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Towards joint city logistics initiatives between Bogota and the Netherlands



Delft University of Technology/Rotterdam University of Applied Sciences

Ron van Duin, PhD

November 2019

Foreword

On invitation of The Holland House and the Royal Dutch Embassy in Bogota I was asked to give a keynote-speech on the latest developments in city logistics in the Netherlands and other countries. Another goal of my visit included to perform a quick-scan on Bogota researching the opportunities to make improvements in the city logistics domain, and if possible, providing suggestions for cooperation between Dutch and Colombian Institutes and companies.

To gain insights on the determining factors in the city logistics domain in Bogota I was pleased to have a couple of interviews with representatives of several organisations during my short stay of 3 days (25/9-27/9). Therefore I thank the following organisations and persons who were willing to share their thoughts and concerns about the city logistics situation in Bogota:

National Planning Department	Diego Día del Castillo David Sanchez
National University of Colombia Faculty of Engineering	Frank Ballesteros Team of Prof. Wilson Adarme Jaimes Students
Private logistics service provider Solistica	Nestor Sanchez Oscar Velandia Team of Solistica
Ministry of Transport	Juan Felipe Sanabria Riccardo Sampaio Sebastiaan Taleo
Ambassador	Jeroen Roodenburg
Holland House	Jan-Willem van Bokhoven
Bogota Chamber of Commerce	Mario Fontalvo Riccardo Sampaio Entrepreneurs/students
EAN University	Marjorie Zomignani Maia Research team

Special thanks go to Alison Paez Rincon (The Holland House) and Natalia Piñeros (Royal Netherlands Embassy Bogota) for their support and devotion during the visits and the excellent organisation of all the meetings. Therefore I really felt myself quite comfortable in Bogota. Hopefully this report forms the basis for a new cooperation.

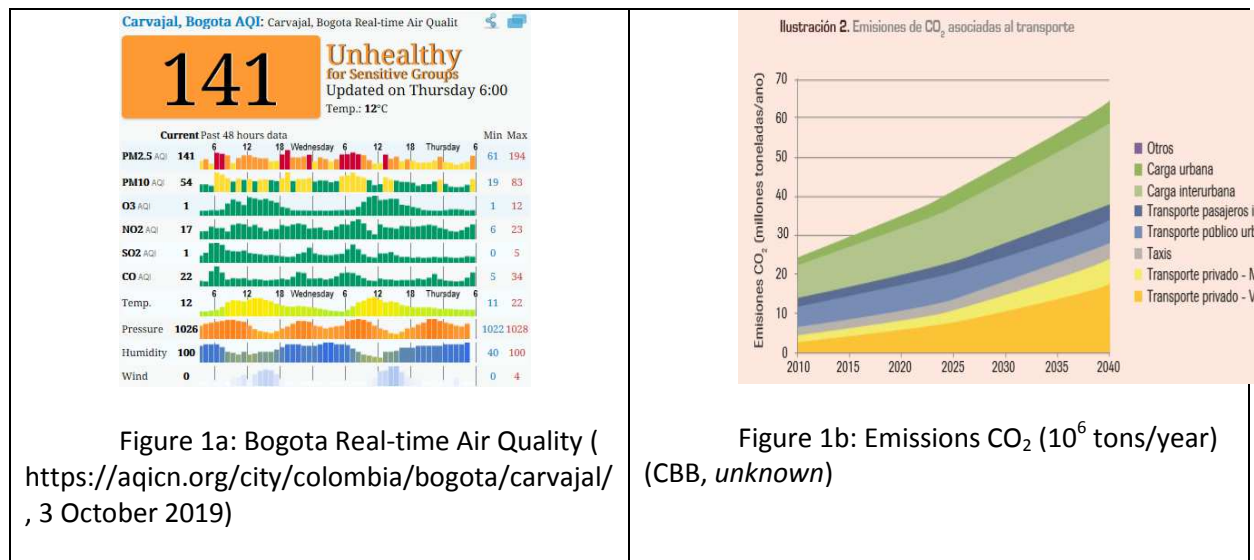
Ron van Duin

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1. Introduction

Surrounded by mountains Bogota has transformed itself in the last decades from a city with poor infrastructure and with significant security and safety problems towards a more sustainable and liveable city. Like many other cities in the world urban freight transport and logistics in general often has been neglected by the local authorities. Bogotá is also a city with high population density, close to 15,000 people per square meter and more than 10 million people, which, in combination with inadequate and insufficient infrastructure, leading to high levels of congestion. The Colombian capital is ranked as the most traffic congested in all of South America and takes fifth spot worldwide (The city paper staff, 2018). The related air quality to these high levels of congestion show representative high peaks of PM_{2.5} levels in the atmosphere (see Figure 1a).



