Collaborative strategies for freight transportation using an ITS

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The problem: Road transportation

32M land deliveries are made in Colombia each year

40% of spare space in each vehicle

2% are empty returns

WHAT IS THE IMPACT?

35% of the total Logistics Costs is attributable to **Transport**

32% of companies consider high transportation costs as a **logistic barrier**

ANDI, 2018 | MINTRANSPORTE, 2019 | DNP, 2018 1 DNP, 2015

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Background

Item	Bogota - Buenaventura	Bogota - Barranquilla	Bogota - Cucuta
Paid freight (COP)	$950.038.000.000	$1.237.074.000.000	$236.611.000.000
Tons moved	15.497.830	12.944.298	4.284.427
Number of trips	1.018.291	1.065.302	421.708
Number of vehicles	43.651	50.832	27.139
Traffic accidents	4.776	12.869	8.119

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State of the art

Collaborative transportation

(I) The use of algorithms (Guy et al, 2008)
(II) The use of information systems (Yong, 2012)
(III) Simulation (Rabe, 2016)

Intelligent Transport Systems

Integrating transport and vehicle inform ation according to supply and demand

¡Data useful for **decision-making** purposes!

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Research Question

Could an ITS contribute to implement collaborative transportation processes, improving the operational performance?

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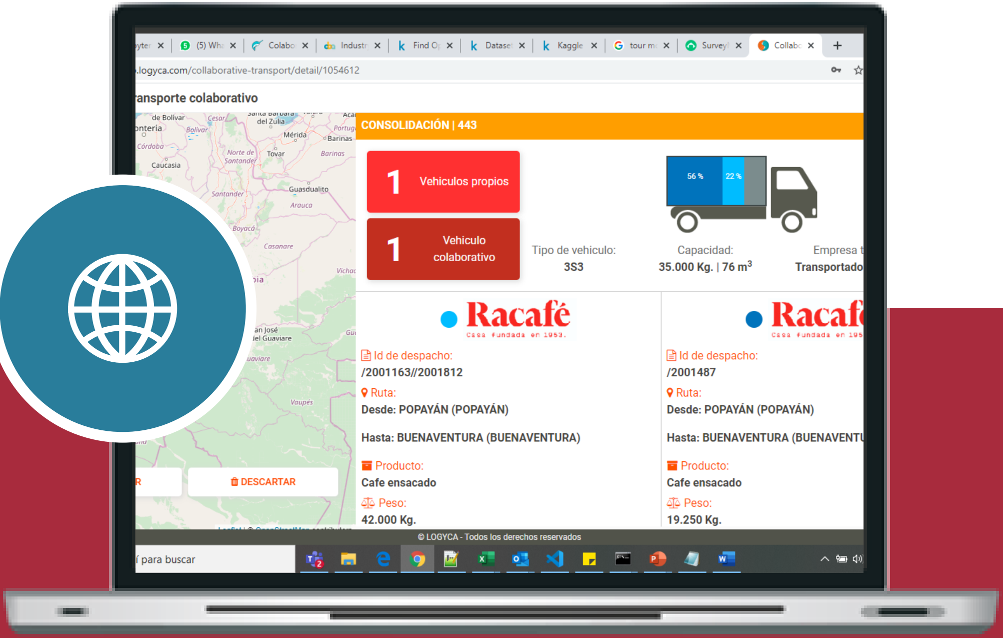
Our contribution

An ITS to find consolidation and compensation opportunities based on **transportation planning data** of cargo generators.



