Towards a New Model to Evaluate Smart Mobility in Latin America

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Eladio E. Martínez-Toro holds a PhD. degree in Geographical Engineering from the Polytechnic University of Madrid, holds two Bachelor's degrees in Industrial Engineering and Surveying from the University of Puerto Rico, Mayagüez Campus. Since 2015 works as a Professor and Researcher at the Paraguayan German University. His line of research is Smart Mobility and the Integration of Public Transport in Latin America. He has presented his research works at various international scientific conferences in cities such as Madrid, Barcelona and Amsterdam.

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PROBLEM DESCRIPTION

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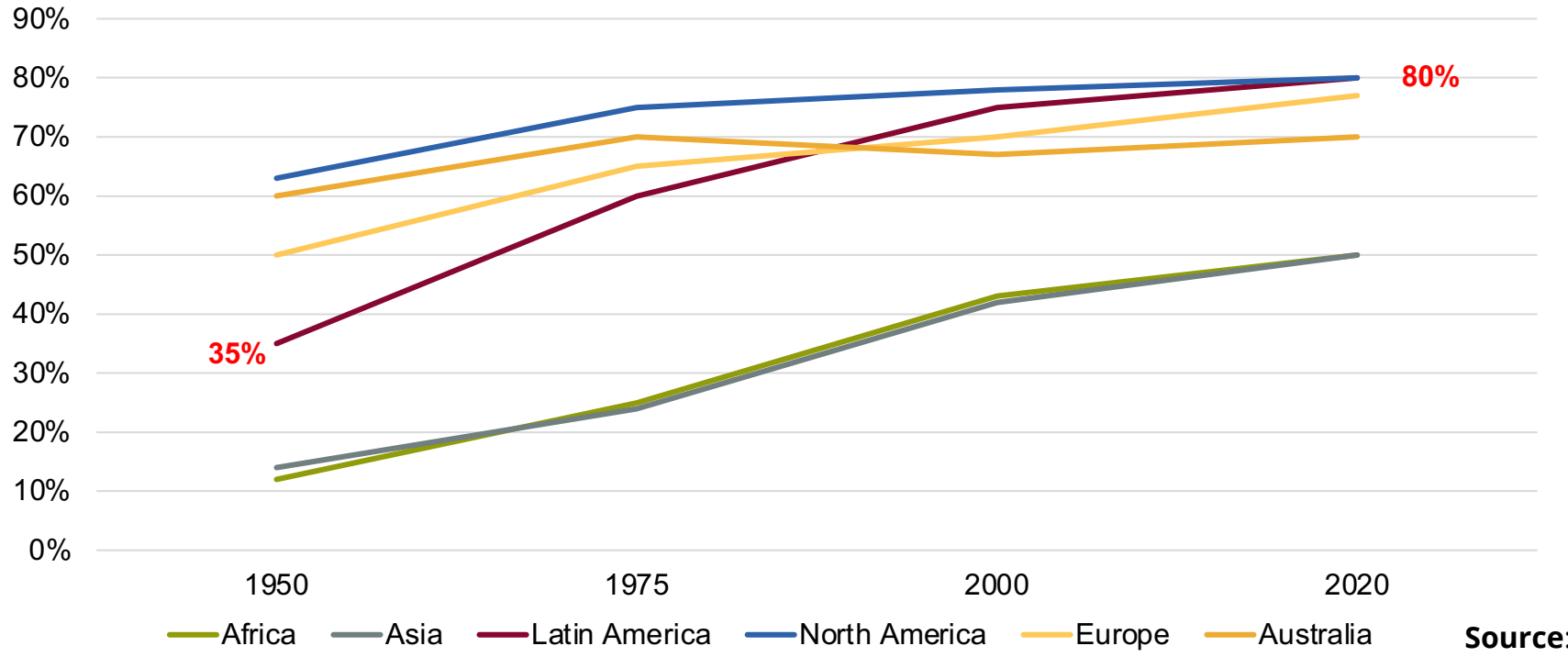
- Latin America is currently one of the most urbanized regions in the world.



Source: *Da Cunha & Vignoli (2009).*

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PROBLEM DESCRIPTION

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- Some cities have started a process of integration of public transport services.
  (Martínez et al., 2019)
- Integration and mobility of public transport is a pending task in Latin America.
- The evaluation of progress in smart mobility in Latin America is complicated:
  - Most of the smart mobility models were developed considering developed countries.
- There is no model that considers the specific characteristics and challenges of smart mobility in Latin American cities.

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OBJECTIVES

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1) Identify a new smart mobility model for Latin America that can serve as the basis for a more effective comparative analysis of urban mobility in the region.

2) Offers a review of the literature of current mobility models and identifies the key indicators and their metrics mobility challenges in Latin America.

Source: https://www.ecointeligencia.com/2013/12/8-smart-city-america-latina-1/

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SMART MOBILITY MODELS ANALIZED

	Authors	Article
1	Cohen (2014)	Smart city index master indicators survey.
2	Lupiañez and Fauli (2017)	Smart Cities: Social evaluation of Smart Cities projects.
3	Battarra et al. (2018)	Smart Mobility in Italian Metropolitan Cities: A comparative analysis through indicators and actions.
4	Aletà et. al. (2017)	Smart Mobility and Smart Environment in the Spanish Cities.
5	Aini and Amani (2017)	Indicators to measure smart mobility: An Indonesian perspective.
6	Orlowski and Romanowska (2019)	Smart Cities Concept: Smart Mobility Indicator, Cybernetics, and Systems.
7	Giffinger et al. (2007)	Smart Cities: Ranking of European Medium-Sized Cities .
8	California Department of Transportation (2010)	Smart Mobility 2010: A Call to Action for the New Decade.
9	Šurdonja et al. (2020)	Smart mobility solutions–necessary precondition for a well-functioning smart city.
10	Martínez-Toro, et al. (2019)	Mobility and Integration of Public Transport Systems in Latin America.
11	Berrone and Ricart (2020)	IESE cities in motion index 2020.