As can be seen in Figure 1 a ‘yellow alert’ is often issued when the air quality index surpasses a density of PM_{2.5} and stays above 150 micrograms per cubic meter for several consecutive days. Considering the public health one should be aware that at the same time inhabitants from Bogota are enjoying their lives outside with sporting and cycling. A serious part of the transport is related to the so-called last mile logistics. In Figure 1b the share of CO₂-emissions caused by the last mile logistics (Carga Urbana) is between 5 and 10% and cargo with an origin or destination in the city (carga interurbano) is about 10-15% of the CO₂-emissions . These figures seem to be comparable to Medellin, another city in Colombia (Gonzalez-Calderon et al., 2018).

The results of this short research (25/9-27/9) are based on 8 expert interviews. The interviews are hold with representatives from the National Planning Department, State University, Private Logistics operator Solistica, Ministry of Transport, Bogota Chamber of Commerce, EAN University and The Embassy of the Net. The main goal of this research is:

To identify opportunities for collaboration with institutes, companies or universities in the field of city logistics between Colombia, i.e. Bogota, and the Netherlands.

To gain more insight in the city logistics domain of Bogota a short SWOT-analysis (Strengths, Weaknesses, Opportunities and Threads) is performed, which is shown in section 2. Section 3 shows some opportunities for collaboration and suggestions for improvements. Finally section 4 ends with conclusions.

2. A SWOT-analysis on Bogota

To identify ultimately promising research initiatives, a SWOT-analysis will be used here. The main opportunities, threats, strengths and weaknesses are mapped out for the city of Bogota. From this systematic frame of reference, it can then be determined which research initiatives are promising or not very promising. In our case, a special form of SWOT analysis is chosen here, namely the confrontation matrix of Kearns (1992). The confrontation matrix contrasts opportunities and threats with strengths and weaknesses. This creates a matrix with four cells that can have the following meanings with regard to research:

- Investigate many promising opportunities to make large innovation steps possible with the strengths (OS);
- Investigate whether opportunities can contribute to an improvement of weaknesses (OW);
- Investigate to what extent the threats have a negative impact on the strengths of the system (TS);
- Investigate to what extent the threats are threatening to the weaknesses and / or can be converted into improvements or disappear completely (TW).

Table 1: SWOT strategies-matrix (Kearns, 1992).

	Strenghts (S)	Weakness(W)
Opportunities (O)	Challenge Use the strengths to better exploit the opportunities.	Defend/improve Use the opportunities and challenges to improve/cover the weaknesses
Threads (T)	Protect Areas where there are opportunities, where a choice must be made invest, disinvest or work together.	Keep the damage Minimise the weaknesses and prevent the threads

The SWOT analysis can actually be used as a kind of compass for navigating the research opportunities and offers the possibility of continuously identifying where possible points of interest lie in the research field. Each cell will be elaborated in the next paragraphs.

2.1 Strengths & Opportunities in Bogota

Based on the discussions with the stakeholders mentioned in the forward some developments are seen as strengths:

Off-time deliveries

As a promotion of Good Practices the Night-time pilot project in Bogota, Cal, Buenaventura and Barranquilla was profiled by the National University of Colombia and The Bogota Chamber of Commerce as a successful project to assess the performance, competitiveness, mobility, security and externalities of logistics operations, from the implementation of night-time loading and unloading pilot. The pilot run with 17 participants from retail, food, petrochemical, beverage and transportation industries that collaborated scheduling their deliveries from 10 pm. to 4 am. in the industrialised

areas of Puente Aranda. Considering the time-related costs, the cost savings estimated for Bogota the average savings on travel costs was 32% by comparing daytime vs. night-time operations based on measurement by using GPS data loggers using the methodology developed by RPI/CoE-SUFS (Ballesteros, 2016). Savings of emissions were measured at several locations: 42% CO, 8% CO₂ and 1,4% PM. During the pilot there were no security and/or safety issues. Another strong issue of this project was the strong commitment of companies, governmental agencies and universities. This is the only way to make serious steps forward. Although the pilot has provided good outcomes, there was a negative perception of companies about performing night-time loading/unloading in terms of potential theft and/or damage of goods.

Growing attention for sustainable, integrated public policies

Another strength is the growing attention for sustainable and integrated public policies, which, in the context of urban mobility, will promote sustainable mobility concepts based on a differentiated use of transport services, strengthening of public transport, active transport modes (cycling and walking) and restricting the expansion of the use of individual motorized transport. The multimodal transport policy plan includes buses, trains, cable cars, cycle paths and airports. The projects under execution aiming at 129 km of roads, 2,969,000 m² of public space and 153 km of cycle paths (Value \$4.4 billion USD), compared to 11,8 km of cycle paths today. Especially the development of cycling lanes provides really good opportunities for cargo bike delivery.

Bundling/collection

In logistics some good examples of bundling/collection can be seen in Bogota. The National Planning Department mentioned the profound role of the company *Argos* who delivers prefab concrete parts for constructions works in which they work closely together with other companies to pick return loads to avoid empty trips in the city. Their promises for 2015 are 544 kg reduction of CO₂ per ton concrete, 205 g SO₂ reduction per ton concrete, 1205 g NO_x reduction per ton concrete and 60g PM reduction per ton concrete. These are really good examples of excellent practices and companies like these should be rewarded for their behaviours in terms of priority gaining access and permits as they are the frontrunners of sustainable logistics behaviour.

