LISBOA 2010
MAY 25/28

16th World Meeting

CONGESTION PRICING: A SOLUTION OR A PROBLEM?

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CONGESTION PRICING: A SOLUTION OR A PROBLEM?

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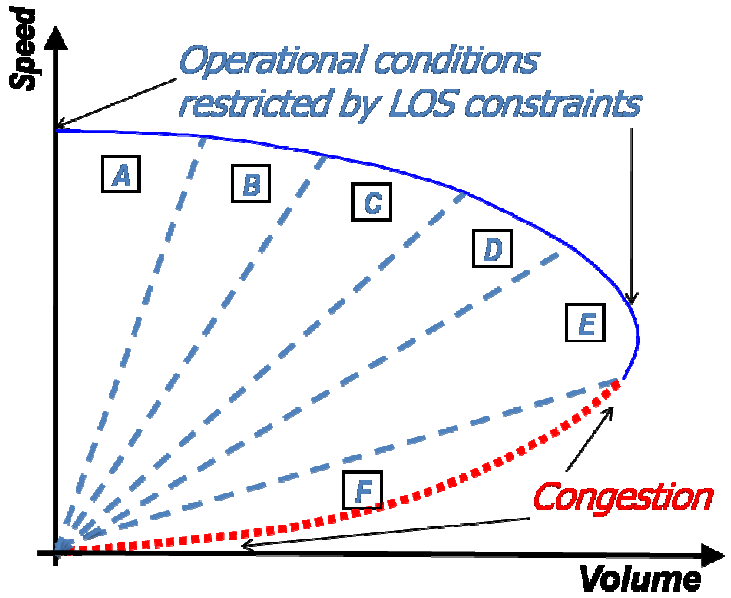
1. Objectives

- Discuss the nature of Road Congestion from the operational and efficiency point of view;
- Discuss the nature of Congestion as an externality and the eventual justification of Road Pricing based on that nature;
- Discuss the right approach to define a new paradigm and institutional framework to deal with congestion:

  "Road & Land Use Congestion Pricing"

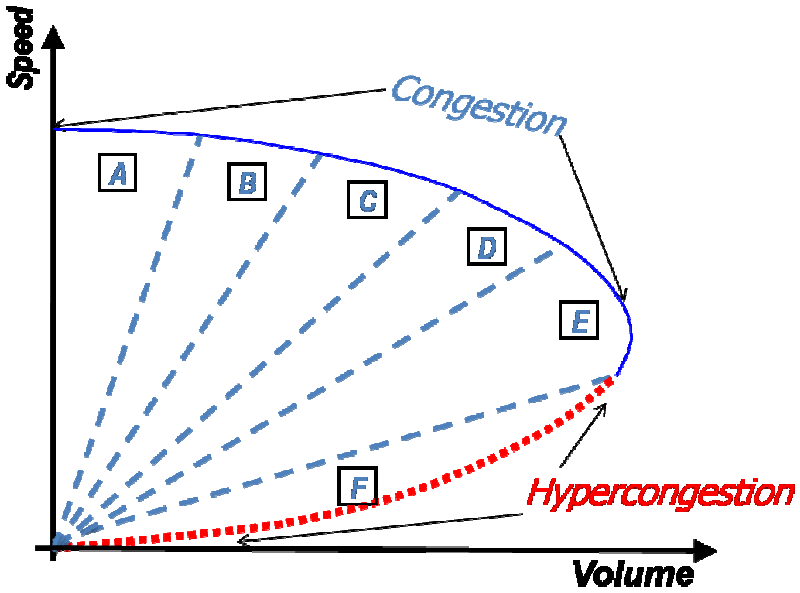
2. What is indeed Road Congestion?

A. Operational approach



System effectiveness is guaranteed and/or acceptable till LOS E and F are reached.

