

A model to evaluate the environmental and energetic efficiency of the territorial functionality (transport and activity location)

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- **RESEARCH PROBLEM**
- **OBJECTIVES AND STRUCTURE**
- **THE MATHEMATICAL PROCEDURE AND MODEL**
- **SOME RESULTS**
- **CONCLUSIONS**

THE RESEARCH PROBLEM

- In recent decades, Southwest Europe metropolises have undergone a process of **territorial dispersion**.
- Traditional **view of sustainability** in transport is strong focuses in **technological** factors
- **Transportation plans** (infrastructure) have been evaluated with the classic transport model (four stages). The **optimization** is mainly on private efficiency (of operators and users) of **generalized costs**, with an **assessment of environmental** indicators (GEI emissions, accidents, etc).
- The transport model considers as **exogenous** the structure of urban activities for the base situation, and for different periods of evaluation (scenarios).
- **Urban planning** applied mainly the strategic environmental assessment method, who is focuses in the incorporation of good environmental practices in the different planning stages, **without a quantity evaluation of impacts**.
- **It is not usual the simulation of environmental relation of transport projects and land urban plan, in a systemic approach over a metropolitan scale.**

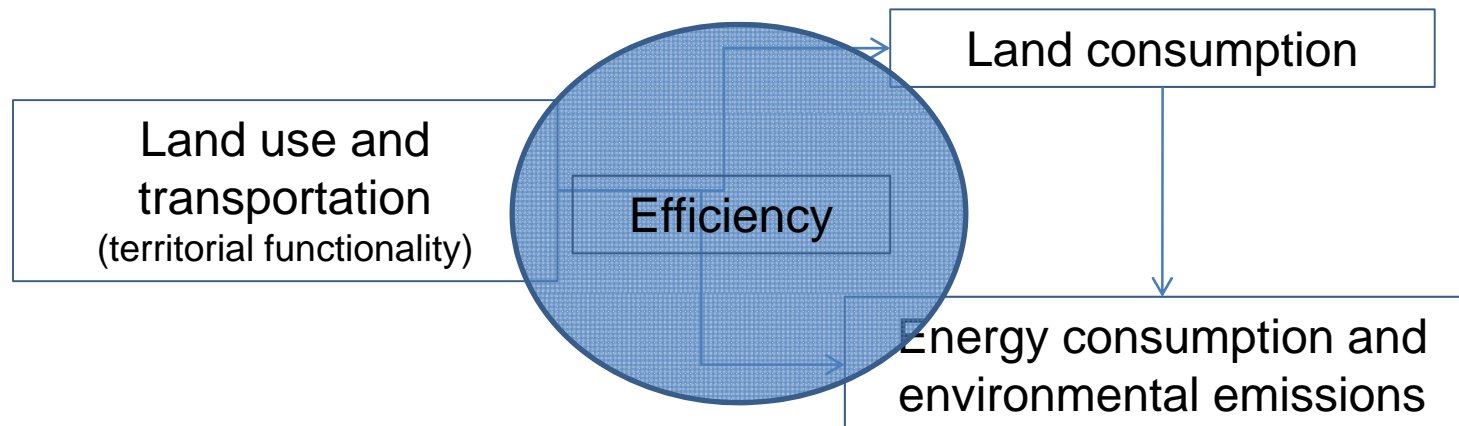
OBJECTIVES AND STRUCTURE

- Today the **decision makers** required the **assessment, monitoring, and prediction of the externalities generated by transport and urban plans, under a comprehensive approach to the phenomenon.**
- **Only with this approach can be identify the trade-off between the different elements of the territorial system.**
- The objective of this work is to build a mathematical model for the metropolitan area of Barcelona (164 municipalities), based on an integrated transport and land use model, to assess the social and environmental efficiency of urban functionality in relation to flows and activities in the territories

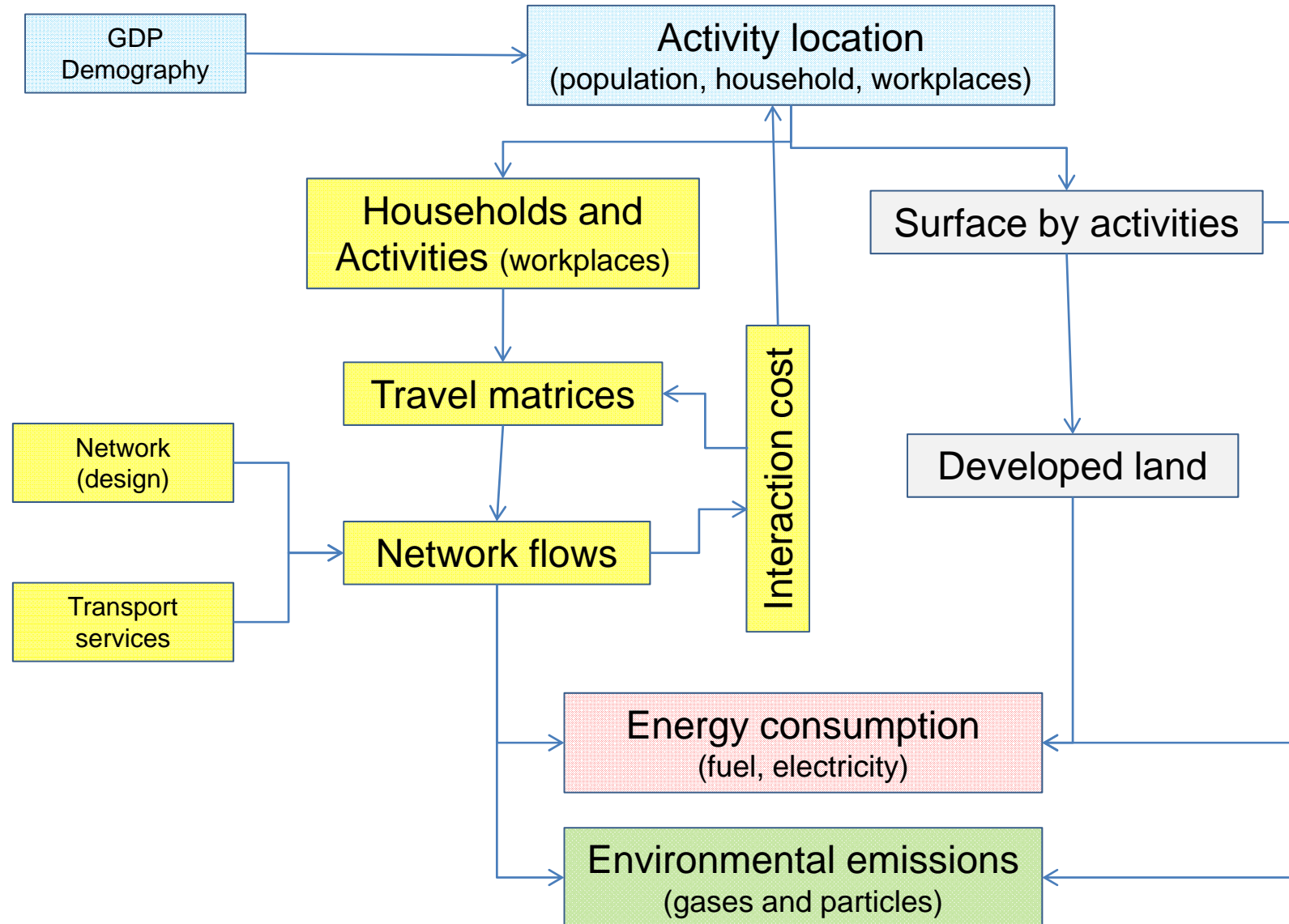
In particular there are four points that underpin the model:

OBJECTIVES AND STRUCTURE

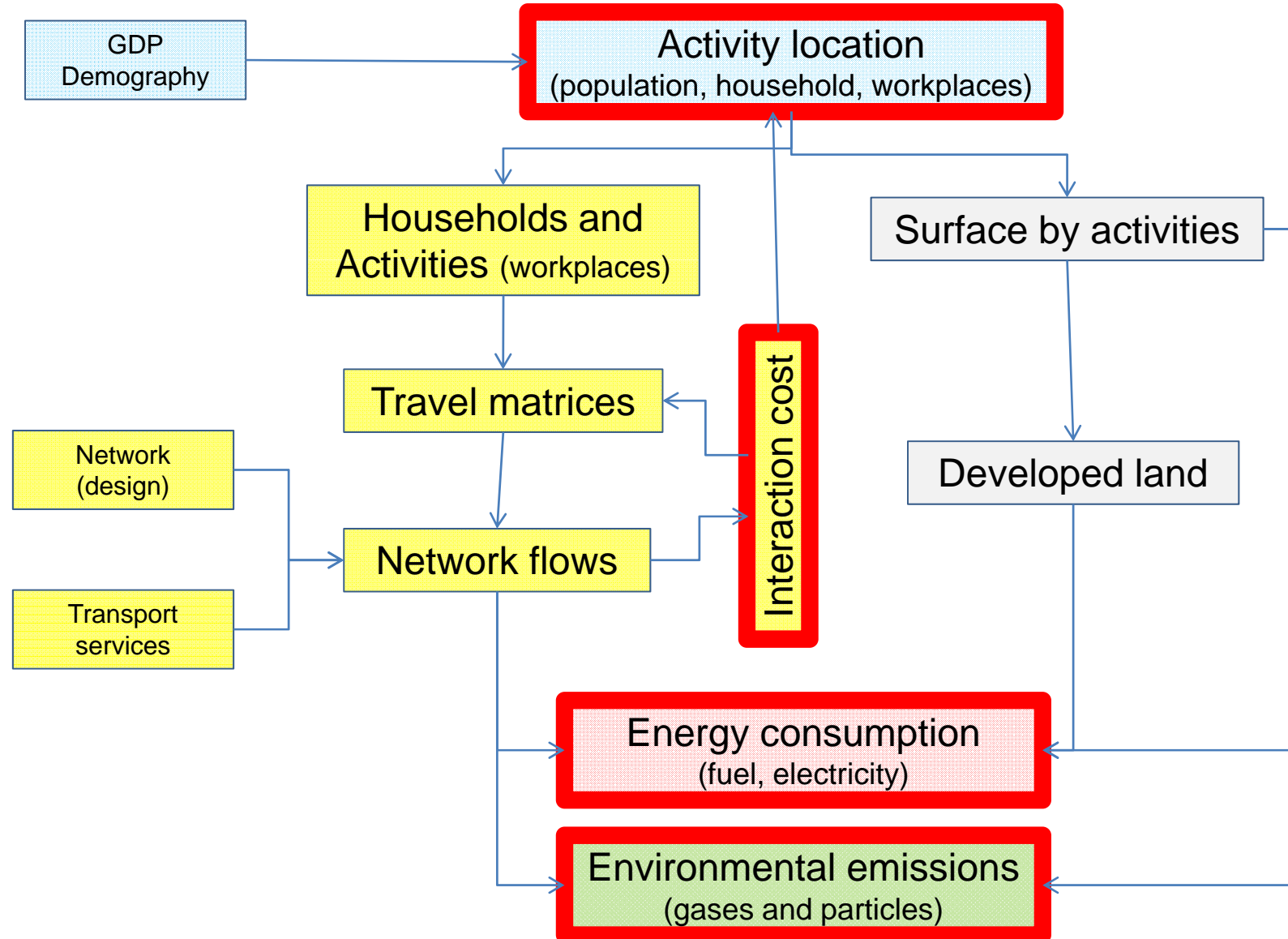
- a) A basic land use-transportation model (LUTM)
- b) An energy consumption and environmental emissions model (produced by the territorial functionality)
- c) A land consumption model (developed land produced by the territorial functionality), and
- d) The assessment of social equity (in access to urban activities, and in there exposure to environmental effects) as and indicator of efficiency of the system.



