

SERVICE TRIPS GENERATION MODELING: AN EMPIRICAL INVESTIGATION

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FREIGHT & SERVICE ACTIVITY

Freight & Service Activity (FSA)

(Holguín-Veras *et al.*, 2017)



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FREIGHT TRIPS

They have as their primary purpose the movement of goods (Freight Intensive Sectors - FIS).

(Holguín-Veras *et al.*, 2017)

| NAICS | Description |
|--|---|
| Freight Intensive Sectors (FIS) | |
| 11 | Agriculture, Forestry, Fishing and Hunting |
| 21 | Mining, Quarrying, and Oil and Gas Extraction |
| 22 | Utilities |
| 23 | Construction |
| 31-33 | Manufacturing |
| 42 | Wholesale Trade |
| 44-45 | Retail Trade |
| 48-49 | Transport and Warehousing |
| 72 | Accommodation and Food Services |



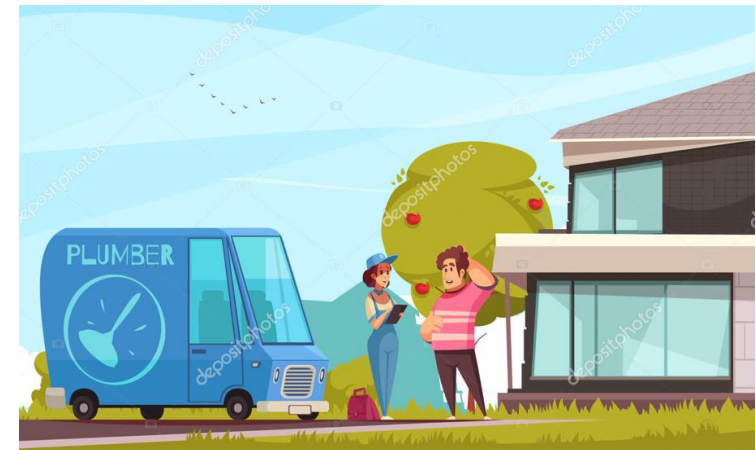
BACKGROUND OF SERVICE TRIPS

Service trips: their main purpose is to carry out a servicing activity (Service Intensive Sectors -SIS).

Types: Scheduled (e.g., maintenance)
Unplanned and not periodic (e.g., emergency)

Some particular problems that service trips pose: **difficulties related to parking**

| NAICS | Description |
|--|--|
| Service Intensive Sectors (SIS) | |
| 51 | Information |
| 52 | Finance and Insurance |
| 53 | real Estate and Rental and Leasing |
| 54 | Professional, Scientific, and Technical Services |
| 55 | Management of Companies and Enterprises |
| 56 | Administrative, Waste Management... |
| 61 | Educational Services |
| 62 | Health Care and Social Assistance |
| 71 | Arts, Entertainment, and Recreation |
| 81 | Other Services (except Public Administration) |