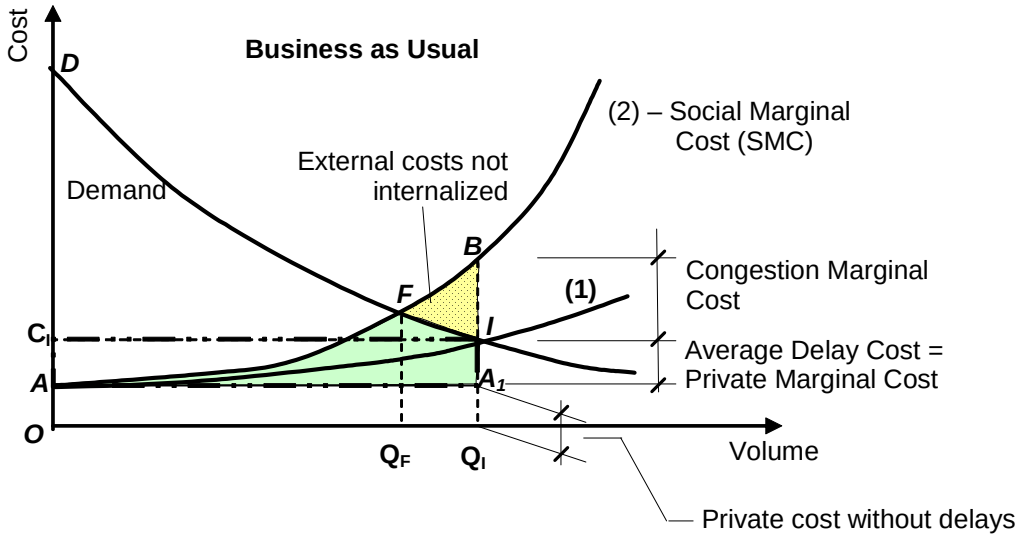
B. Efficiency approach

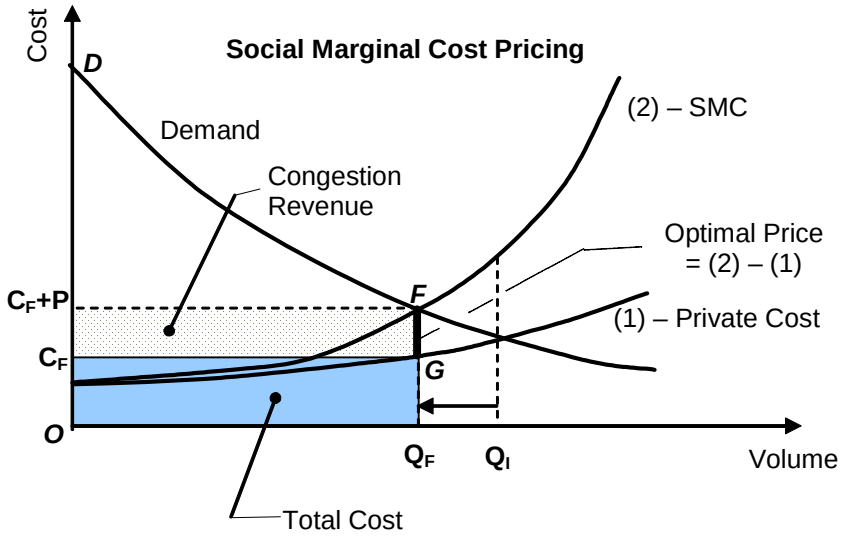


System may be inefficient even in LOS A, if Price=MCost is not guaranteed from the beginning.

3. Congestion charges: individually priced, but a collective endeavour?

Price = Individual Social Marginal Cost?





In the name of Economic Efficiency ? ...

Assuming:

- Price must be defined at the individual level;
- At that level the delays imposed by each of us over the other road users have characteristics of externality – that's true!