Air quality measurement

To measure and visualise the current air quality in Bogota is one of the challenges of the research team *Indevos*. It is a research and development group of the EAN University whose mission is to accelerate sustainability and innovation in Colombia. At this moment they are collecting real time measurement of the air quality in several areas of Bogota by the use of mobile environmental laboratory (Mitsubishi, see figure 2). Knowing and showing this type of data is the first step to a better understanding of the air quality in Bogota. It is a necessity to create more sustainable awareness!!

Figure 2: Mobile environmental laboratory for air quality measurement (Project Indevos)



2.2 Threads and strengths in Bogota

Congestion

As described in the introduction the main problem of Bogota for their city logistics operations is congestion. Bogotá (Bogotá, Cajicá, Chía, Cota, Funza, La Calera, Madrid, Mosquera, Sibaté and Soacha) will have twice as many vehicles in 2020 as it has today. In 2030 there will be three times as many. In 2040 it will have 12 million cars. Complicating matters even more is the effect that economic growth will have on the number of trips per inhabitant made each day. This means that the roads will have to serve a greater demand by vehicles. While more cars are on the roads, average speeds will decrease and as a consequence the duration of trips will become longer. For Bogotá, the study calculates that the average circulation speed on some major thoroughfares of the city is today between 20 and 30 kilometres (between 12 and 19 miles) per hour during morning rush hours. In 2012 the impact on the important artery -the Carrera Séptima- will be devastating. The average speed during rush hours will be seven kilometres (over four miles) per hour, as will the rest of the roads of the city (Semana, 2008). Representatives of the Ministry of Transport illustrated that a delivery trip from a warehouse to the innercity could take 5 to 7 hours. About 40% of the trips is empty driving! For the full trips about 90% has a load factor on average about 70%. There is still a lot of empty transport capacity on the road. The same could be said about the warehouses. Most of them are just half full.

Street litter

Incorporating waste pickers into municipal systems has made a major impact in Colombia. The annual amount of tons of waste recovered and recycled has increased dramatically — going from 97,905 tons per year in 2016 to 536,092 tons per year in 2017. Despite the policy efforts of Colombia to professionalise its solid waste management, by introducing an integral and more sustainable approach, to decrease landfilling and to increase recycling (which is commonly referred to as the 'Basura Cero' (Zero Waste) approach) the streets of Bogota still have a lot of litter (many plastic bags along the roads). Despite the fact that there are clear and inclusive laws in the country, waste pickers have faced major setbacks. Today, however, the system of waste-picker integration and recycling has been weakened and is under threat by new measures (Parra, 2019).

Insecurity

Income disparities are huge, more than half of the urban population belongs to the lower income strata, and an additional 40 percent to the lower-middle income segment and only a timid share make part of the upper strata. Conjointly, these factors create unique conditions for urban freight. In the 1990s the government began a series of development projects to solve these problems. In the area of transportation, the program has positively impacted the commutes of more than 300 people a day and shaved 25 percent of transit time off of the overall city commute. But the largest improvements have been made at the residential level. More than one million city residents have benefited from the 55 urban space upgrade projects throughout the city — especially those that have focused on low-income slums.

Across the city, 89 non-legalised slums, known as barrios, were made legal and incorporated with public information offices established within them. This legalization and legitimization of the neighbourhoods gave residents a political voice in their communities and helped to increase participation and reduce crime (Borgen, 2015). However in discussion with the logistics

entrepreneurs it was often mentioned that security forms a major barrier to implement off-time deliveries. Whether this is a general perception or a real fact could be investigated.

2.3 Weaknesses and opportunities in Bogota

Urban freight policy problems

Every municipality has its own problems and per city the importance of urban development is viewed differently. The mayor, who changes every 4 years, plays an important role in this. The change of management ensures that major decisions are kept on hold for several periods. The popularity of the mayor among his/her followers varies greatly per municipality and influences his or her decision-making. The rules concerning land distribution and land ownership are also determined per city. This complicates an integrated area approach and harmonisation of the rules and forms a problem with the expansion of cities outside the existing municipal boundaries, under the influence of population growth. Besides the changes in the policy plans every four years there exists a diversity of regulations for different zones in the city. Different city logistics measures such as time-window regulations) causing problems to the logistics service providers. Both the Ministry of Transport and the National Planning Department address these problems but they don't have any mandate to show their influences. The local authorities should be in a constant dialogue with the users of their infrastructure (freight carriers & Logistics service providers) to search for better solutions integrally. The national authorities can support the local authorities as they know the situations throughout the country and in other cities.