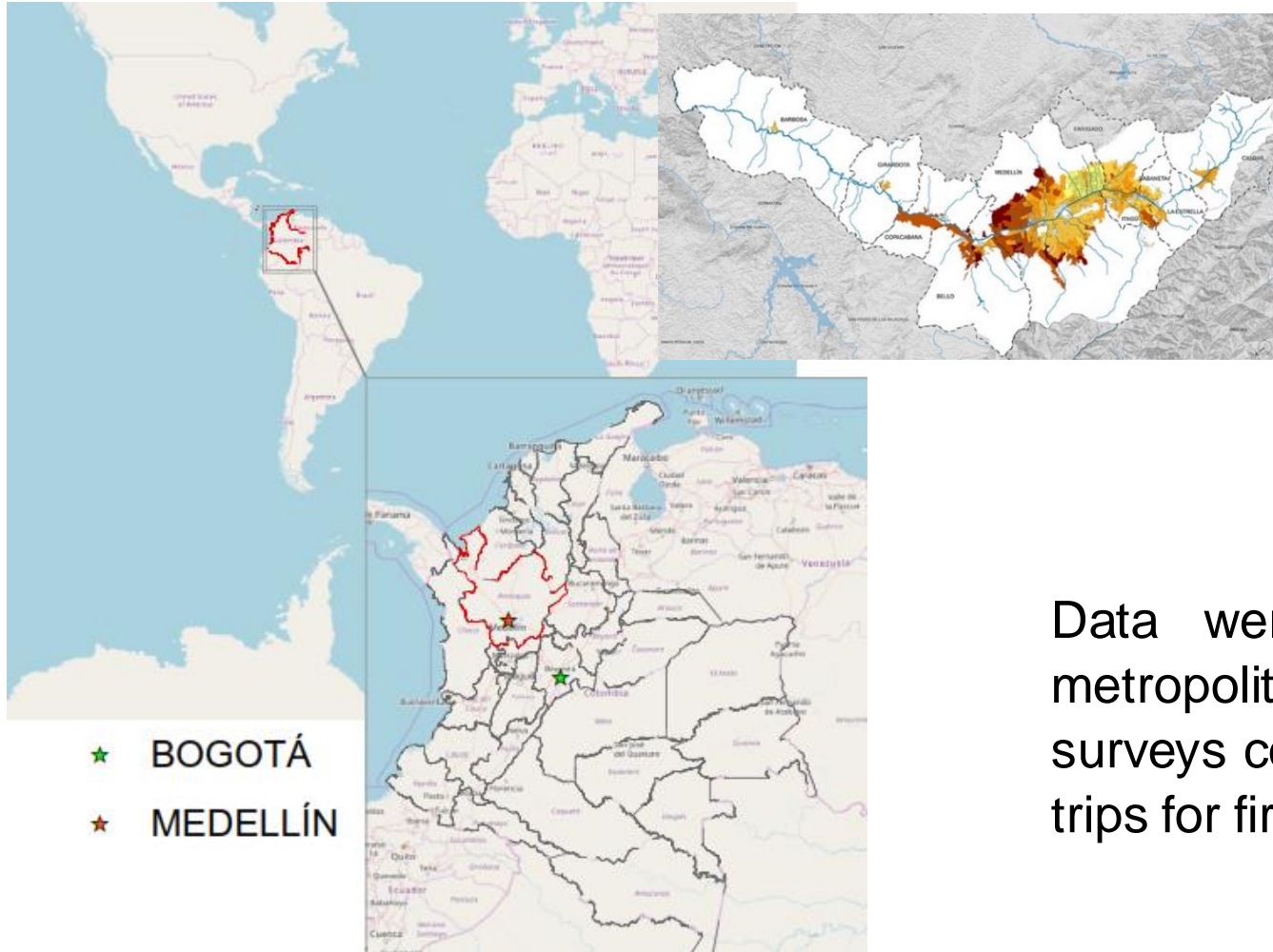


BACKGROUND OF SERVICE TRIPS

- **STG:** service trips attraction (STA) + service trips production (STP)
- **STP:** total of the trips made from the establishments specialized in services toward a destination where they will be performed a service activity
- **STA:** total number of vehicle trips that arrive at the establishment to perform a service activity

- **FTG:** freight trip attraction (FTA) + freight trip production (FTP)
- **FTA:** number of freight vehicle trips arriving at the establishment to transport the Freight Attraction
- **FTP:** number of freight vehicle trips that depart from the establishment to transport cargo to other destinations.

CASE STUDY: MEDELLÍN



The Medellín Metropolitan Area (MMA) is located in Northwest Colombia.

- ✓ Composed of 10 municipalities
- ✓ Population of 3.9 million inhabitants
- ✓ Main urban area: Medellín

Data were obtained from Medellín (Colombia) metropolitan area (MMA) origin-destination freight surveys conducted in 2017-2018 to analyze service trips for first time in the region.

