology to other contexts. It is important to mention that a general typology of ULS would allow a valuable tool for decision makers on the many aspects that can be useful for the selection, design and/or location of logistics spaces in any type of city or context.

3. Research Methodology

Boudouin et al. [2] present a typology of ULS for the European context, according to their applicable spatial and functional coverage, with slightly different objectives in comparison with the Colombian context. These spaces are classified into two large groups, the Generalist ULS and the Specialist ULS. This typology (see Table 1) was used as the basis for this study. On one side, Generalist Urban Logistics Spaces are considered as high-rotation storage platforms, as points of articulation between urban and interurban areas. Generally, these sites tend to be easily accessible and located near the delivery areas, which makes them very desirable spaces. Among these are the so-called urban logistics areas, distribution centers, and multifunctional buildings. On the other side, the problems of urban deliveries are not of the same type, each city, each context has its own specificities and according to social and economic issues. Therefore, Specialists Urban Logistics Spaces adapt to a wider range of products and clients, and are categorized, spatially and functionally, into three groups.

Table 1: Comparison between Generalist and Specialist urban logistics spaces.

	Types ULS	Summary
GENERALIST	Urban Logistics Zones (ULZ)	It allows the actors of Urban Logistics to position themselves close to customers to minimize vehicle movements. <i>Functionality: Transshipment and Operations before final delivery.</i>
	Urban Distribution Centres (UDC)	It manages the transport flows in the city to channel it to a site where they are consolidated and sent by a specialized operator. <i>Functionality: Operates dense areas in the most complicated hours.</i>
	Logistics Hotels: Multi-Functional Buildings	Multi-purpose building, Ability to integrate various types of activities around logistics and distribution. Large and attractive space increases the economy.
SPECIALIST	Vehicles Host Point (VHP)	Vehicle Host Points, due to the negative effects of other users. (Congestion, disorganization and other annoyances.) Appropriate place to park, which allows safe access for delivery drivers to operate their deliveries.
	Goods Reception Points (GRP)	Replacement interfaces of the recipient, to avoid the last meters. The division is both spatial (Point of arrival or departure of the shipment) and temporary (delivery or collection in a period of time according to the interests of both parties.)
	Urban Logistics Boxes ULB	Interfaces between the operator and the client, without any kind of necessary human presence at the place of transshipment. The main advantage of this is the control of time. (The notion of time is very important). The boxes can be fixed or mobile. They are implanted in private or public places.

Source: Adapted for academic purposes in [2].

In Colombia, the development of the logistics sector has been one of the biggest bets in the country in recent years, in a logical attempt to take advantage of land availability and the excellent strategic location of the country's ports, especially in the Caribbean Region[13]. Thus, the city of Barranquilla and its metropolitan area have had in the last years a strong vocation to be a center of logistic, industrial and specialized services, whose main task is to act as a link node of the country and the global economic dynamics. For this reason, the city of Barranquilla is taken as a case study.

Given the exploratory nature of this research, a qualitative study has been carried out to understand the specificities of urban logistics spaces in the city of Barranquilla, Colombia. This research is composed of a set of interviews to address the city's case study. The case study research approach is based on methods and tools used to collect information in the natural and unique context in which the studied phenomenon is developed considering the contextual and temporal aspects [14][15]. The importance and value of this method increases when existing perspectives or previously developed perspectives are not necessarily applied to the study in new contexts [14]. Therefore, the above characteristics justify the case study approach as one of the inputs for the diagnosis of the city under study. It should be noted that studies of regulations, standards and other official and technical documents on logistics legislation in Colombia are, at this time, beyond the scope of this study. They will be analysed in future research developments.

The non-concentric characteristics of most Colombian cities, the population size, the growth of the cities, the complexity of mobility, among others, as well as the conditions, characteristics and regulations of the municipalities of the region call for particular and different context that needs to be explored. Information was collected using semi-structured interviews. An interview's guide on a set of selected stakeholders in the city Barranquilla, Colombia, was carried out, to verify how the proposed typology and taxonomy from literature can be changed to deal to the Colombian (and Latin American) reality.

Starting from the European typology of ULS, we identified which of these types of logistics spaces exist in the city of Barranquilla. Nine companies both public and private with different types of logistical participation (one 1PL, one 2PL, one 3PL, four 4PL, one 5PL and one public entity), were selected for the interviews. Logistics Managers, Supply Chain Managers or the equivalent were approached. The guided interview consisted of two main parts. The first was oriented to ask managers if they consider that there are logistics spaces in the city, according to the typology obtained from the literature review. No information on this typology was provided to the interviewee. In a second stage, the respondent was informed about this typology and then asked about his or her knowledge of these types of ULS.