Knowledge dissemination

(Applied research) Universities in Bogota play an important role in the city logistics development. The off-time delivery project was a good example of such a project. With practice based research EAN takes a leading role in making the transition to city logistics practice. Still, at the university the research is still too much academic in terms of scientific contributions (which is evident for an University), however stronger involvement could be established with real time measurements by students. Bachelor and master thesis students could contribute to parts of the research and making the real connection with companies and governmental agencies. For companies and governmental agencies it is even better because they can see if the student is qualified enough to become a professional in their organisation. The universities should be more involved to share their knowledge with partners in the working field. The Bogota Chamber of Commerce has an inspiring role for the entrepreneurs in the field of city logistics in which they share value knowledge and experiences of city logistics initiatives in their courses and workshops. A closer cooperation between the knowledge partners, governmental agencies and the field of practice will help the awareness and the development of sustainable city logistics.

Nano-stores

In Bogotá, as in many cities in the region nano-stores and small outlets coexist with structured and modern retail outlets. It is estimated that a nano-store can receive over 30 deliveries per week, which complicates the urban freight puzzle. In Bogotá, around 17,000 freight trucks enter the city of every day, a city where the freight movement landscape differs vastly from that of Europe. What complicates the situation is the underdeveloped logistics system in the country, where Bogotá serves as a huge consolidation hub for all freight within the country, independent of origin or

destination (Jallow & Johansson, 2015). As a consequence there are about 140,000 nano-stores at 100,000 different distribution locations in the metropolitan area, a characteristic that normally would favour the use of small vehicles. Motorised vehicles are responsible for this large share of the urban distribution, operating at poor utilisation rates, rendering high logistics and operational costs for transport service providers. At the same time these vehicles are constantly competing for public space with the other transport options. Much of urban logistics in Bogotá is characterised by informality and 'single owner – single store-issues'. Until recently, urban logistics has almost exclusively been a concern of private enterprises, and, no majority based consensus exists within the local logistics industry in relation to create logistics platforms and centres. Thus, although some large firms do have distribution plans, cargo movement in Bogotá is of very complex character. Furthermore, much of the freight activity is carried out using non-conventional cargo vehicles (e.g. freight trucks), such as motorcycles, cargo-motorcycles, cars, taxis, and cargo bikes (Jallow & Johansson, 2015). Today there are some urban consolidation centres (UCCs) in Bogotá operated by private firms. These firms locate the UCCs where it best suits them and subsequently also take charge of the administration. The work of Kin (Kin, 2018) and Fransoo et al. (2017) show case studies in which UCCs (cluster-analysis on freight profiles) could play a vital role in the distribution to the shops. Complicating things there is a lack of data about freight demand, especially in developing countries. The lack of data is the result of multiple factors: the difficulty of collecting the data, lack of awareness about the importance of proactive public-sector involvement in freight transportation management, the cost of collecting the data, among other reasons. In this part universities can be of help by performing real measurements in specific streets and areas to obtain better insights in the supply profiles of the nano-stores.

2.4 Weaknesses and threads in Bogota

Immobility/Population growth

According to Gonzalez-Calderon et al. (2018) the results from the cordon survey provide a panoramic view of freight flows. They show that 33,274 tons enter the metropolitan area every day; 35,240 tons leave it, and additionally, 27,653 are external to external flows. An additional 2400 tons of trash as well as 8000 tons of construction materials waste (debris) are produced and transported every day within the metropolitan area. The external-internal and internal-external flows are similar (30% of the total each) and 85% of the cargo is transported by trucks. Inside the region, 15% of the cargo is composed by the flows between small establishments, debris, and trash. If Colombians today feel stuck in traffic in Bogotá, Medellín and Barranquilla, they won't be able to imagine the chaos that awaits them in the next ten years. For business people trying to get their cargo to Colombian ports it will be an even greater disaster. With the increase in the number of cars, motorcycles and trucks, and the lack of roads, the country is moving towards complete immobility. The most paradoxical of all is that economic growth, which is what has generated the accelerated increase of the number of vehicles in the country, will come to a standstill just when the big cities collapse because of poor mobility. According to the study (Gonzalez-Calderon et al. (2018) today the rate of vehicular motorisation (cars and motorcycles per inhabitant) is robustly growing and will continue to do so in upcoming decades.

2.5 Summing up the SWOT-analysis in Bogota

Table 2: SWOT strategies-matrix City Logistics Initiatives Bogota (based on Kearns, 1992)

	Strength (S)	Weaknesses (W)
Opportunities (O)	Challenge Off time deliveries Consolidation projects Cycling roads Air quality measurement	Defend/improve Knowledge dissemination Nano-stores Change of policy every 4 years
Threads (T)	Protect Congestion Waste on the streets Insecurity in certain areas	Keep the damage Immobility Population growth

3. Opportunities for collaboration/suggestions for improvement

From the SWOT-Analysis it can be concluded that there are only(!) two ways for urban freight transport to avoid the congestion in Bogota by using **off-time deliveries** and **more efficient bundling of goods (or a combination of both)**.