SERVICE TRIPS - HOUSEHOLD ORIGIN/DESTINATION SURVEY

AMVA conducted the households origin-destination survey in 2017. The survey asked about service trips and deliveries to households. These data allowed to classify the trips by service type and transportation mode.

| Service type /mode | Walk | Bicycle | Motorcycle | Car | Pick up/ Van | Small truck | Large truck | Does not know | NA | Total | % |
|----------------------|------------|-----------|------------|------------|--------------|-------------|-------------|---------------|------------|-------------|-------------|
| Appliances repairing | 66 | 6 | 160 | 39 | 4 | 8 | 2 | 30 | 49 | 364 | 32,4% |
| Other repairing | 27 | 3 | 156 | 46 | 12 | 7 | 1 | 19 | 24 | 295 | 26,3% |
| Cleaning | 25 | 0 | 33 | 10 | 4 | 3 | 1 | 19 | 31 | 126 | 11,2% |
| Beauty services | 79 | 6 | 42 | 12 | 0 | 1 | 0 | 6 | 8 | 154 | 13,7% |
| Health | 2 | 0 | 17 | 55 | 1 | 6 | 2 | 2 | 8 | 93 | 8,3% |
| Private classes | 3 | 1 | 6 | 1 | 0 | 0 | 0 | 4 | 1 | 16 | 1,4% |
| Other | 9 | 2 | 23 | 10 | 2 | 1 | 0 | 21 | 6 | 74 | 6,6% |
| Total | 211 | 18 | 437 | 173 | 23 | 26 | 6 | 101 | 127 | 1122 | 100% |
| % | 18,8% | 1,6% | 38,9% | 15,4% | 2,0% | 2,3% | 0,5% | 9,0% | 11,3% | 100% | |

Services by transportation mode by day

| Delivery type /mode | Walk | Bicycle | Motorcycle | Car | Pick up/ Van | Small truck | Large truck | Does not know | NA | Total | % |
|---------------------|------------|-----------|-------------|------------|--------------|-------------|-------------|---------------|-------------|-------------|-------------|
| Letter/ Document | 201 | 13 | 266 | 5 | 4 | 13 | 1 | 132 | 108 | 743 | 17% |
| Parcel máx 30 kg | 13 | 3 | 112 | 42 | 10 | 57 | 17 | 19 | 20 | 293 | 7% |
| Meal delivery | 52 | 31 | 1088 | 18 | 3 | 6 | 0 | 41 | 66 | 1305 | 30% |
| Medicines | 27 | 17 | 508 | 8 | 3 | 6 | 1 | 15 | 27 | 612 | 14% |
| Groceries | 24 | 9 | 255 | 24 | 6 | 16 | 2 | 13 | 21 | 370 | 8% |
| Other | 1 | 1 | 22 | 6 | 2 | 17 | 2 | 3 | 13 | 67 | 2% |
| NA | 5 | 1 | 3 | 1 | 1 | 0 | 0 | 5 | 1005 | 1021 | 23% |
| Total | 323 | 75 | 2254 | 104 | 29 | 115 | 23 | 228 | 1260 | 4411 | 100% |
| % | 7,3% | 1,7% | 51,1% | 2,4% | 0,7% | 2,6% | 0,5% | 5,2% | 29% | 100% | |

Deliveries by transportation mode by day

SERVICE TRIPS - ESTABLISHMENT SURVEY IN MMA

| Division | Group | Class | Description |
|-----------|-------|-------|---|
| 18 | 181 | 1812 | Service activities related to printing |
| 33 | - | - | Repair and installation of machinery and equipment |
| 39 | - | - | Remediation activities and other waste management services (pest control) |
| 62 | 620 | 6209 | Other information technology and computer service activities |
| 75 | 750 | 7500 | Veterany activities |
| 81 | 811 | 8110 | Combined facilities support activities |
| 81 | 812 | - | Cleaning activities |
| 86 | 869 | 8690 | Other human health activities |
| 87 | - | - | Residential care activities |
| 95 | - | - | Repair of computer and personal and household goods |

The table shows services that was declared by the surveyed.

Sections 33 and 95 are the most establishments belong to, according with data obtained.