4. Findings

4.1 Types of Urban logistics spaces for Barranquilla city by stakeholders

All cities in the world have particular characteristics in terms of their territorial organization, mobility, regulations and other fundamental aspects for the development of an urban logistics system. In the case of Colombia, the country is very diverse according to the context and needs of each region. The nine (9) actors of the logistic system of the city of Barranquilla who were interviewed, gave us their own definition of the logistic spaces according to the reality they live every day. From the interviews it can be inferred that in the context of Barranquilla an urban logistical space (ULS) is an area, which forms part of the supply chain, in which various essential operations (and services) are developed, allowing the distribution of goods with the objective of satisfying the needs of the clients and final consumers. Subsequently, the interviewees made their own classification (without having the proposal in the background section). Table 2 presents a summary of the ULS mentioned and the frequency.

Table 2: ULS of Urban Logistics System of Barranquilla's city.

STAKEHOLDERS	Types of Urban Logistics Spaces (ULS) Barranquilla																			
	Free trade zone	Industrial Parks	Package Store	Distribution centers	Lots	Ports - Docks	Place of transshipment	Industrial plant	Logistic agencies	Points of sale	Enlistment areas	Logistic centers	Business Centers	Logistics operators.	Customs warehouse	Green zones	Parking lots	Shed	Warehouses	
1	1 PL	x	x	x	x	x														
2	4 PL	x	x	x	x			x	x	x			x							
3	4PL	x	x	x	x	x						x		x	x		x			x
4	5 PL	x	x	x	x								x	x		x	x	x		x
5	3 PL	x	x	x	x							x								
6	2PL	x	x	x	x									x				x		x
7	4 PL	x	x	x	x									x				x		
8	Public	x	x		x									x	x					x
9	4 PL	x	x	x	x		x			x				x						x
Total		9	9	8	9	2	9	1	1	1	2	0	2	2	6	2	1	3	1	5

Source: Own preparation based on the results obtained from the study.

According to the definitions of the ULS that are part of the context of the city of Barranquilla, there is a lack of denomination and classification of them. This is evidenced by the fact that most of the ULS that make up the city's logistics system carry out similar or even the same operations. The main reason that makes these logistics spaces easily identifiable by the actors is the volume of goods they handle. However, some of these spaces have more technology than others, which makes them very attractive, especially for users who require a type of integrated logistics service.

Knowing that most of the ULS in Barranquilla are identified by the actors according to the volume and variety of logistic services they offer, in the spaces mentioned by the interviewees, we found that their characteristics allow some of them to be "homologated" according to their functionality and coverage as is the case of the Parcel, Batch and Warehouse; these three spaces can be found in different sizes, and allow the storage of the merchandise before proceeding with its distribution. We also find Distribution Centers and Logistics Centers, both spaces are conceived as relatively large, technified spaces, where various types of basic logistics activities are carried out, to finally distribute goods, generally of all types.

4.2 Types of urban logistics spaces (ULS) in Barranquilla, according to the proposed typology

For the second phase of the study on the typology of urban logistics spaces (ULS), they were made known to the interviewees, the types of ULS that make up the logistics system of Europe and some definitions and characteristics of these spaces. Once the interviewees knew the categorization of the logistics spaces of the European context, they related the spaces of the city of Barranquilla (mentioned above), with the typology provided. Table 3 presents the relationship described by the participants of the study.

Table 3: ULS of Barranquilla's City according to the European typology.

STAKEHOLDER S	Types of Urban Logistics Spaces (ULS) Barranquilla					
	Generalist			Specialist		
	Urban Logistics Zones (ULZ)	Urban Distribution Centres (UDC)	Logistics Hotels: Multi-Functional Buildings	Vehicles Reception Point (VHP)	Goods Reception Points (GRP)	Urban Logistics Boxes ULB
1	x	x	x	x	x	
2	x	x	x	x	x	
3	x	x	x		x	
4	x	x			x	
5	x	x	x			
6	x	x	x	x	x	
7	x	x	x		x	
8	x	x	x			
9	x	x		x	x	

Source: Own preparation based on [2]

According to the ULS proposed typology, and to the relationship expressed by the interviewees, about the types of logistics spaces, it is denoted that most of the urban logistics spaces (ULS) that make up the logistics system of the city of the case study, they are Generalist spaces; high rotation platforms, where various types of operations are carried out depending on the distribution logistics and generally easy access to participants in the supply chain. Barranquilla is currently venturing into the design, creation and use of modern and more integrated spaces such as the Multi-Functional Buildings. In the opposite case, Barranquilla still does not have many Specialist Urban Logistics Spaces (ULS). In relation to Vehicles Reception Point (VHP), and Goods Reception Points (GRP) can be found today in private companies. While the ULB Urban Logistics Boxes are not part of the city's logistics system.

