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**A Discrete Choice Approach to define Individual  
Parking Choice Behaviour for  
PARKAGENT Model**

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IMOB

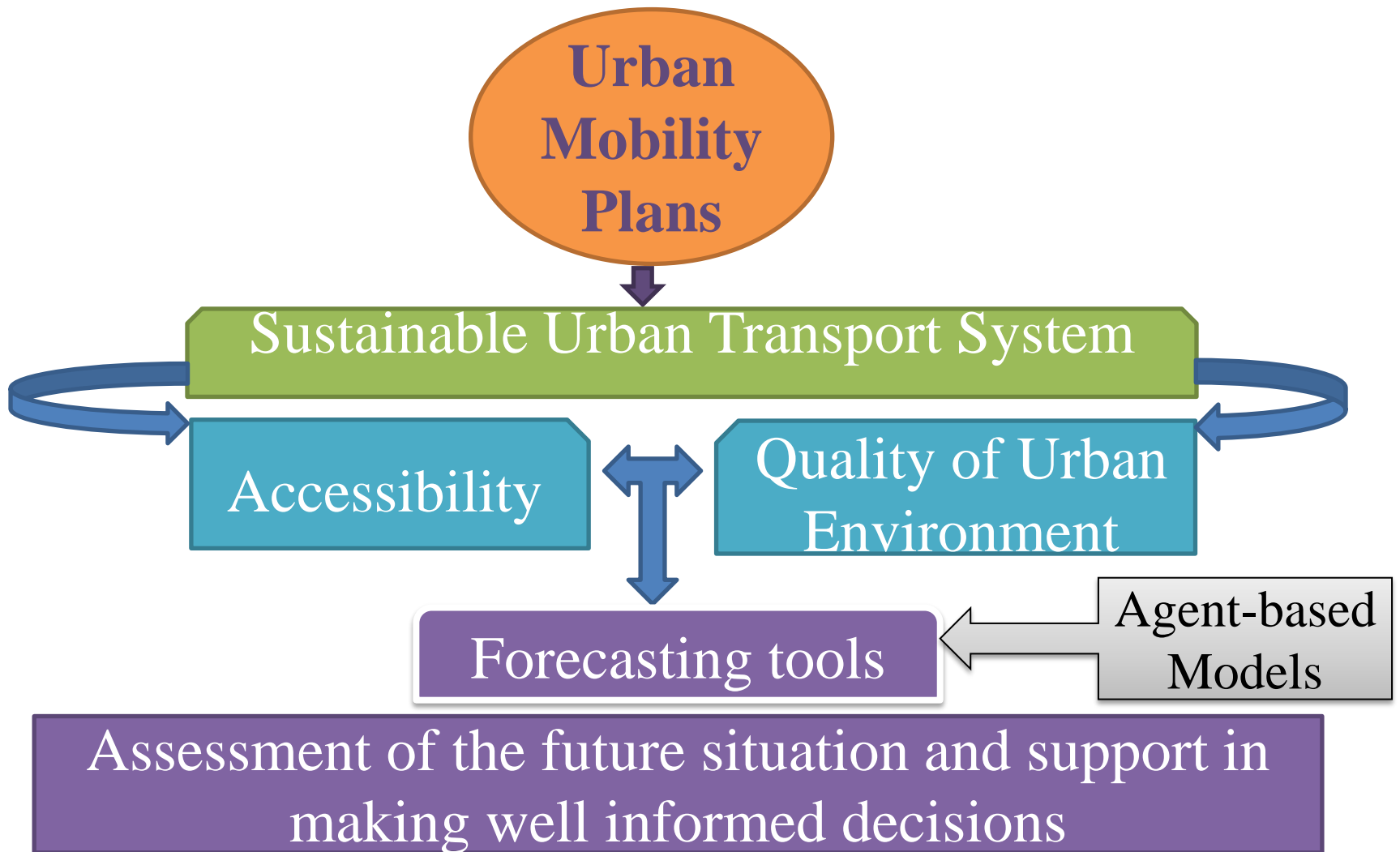
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# Introduction



# Modelling Parking Behavior with Agent Based Models

1.

- PARKAGENT (Benenson et al., 2008)

$$F_{\text{exp}} = p_{\text{unoc}} \frac{P_{\text{unoc}} = N_{\text{unoc}} / (N_{\text{unoc}} + N_{\text{occ}})}{\times \text{Distance To Destination / Length Of Parking Place.}}$$

Models  
Parking  
Search

2.

- SUSTAPARK (Dieussaert et al., 2009)

$$U_{\text{on-street (free)}} = \exp(\beta_1 \cdot At + \beta_2 \cdot St + \beta_3 \cdot Et + \beta_4 \cdot \text{Fee})$$

Models  
Parking  
Search  
&  
Choice

3.