The web system is based on clusterization and optimization algorithms

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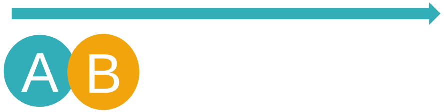
Collaborative approaches

Cargo compensation



Cargo consolidation

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Overview of the methodology

1 year of information

500 trips per week

Planning
- Frequency
- Timespan

Information sharing
- Standard template - xls

Opportunities generation
- Consolidation
- Compensation
- Mixed

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Overview of the methodology

Planning
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Opportunities generation
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- Source and target
- Transported weight and volume
- Products categories and subcategories
- GTIN13 and GTIN14
- Vehicle capacity and kind
- Shipment and delivery dates
- Costs

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Overview of the methodology

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ITS design
- Algorithm design
- User experience design (leaf left)

ITS development
- Open source tools (Angular, back: Phyton)

Information gathering
- **Four** companies.
- **One year** of data

ITS testing
- **52** tests

Results analysis

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Overview of the methodology - ITS

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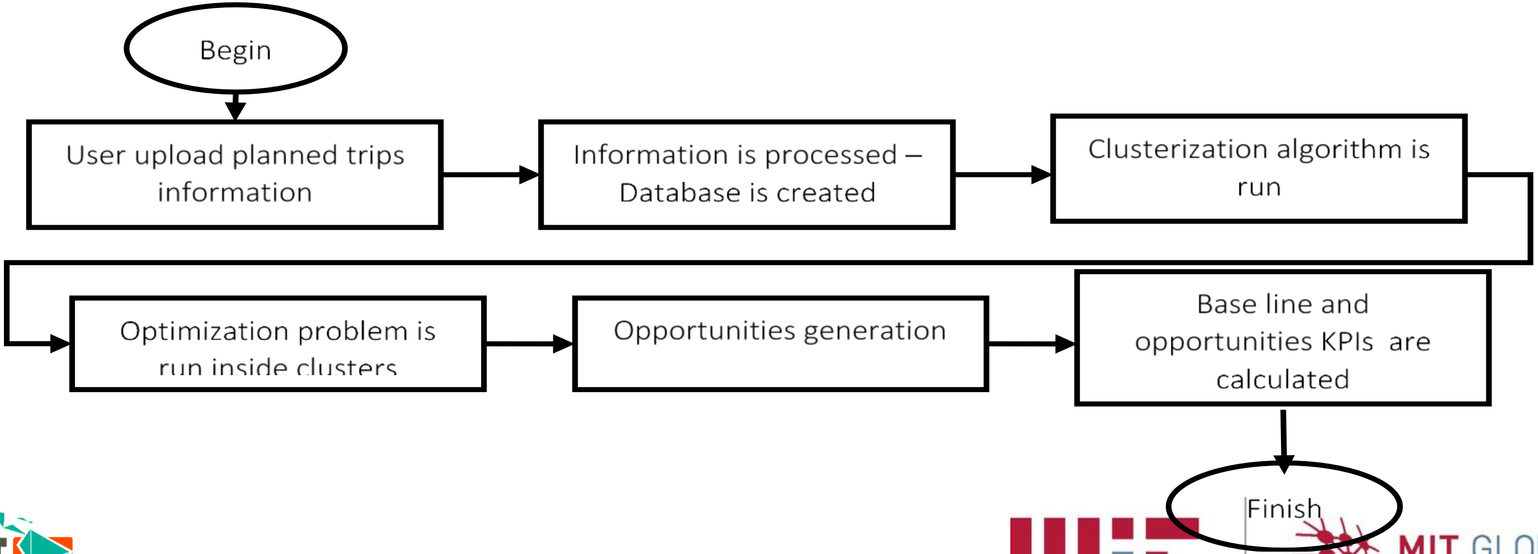

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Constrains

- Delivery date and time match among enterprises (same day)
- Products are compatibles for consolidation.
- Origins are within a range of 30km around.
- Destinations are within a range of 30km around.
- Collaboration can be done with a maximum of three enterprises.