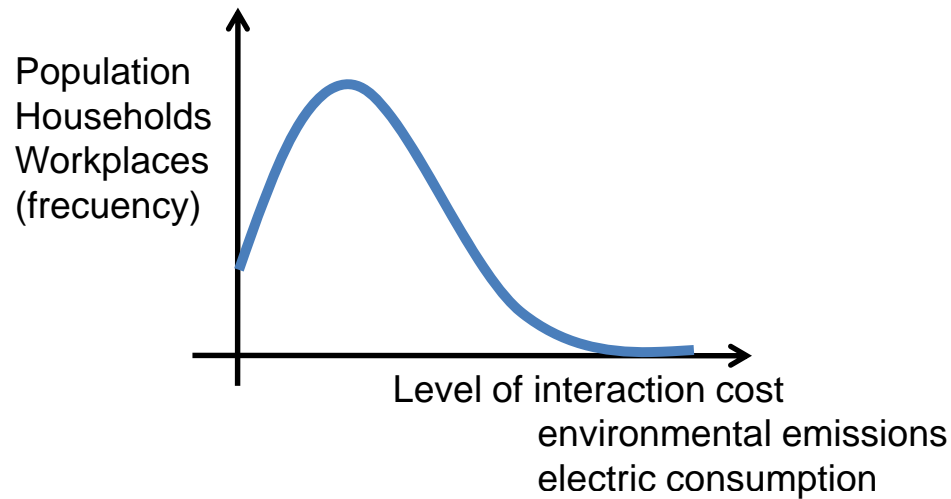
THE MATHEMATICAL PROCEDURE



THE EFFICIENCY ASSESMENT



EFFICIENCY INDICATORS



Quantitative indicators of efficiency

Mean value

Median value

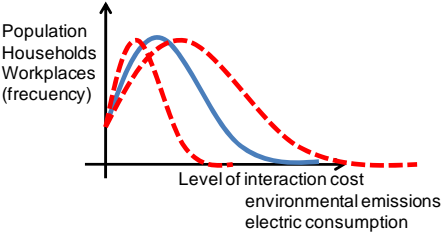
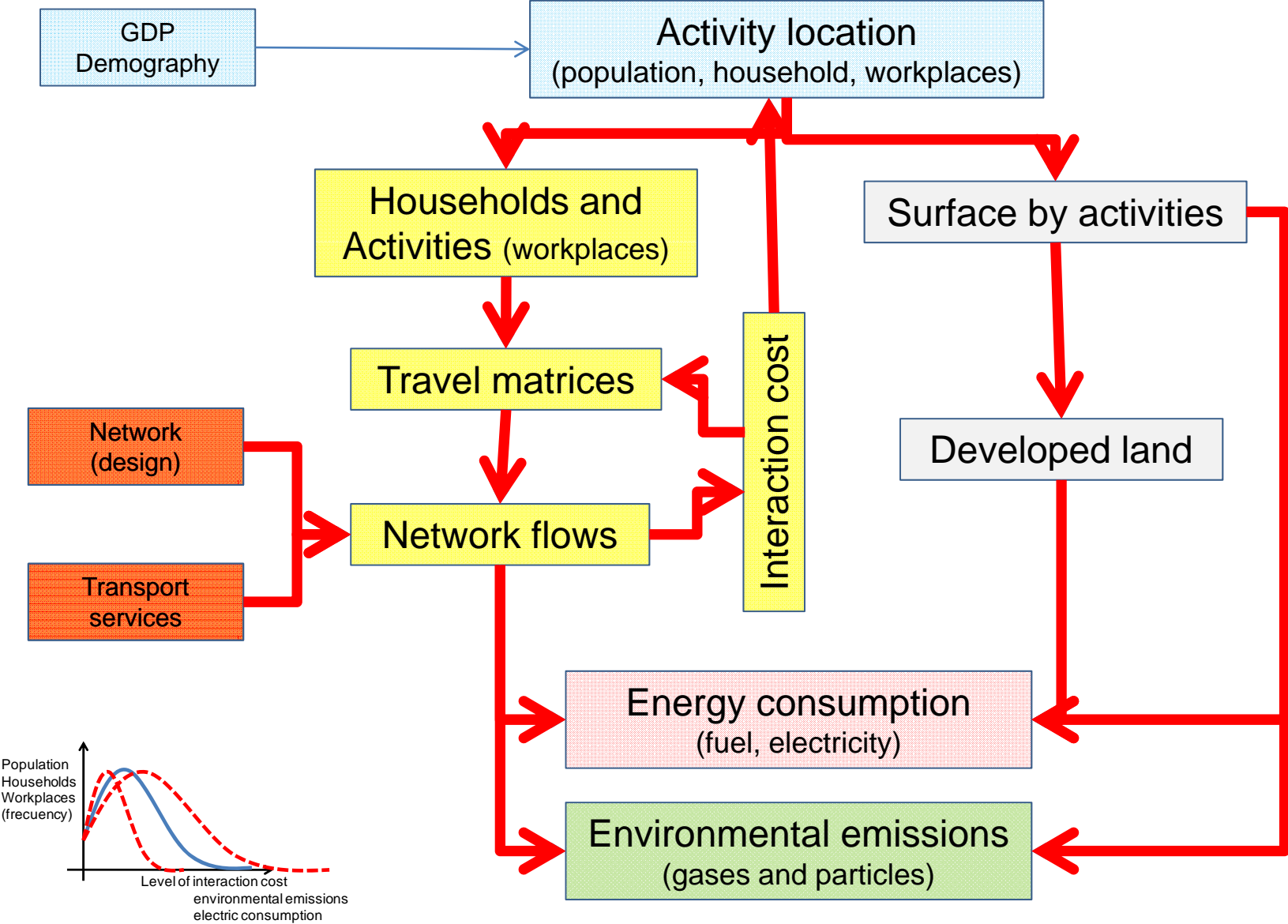
Dispersion of values