3.1 Off-time deliveries

The off-time deliveries is a good measure which example is followed in many large cities in the world. Many lessons learned can be derived from the implementations. Holguin-Veras et al. (2014) suggested some recommendations for establishing a robust outreach process:

- (1) Designate one person at the key city agencies as the point of contact, and with the authority, to deal with freight issues. The designation of such a “freight person” is a highly recommended first step that will likely have a significant impact. Over time, that person will gain a deep understanding of the functioning of the UFS, get to know the key individuals in the business, and develop a network of contacts that could prove useful throughout the process. Equally important, the industry’s varied agents will know whom to contact for information, a welcome advantage when trying to navigate complex institutional environments.
- (2) Create an Industry Advisory Group (IAG). An IAG is designed to be a forum for the discussion of UFS issues that meets several times a year, or when the need arises. The IAG could provide city agencies with vital industry feedback on key issues, and on policies and programs that the city agencies want to pursue. However, it is important to ensure that the IAG reflects the overall composition of the industry. Shippers, carriers, and receivers of the key industry sectors, both small and large, should be involved to provide city agencies with a solid idea about the issues, needs, and expectations of the entire UFS community. For Bogota this role could be taken by the Chamber of Commerce.
- (3) Complement IAG input with targeted outreach efforts. Since it is unlikely that many business owners or managers could participate in the IAG in a sustained fashion (typically, the majority of attendees of IAG meetings are trade group representatives) it is important to complement the input received. Some suggestions are to: (1) ask the trade groups to disseminate short articles about city initiatives of concern to their members; (2) attend trade group meetings and conferences; and (3) arrange for meetings with key companies to gather input directly.

At the same time it can be observed that the introduction of off-time-deliveries sometimes has been supported with introduction of cordon pricing for regular daytime delivery. **The off-time delivery is still one of the best ways to avoid the strong influences from the daily congestion.** The cost saving which can be obtained by logistics operators can be partly shared with the extra cost for receiving the goods by the retailers.

Researchers and students from both universities in Bogota could do more practice-based research by capturing all the experiences with off-time deliveries projects around the world. Some in-depth-interviews with partners from foreign countries can enrich the knowledge how to implement off-time delivery strategies. People like Stacy D. Hodge supervised the implementation in New York city. These experiences are very valuable to give a restart to the off-time delivery project in Bogota.

3.2 From collecting data to urban consolidation centres/hubs

At first, collaboration work among all actors, coordinated policies and strategic planning, information, statistical data/data acquisition and implementing new freight trucks technologies for city distribution, are the main issues to deal with in city logistics. In order to provide 'a common discussion ground' among all the actors, city-administrating representatives can take the leading role. For Bogota this is certainly done by the Logistics Cluster Bogota chamber of Commerce. Restrictive measures are recommended for the most polluting and heavy freight vehicles, also improving the cooperation at the local level among the relevant stakeholders, as well as removing non-technological barriers, and promoting public private initiatives. While in the process collection of urban freight data, it is essential to keep the units of analysis and classification terms consistent between studies. This would help to ensure greater comparability between the results of different studies. This way it would be possible to combine the results of smaller studies in order to see the entire freight transport activity picture. It would also be beneficial to introduce permanent or periodic surveys in the field as they provide an important basis for evaluation of suitable measures. **In essence it is important to know the delivery profiles of the streets in Bogota!** Traffic counts, interviews with shops can be carried out by students of both universities

Urban consolidation centres (UCCs) have been increasingly promoted as an instrument to gain greater improvements in the air quality, CO₂ emissions and noise reduction, achieving high effectiveness of land use by reducing the total distance travelled (Malhene et al., 2013; Allen et al., 2014). As for UCC implementation, on the basis of evidence available (Browne, 2005; Marcucci and Danielis, 2007) UCCs are generally preferable within specific areas, which have 'delivery or traffic congestion' related problems or even overloaded historical territories (usually located in the city centres). Also, UCCs are highly efficient within major construction sites or territories that are undergoing the process of 'retailing renaissance', new and large commercial development in urban areas and outside of cities (Brown et al., 2005). Delays upon loading/unloading give a straight influence, especially to the stakeholders. In addition, acceptance of UCCs among private stakeholders is relatively low. According to their initiatives, there is a need of reducing the number of freight vehicles and availability; to restrict the loading schedule, but that will definitely cause decline in the volume of goods. Vidal Vieira and Fransoo (2015) suggest more careful cooperation between drivers, shipper partners and freight operators, especially regarding local parking, accessibility, regulations, and flexibility to receive the goods in off-time windows. However, Olsson and Woxenius (2014) show on the example of UCC in Gothenburg, where former freight delivery routines were replaced with one electric vehicle, it resulted with about 50% of pollution and noise reduction. But the most important fact is that the amount of undesirable traffic and extra vehicle movements was reduced by 30%. **Obviously the concept of implementing UCCs could work also quite well for Bogota especially with the usage of Light Electric Freight Vehicles (so called electric cargo bikes).**

