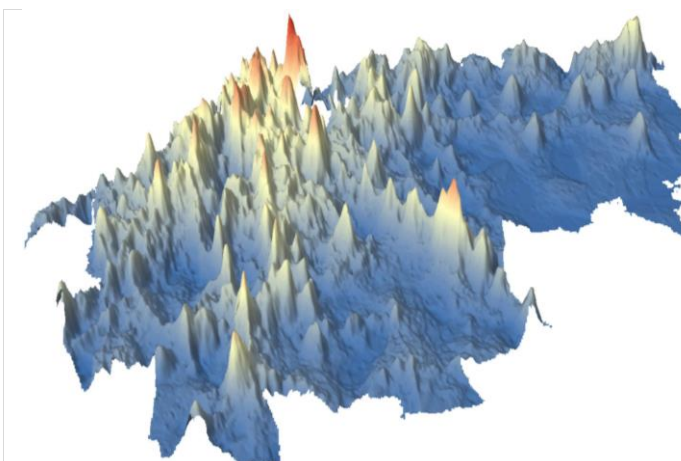


# A new pedestrian demand model for Havana, Cuba

## Overview

This note presents a new model to estimate the potential demand for walking trips in Havana, Cuba. The model covers the whole city, identifying the areas with higher potential demand. The model was developed using open-source geographic information on land use, location of public transport nodes, and the road/street network. The results of the model were then validated in a half-day workshop with representatives from the national and municipal planning and transport authorities in Havana, researchers, and students.



*The new Havana Pedestrian Demand Model in 3D*

## Key Findings

- Pedestrian demand can be modelled even in a context of data scarcity, using open-source geographic data.
- As expected, the model revealed a peak of demand for walking in central areas. However, other peaks were also evident in more suburban areas, along main public transport axes.
- There are some differences between the modelled pedestrian demand in Havana and the expectations of local residents, particularly in the periphery of the city

## Objectives

The objective of this research was to build a model that estimates the potential demand for walking in Havana, as the city currently lacks a tool to understand how this demand varies across the different neighbourhoods.

We also aimed at validating the developed model in a workshop with local residents, to gather feedback on

- How well the model represented local residents' perceptions of walking levels in the city
- Whether the distribution of potential walking demand is reflected on the quality of the pedestrian infrastructure.

## Background

The new Havana Pedestrian Demand Model used a modelling approach developed by Dr. Ashley Dhanani as a part of the UCL Street Mobility project (<http://www.ucl.ac.uk/street-mobility>). This modelling approach represents pedestrian demand values as a continuous variable across space. This goes beyond the state of the art, since most existing methods rely on using administrative boundaries.

The model draws on different datasets to build a statistical picture of the potential of streets to be used for walking as a transport mode (Dhanani et al, 2017). These datasets include information on land use intensity and diversity, public transport accessibility, population density, and street network accessibility.

This model has been proven to be a good predictor of observed pedestrian activity in two cities in the UK (London and Birmingham) and has been expanded to cover the whole country.

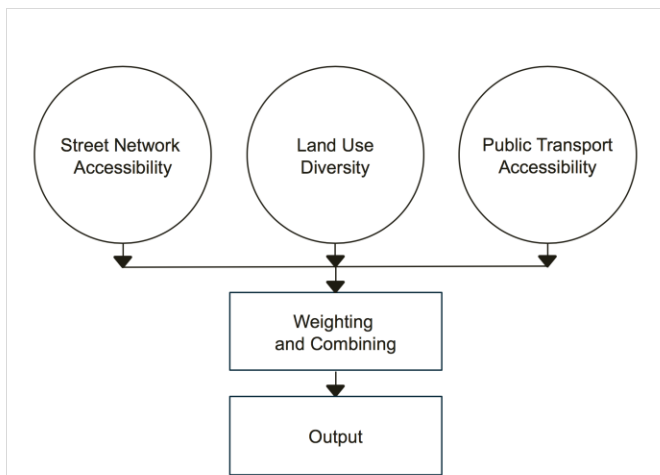
The model is intended to be used for transport planning and evaluation purposes; for example the assessment of existing pedestrian infrastructure and of areas where transport infrastructure or volume of motor vehicles are barriers to pedestrian movement ("community severance").

## Methods

### Building the model

In order to construct a pedestrian demand model for Havana, suitable data sources had to be identified. While similar models in the UK could use detailed official geographic data, comparable data was not available in Cuba. Open Street Map data was identified as the best alternative.

Using this data required several modifications to the model as previously developed in the UK. Our approach is shown in the diagram below. We weighted and combined information on street network accessibility, land use diversity, and public transport accessibility - three factors that have been shown in previous research to be correlated with walking flows.



*Pedestrian demand model components generated from Open Street Map data*

Because of lack of data, population density (a component of the original model developed in the UK) was not used in the Havana model.

