Clean, Silent, Space-Efficient And Non-Trivial Urban Freight Delivery: An Overview Of Cycle Logistics In Rio De Janeiro – 17-05735

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A Long History & Thriving Practice

This paper uses the definition of cycle logistics put forth by Schilwa et al. (2015): "the use of human powered or electrically-assisted standard bicycles, cargo bikes, and cargo tricycles for the transport of goods between A and B, primarily in urban areas" (p.52). Using bicycles and tricycles for delivering urban freight can help reduce the negative effects of motorized freight delivery and create more sustainable cities (7–14). Last-mile delivery of urban freight is considered one of the most (or the most) expensive and polluting, and least efficient parts of the whole supply chain (15).

Cycle logistics appear to have a long tradition in Rio, as evidenced by an article in the newspaper *Jornal dos Esportes* (as cited in Soares Coutinho, 2013) reporting on a race of cycle delivery vehicles that was organized in 1935. Another newspaper article (Jornal do brasil, 1971) reports that many cargo tricycles used by businesses in the city center, and that these establishments reduce their delivery costs by up to 80% with these vehicles. Anecdotal observation suggests that the use of cycle logistics may have increased, at least in Copacabana, since the 1980s.

Figure 1 Tricycle in Rio de Janeiro in 1971

O triciclo, sem respeitar sinais nem mãos de direção, é ameaça permanente nas ruas do Rio

Source: Jornal do Brasil

Inventory & Survey in 9 Commercial Centers

The data presented in this paper was gathered as part of a project carried out by the Brazilian NGO Transporte Ativo, in partnership with the Brazilian office of the international NGO the Institute for Transport and Development Policy (ITDP Brasil). The goal of this project was to discover key characteristics of cycle logistics in Rio de Janeiro. The tools applied were an inventory and survey of establishments that used cycle logistics. The inventory and survey were designed to determine the following information on human-powered vehicles for urban freight delivery commercial centers of the city:

- Number and types of establishments that used these vehicles
- Types of human-powered vehicles they used
- Who owned these vehicles
- Number of people the establishments employed to make the deliveries
- Number of daily workday deliveries
- Geographical reach of deliveries made

Figure 2 - Sites of inventory and survey

(Clockwise from left: Santa Cruz, Campo Grande, Bangu, Madureira, Ilha do Governador, Centro, Copacabana, Tijuca, and Taquara.

The researchers wished to survey a geographically diverse group of dense commercial centers of Rio de Janeiro in the city's seven sub-prefectures. As such, they consulted with a specialist at the municipal autarchy charged with implementing and maintaining projects in public spaces (RioUrbe) to select the densest square kilometer in terms of commercial activities, as evidenced by business establishments and shoppers. Considering budget and time constraints, the researchers identified nine commercial areas that contained a broad range of income and urban typologies, and were geographically evenly distributed across the city. After identifying nine commercial centers in the city's seven sub-prefectures, the researchers identified the boundaries of the areas where the inventory and survey would take place in consultation with the specialist at Rio-Urbe. The goal was to identify a square kilometer in each of the nine areas. The mean area of the survey sites was 1.03 square kilometers (standard deviation 0.05).

Vehicles

Researchers found a total of 628 vehicles. Of these, 271 were regular bicycles (43% of all vehicles), 216 cargo bicycles (34.5%), and 141 tricycles (23.5%). All of these vehicles are 100% human powered, and no electric cycles were found.

Table 2 Types of Vehicles

Regular bicycle[1]	Cargo bicycle	Cargo tricycle
271 (43%)	216 (34.5%)	141 (23.5%)

All photos by Zé Lobo.

Abstract

This paper presents information on cycle logistics (the use of bicycles and tricycles for last-mile urban freight delivery) in Rio de Janeiro. The authors first review literature on delivery of urban goods by bicycle and tricycle. They then describe the research design, and present the results of, an inventory and survey of businesses using cycle logistics in nine commercial centers of Rio de Janeiro. The authors then compare the practice of human-powered urban freight delivery in that city to current trends in bicycle and tricycle delivery in Europe and the North America. Finally, they outline a research agenda for human-powered urban freight delivery in Rio de Janeiro.
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Establishments

The inventory identified a total of 322 establishments that used human powered vehicles for cycle logistics in the nine commercial centers of Rio de Janeiro. These establishments belonged to the broad categories of food and beverage (49%), manufactured goods (22%), services (15%), and health (14%).

These establishments included: 51 restaurants (16%), 44 pharmacies (13.5%), 39 supermarkets (12.5%), 27 hardware & building supplies stores (8.5%), 24 pet shops (7.5%), 22 beverage distributers (5%), 21 clothing cleaners (7%), 15 juice stores (5%), 13 bakeries (4%), 13 mattress stores (4%), and 52 other types of establishments (17%) of which there were fewer than 13 total establishments counted. The last category ("other") included butchers, key smiths, lighting stores, florists, postal services, and 17 other types of businesses.