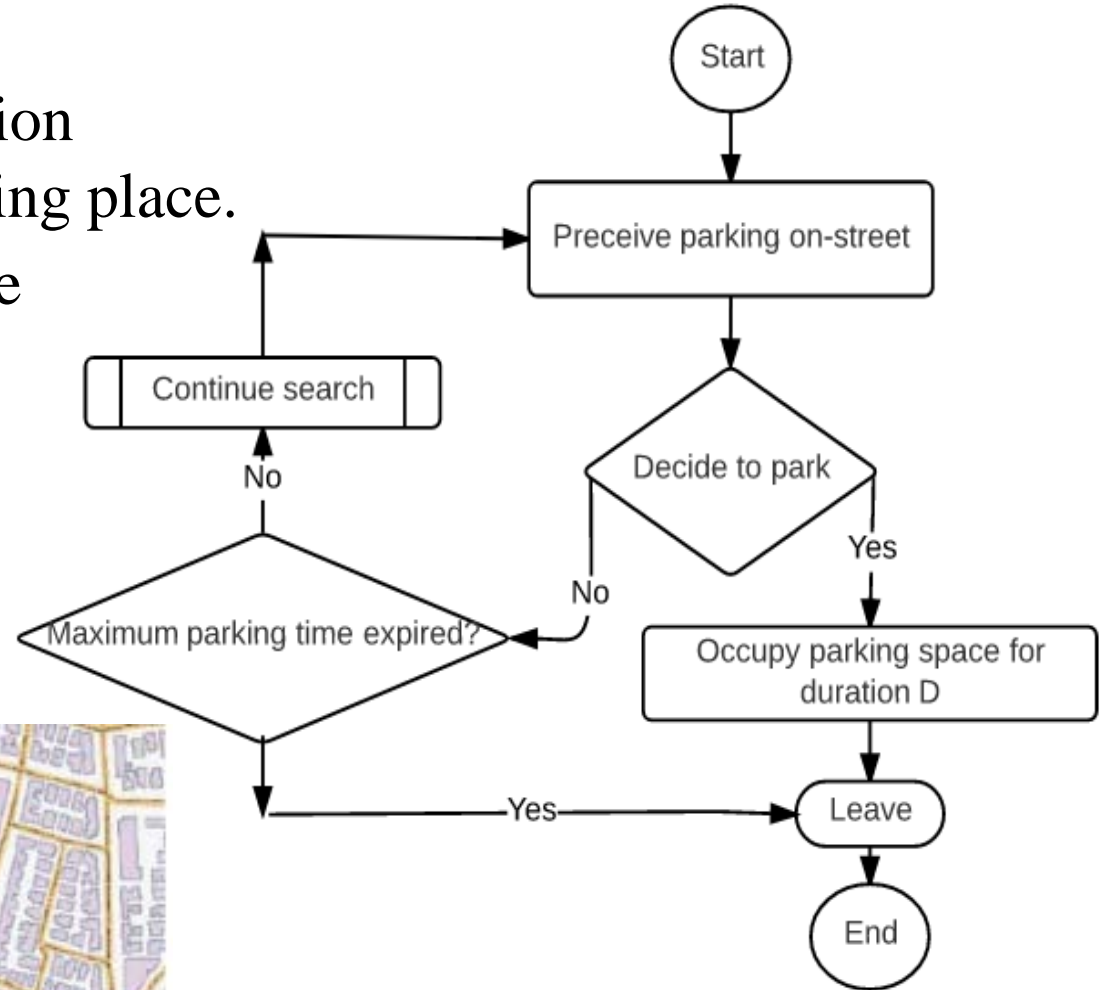
- MATsim model (Waraich and Axhausen, 2012)

$$U_{\text{parking},i} = U_{P_{\text{cost},i}} + U_{P_{\text{searchTime},i}} + U_{P_{\text{walk},i}} + \epsilon_i$$

To propose a behavioural model of parking choice that improves the representation of parking choice process in PARKAGENT model.

# Car drivers' parking behavior in PARKAGENT

1. Driving towards the destination.
2. Searching for parking.
3. After passing the destination
4. Staying at the found parking place.
5. Leaving the parking place