We also found that land use data was incomplete, covering mainly tourist locations, likely due to the points being added by visitors. This also led to duplicate records that had to be removed.

The other challenge was identifying public transport nodes and their usage volumes. Unlike in UK cities, in Havana the highest usage flows and associated pedestrian activity occur at bus stations and stops, not train stations. Local knowledge is needed to accurately model the likely pedestrian activity levels associated with the different types of public transport nodes. For example, some bus stations/stops are more important than others, due to their location along certain bus routes.

Estimating a pedestrian demand model for Havana highlighted some aspects about working in data-poor environments. The adapted methods allowed for a model to be successfully constructed from open source geographic data. However, land use data limitations likely caused this component of the model to be the most unreliable. These factors would have to be considered when replicating the pedestrian demand model in other data-poor environments.

### Validating the model

A half-day workshop was organised with local residents. Participants organised in groups, reflecting and discussing the results of the pedestrian demand model and commenting on:

- Areas with higher/lower pedestrian demand than showed in the model
- Whether areas around bus stations were well represented in the model

In a second activity, participants assessed the model in comparison with their perceptions of the quality of the walking environments, commenting on:

- Areas with good and bad walking environments
- Areas where crossing the roads is difficult or dangerous.



*Evaluating pedestrian demand model*

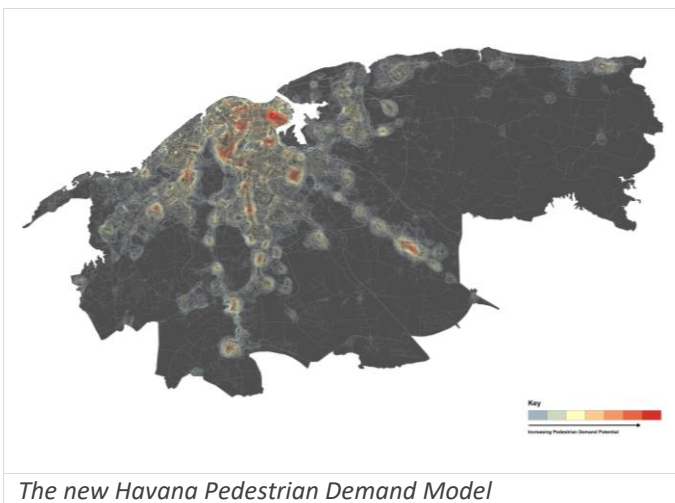
## Results

### ***Pedestrian demand model***

The model is shown in the map below. As expected, there is a peak of demand for walking in central and tourist areas in the North of the city.

However, other peaks were also evident in less central areas, along main public transport axes irradiating from the centre towards the Southwest and South parts of the city.

There are also large parts of the city in the Eastern region with low estimated pedestrian demand. This may reflect the reality or it may reflect lack of enough data to model some of the components of the model in that region.



*The new Havana Pedestrian Demand Model*

### ***Results of validation workshop***

The pedestrian demand model was generally recognised by workshop participants as representing the overall pedestrian activity patterns in Havana.

However, the relative levels of modelled pedestrian demand were not always what they expected from their own knowledge, especially in non-central areas of Havana. The map overleaf is a synthesis of participants' comments.

Several places were identified by the participants as having lower pedestrian activity than what the model presented. These places were identified as local, mainly residential neighbourhood centres.

Other places were identified as with higher observed pedestrian levels than what the model presented. The places were mostly hubs and key intersections which act as 'natural' transfer points for public transport, such as La Virgen del Camino and 100 y Boyeros.



*Evaluating the pedestrian demand model*

Participants also noted that the patterns of daytime and night-time pedestrian flows may differ, because different land-uses attract people at different times of the day. In that sense, having "a" pedestrian model is not enough.

There were several discussions about whether high pedestrian demand is reflected in good walking environments. The general consensus was that it is not reflected.

For example, streets that are bus transfer points, which have large number of pedestrians, tend to have poor built environments for walking. This was the case of Carretera Central (a ring road towards the outskirts of the city) and Monte, identified as the main areas of "conflicts" between pedestrians and motorised vehicles (both cars and buses).

There were also other places with high demand for walking but with bad conditions for crossing roads. This includes main highways, such as the waterfront road (Malecon), Boyeros, the Central Ring Road, and other roads connecting the city centre with the outer municipalities. Most of the crossing issues were linked to the fact that roads/streets were designed for motorised vehicles and not for people; for example roads with up to 6 lanes for vehicles, no median strip, no signalised crossings for most of their length, and very short crossing times where there are available.

## Future Work

The next step following this work would be to further develop the pedestrian demand model so that it more accurately represents the land uses in the city, as well as more precisely modelling the transport accessibility based on accurate representations of the relative usage levels of the access points for different modes of transport.

## References

Dhanani, A., Tarkhanyan, L., & Vaughan, L. (2017). Estimating pedestrian demand for active transport evaluation and planning. *Transportation Research A* **103**, 54-69.

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