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Predicting Pedestrian Trips to Urban Commercial Landuse

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Walking as a mode of transport

- “Walking—**most fundamental** mode of transport for **short distances**.” (Bhagat et al., 2014)
- Trip purpose –**work-trip, recreation-trip, market-trip** or being a **feeder** to and from **a transit stop**.
- Lots of **advantages**— public health, reduction in air pollution, reduction in congestion etc. (Blomberg et al., 2000) (Krizek & Forsyth, 2009) (Powell & Blair, 1994).
- Walking—**major chunk of our trip**—yet we ignore the part (Blomberg et al., 2000)



Pedestrian
share as a
transportation
mode around
the world



7 European countries –12-30% of trips by walking (as main transport mode), the highest figure being for Great Britain. (*Commission, 2012*)



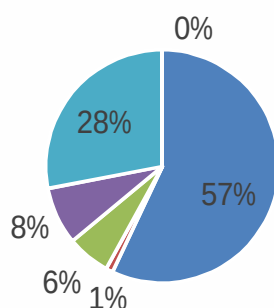
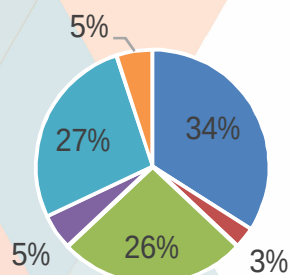
New York—39% modal share, while in Paris—just 4% (*Journeys, 2011*)



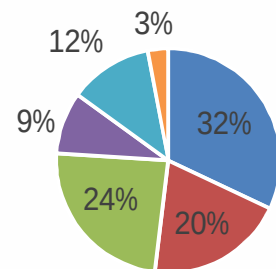
Prague, Sydney, Singapore, New Delhi, Shanghai, Rome –for about 25 % of the total trips (*Journeys, 2011*)

Pedestrian share as a transportation mode in Indian Cities

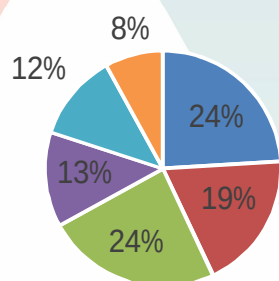
Category 1a (<0.5 mil; Plain Terrain) Category 1b (<0.5 mil; Hilly Terrain)



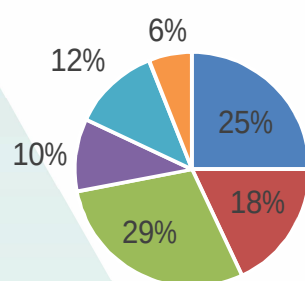
Category 2 (0.5-1.0 mil)



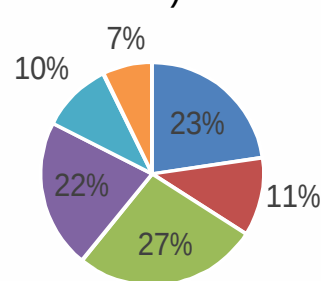
Category 3 (1.0-2.0 mil)



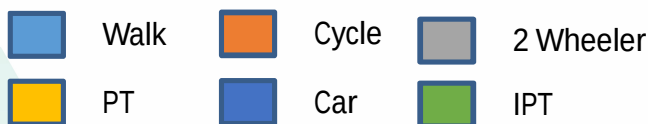
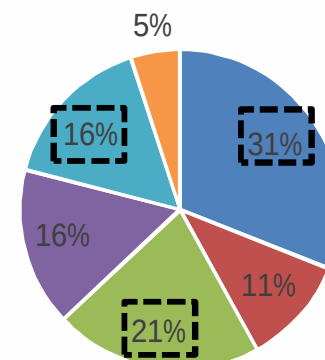
Category 4 (2.0-4.0 mil)



Category 5 (4.0-8.0 mil)



Overall



(Wilbur Smith Associates and Ministry of Urban Development, 2008)

