Quantitative Analysis of the GHGs emissions from Transport Infrastructure Projects

Case study: Pedestrian walkway in Bandung

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Introduction to TEEMP

TEEMP – Transport Emissions Evaluation Model for Projects (can be pronounced as “temp” or temporary)

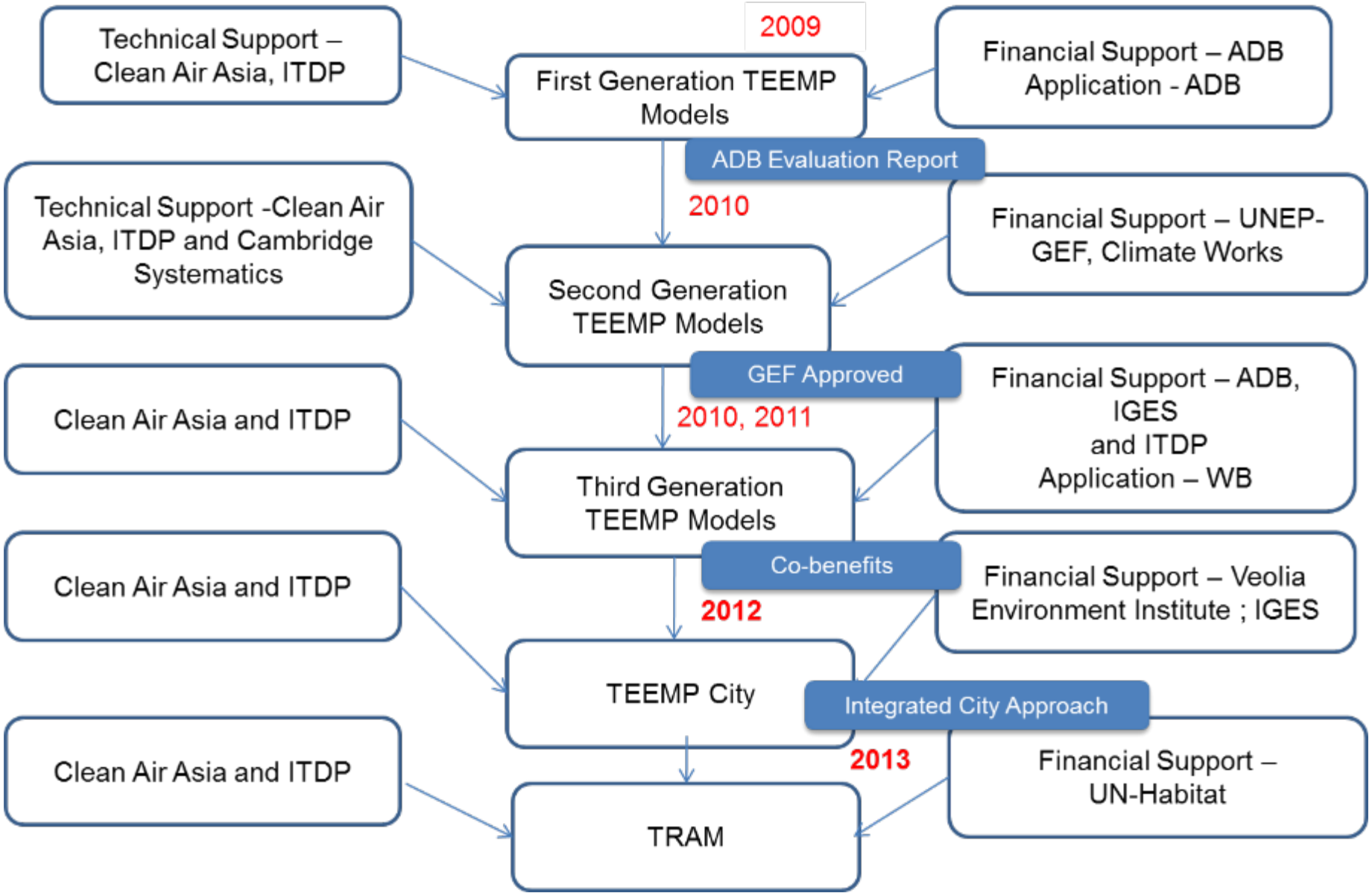
TEEMP BRT - Full Model

Please fill up the details going from TOP to BOTTOM. Green labels will lead you to input cells. The blue labels either contain results, default values or guidance.