Disimilarity – GINI

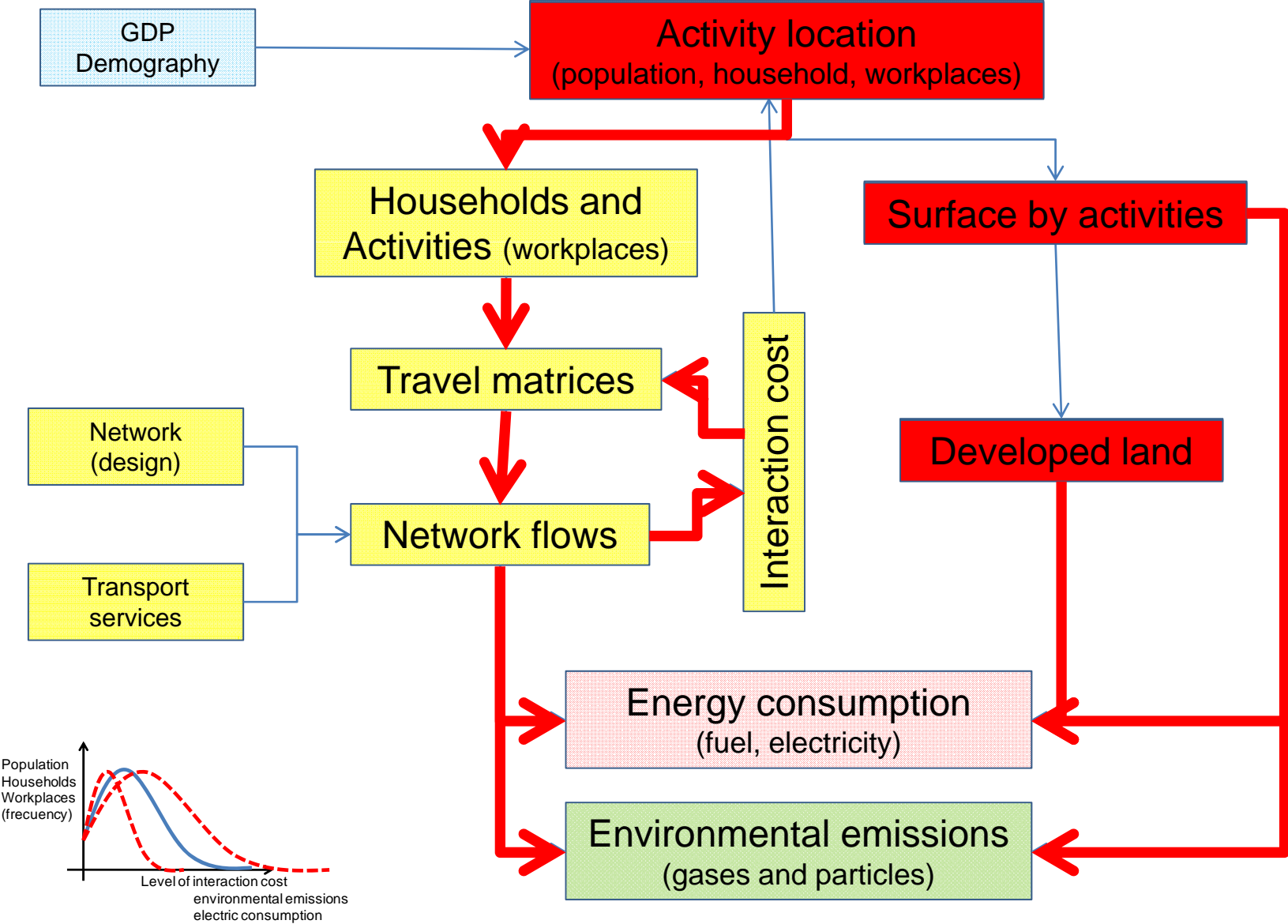
Disimilarity – Duncan

Exposure

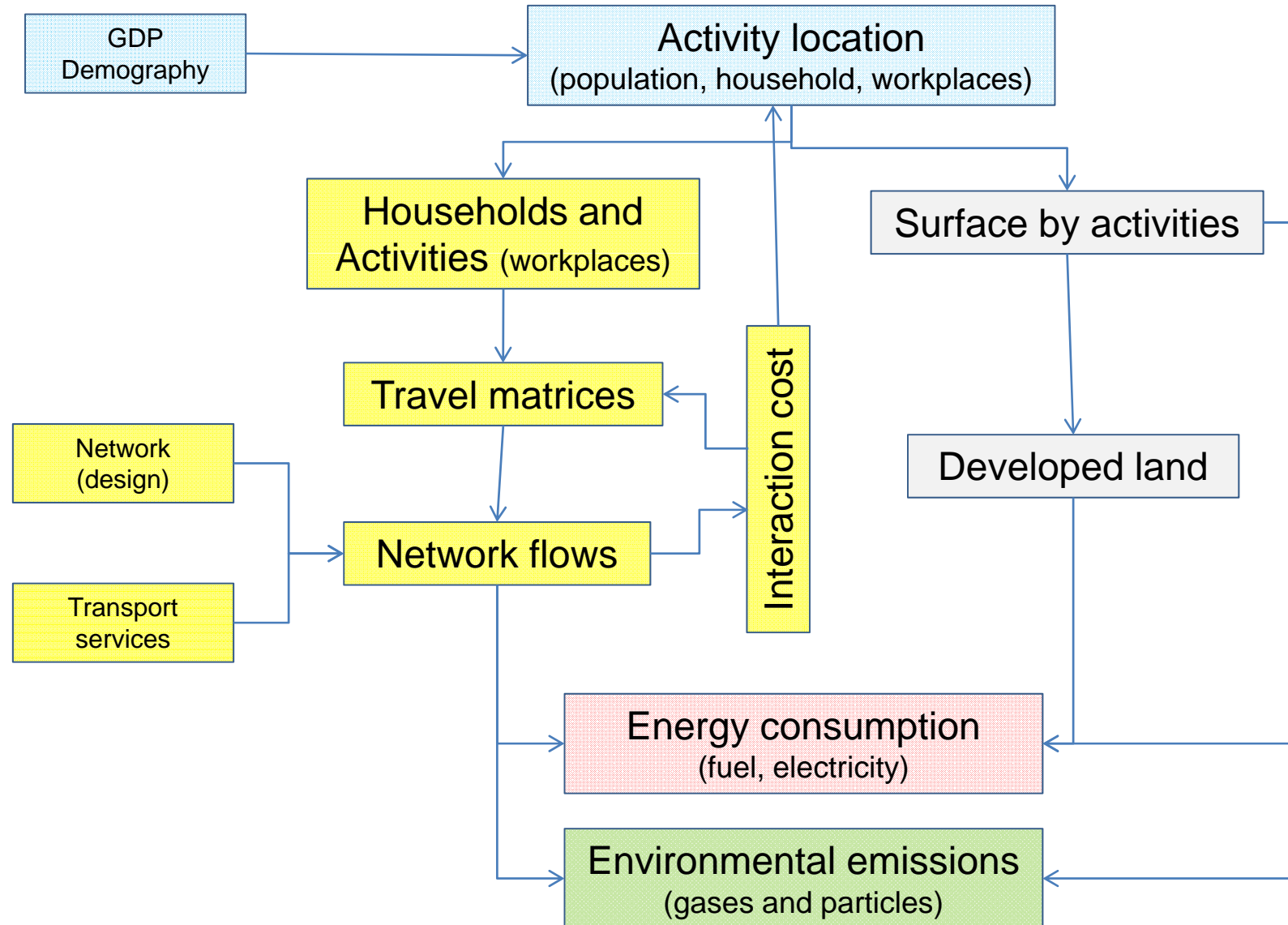