3.3 Setup of urban consolidation by the usage of cargo bikes (LEFVS)

Like Jallow & Johansson (2015) explained that without a proper understanding of how knowledge is actually transferred, successful implementation is difficult. The transfer of novel ideas between institutionally diverse contexts is a complex and indirect affair that involves a wide range of informal interactions. It also identifies that perception issues and a lack of awareness constitute important barriers to the successful implementation cargo bikes in Bogotá. Although it is argued that transport companies play a pivotal role in pushing for a modal shift, the importance of local

authorities in that process must also be stressed. Role of the municipality can vary from a low to maximum participation by introducing environmental zones for polluting traffic, providing privileges for LEFVs, bringing supply and demand of facilities together (platforms), making current traffic data available, stimulating subsidies for clean transport, sustainable procurement by facilitating logistic facilities and loading capacity, remodelling roads into bicycle only streets and self-experimenting by deploying LEFVs for their own services.

Still many businesses are still reluctant to implement the use of LEFVS. Fleet decision makers and the customers of logistics operators show reservations about using cargo cycles, while the prevalent conditions and cultures of many small-sized cycle freight companies prevent a professionalisation of the sector. Case-based research can be executed in theoretical or real-life experiments by using different theories, models and practical methods and with input from specialists through workshops, expert sessions and interviews. Experiments could be setup in a 'livinglab'-environment (Quak et al., 2016) to test and collect knowledge, on the one hand via evaluations with stakeholders and on the other hand by monitoring vehicles with GPS loggers and cameras. In collaboration with different businesses, various logistical concepts with LEFVs can be mapped out and analysed compared to regular van/truck transport (Ploos van Amstel et al., 2018; Moolenburgh et al., 2019).

According to Butrina et al. (2018) cargo bikes have some competitive advantages over delivery trucks. This type of LEFV has more choices to manoeuvre through a city using the road, bike lane, sidewalks, and accessing pedestrian-only areas to find the quickest or shortest route to the destination. To deploy LEFVs efficiently, adjustments must be made in how logistics are planned, for example by clustering orders (even more) geographically and using planning software with routes suitable for LEFVs. This requires sufficient shipment density, or short distances between the stops. All logistics concepts have a collection/consolidation point. This is in line with Lenz & Riehle (2013) who claim that the availability of city centre hubs ensures the necessary efficiency is one of the special requirements associated with the use of cargo cycles. Also, Anderluh et al. (2019) define the 2E-VRP (2 Echelon), where freight is transported from the depot(s) to rendezvous points, so-called satellite facilities, from which it is transported in the second echelon to the final customers. The 2E-VRP can either incorporate synchronization constraints between the first and second echelons depending on whether the possibility of intermediate storage at the satellites is given or not. Other distinguishing factors are the number of depots, heterogeneous or homogeneous fleets, time window constraints, etc. LEFVs position in traffic, including the rules for the use of cycle lanes and pedestrian areas, is not unambiguous and requires further investigation. The integration of the vehicles into the urban traffic networks is a necessity. Examples include the design of comfortable and safe routes, such as bicycle streets, and the creation of loading and unloading areas.

Experimenting with LEFVs leads to greater awareness, knowledge and behavioural change. For instance, the weather conditions can have a strong influence on the maintenance of the cargo bikes. The driving of a LEFV takes some time getting used to in the beginning, but is perceived as simple. Drivers of LEFVs receive positive reactions from customers and the general public. More pleasant than the grumbles that truck drivers often get when they are unloading. According to Gruber et al. (2014) a majority regards the LEFVs as highly competitive for delivery tasks in their specific urban surroundings, which include 7 of the 15 biggest German cities. Furthermore, messengers see LEFVs as an opportunity for generating public attention (and possibly new customers) and contributing towards environmental protection.

As mentioned in Balm et al. (2017) the selection criteria for potential LEFVs are small and light shipments (as the vehicles have limited loading capacity), High network density (the vehicles are limited in range but save time during parking (and searching)), time-critical deliveries (speed and reliability are great selling points) and opportunities for innovation and growth (customer demand and competition influence transition towards new concepts). *For this reason, in Bogota, the opportunities can be found in parcel delivery (DHL), pharmaceutical products (Solistica) and foods, grocery goods (Rappi).*

DHL

DHL is a leader in the deployment of bicycles in its network. The Cubicycle is a bicycle on four wheels with a detachable container of a cubic meter, the size of a Euro pallet of 80x120x100 centimeters. This makes it easy to integrate into the standardised transport process. The most important advantages compared to other bicycles are the content and better connection to the operational systems. The Cubicycle was built by Velove from Sweden and has electric pedal assistance, in particular to get going in the first few meters. The Cubicycle runs smoothly, is surprisingly agile and has a short turning circle. Despite the large container, the bike fits perfectly on the bike paths. For example, the standard dimensions of posts on a cycle path have been taken into account. The height of the bicycle is also chosen in such a way that other cyclists can easily look over it. That is how the Cubicycle distinguishes itself from existing high-volume bicycles. The big difference with the other 40 bikes that DHL uses in Dutch city centres is that larger packages can also be taken along. Compared to the Parcycle (parcel box bike) and certainly in comparison with the backpack on the regular bike, the container of the Cubicycle offers much more space. On an average journey, it is loaded with 125 kilos of shipments and the bicycle courier travels about 50 km a day.