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MOBILITY CHALLENGES IN LATIN AMERICA

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Challenges	Consequences
Advance levels of urbanization and economic growth, lack of road infrastructure	Fast level of motorization, increase in traffic congestion
Elevated travel time of citizens	Represents a great mobility problem in terms of transport time
Inoperative and incompleteness of the integration of the transport systems	Long travel times and high cost of transportation
Precarious and dangerous transport conditions	High levels of traffic accidents
Traffic congestion and lack of regulations of the quality, maintenance and age of cars	Environmental pollution, noise pollution deterioration in the state of the streets
Lack of safety of the users	Experience of unsafe transport conditions

Source: Own elaboration.

SUMMARY OF MOBILITY CHALLENGES

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Physical Indicators

✓ Vehicular congestion, travel times and the presence of an adequate and inclusive ICT infrastructure.

Advancement in Smart Mobility

✓ Sufficient planning capacity of transport authorities and access to financial resources.

Environmental factors

✓ Represented by air pollution levels and to considers key indicators on security which can be expressed in the level of traffic accidents and user safety.

Source: https://www.globalfleet.com/fr/maas-smart-mobility/latin-america/features/future-mobility-latin-america

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PROPOSED SMART MOBILITY MODEL FOR LATIN AMERICA

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- ✓ The combined models proposed by Martinez-Toro et al., Lupiañez et al., and Berrone et al., are found to be most relevant to construct a new model to evaluate smart mobility that considers specific challenges and conditions in Latin America.
- ✓ The smart mobility model proposed includes the interactions between key regional mobility challenges, their indicators and metrics to measure each indicator.
- ✓ To evaluate the eight mobility challenges, fourteen indicators were selected after the analysis of the most representative existing smart mobility models.

Source: https://www.intertraffic.com/news/the-top-5-mobility-developments-in-latin-america/

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PROPOSED SMART MOBILITY MODEL FOR LATIN AMERICA

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Mobility Problem	Indicator	Metrics	Author
Vehicular congestion	-Traffic index -Exponential traffic index -Traffic inefficiency index	-Average one-way travel time to work in minutes -Estimation of dissatisfaction due to long commute times with exponential levels of dissatisfaction with travel time to work above 25 minutes -Estimation of inefficiencies in travel time caused by transport by private car compared to public transport	Berrone and Ricart, 2020.
	-Number of vehicles	-Number of private vehicles per inhabitant	Lupiañez, and Fauli, 2017.
Time spent traveling	-Travel time	-Additional time needed to 30 minutes of travel distance	Lupiañez, and Fauli, 2017.
ICT infrastructure	-City-wide Internet coverage -Digital transport service platforms with real time information	-Internet penetration rate per inhabitant in the city -Percentage of transport companies with digital transport service platforms that offer real time travel information	Martinez-Toro, et al., 2019.
Transport system and payment integration	-Geographically integrated transport modes -Integrated digital payment systems among transport modes	-Percentage of transport service companies with integrated transport modes -Percentage of transport service companies with integrated digital payment systems among transport modes	Martinez-Toro, et al., 2019.

Source: Own elaboration.

PROPOSED SMART MOBILITY MODEL FOR LATIN AMERICA

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Mobility Problem	Indicator	Metrics	Author
Financial resources	-Public, private, and multi-lateral investments in mobility programs	-Amount of total investment available for mobility per 100,000 inhabitants per year	Martinez-Toro, et al., 2019.
Environmental pollution	-Emission of CO_2, PM10, and PM2.5	-Emission CO_2 in grams per minute por passenger -Annual average of the number of particles PM10 in the air whose diameter is less than 10 μm. -Annual average of the number of particles PM2.5 in the air whose diameter is less than 10 μm.	Berrone and Ricart, 2020.
Traffic accidents	-Number of deaths in accidents	-Number of deaths in accidents per 100,000 inhabitants per vehicle	Berrone and Ricart, 2020.
User safety	- Public transport services that offer real-time information -Victims related to transportation	-Percentage of public transport companies that offer on-line and real-time travel information -Transport-related victims per 100,000 inhabitants	Lupiañez, and Fauli, 2017.

Source: Own elaboration.

CONCLUSIONS

- This study on smart mobility has identified key problems that are relevant to evaluate the progress in smart mobility in urban areas in Latin America.
- The challenges include the traditional factors related to elevated vehicular congestion and long travel times but also problems related to a lack of integrated transport and payment systems, deficiencies in ICT infrastructure and a lack of financial resources to finance smart mobility programs.
- Other important factors include air pollution, traffic accidents and user safety.
- The research also analyzed eleven models that evaluate smart mobility of which three models were found to be most relevant to evaluate the key smart mobility challenges in Latin America.

CONCLUSIONS

- The models developed by Martinez-Toro et al., Lupiañez et al., and Berrone et al., together provide an accurate set of smart mobility factors and indicators that cover the mobility challenges in the region.

- The new model enables researchers to conduct more realistic and effective data-driven evaluations of mobility challenges and the progress in smart mobility in different Latin American cities.

FUTURE WORK

- We propose the development of a comparative smart-mobility index of Latin American cities.
  - ✓ To accomplish this, we propose to set up a panel of experts with representatives of mobility professionals and researchers, government, private industry, and end users.
  - ✓ The panel is to validate and assign individual weightings to the model´s indicators and to homogenize the values obtained to have a uniform numerical index that facilitates a more realistic evaluation of smart mobility in Latin America.

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Questions?

Thank you!

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