EVALUATION PROCESS : Assesment the effects of A TRANSPORT PROJECT



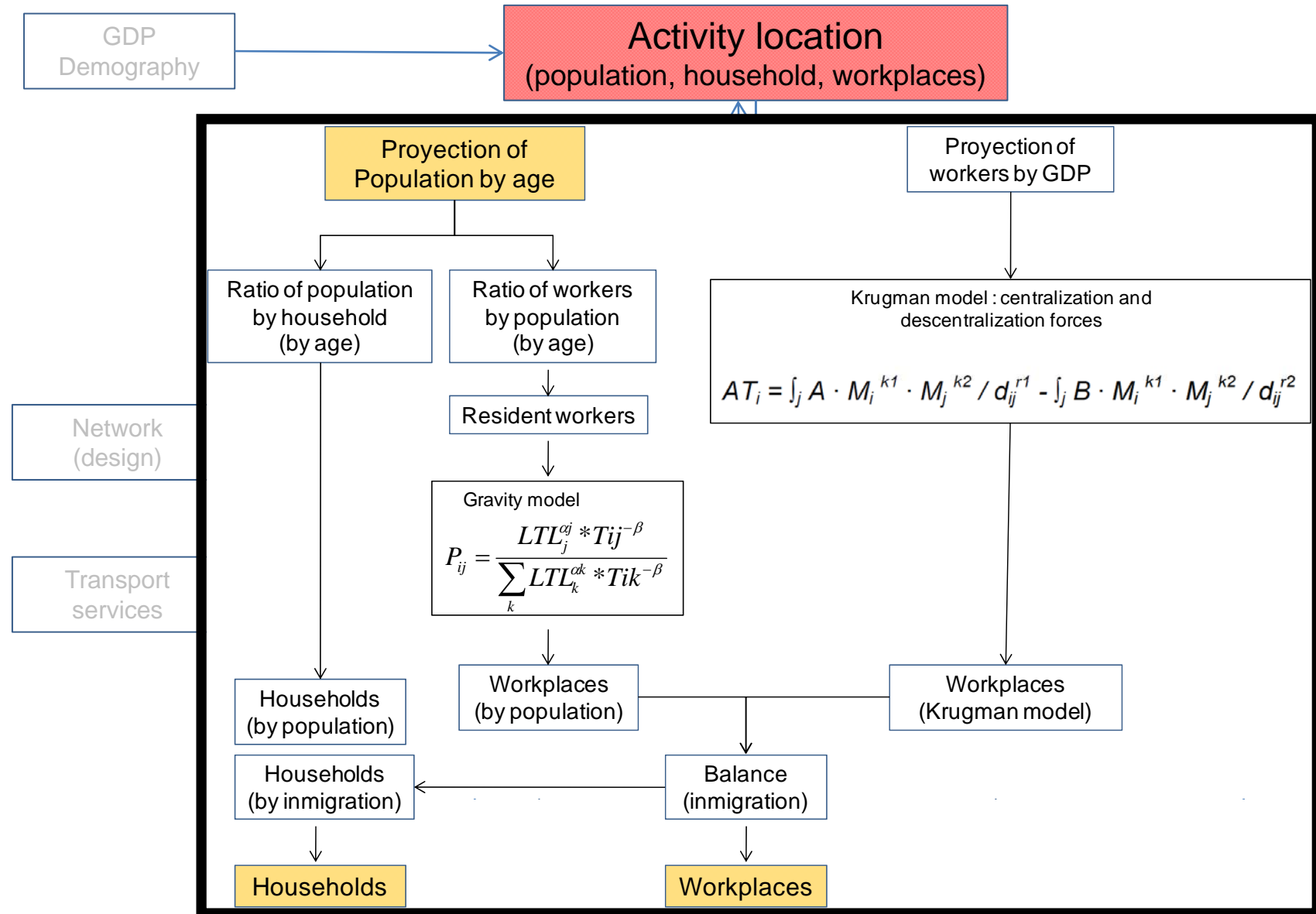
EVALUATION PROCESS : Assesment the effects of AN URBAN PLAN/PROJECT