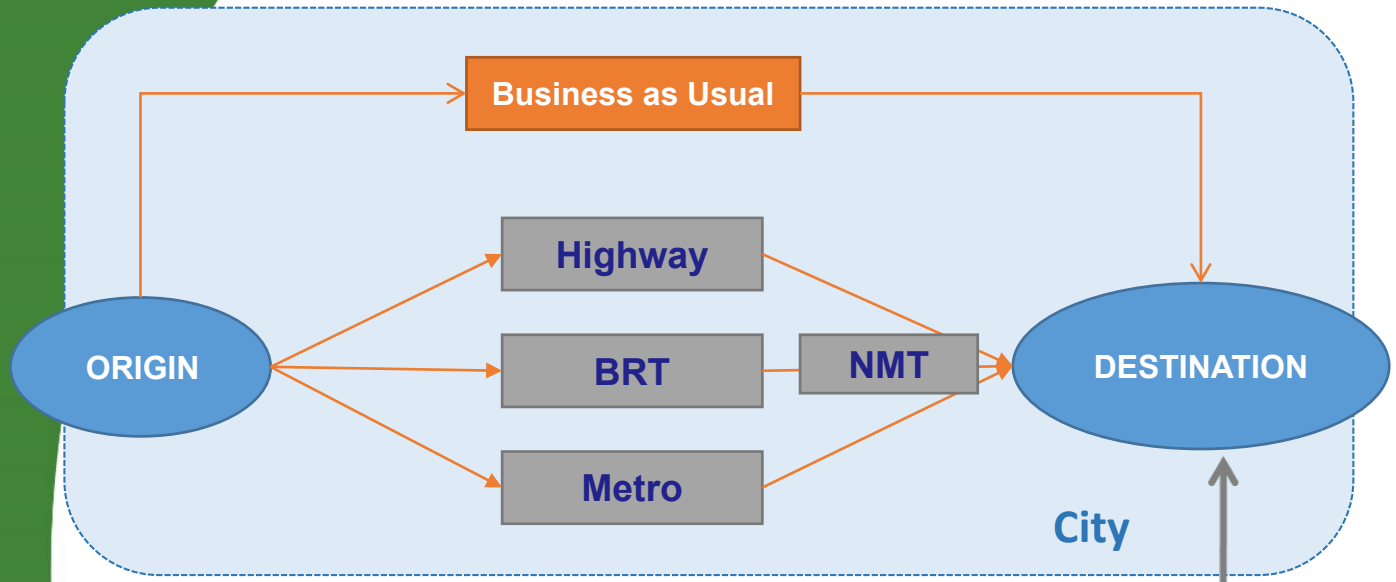
Basic Information

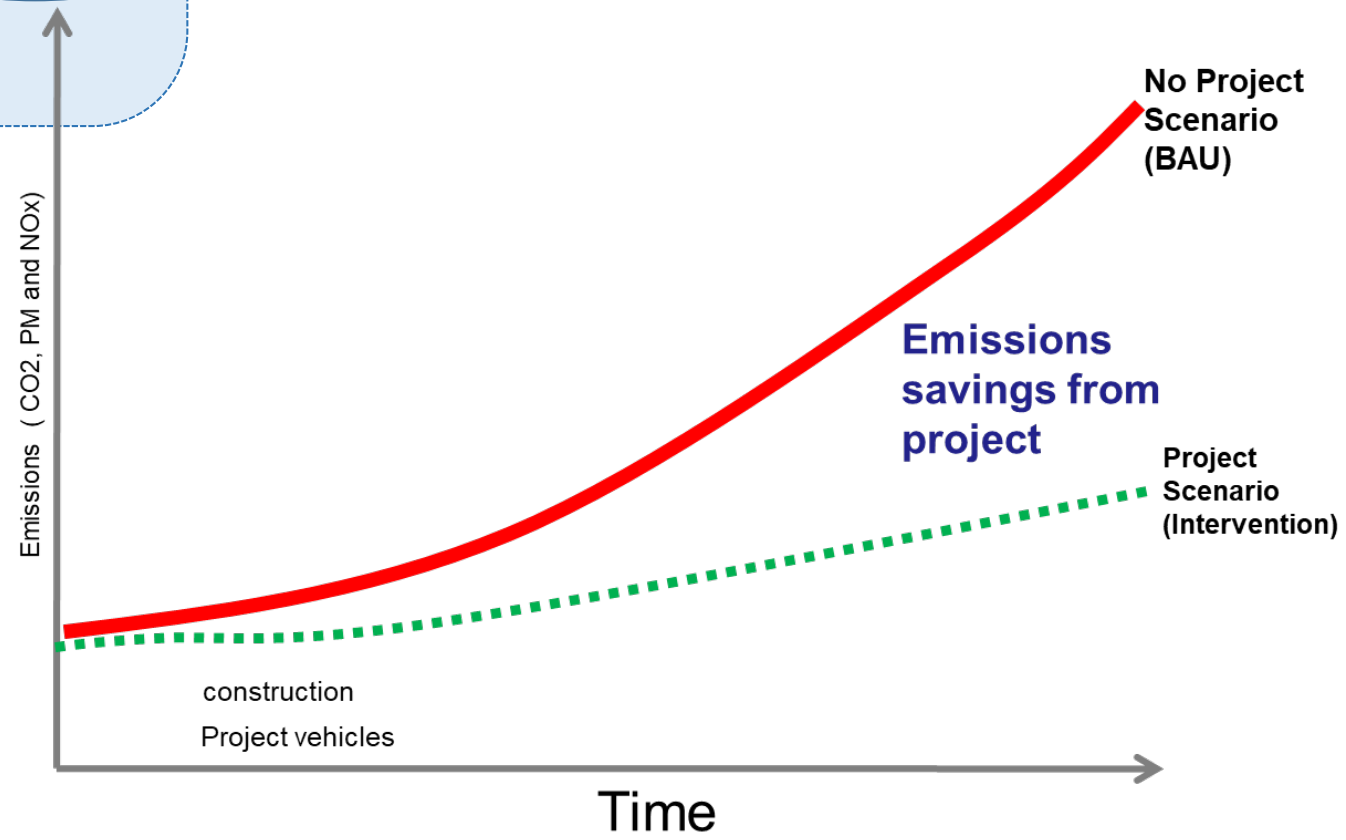
Project name
Location
Details
Base year
Days in a year