SERVICE TRIPS PRODUCTION (STP)

The table summarizes the service production of establishments in the service sector.

| City | | Service sector (1000) | | | | | | | | | Total | % Total |
|--------------------------------|--------------------|-----------------------|--------------|-------------|-------------|-------------|-------------|--------------|-------------|--------------|---------------|---------------|
| | | 1812 | 33 | 6209 | 7500 | 8110 | 812 | 8699 | 87 | 95 | | |
| Main city | Medellín | 218 | 924 | 212 | 177 | 38 | 287 | 511 | 94 | 922 | 3383 | 76,4% |
| North Municipalities | Barbosa | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 5 | 8 | 0,2% |
| | Bello | 7 | 55 | 7 | 18 | 1 | 15 | 35 | 2 | 47 | 187 | 4,2% |
| | Copacabana | 1 | 27 | 1 | 2 | 0 | 7 | 8 | 1 | 14 | 61 | 1,4% |
| | Girardota | 0 | 8 | 1 | 3 | 0 | 0 | 4 | 0 | 11 | 27 | 0,6% |
| Sub-total North municipalities | | 8 | 90 | 9 | 23 | 1 | 22 | 50 | 3 | 77 | 283 | 6,4% |
| South Municipalities | Caldas | 0 | 24 | 0 | 6 | 0 | 0 | 2 | 0 | 19 | 51 | 1,2% |
| | Envigado | 10 | 56 | 17 | 31 | 2 | 30 | 9 | 16 | 81 | 252 | 5,7% |
| | Itagüí | 15 | 120 | 13 | 24 | 1 | 19 | 0 | 0 | 110 | 302 | 6,8% |
| | La Estrella | 0 | 11 | 0 | 5 | 1 | 9 | 1 | 2 | 11 | 40 | 0,9% |
| | Sabaneta | 9 | 36 | 6 | 20 | 5 | 15 | 4 | 1 | 22 | 118 | 2,7% |
| Sub-total South municipalities | | 34 | 247 | 36 | 86 | 9 | 73 | 16 | 19 | 243 | 763 | 17,2% |
| Total | | 260 | 1261 | 257 | 286 | 48 | 382 | 577 | 116 | 1242 | 4429 | 100,0% |
| % Total | | 5,9% | 28,5% | 5,8% | 6,5% | 1,1% | 8,6% | 13,0% | 2,6% | 28,0% | 100,0% | |

Sections 33 and 95 are the most establishments belong to, with 56,5%.

Medellin is the city of AMVA with the largest number of establishments providing services.

SERVICE TRIPS PRODUCTION (STP)

Population: 4429 establishments in AMVA that provide service trips,

Sample size: 107.

Characteristics of service companies are shown below.

| Employees/ Establishment | Duration of work shift (h) | Establishment with storage | Establishment with own parking | Establishment with own vehicles | Establishment with hired vehicles |
|-----------------------------|-------------------------------|-------------------------------|-----------------------------------|------------------------------------|--------------------------------------|
| 10 | 9,6 | 35% | 21% | 68% | 33% |

Special attention should be given to parking policies related to service trips. This result about parking duration is about 30% higher than the one found in a study conducted in NYC and Troy, NY, (1.5 hours (90 min)).

| Number trips /day/ establishment | Duration /service |
|-------------------------------------|--------------------|
| 4,9 | 2,2 hour (132 min) |

Survey data allowed to estimate that 29,930 service trips per day are produced in the MMA

SERVICE TRIPS PRODUCTION (STP)

Residential care activities are big service trips generators.

Those companies have bigger number of employees than other service sectors, that can affect the average number of STP.



| Average number employment/ establishment | number of own vehicles | of own ambulances | Average number trips/day/establishment |
|--|------------------------|-------------------|--|
| 134,5 | 9,4 | 1,5 | 17 |