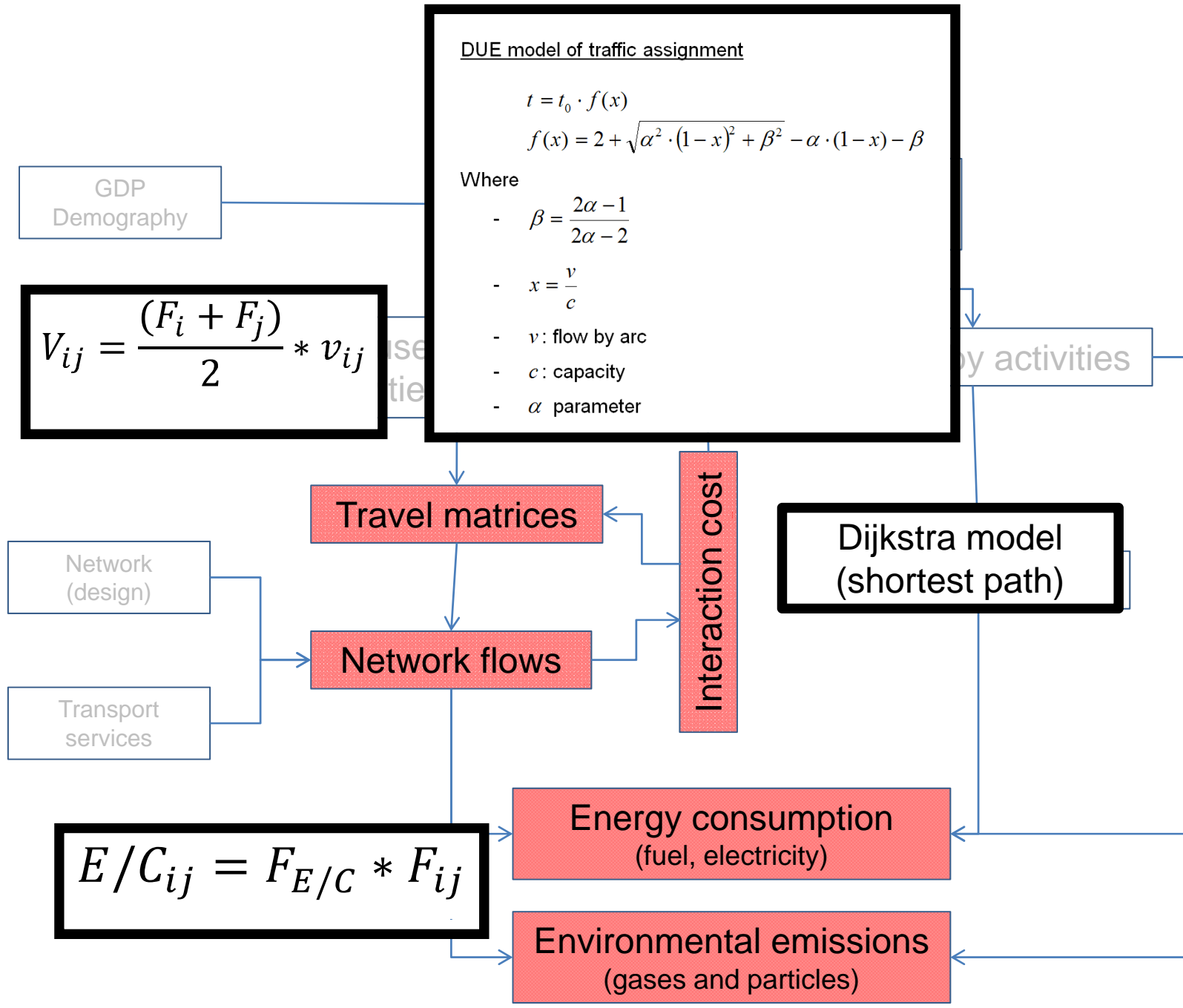


THE MATHEMATICAL MODEL

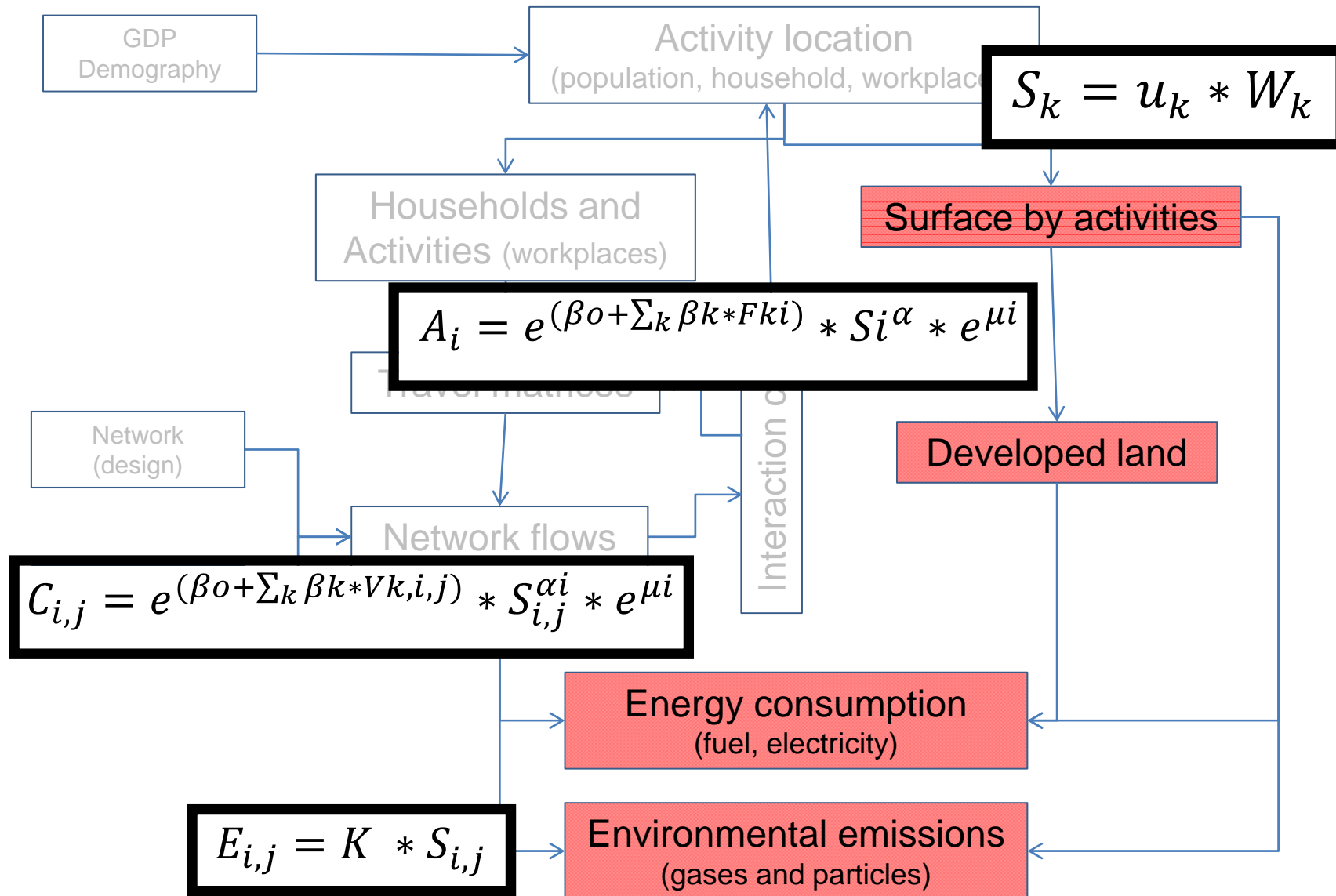


THE MATHEMATICAL MODEL





THE MATHEMATICAL MODEL



SOME RESULTS

31/08/2011

16:15 - 18:00

Room 104_Wed_4

Special Session

ZZN. SS- PROCESS. OF URBAN. ALONG THE EUROPEAN COASTAL AREAS