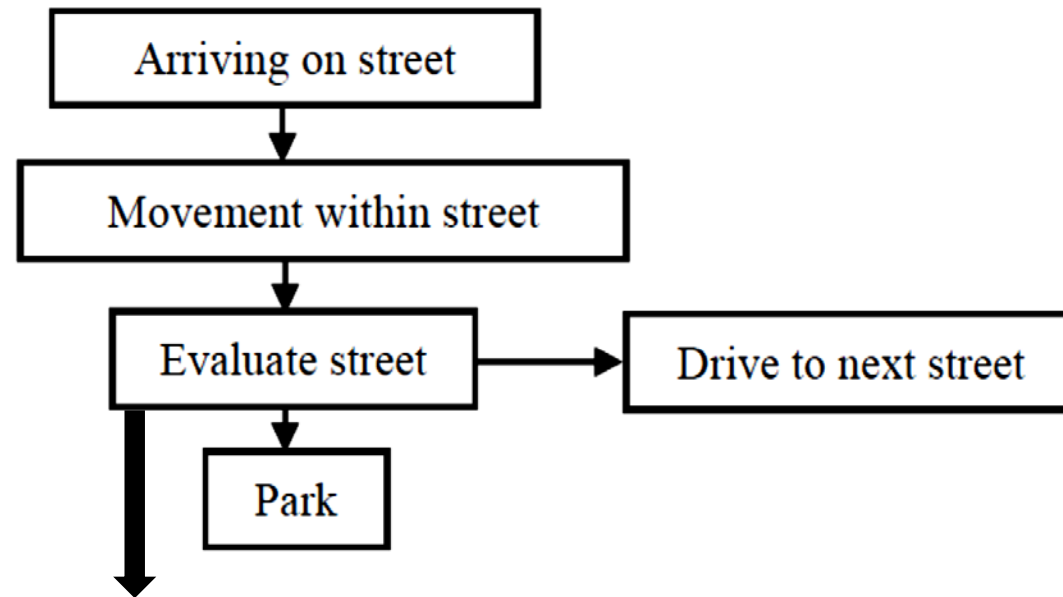


# Agents' parking decision in PARKAGENT

- The agents' decision to park is based on **expected free parking spaces** between the current location and the destination.
- Expected free parking spaces = Probability of getting free parking place\* distance to destination/length of parking place.
- Probability of getting free space = Number of free parking spaces/Total number of parking spaces
- **$F_{exp} < 1$  (parks)**
- **$F_{exp} > 3$  (continue driving)**



# On-street parking choice behaviour



The decision of an individual to park on-street depends on the utility maximization ( $U_i$ )

# Extension of agents' on-street parking choice behaviour in PARKAGENT

The decision of an agent to park at a parking place should consider factors associated with street (e.g. occupancy, cost, security, etc.) and personal characteristics (e.g. age, gender, income, etc.).

$$U_i = \beta_{0i} + \sum_{k=1}^k \alpha_{ik} (X_{ik}) + \sum_{k=1}^k \beta_{ik} (Y_{ik}) + \epsilon_i.$$

Where,

$\beta_{0i}$  = alternative-specific constant

$\alpha_i$  = weight (or parameter) associated with personal attributes  $X_1, \dots, X_k$  of individual  $i$

$\beta_i$  = weight (or parameter) associated with street attributes  $Y_1, \dots, Y_k$  available to an individual  $i$

$X_i$  = personal attributes of the individual  $i$

$Y_i$  = street characteristics available to individual  $i$



# Extension of agents' on-street parking choice behaviour in PARKAGENT

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- Identification of attributes and attribute levels
- Stated preference questionnaire survey (Online questionnaire )
- Data collection (1096 respondents)
- Analysis (Multinomial logit model using SPSS)

# Identification of factors affecting on-street parking choice

Sr.No.	Attributes	Description	Attribute level
1.	Parking costs per hour	The price that the driver has to pay for parking its car usually defined on hourly basis.	1. 1 euro/hour 2. 2 euro/hour 3. free
2.	Distance to destination	The distance of the street where car is parked from the destination.	1. 100m 2. 200m 3. 300m
3.	Occupancy rate	The number of cars parked in a street (expressed as percentage)	1. Low, occupancy, 50% 2. Medium occupancy, 75% 3. High occupancy, 100%
4.	Available security	Presence of security features in a street to avoid theft/vandalism of vehicles.	1. Nothing 2. Guards 3. CCTV camera

# Multinomial Logit Model Estimates

Street Attributes	Part-worth utilities	Significance level
Over all utility (intercept)	1.505	0.000*
Parking cost (1 euro/hour)	-0.867	0.000*
Distance to destination (100m)	-0.322	0.089***
Occupancy (Low occupancy, 50%)	-0.431	0.010**
Available security (Guards)	0.280	0.042**

(\* \*\* \*\*\* indicate significance at 1%, 5% and 10% level).

- Part-worth utilities of parking cost, distance to destination, occupancy and security are in the expected direction, giving face validity to the estimated model.
- The model fitting information ( $p = 0.000$ ) indicates that the overall model is statistically significant.

# Conclusions

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- Car drivers' decision to park in a street also depends on the **prevailing parking situation of street**.
- PARKAGENT is used as a parking policy evaluation tool, it is important to include **street related factors** when analysing the effects of suggested parking measures.
- Literature on parking choice does not provide insights regarding the influence of **factors representing the parking situation** such as occupancy, availability of security, parking duration, surrounding activities etc. on car drivers' preferences.
- This behavioural modelling approach will **enhance the simulating capability of PARKAGENT model** by representing the parking choice decision of agents in a **more realistic way**.
- The next step in this research is to **perform simulations to measure the predictive capability** of the extended PARKAGENT model.

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**THANK YOU**