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Experimental setting

PARTICIPANTS

4 Manufacturer Companies

INFORMATION DEFINITION

6 Main data fields:

- Source and target
- Weight and volume
- Products categories (GTIN standard)
- Vehicle capacity and kind
- Shipment and delivery date
- Costs

INFORMATION GATHERING

20K Historical deliveries Database (2018)

TESTING

52 Algortihm execution

RESULTS

4 Indicators evaluated

- Number of opportunities
- Saving percentage
- Vehicle occupation
- Service level impact

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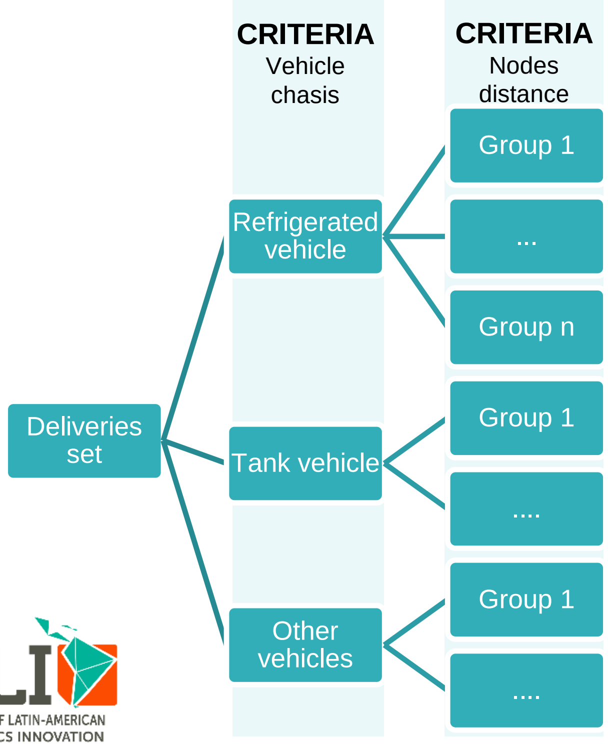
Quantitative approach

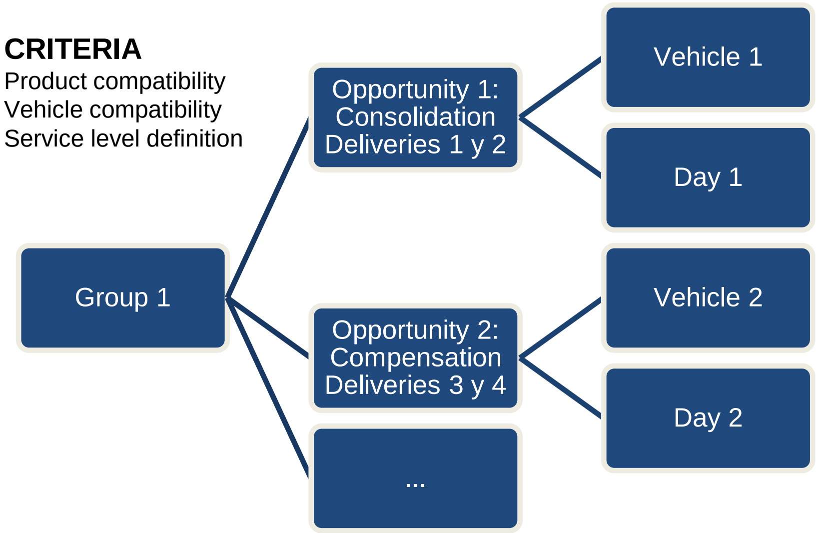
First Step: Clusterization algorithm



Second Step: Optimization algorithm

Allocation model for each group:
¿Which deliveries combination?¿When?¿Which vehicle?