Chair: Josep Roca

Jorge Cerda, **Yraida Romano**, Claudia Perez, Josep Roca

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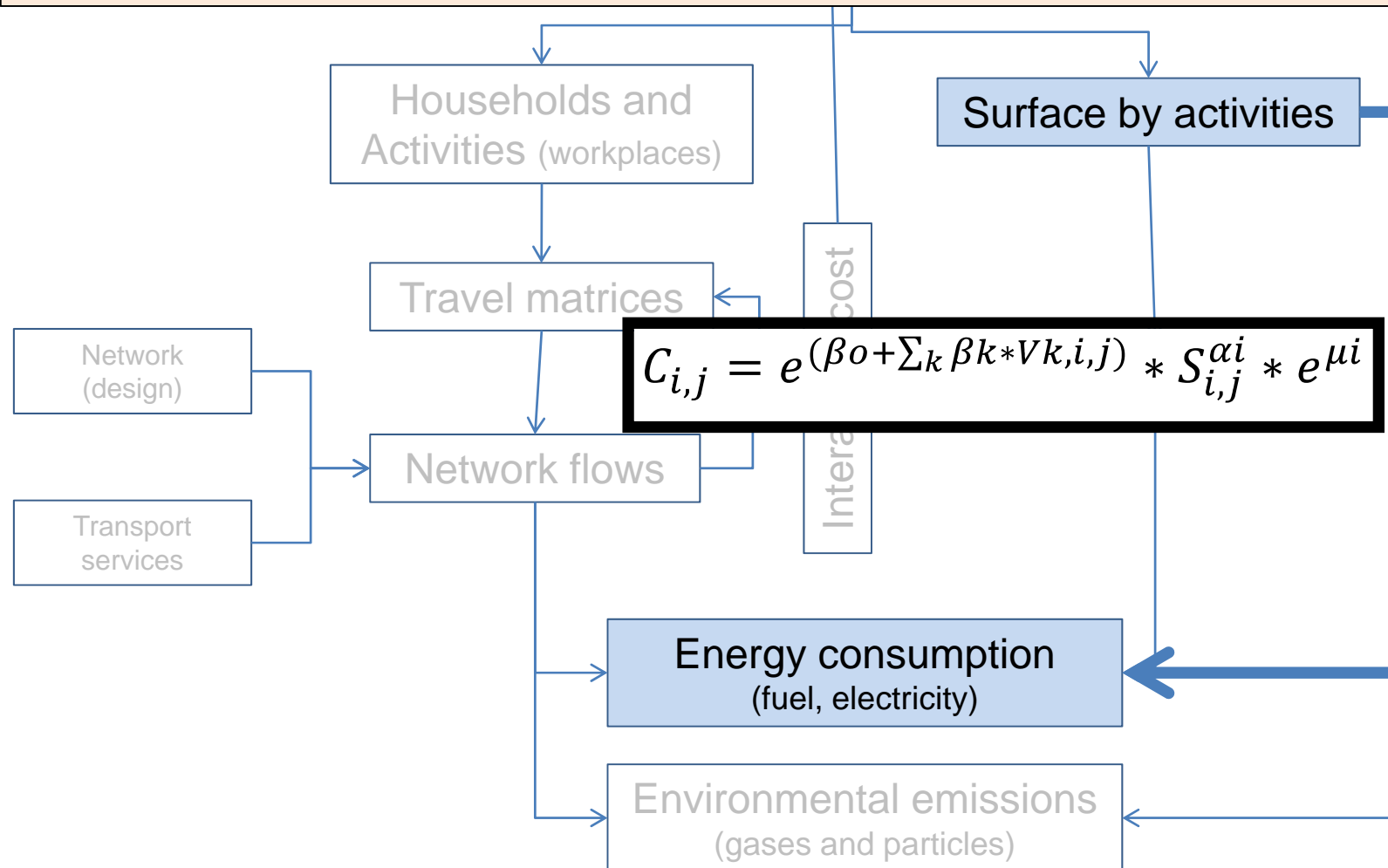
QUANTITY VIS QUALITY OF SCIENTIFIC PUBLICATIONS: AN ANALYSIS FOR MAIN CITIES OF SPAIN (2001-2007)