TEEMP Development

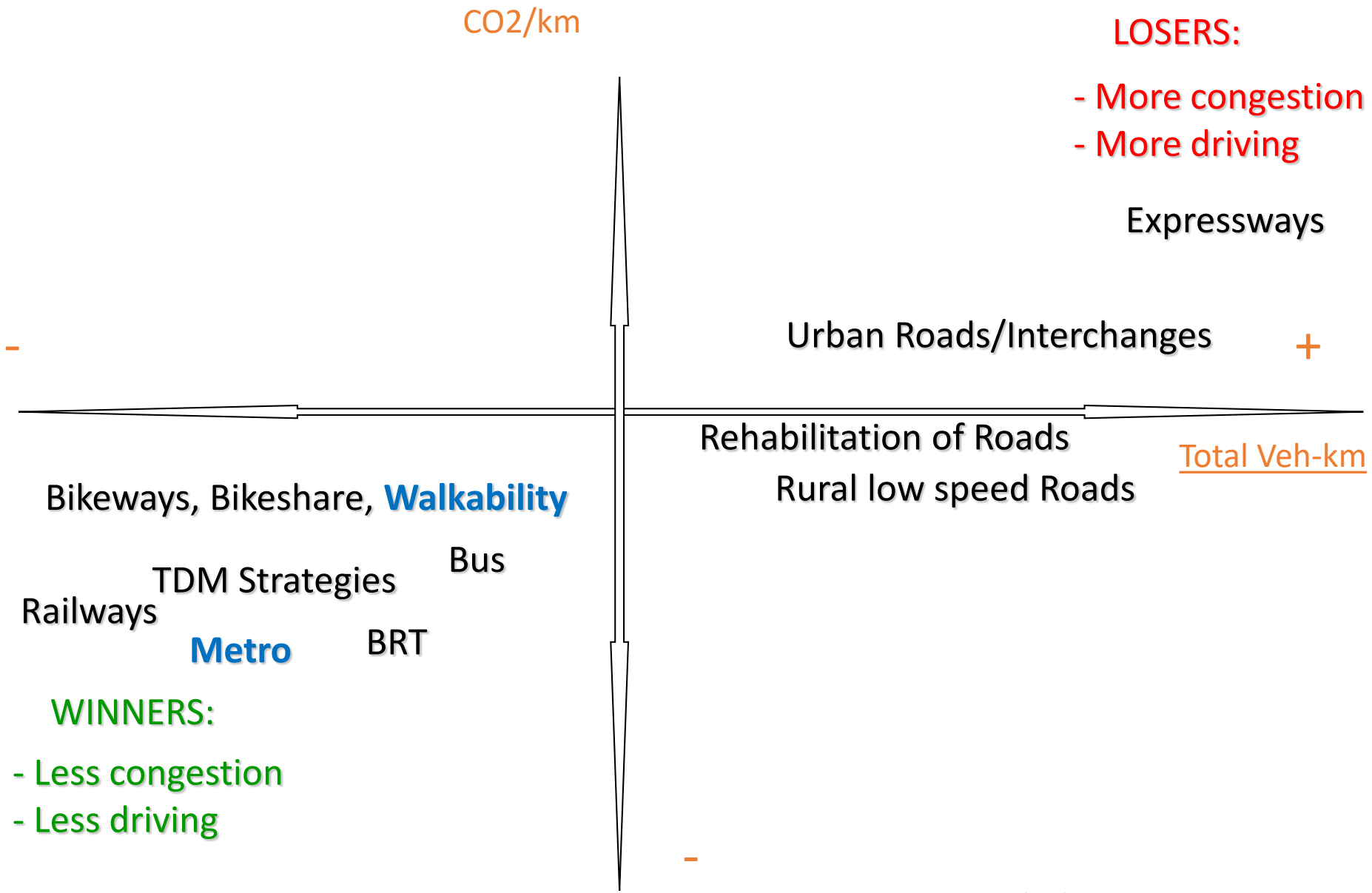


Introduction to TEEMP: BAU vs Interventions





Transport project outcomes: More or Less Carbon?