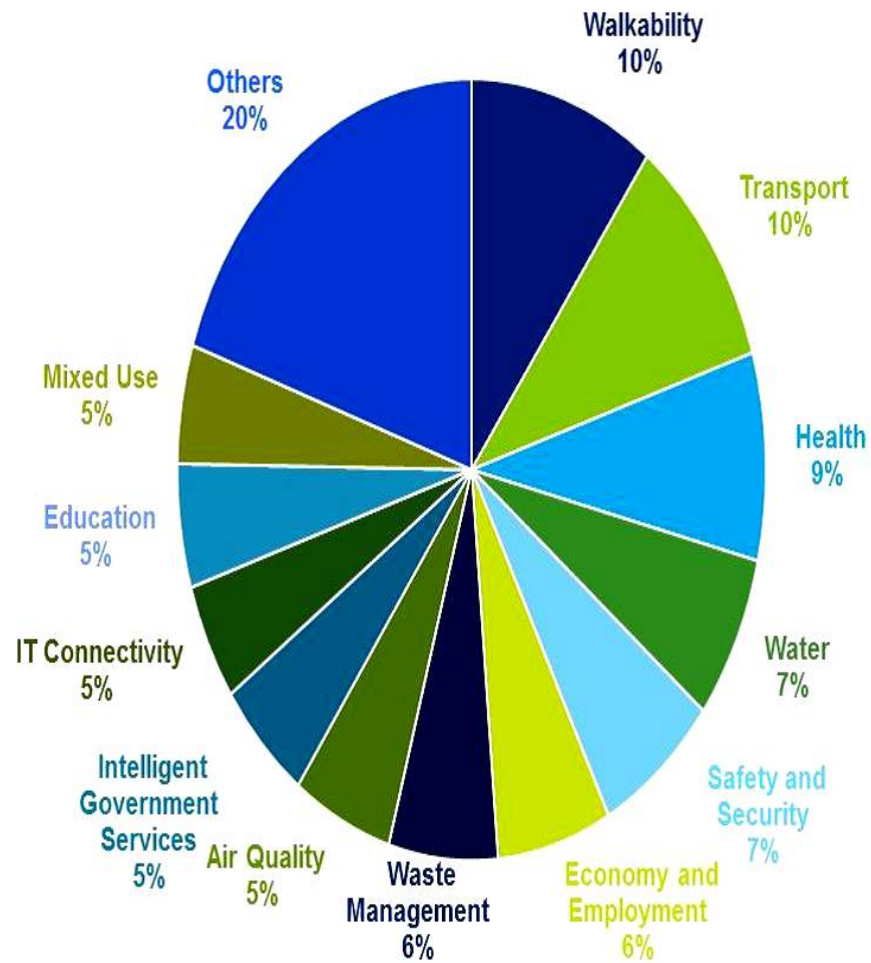
Smart City & Mobility

- Examples
 - Congestion Pricing
 - Flexible Work Schedule
 - Carpool
 - Signal coordination