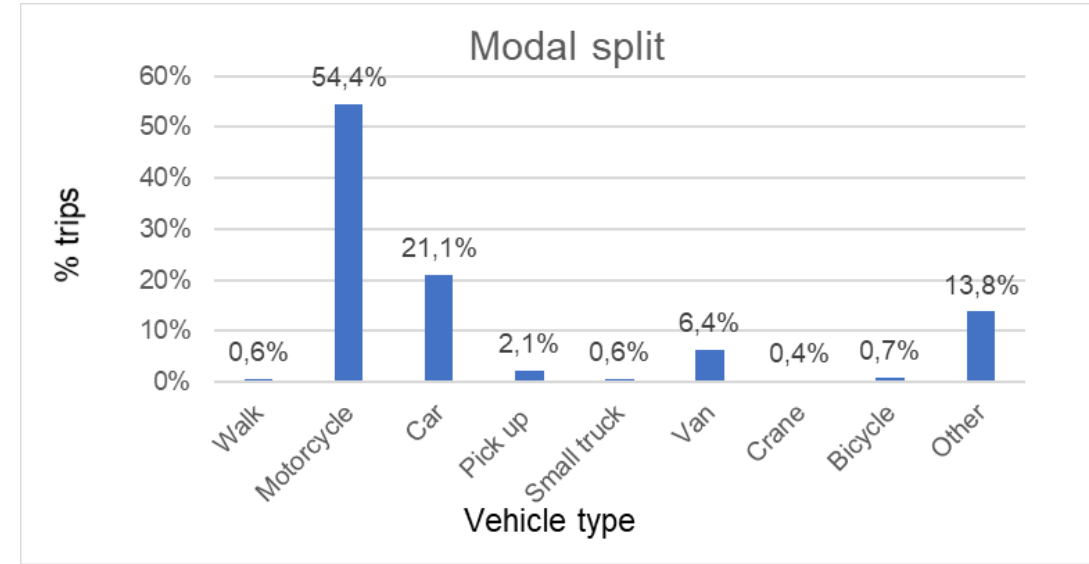
Special case in residential care activities: That company generates 519 trips/day.

| Total employment | Total number of own vehicles | Total number of own ambulances | Average number trips/day |
|------------------|------------------------------|--------------------------------|--------------------------|
| 800 | 55 | 15 | 518,57 |

SERVICE TRIPS PRODUCTION (STP)

Figure depicts the modal split of service trips in the MMA.

The most typical timing for service trips is between 08:00 – 17:00.



Places used to park by the vehicles that made service trips.

| Parking places | | |
|---|-----------------------|---------------------------|
| Parking spaces provided by the customer | On the street-allowed | On the street-not allowed |
| 34% | 31% | 28% |

This could be, in part, evidence of the need to provide spaces for the parking of vehicles in which a service is provided.

SERVICE TRIPS ATTRACTION (STA)

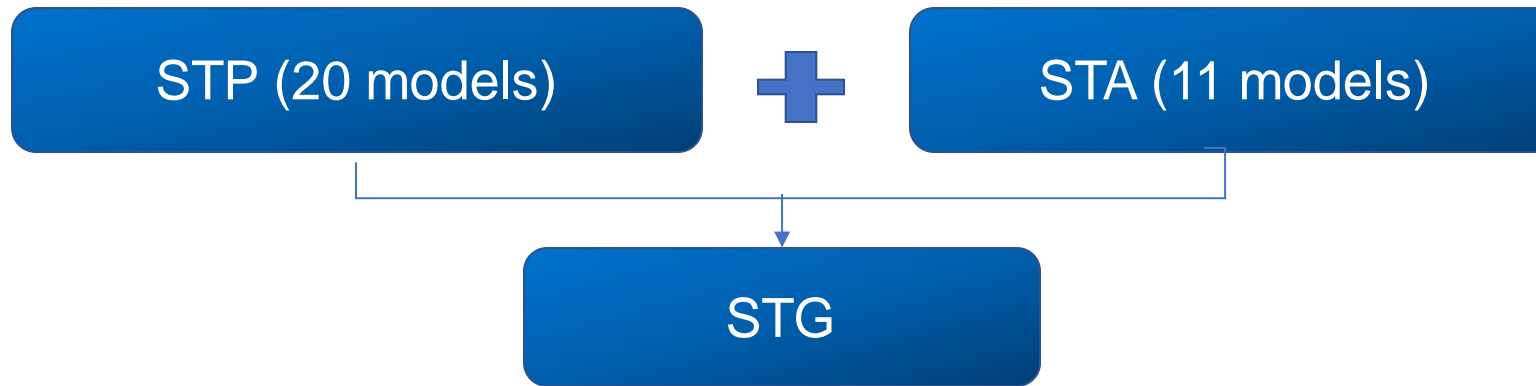
- The 2018 freight origin-destination survey allowed to infer the STA patterns.
- The sample size is 70 establishments and it is composed of those establishments that declared to receive services.