Figure 3: DHL cubicycle in operation

So DHL has already has a very good past performance on implementing LEFVs in The Netherlands in their logistics operations and now it is extending the field of application to other European cities. Important contact person is Marijn Slabbekoorn, who has been responsible for the DHL Express Netherlands sustainability program and now working on the European sustainability program.

Solistica

Solistica is a company of FEMSA, which creates financial and social value in Latin America through companies and institutions such as OXXO, Cruz Verde drugstores, Coca Cola, and Heineken. Solistica has more than four thousand clients, 442,000 square meters of warehouses, and employs over 21,000 people in Colombia, Mexico, Brazil, Nicaragua, Panama, Costa Rica, and the United States. The warehousing activities are located strategically in the most important cities of Colombia, where they consolidated the goods for the last mile delivery. Especially the department in Bogota is specialised in (un)conditioned drugstore goods. Their challenge is to deliver the goods on the optimal control of temperature. As most of the deliveries are just a box this type of freight flow fits well to the criteria of LEFVs.

Rappi

Rappi's is a fast growing and sometimes controversial Colombian startup who wants to Deliver 'Everything' which enhances a broad range of products and services available for delivery. The mobile app lets users order groceries, food or drugstore medications, but also send money (cash) to someone, or have a courier withdraw money from their bank account from an ATM and get it delivered to them, also, the couriers can offer transport personal belongings (such as house keys, wallets, purses and more). Sometimes couriers even walk customers' dogs. Its UI (user interface) looks like supermarket shelves and users can swipe items into their basket. Customers can pay in cash or via debit and credit cards. An e-commerce platform is used by other retailers such as Walmart, El Corte Inglés and Cenconsud. As this company is often seen on the streets and its controversial position as a logistics service provider the company could improve their social responsibility by taking a bigger interest in bicycle delivery.

Other partners

Customers of the afore-mentioned companies are important partners when it comes to a project for the introductions of LEFVs. Also the universities (Bogota) can play here a crucial role by doing the operational measurement of the operations. Collecting and analysing data is needed to design different delivery profiles. It is important to have real time data in order to make realistic benchmarks to show the real benefits of the LEFVs. For students it can also be interesting being a part of the real logistics operations as a learning experience (see for example: https://www.youtube.com/watch?v=ETIj9_S4rWM). At the same time it is also good that governmental agencies are involved to learn how their roles can support the development of LEFVs in the cities of Colombia to standardise approaches and supporting measures. The project cannot start without bicycles. Therefore it is important collect contacts where bicycles can be obtained from *Fundacion Gero* (Emiro Romero) and *Dockr* (KeesJan Blankenstijn & Boris Kuijpers). Dockr is part of the International company *PON* and provides a business-to-business program, several Pon companies - including Gazelle, Orion, MiND and ModiForce - work together on a family of electric transport solutions: from electric cargo bikes and electric company cars to electric trucks, Transport as a service. In contact with their customers they experience that everyone tries something, but the range is fragmented, some developed their own electric vehicles or run pilots with cargo bikes according to Kuijpers. There is a need for a large, stable partner who can offer a total solution. With DOCKR they take care of that (Figure 4).



Figure 4: Rental Light Electric Freight Vehicles of Dockr.

Another important supplier of cargo bikes is *Velove* from Sweden (contact person: Johan Erlandsson). They developed the bikes for the DHL operations. The cargo bike carries up to 300 kg and 2 m³ and is designed to work well on bike lanes, with its width that is smaller than family cargo bikes. In the world they have customers in 20 countries and relationship with a number of big brands.

For the cargo bikes it necessary that the make optimal usage of the bikelanes. *Routigo* is a system that allows vehicle and cycling routes to be optimised and interpreted in real time. RoutiGo (contact person: Patrick Okkersen) offers a clear dashboard on which one can see all drivers and routes. The platform calculates the most efficient stop sequence. An ETA indicates the time of delivery and you can easily add pickups and extra stops. This way it provides continuous insight into the delivery operation with the flexibility to make adjustments if necessary

3.4 Towards usage of smart apps in transport and logistics

Nordtømme et al. (2015) support the idea of Vidal Vieira and Fransoo (2015), also on the level of collaboration between companies, which can lead to new ways of organising freight activities, requiring public-private collaboration. Companies could also invest in conducting recurring meetings to share demand forecasting, improve fleet and route planning, and solve some problems related to factors such as delay, mistakes, damaged goods, and theft. Within the logistics industry the sharing economy is considered to be one of most promising - disruptive – developments that could render a major contribution in reducing the CO₂ intensity of its operations. Sharing unused and/or underutilized resources, can unlock new efficiencies in the logistics value chain in an industry where efficiency is the name of the game. Good practical examples of these sharing concepts in logistics are *Cargostream*, *Uberfreight*, *Quicargo* (for transport capacity sharing) and *Stockspots* (for warehouse space sharing) . These examples show advantages in terms of reduction of transportation costs (-15%), lower CO₂ emissions (-20-25%), lower congestion that are straightforward for both industry and society (Gesing, 2017).