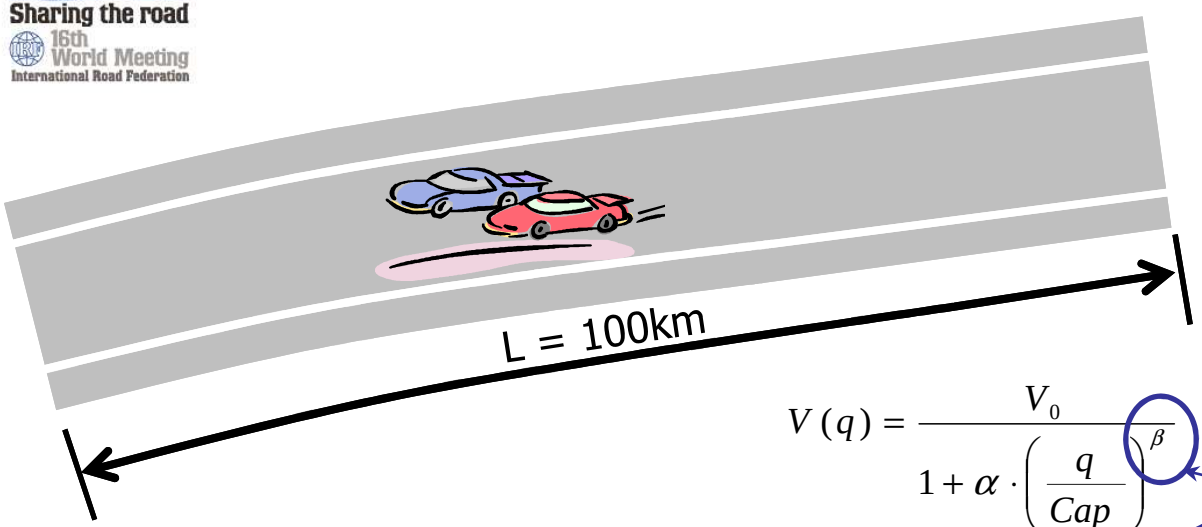
Having in mind that:

- First order impacts of congestion are not an external cost for the Society, because all costs are supported inside the Road Users Group (unlike Air Pollution, for instances).

A big question arises:

- Who is the owner of the Propriety Rights of the 'efficiency Revenue';
- Who should decide and benefit from Road Pricing Revenue, as there is no Damage Cost to recover!

Example (Using the Bureau of Public Works function (BPR, USA) :



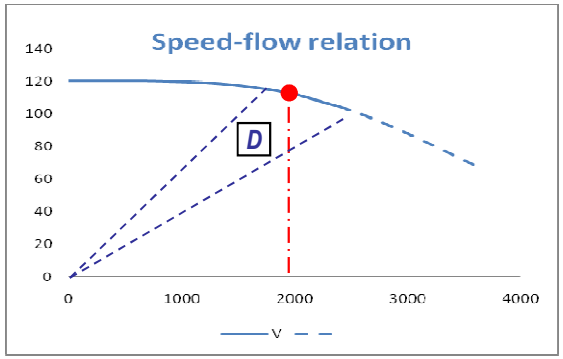
Data:

- Motorway
- Free-flow speed = 120 km/h
- Capacity = 2.400 pcu/h
- Flow = 2.000 pcu/h
- Speed = 112 km/h
- Total travel time = 53,6 min

$$V(q) = \frac{V_0}{1 + \alpha \cdot \left(\frac{q}{Cap}\right)^{\beta}} \rightarrow V(q) = \frac{V_0}{1 + 0{,}15 \cdot \left(\frac{q}{Cap}\right)^{4}}$$

Results:

- Average Delay Time (ADT) = T-T_0 = 3,6 min
- Marginal Delay Time (MDT) = ADT . β = 14,4 min



- Using a composite Value of Time (VOT_c) = 17,5 Euros/hour

- Average Delay Cost (ADC) = ADT . VOT_c =1,05 €/100 vkm
- Marginal Delay Cost (MDC) = ADC . β = 4,20 €/100 vkm

- Using MDC for Road Pricing purposes > Revenue (4 hours x 220 days) = 7.392.000 €/100km.y

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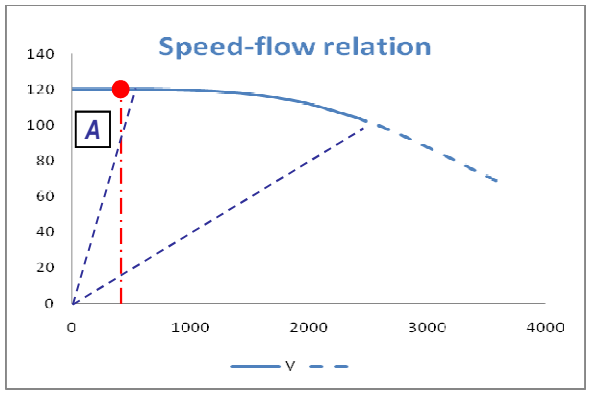
Example (cont.)