Smart City Proposal for Rajarhat New Town

Citizen's Feedback

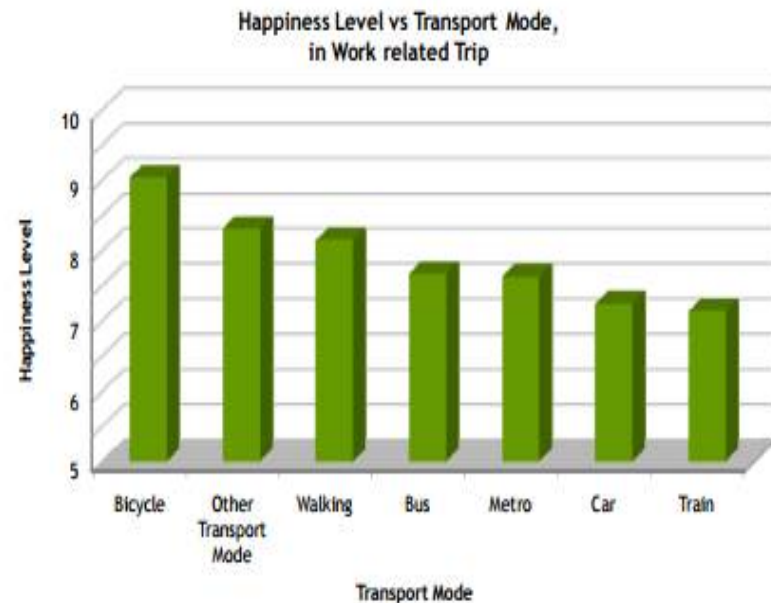


- Walkability
- Transport
- Safety & Security
- Economy
- Employment
- Water Management

Transport and Happiness

Satisfaction Level	Low	Average	High
Private Car			
Metro			

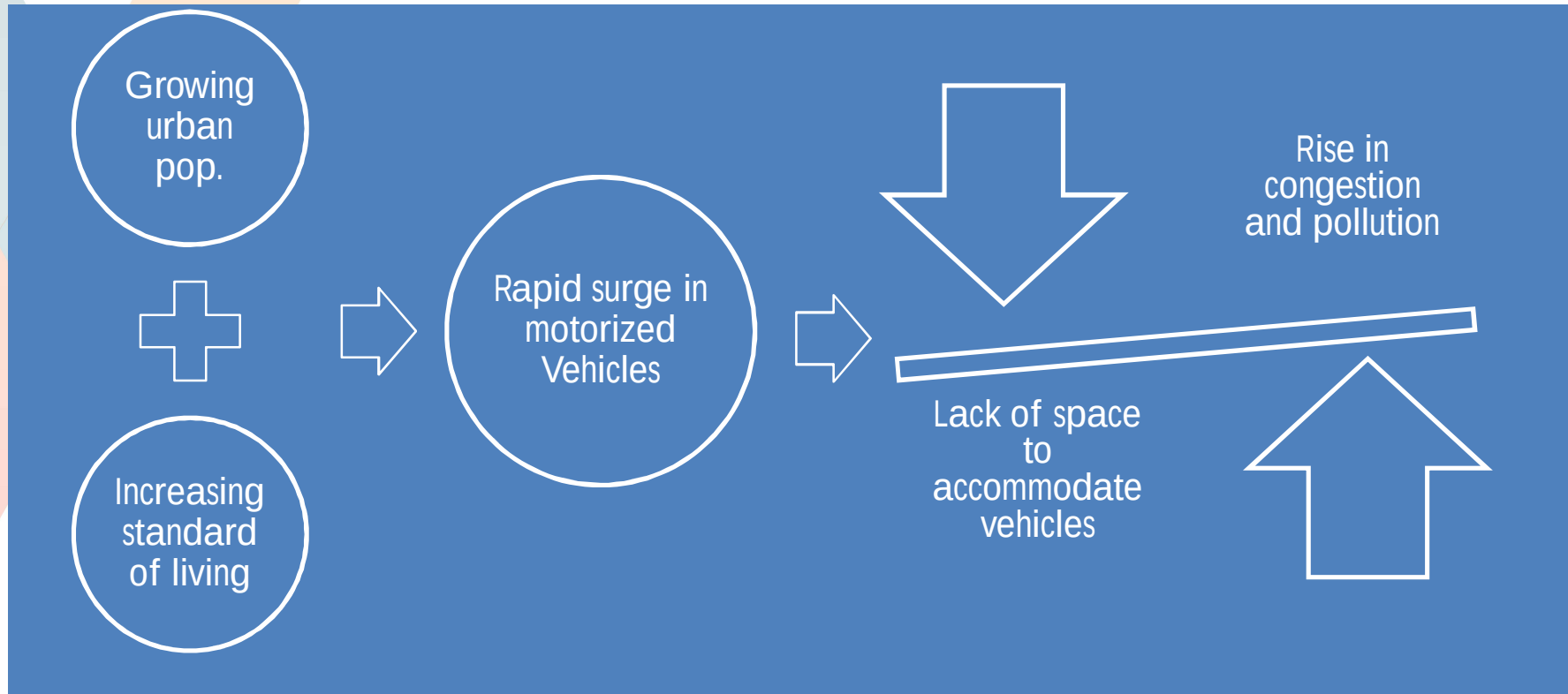
Reference: EXPERIENCED AND EXPECTED HAPPINESS IN TRANSPORT MODE DECISION MAKING PROCESS, 12th WCTR, Lisbon, Portugal