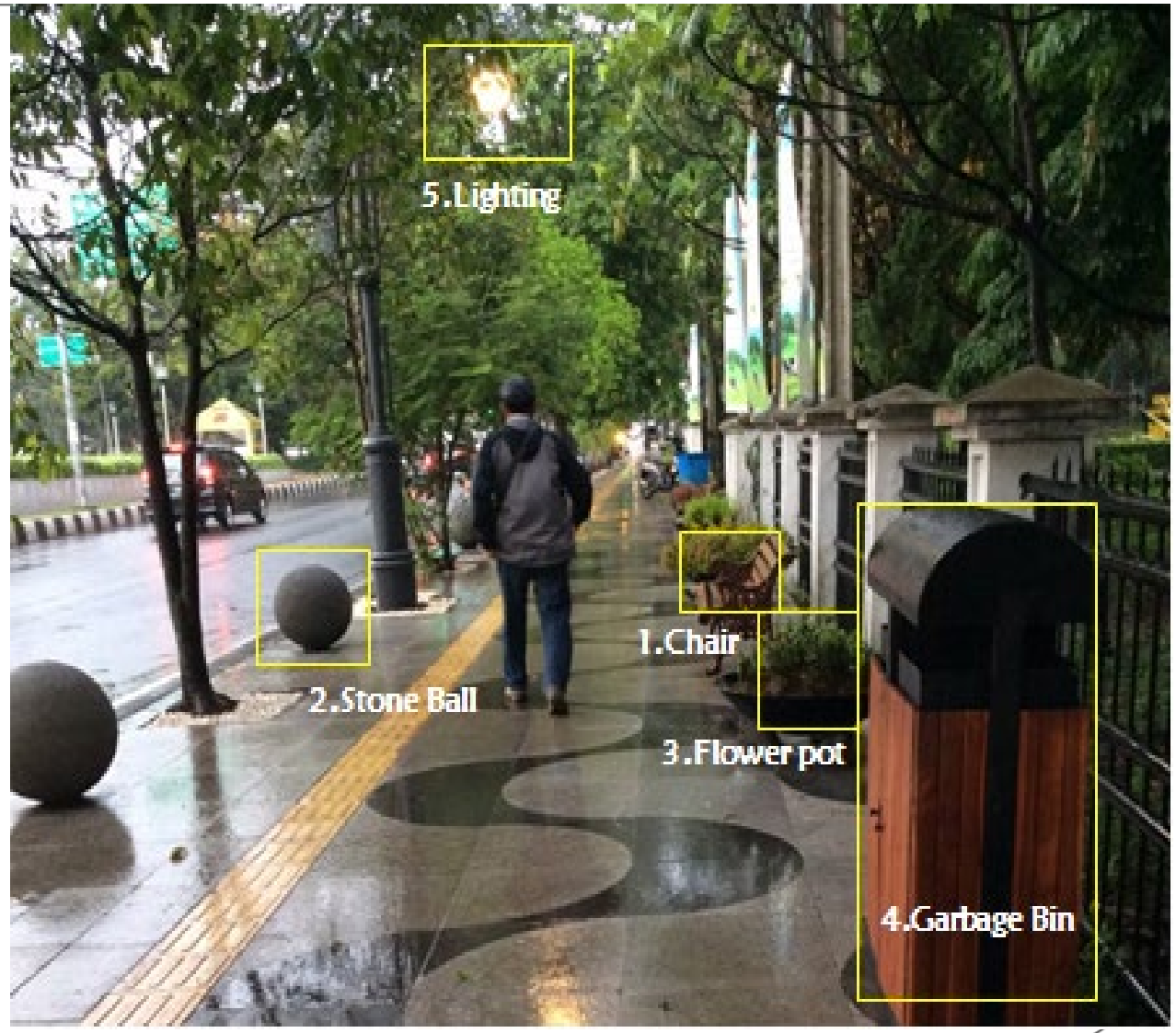


Source : Modified from Lee Schipper presentation in BAQ

Bandung Pedestrian Improvement Program

Panca Trotoar

1. All sidewalk should have chair
2. All sidewalk must have stone ball as safety item for pedestrian
3. All sidewalk have to be decorated with flower pot
4. All sidewalk must have trash can for cleanliness
5. All sidewalk must have public street lighting



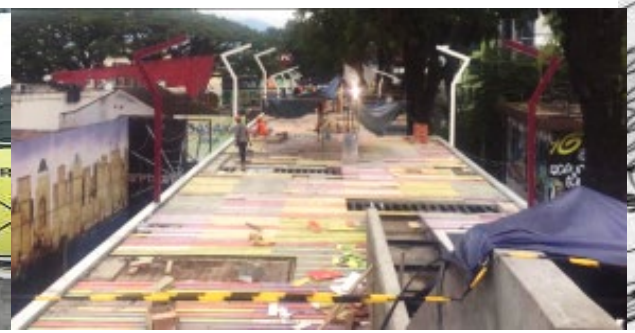
Pedestrian Improvement Program

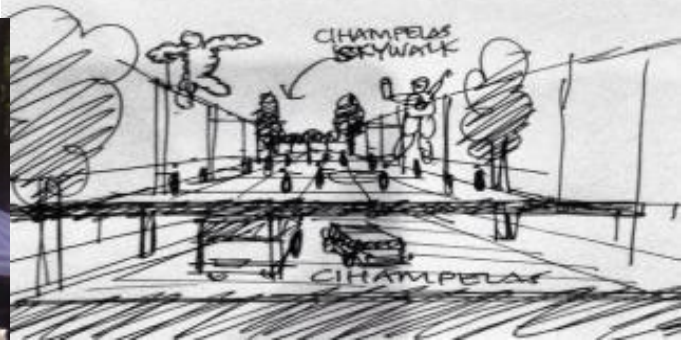
Pedestrian Sidewalk an Maps on Jalan Riau

The sidewalk on RE Martadinata was built using granite and decorated with sidewalk chair, stone ball, lighting, flower pot, garbage bin (panca trotoar) and the city maps is also included to give direction for places in the city.

Cihampelas Skywalk Bandung

- The main purpose is to provide special place for walking and shopping in Cihampelas
- the streetvendor and pedestrian on Cihampelas street will be moved to the skywalk
- Total cost ± 45 billion rupiah
- Construction since September 2016





Pedestrian Improvement Program

Revitalization for Pedestrian and Sewerages

1. There are 19 points area where the sidewalks and sewerage has been improved in 2016
2. The purpose for this project is to prevent the flood in Bandung City and to improve the sidewalk condition to be more beautiful, safe, and comfortable
3. The sewerage will be widened, sidewalks will be fixed and readjusted according to Panca trotoar concept
4. Total cost ± 25 billion rupiah