| Mode | Percentage |
|--------------|-------------|
| Walk | 0,7% |
| Motorcycle | 77,5% |
| Car | 5,2% |
| Pick up | 4,5% |
| Small truck | 10,5% |
| Van | 1,6% |
| Total | 100% |

ISIC 33 - *Repair and installation of machinery and equipment* is the main service demanded with almost 61% trips.

| ISIC Service Sector | % Total |
|---|-------------|
| 33 - Repair and installation of machinery and equipment | 61,0% |
| 62 - Other information technology and computer service activities | 0,0% |
| 8110 - Combined facilities support activities | 17,5% |
| 8690 - Other human health activities | 3,3% |
| 95 - Repair of computer and personal and household goods | 13,3% |
| 1812 - Service activities related to printing | 0,3% |
| 39 - Remediation activities and other waste management services | 4,3% |
| 812 - Cleaning activities | 0,2% |
| 87 - Residential care activities | 0,2% |
| Total | 100% |

SERVICE TRIPS GENERATION (STG) MODELING



- STG models are estimated based on the 2018 freight OD survey conducted in the MMA.
- The most influential variables affecting service trips were the total number of employees per establishment, service duration and the total area of the commercial establishment.
- They considered different industry sectors and cities (service trips per day).

STP MODELING (Preliminary Results)

STP modelling is a completely new exercise in MMA, and even in Colombia. To the authors best knowledge this is one of the first research related to STP.

Study made in the NY State Capital Region (J. Holguín-Veras *et al*, 2017), only STA.

Best models are presented next:

| Type of Model | Model | F-Value | Variables |
|---------------|-------------------------------|---------|--|
| No Linear | $Y = X_i^{0,464}$ (10.094) | 101.89 | X_i : Number of employees by establishment (in all MMA for all service sectors) Y: Service trips/ establishment/ day |
| Linear | $Y = 0.108 * X_i$ (46.711) | 2181.9 | X_i : Area (m²) (in all MMA for all service sectors) Y: Service trips/ establishment/ day |
| No Linear | $Y = X_i^{0,174}$ (5.819) | 33.86 | X_i : Service duration (minutes) (in all MMA for all service sectors) Y: Service trips/ establishment/ day |

STA MODELING (Preliminary Results)

Data obtained from the 2018 Freight origin-destination survey.
Data in STA were not the focus of the survey.

Best models are presented next:

| Type of Model | Model | F-Value | Variables |
|---------------|-----------------------------------|---------|--|
| Linear | $Y = 0.005 * X_i$ (1.94) | 3.74 | X_i : Number of employees by establishment (in all MMA for all service sectors) Y: Service trips/ establishment/ day |
| No Linear | $Y = 0.058 * \ln(X_i)$ (2.939) | 8.64 | X_i : Number of employees by establishment (in all MMA for all service sectors) Y: Service trips/ establishment/ day |
| No Linear | $Y = 0.029 * \ln(X_i)$ (3.946) | 15.57 | X_i : Area (m²) (in all MMA for all service sectors) Y: Service trips/ establishment/ day |

CONCLUSIONS

STP modelling is a completely new exercise in MMA, and even in Colombia. To the authors best knowledge this is one of the first research related to STP.

The **most influential variables to explain STG** for both production and attraction: the total number of employees by establishment, the total area of the commercial establishment and service duration. Information about those variables is usually available. Thus, STG can be carried out for similar urban areas (developing economies) using the proposed models of this research.

The STG models help to the analysis about the effect that service trips have on traffic congestion and about the use of parking lots in urban areas.

It is expected that this study contributes to the search of initiatives and to the design of public policies towards improving the solution of the problems generated by service trips, mostly ignored by the government's planning, especially in developing economies.

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THANK YOU!

QUESTION?

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