Additional flow regimes:

A. High quality for users - LoS A

- Flow = 300 pcu/h
- Speed = 120 km/h
- Total travel time = 50 min
  (no delays at all!)

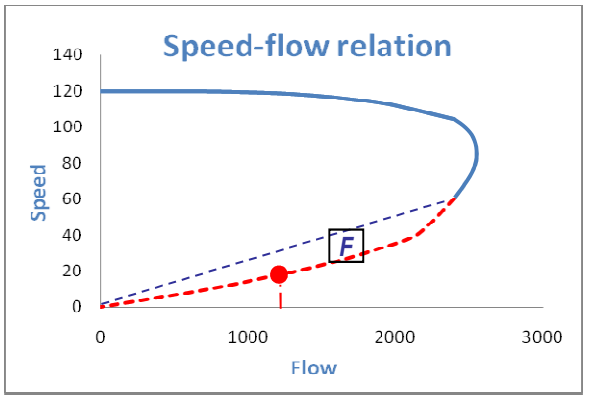


Results:

- Average Delay = Marginal Delay = 0
- No congestion cost or pricing at all

F. Saturated and unstable flow - LoS F

- Flow = 1200 pcu/h
- Speed = 18 km/h
- Total travel time = 5 h and 41 min
  (only occurs very occasionally, like in the 1st of August)



Results:

- ACT = 291 min / MCT = 441 min
- ACC = 84,99 €/100 vkm / MCC = 120,11 €/100 vkm
- It's better not to present global pricing results!

(On the branch F the Greenshield function was used as the BPW function is not possible to use)

Example - generalization

Using a generalization of Bureau of Public Works (BPR, USA) function:

Type of Road	Free-flow Speed V_0 (km/h)	Capacity (pcu/h)	α	β
Main Routes (IP's) and motorways	100	2000	0,42857	3
Other Complementary Routes (IC's) and quality National Roads (EN's)	90	1800	0,42188	2,7
Other National Roads and quality Regional Roads	70	1200	0,7	3,5
Other Regional (ER's) and Municipal Roads (EM's)	50	900	0,65217	3,5

(PETS, 1999)

$$V(q) = \frac{V_0}{1 + \alpha \cdot \left(\frac{q}{Cap}\right)^{\beta}}$$

$$T(q) = T_0 \cdot \left[1 + \alpha \cdot \left(\frac{q}{Cap}\right)^{\beta}\right]$$

Very simple – <u>everyone can compute marginal cost</u>. For a trip:

1. Identify de free-flow travel time (T_0) – for instances, by travelling at night;
2. Identify de peak-hour travel time (T) – not difficult!
3. Average Delay Time (ADT) = $T-T_0$
4. Marginal Delay Time (MDT) = $(T-T_0) \times \beta$
5. To obtain costs one have just to multiply by the Value of Time (VoT)

4. What kind of global paradigm ?

Where to start from and what are the complementary and contrary principles?

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Different (opposite?) Pricing Principles …