No	Road Name
1	Jl. H Djuanda - Segment 1 (from Jl. Surapati until Jl. Martadinata)
2	Jl. H Djuanda -Segment 2 (from Jl. Dipati Ukur until Jl. Surapati)
3	Jl. R.E Martadinata - Segment 3 (from Jl. Aceh until Jl. A.Yani)
4	Around City Hall Office of Bandung City
5	Jl. Cibadak - Segment 1 (from Jl. Otto Iskandardinata until Jl. Astana Anyar)
6	Jl. Cisitu Lama 8,9,11
7	Jl. Sudirman - Segment 1 (from Jl. Otto Iskandardinata until Jl. Gardujati)
8	Jl. Buah Batu - Segmen 1 (from Jl. Soekarno Hatta until Jl. BKR)
9	Jl. Otto Iskandardinata - Segment 1 (from Jl. Stasiun Timur - Jl. Sudirman)
10	Jl. Ahmad Yani - Segment 1 (from Simpang Lima - railroad)
11	Jl. Dipati Ukur - Segment 1 (from Simpang Dago - UNPAD)
12	Jl.Aceh
13	Jl. Sukabumi
14	Jl. Ir. H Djuanda
15	Jl. Kopo
16	Jl. Mohammad Toha
17	Jl. Sriwijaya
18	Jl. Cibaduyut
19	Jl. Sukajadi

IGES's 4 Steps Approach on Assessment of Pedestrianisation Program

Step 1

First Step – Baseline Survey: Understanding the influential factors on walking decision

- Literature review & Develop & Design Survey for different groups
- Implement the survey at the several locations of pedestrianisation program in Bandung for three different groups: (a) home based survey – 200 household; (b) Walkers/ Pedestrian Users – 150 People; (b) Non-walkers/Private Vehicle Users – 150 People.
- Analyse the walking decision making process by using social-ecological framework

Step 2

Second Steps – Developing Walkability Index of Pedestrians in Bandung

- Pedestrian facilities performance indicator in a wider point of view beyond the pedestrian level of services (PLOS) based on physical measurement
- Not only consider walkers views, but also accommodate non-walker perspectives
- Applied to several pedestrian facilities in Bandung

Step 3

Third Steps – Simulation Model to Assess the effect of Widening Pedestrian Facilities

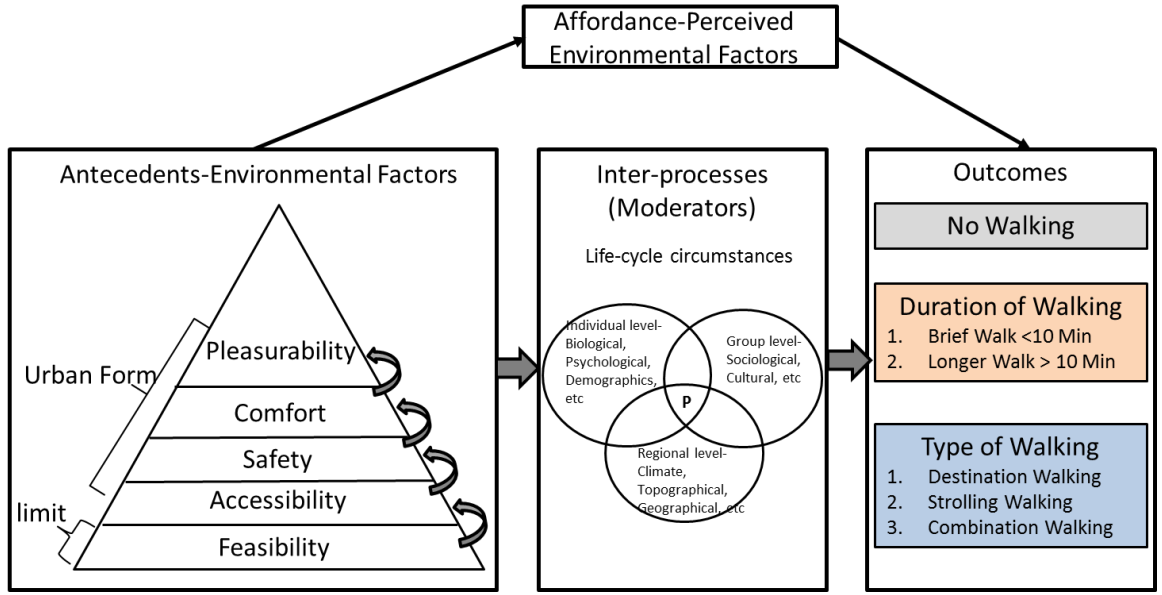
- Simulation for Pedestrian and Vehicle Traffic Interaction by using Vissim and Viswalk Model
- A micro simulation model was conducted at two locations at different intersections within pedestrianisation network in Bandung

Step 4

Four Steps – Analysis of Impact of Pedestrianisation Program on Willingness to Walk

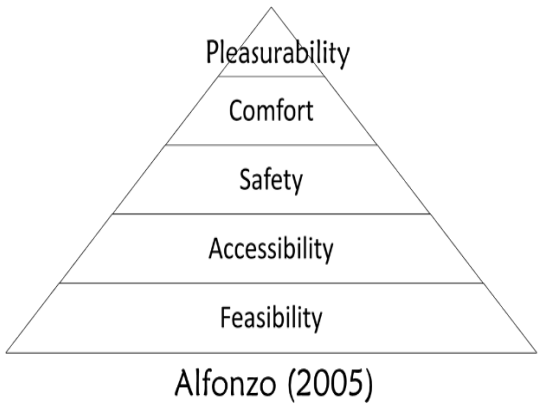
- Quantitative Assessment using Behavioral analysis based on a Logit Model.
- Consider several factors such as: biological, psychological and demographics factors.
- Applied for different group of people in Bandung