For the underutilised warehouse-capacities in Bogota *Stockspots* can be the solution. Stockspots is a specialist in on-demand warehousing and innovators of the new warehousing world.

Their marketplace connects shippers quickly in their need for warehousing and fulfilment services with space providers who have it. This brings space providers profit out of their unused warehouse space which also leads to a reduction of warehouse waste and give shippers an easy and affordable way to solve inventory overflow and fulfilment needs. It works like an AIRBNB for companies. No long-term contracts or fixed-fees, but pay-per-use and easy understandable technology which makes the collaboration between the shipper and space provider more reliable, flexible and faster. With more than 500 European logistics partners they will make warehousing future proof. The CEO of Stockspots, Remko Been, is currently expanding in Europe. Likely Colombia could also be an interesting market as an starting entrance to Latin America.

3.5 Knowledge dissemination

Exchange programs could be setup between the universities (both in Bogota but also with Delft and Rotterdam) to share knowledge on city logistics. It is interesting to establish some master graduate projects in which master thesis students are jointly supervised by two universities. An example of a thesis topic could be a feasibility study towards the introduction of LEFV for a specific consolidating company. Often this is an easy way of exchanging knowledge and for the students it can be a wonderful life experience to live abroad for a specific period. Besides the International collaboration the students from Bogota universities should graduate more in the working field of city logistics which means working for governmental agencies and logistics companies. This helps both companies to obtain the latest knowledge in the field and a potential could employee after the graduation. By having graduates in companies universities obtain more insight in the real problems of companies they are confronted with in practice. These insights can lead to more valuable solutions both in science and practice.

3.6 Bike sharing program

As started in Mexico city it might be interesting to setup a bicycle sharing program to stimulate inhabitants of Bogota to make mode shift from car to bicycle (to reduce the congestion). In February 2010, the government of Mexico City inaugurated a new bicycle sharing network called EcoBici. With distinctive red and white liveried bicycles, the network as of February 2015 consists of 444 stations with 6,500 bicycles. With more than 240,000 registered users, it has been argued that Ecobici is the largest bicycle-sharing program in North America. The system is run by a private company, but was funded by the government with an initial investment of 75 million pesos. Users of the system are required to purchase an RFID card at a cost of 400 pesos which will provide them with access to the bicycles for one year. Use of a bicycle is free for the first 45 minutes; extra charges are applied for use beyond this time limit. In the Netherlands the following sharing biking companies (Figure 5) can be found: Donkey Republic, Mobike and OV-fiets, where the OV-fiets (connected to public transport) is the most expensive one.



Figure 5: Example of bike sharing

4. Conclusions

Based on the interviews and reading some background materials the flowing initiatives could be started to improve the city logistics performances in Bogota:

Project	Who should be involved	Key role
Restart of Off-time deliveries project	Other foreign universities who worked on Off-time deliveries Pilot managers of other towns to obtain their experiences	National University of Colombia Bogota Chamber of Commerce
Know the delivery profiles of the streets in Bogota Setup of urban consolidation centres/hubs (feasibility studies)	Delft/Rotterdam Universities Municipality of Bogota National Planning Department Logistics service providers	National University of Colombia EAN University
Setup of urban consolidation by the usage of cargo bikes (LEFVS)	Fundacion Gero Logistics service providers DHL Solistica Rappi Dockr Routigo Velove Delft/Rotterdam Universities	National University of Colombia EAN University Bogota Chamber of Commerce National Planning Department
Towards usage of smart apps in transport and logistics	Cargostream, Uberfreight, Quicargo Stockspots Or identical companies in Colombia.	National Planning Department Ministry of Transport
Knowledge dissemination	Any company or institute related to city logistics Foreign Universities (like Delft/Rotterdam Universities)	National University of Colombia EAN University
Setup of a Bike sharing program	New companies in Colombia Public transport companies (bus)	Ministry of Transport Municipality of Bogota National University of Colombia EAN University

The presented overview contains starting ideas for improving the city logistics' situation in Bogota. The key role assignment is just based on my own judgement. This is not verified with the mentioned stakeholders. Each idea should be elaborated more in detail by specifying the steps of (research) action and the participating partners. I hope this report gives inspiring ways for improvement to the city logistics in Bogota. The mentioned contacts in this report can be opportunities to collaborate more closely with Dutch companies and universities.

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