It should be noted that unlike the European context, in Barranquilla there are no urban logistics spaces that are administered by the government, accessible to any company that requires it. However, there are private companies that have their own points, and logistical spaces for their operation. Nowadays, the collaboration of different stakeholders (public and/or private) is being achieved and they are reaching an agreement for the management and use of this type of space, which is considered an advance for the city's logistics system. Regarding the typology of Generalist ULS, Urban Distribution Centres are present both in Europe and in Colombia, although with some small differences. Unlike the Colombian reality, the typology of European ULS indicates that the Urban Distribution Centres operate in the densest areas and at the most complicated times, while in Colombia, the ULS are generally located in the surroundings of the city (of easy access) and operate at the quietest times, facilitating the dynamism of the city.

4.3 How could the Urban Logistics Boxes (ULB) improve Barranquilla's city logistics system?

As mentioned in the previous section, Barranquilla does not yet have the Urban Logistics Boxes. Once it was identified that this logistical space does not form part of the city's logistical system, the actors involved were asked how they considered that the Urban Logistics Boxes could improve the city's system. All interviewees agreed that an automated and technologically advanced space, such as the Urban Logistics Boxes, could greatly improve the logistics system. They described that it could be a much more agile flow system, more economical in terms of time, transport, human resources and other types of costs that are considered for logistics operations. They considered aspects that affect not only the logistics system, but the pace and dynamism of the city in general. The importance of a space of this type for the reduction of environmental impact was also mentioned, which is part of the main objectives of Colombian Logistics until the year 2022.

5. Generalization issues

Due to its strategic location, Barranquilla’s city, during the last decades has had a strong vocation to be a logistic and industrial centre. Although each city has specific characteristics, it is possible that there are some cities, such as Barranquilla, that have similar logistical spaces, and that their geographical location allows for similar management of these types of spaces. For this reason, this section proposes a classification of ULS, aimed at cities that have specific areas such as ports and docks, especially if they are located in developing countries. The following proposed ULS classification refers to the type of operations carried out and the volume of trade handled (see Table 4). It should be noted that due to its privileged geographical location, Barranquilla has a kind of specialized urban logistics space such as ports, located on the coast or on the banks of a river where ships carry out loading and unloading operations.

Table 4. Preliminary proposed classification of Urban logistics spaces (ULS) for the Barranquilla context

Volume of Goods	Generalist			Specialist	
	Storage Centers	Integral Consolidation Centers	Centers for Logistics management	International trade handling	Specific areas
-	Lots	Point of sale	Logistic agencies	Free trade zone	Enlistment areas
	Package Store	Logistic centers	Business centers	Customs warehouse	Docks
+	Warehouses	Distribution centers	Logistics operators		Transshipment facility
	Shed	Industrial Parks			Green Zones
	Industrial Plant				Parking lots
					Ports/intermodal structures

Source: Own elaboration based on the results obtained from the study.

Table 4 shows a typology of urban logistics spaces that can be applied to different port cities in the world, given the characteristics of the city of Barranquilla.

When examining it in depth, we observe that most of the types of facilities are found in other contexts:

-Storage centres and integral consolidation centres are located in different cities in both developed and developing countries. However, since these facilities are generally located in areas of activity, the main differences are organizational and location, but not technical and functional, the main characteristics that define these platforms and their organizational issues remain similar in most contexts. In fact, in developed countries, the main industrial and business zones are located in peripheral areas, and in developing countries the mix of space (households, retail and industry/business) is greater, but the difference then arises in the location and socio-economic options, not in the functional aspects of the facilities.

-Logistics management centres are mainly business-related, and then seem to be applicable to different contexts, with cultural and socio-economic issues being on a second level to technical and functional issues.