- Happiness can be defined as

$$happiness = f(\text{infrastructure condition, user satisfaction})$$

Why focus on pedestrians in India?



- Compact urban core--Most of people need is within 1-mile or 20 minutes
- High volume of pedestrians in urban core
- Expensive, and mostly counterintuitive, to build/expand roads to ease congestion
- Lack of physical space in congested urban areas to build/expand roads

Pedestrian Issues

Decrease in pedestrian activity can be attributed to

Improper or poor design of pedestrian infrastructure

Automobile -oriented policies

Absence of designated sidewalk

Dis-continuous and /or mostly un-segregated pedestrian facility

Absence of quality markings and signage at crosswalks etc.



Pedestrian Issues



Obstruction of sidewalk due to **parking** of cars on them



Obstruction of sidewalk due to **poor condition** of Facility

(Image source: <http://urbanmobilityindia.in/Upload/Conference/f7077d63-2d89-4e7b-bf02-a946f174bc18.pdf>)

Related Initiatives by the Government of India



AMRUT

- emphasized on developing infrastructural facilities
- Favors NMT transportation Policies



SMART cities mission

- achieving efficient urban mobility
- favorable administrative service for the pedestrians.

(UAY) Uchchar Avishkar Yojana



National Urban Transport Policy (NUTP)

- Policy focus is “to move people not vehicle”
 - Equitable allocation of road space (public vs. private modes of transport).
 - Priority to use of public transport (all million plus cities to plan for high capacity transport systems).
 - Priority to non-motorized modes.

Need for the Study

For providing such pedestrian infrastructure and design aids:

- Necessary to determine —**the factors** that are affecting the decision to walk
- Determine—**how these factors** affects the decision
- Develops a **relationship** between trip purpose, physical & socio-economic conditions and the choice of the mode.

3 Different Character of the Study Sites

IIT KGP Campus



Low Density—Adequate physical infrastructure that encourages high pedestrian movements.

- Heterogeneous mix of dense urban population
- Typical condition of the Indian urban transportation network.
- The site was along a commercial corridor that had partial pedestrian facilities.

Gol Bazaar, Kh arapur



Moderately Dense—Lacks the basic amenities that are essential for a pedestrian corridor.