A. BAU Motorway Pricing Principles …

Motorway seen as a Value Added service: → **TOLL**

- Improved travel time;
- Improved safety;
- Improved comfort

Simple to understand * simple to accept

B. Road Pricing as an efficiency tool …

Each time Demand grows: → **TOLL Charges grow**

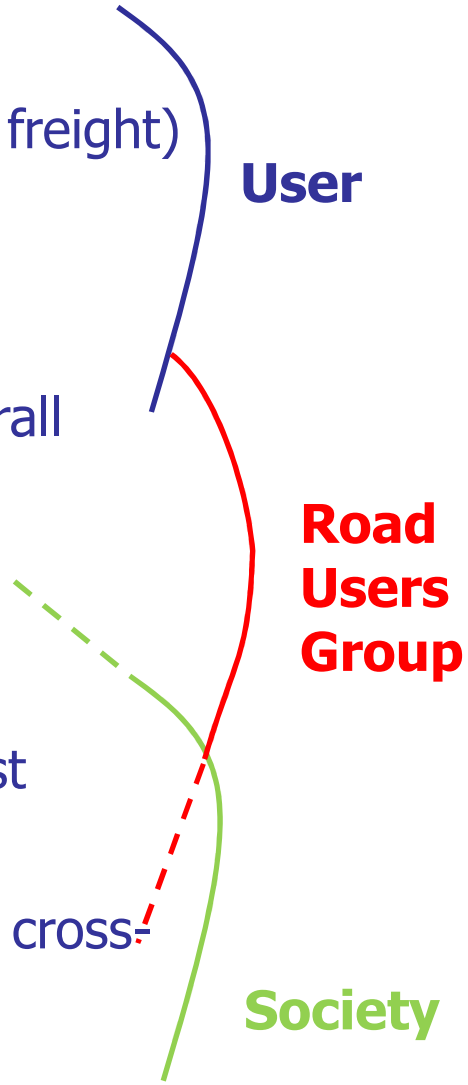
- Travel time deterioration;
- Loss of comfort and reliability

- Improve Economic efficiency;
- Release Environmental pressure

Not understandable (counterintuitive) nor accepted by Users

Quality of Service (QoS) main drivers:

- Traffic Level of Service (LoS A, ..., F);
- Trip reliability targets (very important for freight)
- Safety targets;
- Comfort and Quality Pavement targets;
- Operational effectiveness (improving overall mobility)
- Energy targets;
- Environmental targets
- Economic efficiency targets (marginal cost pricing)
- Financial targets (transport accounts and cross-subsidisation)



Traffic Quality driver – *Levels of Service (LoS)*

HCM, (2000)

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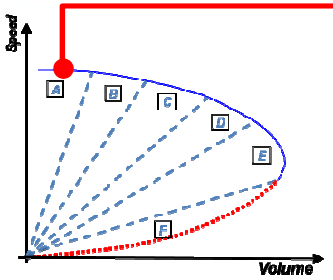
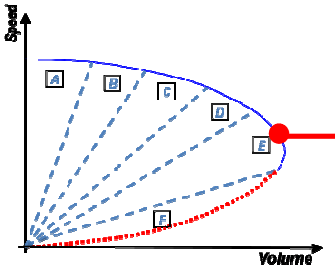
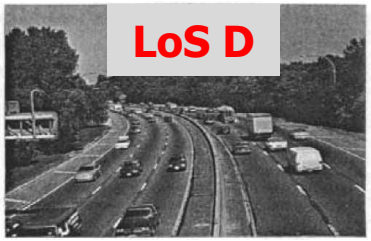
Operational (user) paradigm:

1. Maximize users Utility (fast travel!)



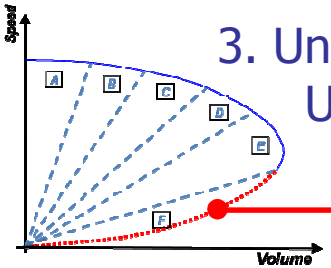


2. Maximize Volume (flow) and Network Mobility



Efficiency (MCCost) Paradigm:

1. Marginal cost almost null
2. Marginal cost and revenues very significant
3. Marginal cost will be unacceptably high – almost impossible to apply



3. Unstable saturated flow; Unpredicted trip arrival

5. Will Congestion Pricing become an acceptable and even interesting solution for road transport?

- **Inter-urban and Rural Transport**
  - Pricing ruled by Quality of Service contractual targets;
  - Users must understand price as a compensation for Value Added services

- **Urban Transport** (more complex)
  - Road Pricing implies cost amounts very high (individual and global);
  - There is the need to find new solutions

❑ **Directions to explore** (next research steps):

- Find solutions to transfer part of Congestion obligations from Road Users to Real Estate and Propriety, relieving pressure from Roads (and Road Pricing).
- Share Road Pricing obligations between Travel and Land Use >> **new concept: "Road & Land Use Pricing"**;

➢ Opportunity to introduce a new taxation paradigm allowing:

- "Road & Land Use Pricing" optimization, using Land Use as congestion generation seeds and for shared accountability;
- Introduction of structural changes in taxes and charges for these economic sectors to fit the new concept of "Road & Land Use Pricing" and eventually to find new solution for the inevitable transition from fossil fuels to renewable energies.

THANK YOU!