Step 1: Hierarchy of Walking Needs & Walkability Index in Bandung



Hierarchy of walking needs within a Social-Ecological Framework (Alfonzo, 2005)

Face to Face Interview 600 People



Alfonzo (2005)

Survey Result

Environmental Factors	Weight
Feasibility	0.14
Accessibility	0.13
Security	0.21
Safety	0.27
Comfort	0.16
Pleasurability	0.09

Step 2: Analysis Walkability Index

- The walkability index model is arranged by walkability components that reflect the performance of pedestrian facilities such as: geometric and surface condition, connectivity to surrounding destinations or public transportation, the sense of safety in crossing, existence of others, width of sidewalk, and the easy access to local stores, visual attractiveness, and social inclusion components (Park et al,2014).

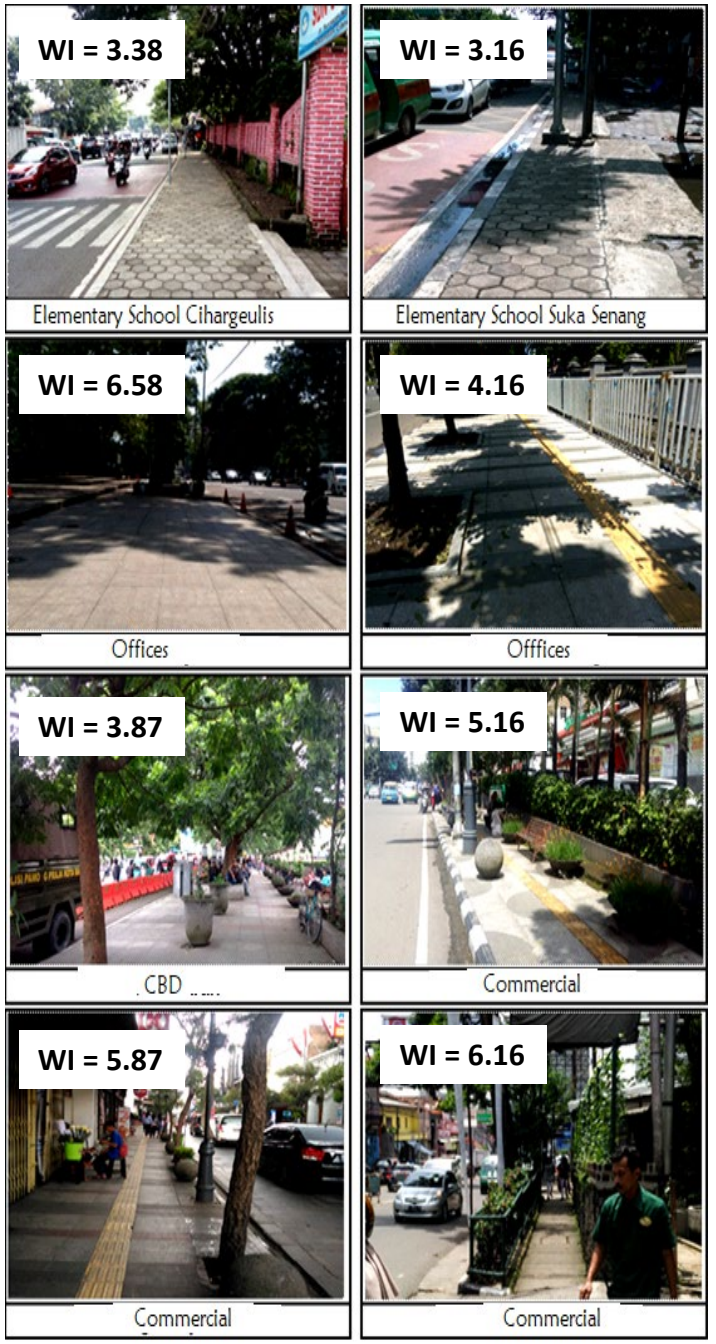
- The assumption is there was a linear correlation between the performance perspective of pedestrian facilities and its physical indicators.

- The analysis was applied to different land-use types such as education facilities, and commercial/business districts, including offices in Bandung city

- Among both pedestrians and non-pedestrians, the attractiveness and visual appeal of pedestrian facilities received the highest score on the pedestrian index. In contrast, facilities for disabled persons and protection from environmental impact received the lowest score.

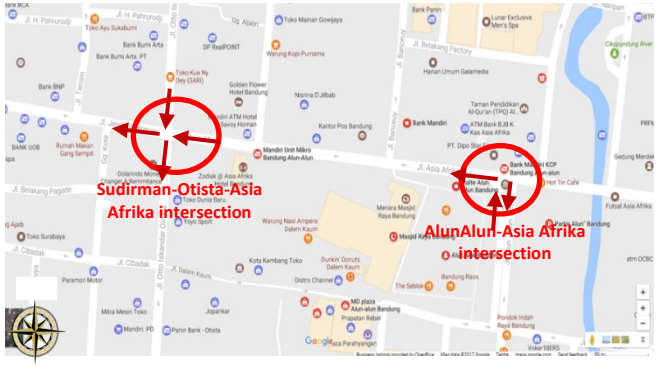
- There were some different perspectives on the key elements of a walkability index among pedestrians and non-pedestrians .

- It is proved by the less number of the pedestrian using the improved walkway.