-The management of international trade and specific areas will not apply to all cities (only those with such activities because they will have customs agencies or specific logistical activities specific to such modes and transport organizations will be able to deploy them), but then, we observe that transshipment/greenfield zones and ports (whether river or sea) and intermodal platforms will be present in a wide variety of cities. The typology seems then a first step into defining a stable, unified categorization but will need further work (for example testing it in other contexts) to state on its robustness and transferability.

Moreover, considering the results obtained, together with an exhaustive analysis of the literature on ULS and the existing ULS typologies, we have been able to propose a general typology of ULS that can be adapted to any type of city (See table 5). It is important to mention that a general typology of SUs according to the design and dimensions of the physical infrastructure, the flows, the types of actors and/or partners interested behind those spaces, and the specific purposes of each type of logistics space would contribute to the relevant location of these, and therefore to the efficiency of the logistics networks, as well as to the improvements in the goods transport sector.

Table 5. General Classification of Urban logistics spaces (ULS).

ULS types		Functionalities
GENERALIST	Urban Logistics zones (ULZ)	ULZ are large multipurpose zones that integrate various types of ULS and allow easy access and location near the delivery zones. Reduces the number of vehicles on the roads and improves operations productivity.
	Urban Distribution centers (UDC)	ULS of medium or large dimension designed for the consolidation and shipment of goods, which facilitates flows, especially in dense areas of cities. Improves the urban environment and limits conflicts between users in the public thoroughfare.
	Logistics Consolidation Centers (LCC)	Logistical spaces with large or medium dimensions, where the cargo is shipped at the same time instead of making small separate shipments. To reduce costs, cargo volume rates are paid.
SPECIALIST	Good Storage Centers (GSC)	Platforms of various medium and large dimensions, which are responsible for the reception, storage and movement within the same warehouse, as well as processing and securing the information of the data generated in each of the processes of logistics operations.
	Logistics managements centers (LMC)	Interfaces generally of small and medium dimensions, where the design of one or several stages of the supply chain is managed, such as procurement, transport, storage and distribution for customers (companies) who require the service. Better plan and manage logistics operations.
	Vehicle Reception Points (VHP)	Vehicle receiving points, medium and large, is used as an appropriate place to park the transport of cargo, allowing safe access for delivery drivers to operate their deliveries. Reduces time to reach the customer.
	Automated Logistics Centers (ALC)	ULS with operator-client interaction, usually small and medium sized. The main advantage of this is time control. ALCs can be fixed or mobile, in public or private places. They are implanted in public or private places. It allows the delivery or collection of goods in the absence of the customer.

Source: Own elaboration [13].

6. Conclusion

This paper is, to the best of our knowledge, the first that inquiries about the urban logistics spaces of a city in a developing country. The city of Barranquilla, Colombia is taken as a research case study, as it was a city that for many years suffered in its logistical processes, and since eight years ago it has been improving in its logistics system, thanks to the integration between the public and private actors so promoting the development of the city. Without forgetting, of course, its strategic location which makes it the owner of a large urban logistical space such as the city's Port, and the ports of the Caribbean Region, which are not related in the European typology of ULS. Barranquilla's Plan of Territorial Organization has suffered constant changes due to land use regulations. Therefore, new research on these issues, including the ULS, becomes difficult when considering the stability of the political ecosystem. This is a negative impact for the advancement of the city's logistic system. In spite of the fact that the city of Barranquilla is the anchor city of the Colombian Caribbean, where most of the region's goods are received and dispatched, there are not enough logistical nodes for transshipment and last mile operations that could generate high costs, and negative satisfaction for customers. -Based on the findings of the interviews, the functionality of the logistic spaces operating in Barranquilla allows us to propose a new typology of urban logistic spaces (ULS), in addition to the ports of the Region. -The different types of operations are carried out in different ULS in an integrated manner, with the difference in the volume of goods handled in them. According to the definition of the Generalist ULS of the European typology, the spaces that are found in the logistic system of the Colombian context (such as Free Zone and Customs Warehouse) could be part of that qualification. However, due to the special conditions, in terms of tax benefits, and handling of international goods, it is considered that they should be included within the classification of Specialized ULS. -Additionally, the results of this study provide valuable information on the numerous aspects that can be useful for the selection or location of ULS and for decision makers who wish to stimulate the development and economic, social, logistical and even environmental progress of the world's cities through logistical configurations. - It is worth mentioning that it would be relevant to replicate the method of information collection in different cities and countries, we could according to the real information of each context.

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