CRITERIA
Product compatibility
Vehicle compatibility
Service level definition



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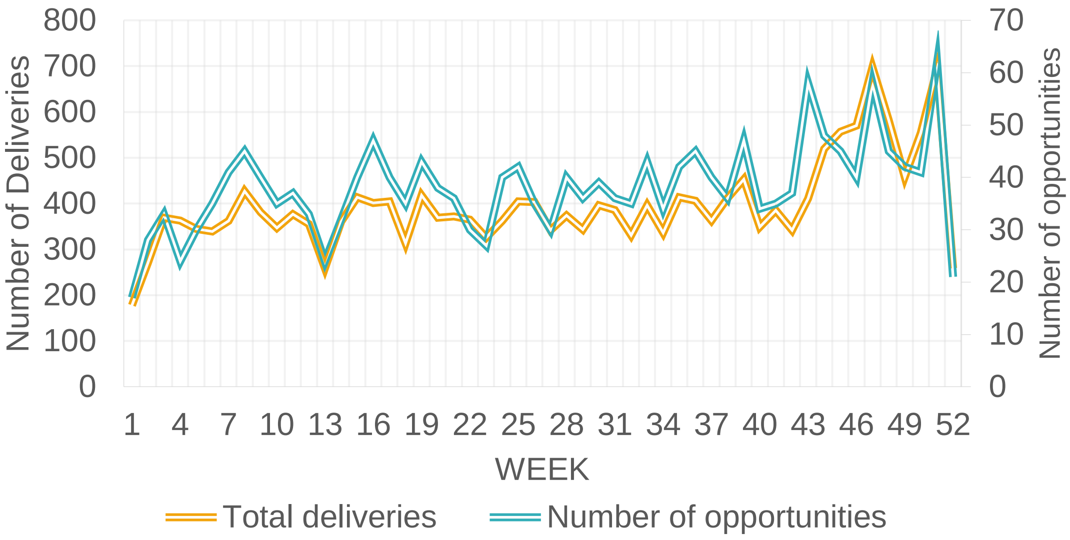
Results and discussion of insights



1976 opportunities

82% are internal opportunities

18% are multi-company opportunities

19.7% of the total planned deliveries for each week can be executed using a collaborative method. Most of the trips can be consolidated.

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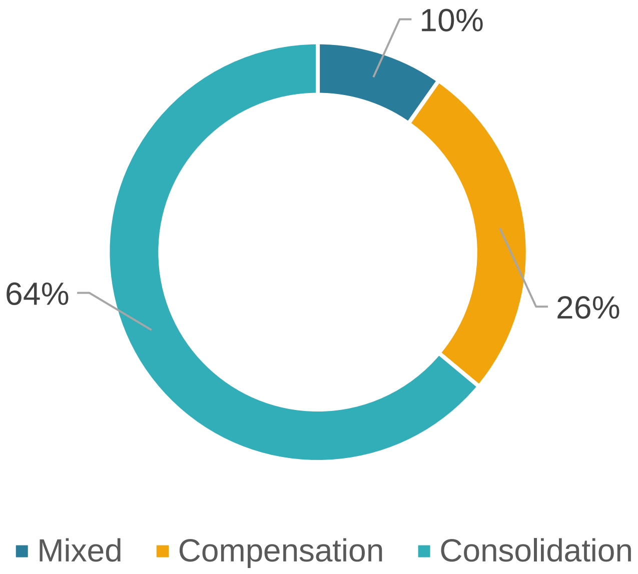
Results and discussion of insights

Consolidation: shippers avoid paying two independent deliveries and are charged with just one common fee, using the same vehicle for both trips.



Opportunities by collaboration type

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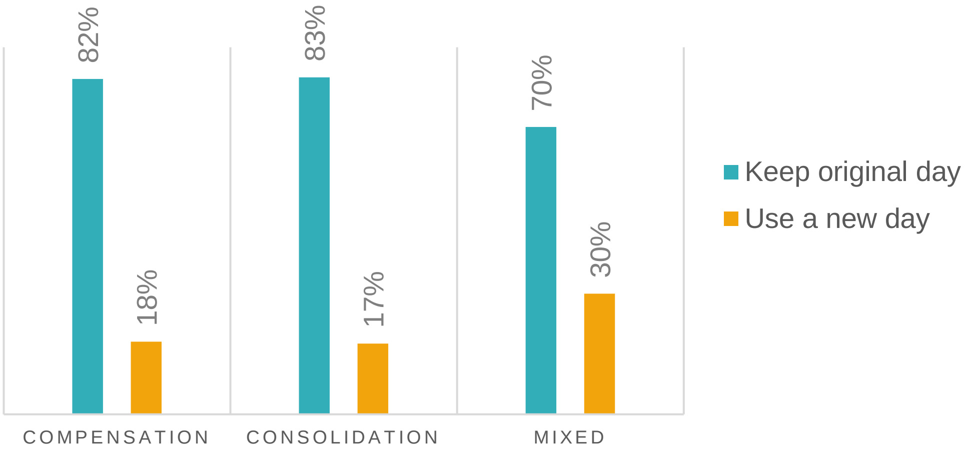
Results and discussion of insights