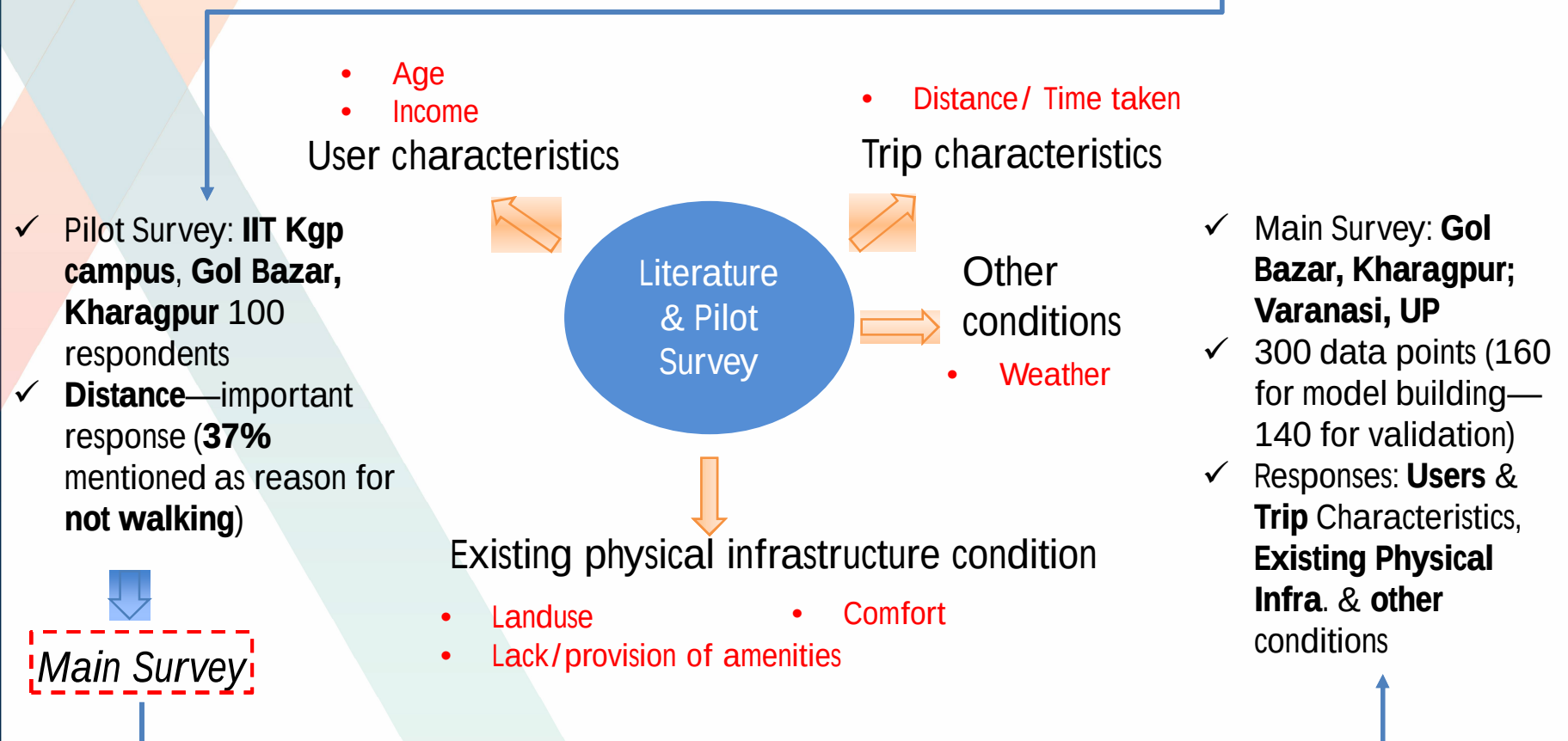
Varanasi



Data Collection

Target respondents: Anyone completing a trip to a surveyed commercial land use

*Selection of determinants from literature and initial **Pilot surveys***



Research Design

Intercept survey on stretches with both with and without walking facilities– Variables Recorded

Quantitative Variables	Range	Code	Range	Code	Range	Code	Range	Code	Range	Code
Age	<15	1	15-25	2	25-35	3	35-50	4	>50	5
Income	< 1 l.p.a.	1	1-2.5 l.p.a.	2	2.5-4 l.p.a.	3	4-8 l.p.a.	4	>8 l.p.a.	5
Distance	0-50m	1	50-100m	2	100-150m	3	150-200m	4	>200 m	5

Qualitative Variables	Responses & Code
Decision of walking: Provision of Infrastructure	Yes=1; No=0
Decision of walking: Proximity	Yes=1; No=0
Decision of walking: Weather	Yes=1; No=0
Comfort	Comfortable=1; Not Comfortable=0
Sub-Landuse Type	Grocery=1; Garment=2; Eateries=3

Binary Logit Model

Model:
$$p = \frac{e^{[2.789 + 0.231(age) - .019(income) - .647(eatery\ landuse) - .481(garment\ landuse) + .180(infrastructure) - 1.304(distance) + .315(comfort)]}}{1 + e^{[2.779 + .231(age) - .019(income) - .647(fooding\ landuse) - .481(garment\ landuse) + .180(infrastructure) - 1.304(distance) + .315(comfort)]}}$$