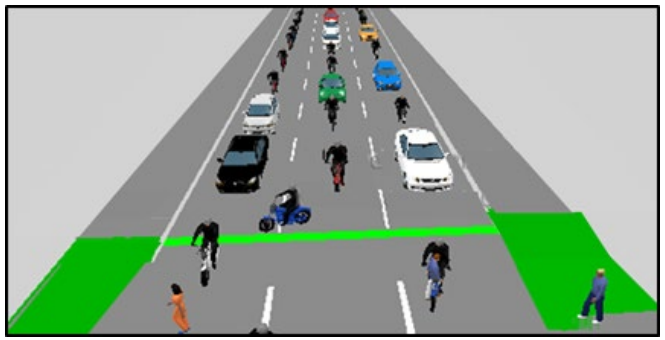
Step 3- Assessing the Effect of Widening Sidewalk

- A question related to the survey results is what would be the impact of introducing some of the desired changes to the pedestrian environment.
- We use micro-simulation model to simulate interactions between pedestrian behaviour and vehicle use. The model considers how several variables related to pedestrians, vehicles and pedestrian environments influence walking and traffic flows. The overarching model consists of ***two models: Vissim*** (traffic simulation model) and ***Viswalk (pedestrian simulation model).*** The changes analysed in the model involved improvements to security and safety; a crossing facility that could help disabled people; and improved connectivity with public transport facilities.
- The model was applied on the two busiest intersections in Bandung, namely: Sudirman-Otista-Asia Afrika and Asia Afrika-Alun Alun.

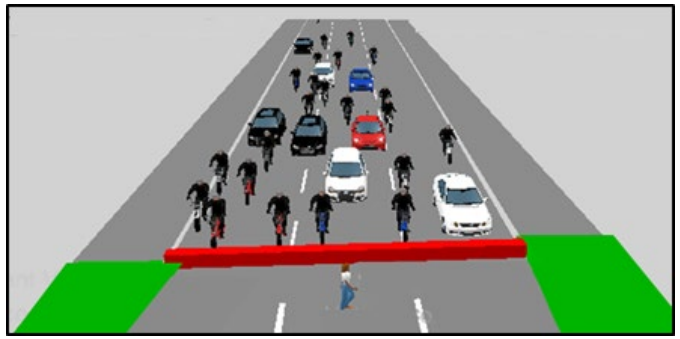


Location of Simulation

Actual Condition



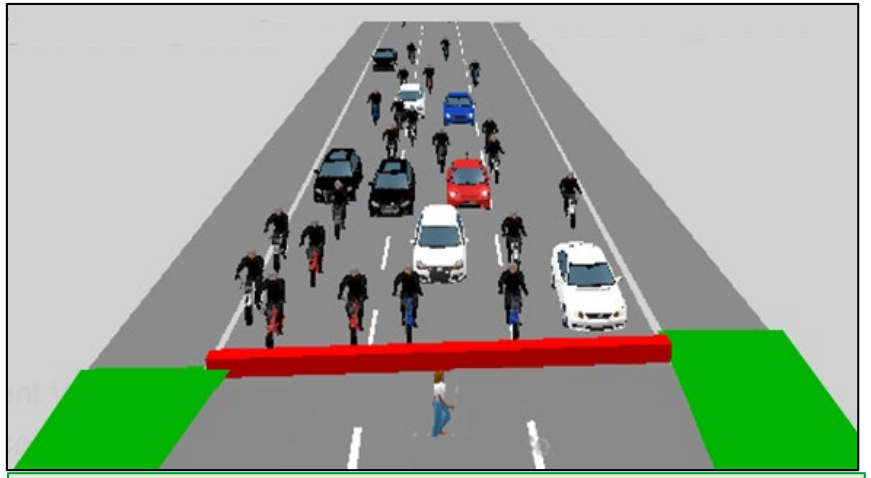
Visual Microsimulation
Before Calibration



Visual Microsimulation
After Calibration

Step 3- Assessing the Effect of Widening Sidewalk

Simulation Model for Pedestrian and Vehicle Traffic



Simulation Model

Actual Condition

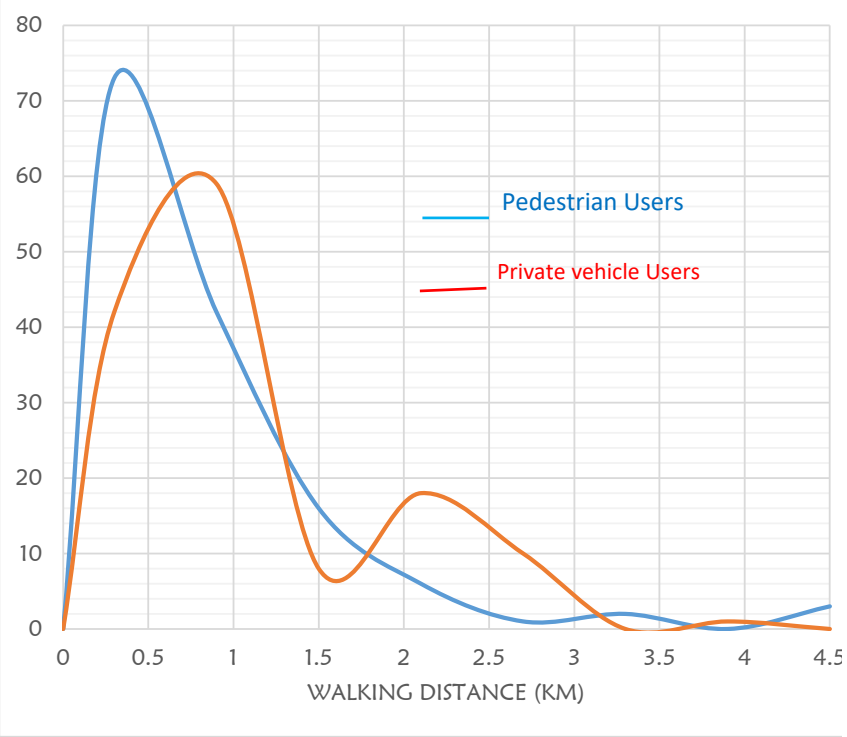
Network Performances (Vehicle)	Avg. Delay (Second)	Avg. Stop (Second)
Existing	222.1	13.8
Widened Sidewalk (1 m)	233.3	13.9