Average percentage savings per delivery by type of collaboration opportunity

Service level impact by type of collaboration opportunity



Cargo consolidation method is the one which generates higher saving, modifying the planned shipment day just in 17% of the cases.

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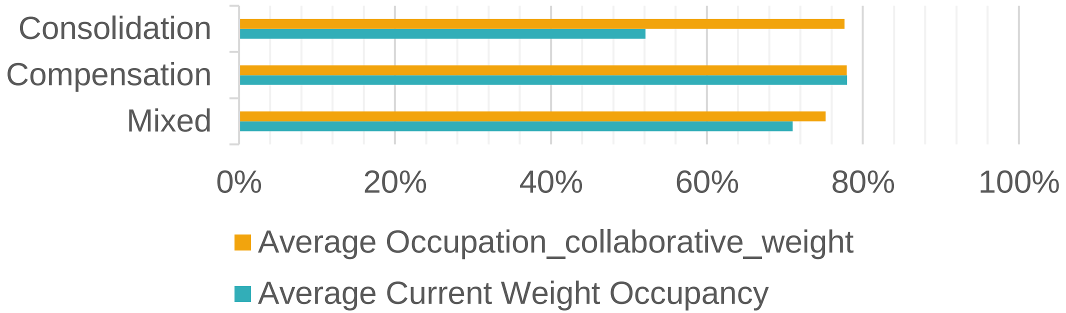
Results and discussion of insights

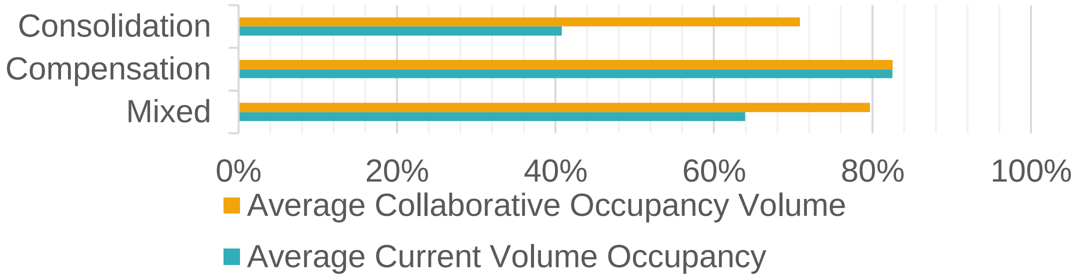
Variation in vehicles capacity utilization is significant, since it rises an average of 17% in weight and 20 % in volume.

Current weight occupation vs Collaborative weight occupation



That variation is more tangible in the consolidation and mixed methods.

Current volume occupation vs Collaborative volume occupation



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Conclusions and future research

01

Information relevance

With historical information and an ITS solution we could find almost **40 collaboration opportunities** per week for the 4 companies.

02

Data quality

Information required to enable collaborative transportation must come from **high quality sources** from all the parties

03

Logistics standards

The use of logistics standards (like products GTIN) enables a common language that facilitates collaborative practices execution

04

Collaboration benefits

Collaborative opportunities could reduce transportation costs in almost **30%** per delivery and increase vehicles occupation in 17% without any impact on service level in 85% of the cases

05

Execution risks

The success of collaborative transport lies not only in a sound planning phase but in a smooth and low risk execution based on transparency an confidence

06

Future research

Study if the proposed ITS has practical implications regarding city logistics as a mean to plan a better policies as well as reducing negative externalities as congestion and emissions

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Thank you!

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