Table 3 Establishments using cycle logistics

Category	Percentage	Type	Number	Percentage
Food and beverage	49 %	Restaurants	51	15.8%
		Supermarkets	39	12.1%
		Beverage distributers	22	6.8%
		Juice stores	15	4.7%
		Bakeries	13	4.0%
		Butchers	9	2.8%
		Others	13	4.0%
Manufactured goods	22.5 %	Hardware & construction supplies	27	8.4%
		Lighting store	4	1.2%
		Others	9	2.8%
Services	15 %	Pet shops	24	7.5%
		Clothing cleaners	21	6.5%
		Mattress stores	13	4.0%
		Key smiths	6	1.9%
		Florists	4	1.2%
		Postal services	3	0.9%
		Others	5	1.6%
Health	13.5 %	Pharmacies	44	13.7%

Workers

Researchers recorded 658 workers that made deliveries of urban freight with bicycles or tricycles. With a 322 establishments, this gave a mean of 2.07 human-powered vehicles per business that engaged in cycle logistics (95% confidence level 1.87-2.26, standard deviation 1.75). Establishments with eight or more human-powered vehicle delivery workers included an office of the national postal service (Correios) with 15 workers, a beverage distributor with 12, a restaurant and supermarket with 10, and another restaurant and two pharmacies with eight. The recorded number of workers was slightly higher than the vehicles counted (622 vehicles), resulting in 1.05 vehicles per worker.

Deliveries and geographical reach

The survey asked how many deliveries each establishment made daily, resulting in 7,524 reported daily deliveries for the 313 establishments that gave answers to this question (nine fewer than the total 322 businesses). This gave a mean of 24.12 deliveries for each business (95% confidence level 27.03-21.2, standard deviation 1.48).
A total of nine businesses reported completing 100 or more daily deliveries included a supermarket (170 deliveries), a restaurant, pet shop and another supermarket (150), a pharmacy and a juice store (120), and a pharmacy, another restaurant, and another juice store (100). These businesses range from large, corporate supermarket chains to small neighborhood businesses.

The mean number of deliveries per worker was 12.02 (95% confidence level 13.14 – 10.91, standard deviation 10.04). The nine businesses with the highest delivery/worker ratio (40 or more deliveries per worker) included two supermarkets (75 and 70 deliveries per worker), two juice stores (50 and 40), three bakeries (two with 50, one with 40), a beverage distributor (40), and a water and ice distributor (40 deliveries per worker). These businesses with the highest delivery/worker ratios had relatively few (between one and three) delivery workers.
Most of the businesses (about 75%) made deliveries in an area of under 3 kilometers, with the remaining 25% delivering in areas up to 8 kilometers from the establishment. Six businesses delivered in an area of up to eight kilometers (five pharmacies and one pet shop).

Commercial centers

Although the areas surveyed were very similar in size (around 1 square kilometer), the number of businesses that used cycle logistics varied greatly. The three centers with largest numbers of these businesses accounted for 89% of the total establishments using cycle logistics: Copacabana was home to 187 of these (58 %), Tijuca, 68 (21 %), and Centro, 32 (10%). In fact, these three areas accounted for 89% of all businesses using cycle logistics encountered in this inventory.

While Ilha do Governador, Bangu, Madureira, Taquara and Santa Cruz had relatively few businesses using cycle logistics, Campo Grande stood out because researchers did not register any such businesses.

Table 4 Commercial Centers and Cycle Logistics

Commercial Center	Businesses using cycle logistics	Percentage of total businesses using cycle logistics
Copacabana	187	58%
Tijuca	68	21%
Centro	32	10%
Ilha do Governador	12	4%
Bangu	9	3%
Madureira	7	2%
Taquara	5	1.5%
Santa Cruz	2	0.5%
Campo Grande	0	0%

Discussion & Conclusion

The domination of three commercial centers (Copacabana, Tijuca, and Centro) in the total of businesses that employ cycle logistics in the nine areas of the inventory raise the question of what circumstances allow these businesses to thrive in these areas. Copacabana and Tijuca are relatively dense, high-income areas with a more "traditional" urban typology – relatively narrow streets, and apartment buildings with street-level businesses. Centro is the business center of the city, and is also a relatively dense, active place, with a "traditional" urban typology, though with fewer residential buildings than in Copacabana and Tijuca. The other areas are lower income and have are relatively less dense and urban typologies typical of peripheral neighborhoods in Latin America (eg, fewer apartment buildings). These variables (income, density and urban typology) should be investigated as possible explanations for the prevalence of cycle logistics in these neighborhoods.

Cycle logistics in Rio may also present non-trivial economies in terms of emissions of greenhouse gases and urban space. In order to determine these, a survey must be structured in a way that means for length of trip, the weight and volume of freight delivered, and deliveries per trip can be determined (this is not possible with the data from the current survey). This information would also allow for a calculation to derive the urban space that these vehicles save, both in terms of parking and road space used had the trips been made by equivalent motorized options – e.g., motorcycles (for bicycles and cargo bikes) and vans (for tricycles).

Given that cycle logistics are a clean, silent, and space-efficient way to complete last-mile deliveries, municipal authorities may have an interest in stimulating such deliveries. The road transportation sector is the largest source of greenhouse gas emissions (39%) originated in the city of Rio de Janeiro, and cycle logistics could help reduce these emissions. According to the Municipal Climate Change Law No. 5248/2011 (39), the goal of the City is to reduce carbon emissions by 20% by 2020; an increase in the use of zero-emissions vehicles (bicycles and tricycles) could help meet this goal.

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