Network Performances (Pedestrian)	Avg. Density (ped/m^2)
Existing	0.0110
Widened Sidewalk (1 m)	0.0105

- Using the simulation model for vehicle and pedestrian traffic and walkability index, the effect of walkway widening can be assessed
- It can be expected that, by the local widening sidewalk, the traffic performance of vehicle traffic will be declining, while the Pedestrian traffic performance is only slightly increase
- This is due to the insignificant divert of vehicle user to the pedestrian

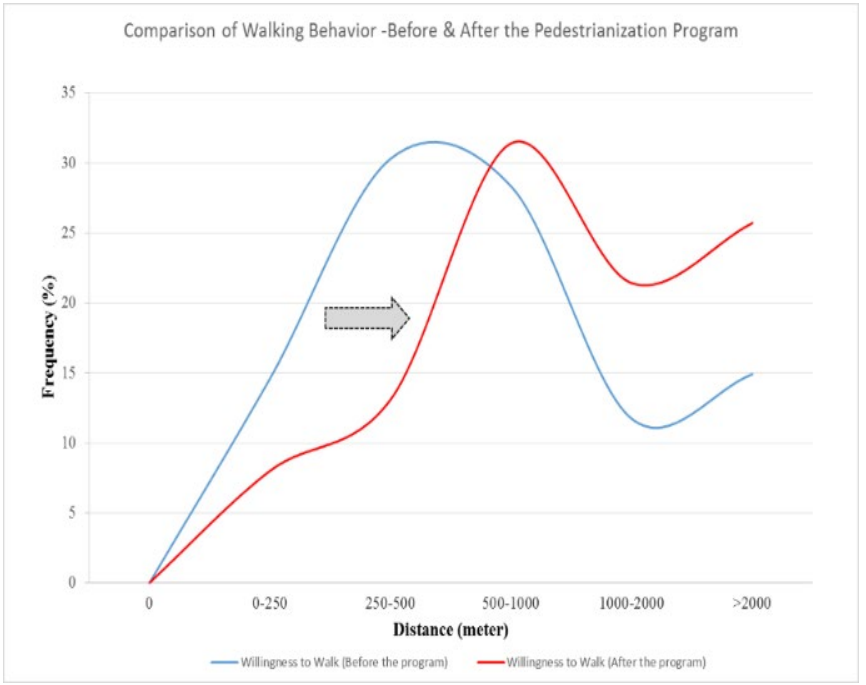
Step 4: Analysis Behavioural Changes & Its Impact on GHG Emissions

Acceptable Walking Distance User and Non-User



- Acceptable walking distance of pedestrian users was approximately 470 meter per day while the survey suggests the distance that private vehicle users would be willing to walk is 0.84 km which is incidentally longer than the estimated result for pedestrian users

Changing Walking Behaviour Before & After Program



- Improvement of pedestrian facilities increases the acceptable walking distance of typical citizens in Bandung, amounting to about 424 meters per day.
- The improvement program had a clear impact on the walking distance in Bandung

Step 4: Analysis Behavioural Changes & Its Impact on GHG Emissions

Quantifying impacts on GHG emissions reduction:

- By combining the data on the acceptable walking distance and assumed influence on the shift from private vehicle use to walking

- The calculation reveals that the changes to the pedestrian environment would yield a decrease of :

a. 1.76 % in volatile organic compounds (VOCs);
b. 1.20 % reduction in carbon dioxide (CO_2).
c. 1.10 % reduction in PM
d. 0.95 % reduction in NOx

- In evaluating these results, it is also important to bear in mind that more significant reductions could be achieved with more significant changes to the pedestrian environment.

Conclusion

- Pedestrian facilities is one of the important factor in ensuring the optimum outcome of Transportation Projects
- It was found out that according to the respondents, the most important parameter in the pedestrian facilities is the security and safety aspect, which is in general not merely determined by the direct pedestrian facilities only, but it should be also influenced by the surrounding condition.
- The next important parameters relate to public transportation and walkway network. The pedestrian facilities must be developed in the integration with public transportation, since most of the pedestrian are going to use the public transportation. Or, sufficient parking facilities, for the private vehicle users.
- From the survey it was revealed that in average adult trip maker in Bandung is willing to walk up to 0.84 km, which means that if the pedestrian facilities is well developed by a proper integration with public transport and parking facilities development and policy, the reduction of private vehicle user in term of vehicle kilometers traveled (VKT) will be quite significant.
- On the other way, a standalone pedestrian facilities development will not maximizing the utility of the facilities, in fact it will reduce the road traffic performances, as the capacity of the road is deducted.

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