“p” is the probability of a walk trip of happening

	B	S.E.	Wald	d _f	Exp(B)
age	.231	.201	1.322	1	1.260
income	-.019	.212	.008	1	.981
landuse			1.616	2	
landuse(1)	-.647	.531	1.486	1	.524
landuse(2)	-.481	.507	.898	1	.618
distance	-1.304	.211	38.040	1	.272
Comfort	.315	.428	.544	1	1.371
Infrastructure	.180	.427	.178	1	1.197
Constant	2.789	.512	9.353	1	16.264

Nagelkerke R² = 0.506 (within acceptable range)

Hosmer-Lemeshow goodness of fit test = 0.605 (>0.05)

Binary Logit Model—Trip Estimation

	total trips/ total combinations	Percentage
For all possible combination for all land use	492/1500	32.8
For all possible combination for grocery	193/500	38.6
For all possible combination for eateries	143/500	28.6
For all possible combination for garment	156/500	31.2

Estimated is % of trips happening by purely walk

- The percentage of pedestrian trips is highest for grocery –38.6% ; garment—31.2% and eatery—28.6%
- The overall percentage of pedestrian trips happening is 32.8%.

Binary Logit Model—Odd's Ratio Analysis

“Odd's ratio”: change in odds for 1-unit increase in one of the independent variable when all other variables are constant

Base condition for comparison:

Landuse	Age	Income	Distance	Comfort	Infrastructure	Odd ratio for	p
1	1	1	1	0	0	Base condition	0.821562

Variable	Odd's ratio
Age	1.03823
Income	0.96398
Distance	0.67591
Comfort	1.05068
Provision of infrastructure	1.03030
Landuse (Eatery)	0.86022
Landuse (Garments)	0.90065
Distance + Infrastructure	0.77854
Distance + Infrastructure + Comfort	0.81801
Income + Distance + Infrastructure + Comfort	0.76544

Odd's ratio <1: Decrease in possibility of walking with respect to per unit increase in variables.

Odd's ratio >1: Increase in possibility of walking with respect to per unit increase in variables.

Calculating odd's ratio for an increase in combination of more than one variables gives an important insight of the practical situations.

Discussions

odd's ratio for *an increase in combination* of more than one variables gives an *important insight* of the practical situations.



Odds's ratios –provide sustainable solutions—both *practically sound* and *economically viable*—changes to design policies

Comfort, infrastructure has +ve correlation
distance, income and landuse has –ve correlation with the possibility of walking.

When odd's ratio is calculated for *increase in more than one variable simultaneously*, it gives approximate magnitude by which *the possibility of walking is being affected*.

Conclusion

- Distance –**strongest (negative) correlation** to the likelihood of walking
- **Comfort and provision of infrastructure** –**strongest (positive) correlation** to the possibility of walking
- The probability of walking to the **three different** types of land use—**negative correlation**—shows that the **existing** pedestrian infrastructure lacks comfort and the users had to travel longer distances to access the land use
- Probability to walk is **most** (.386) to **grocery store**, indicates –**better integrated** with the existing residential land use—**in comparison to eatery and garments**
- **Overall negative correlation** between walking and accessing these land uses show that **mixed land use** has to be further promoted
- Implies change in design guidelines—**compact and comfortable designs** necessary to improve the likelihood of walking

Acknowledgements

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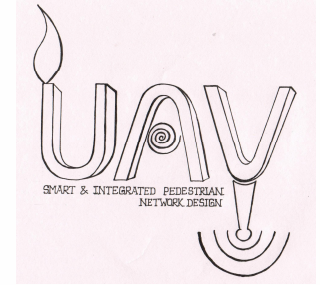
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Ministry of Urban Development (MoUD), Government of
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“

Whether you live in a city or a small town, and whether you drive a car, take the bus or ride a train, at some point in the day, everyone is a pedestrian.”

- USDOT

Thank you for your attention!



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