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OTHER PARTIAL RESULTS

Optimizing the location of activities in terms of minimizing power consumption in the Metropolitan Region of Barcelona

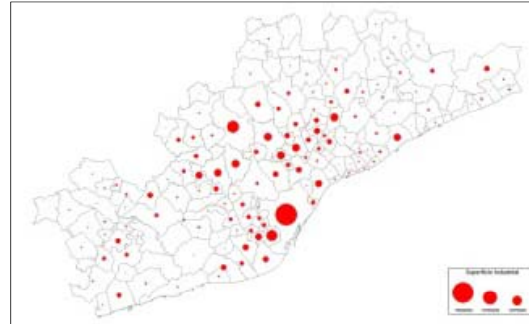


$$C_{i,j} = e^{(\beta_0 + \sum_k \beta_k * V_{k,i,j})} * S_{i,j}^{\alpha_i} * e^{\mu_i}$$

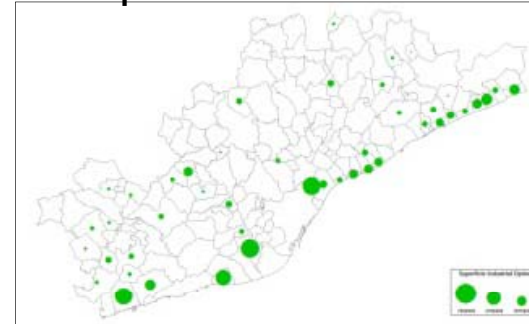
| Variables | Electric consumption models | | | | | | | | | | |
|--|-----------------------------|-----------------------|-------------|-------------|--------------------|-------------|--------------|-------------|-------------------|-----------------------------|------------------------|
| | Residence | Public administration | Shops | Education | Financial services | Hotels | Industry | Health | Personal services | Transport and communication | Public lighting system |
| Constant | 1,207 | -7,763 | 2,718 | 4,489 | 6,221 | 3,335 | -5,965 | 7,722 | -7,698 | -8,388 | 10,496 |
| Ln (residence surface) | 1,001 | | | | | | | | | | |
| Ln (Public administration surface) | | ,764 | | | | | | | | | |
| Ln (Shops surface) | | | ,921 | | | | | | | | |
| Ln (Education surface) | | | | ,847 | | | | | | | |
| Ln (Financial services surface) | | | | | ,868 | | | | | | |
| Ln (Hotels surface) | | | | | | ,377 | | | | | |
| Ln (Industry surface) | | | | | | | 1,138 | | | | |
| Ln (Health surface) | | | | | | | | ,793 | | | |
| Ln (Personal services surface) | | | | | | | | | 1,200 | | |
| Ln (Transport and communication surface) | | | | | | | | | | ,514 | |
| Summer minimum temperature | ,106 | | ,161 | | | ,477 | | | ,427 | | |
| Summer average temperature | | ,686 | | | | | ,346 | | | ,814 | |
| Average working time | | | | | | | ,158 | | | | |
| Average time of personal engagement | | | | | ,164 | | | | | | |
| Ln(Total developed land) | | | | | | | | | | | 1,326 |
| % developed land between cadastral areas | | | | | | | | | | | 10,454 |
| Adjust R square | ,909 | ,531 | ,725 | ,696 | ,773 | ,448 | ,638 | ,705 | ,543 | ,511 | ,546 |

Industry surface

Base situation



Optimal situation

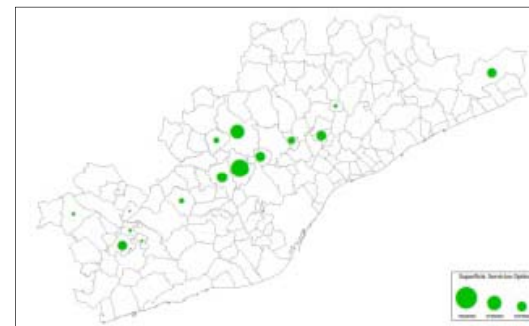
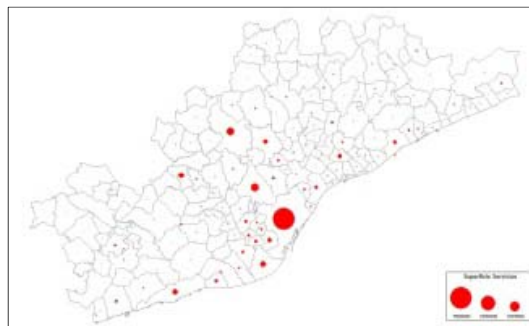


The best scenario of surface location for all activities, reduce the total electric consumption in 17,4%.

In an absolute point of view, this optimal location is in contradiction with all the urban and social concept of activity location (agglomeration, diversity, etc).

But in a relative point of view, this analysis give information about the electric “advantages” or “disadvantages” of building a square meter more, by activity and territory.

Services surface



FINAL REMARKS

- The model is currently under construction, joining the calibrated models of consumption and environmental emissions to an existing transport model in the metropolitan area of Barcelona (SIMCAT).
- The functional design of the process has been adapted to the availability of information for the different sub-models and procedures.
- An important learning is that it is necessary to maintain consistency throughout the procedures, in scale and complexity of the different models/analysis. This means that it must integrate appropriate techniques in each dimension, but not the more complex developments, because the global model requires consistent inputs and outputs between dimensions.
- The current calibrated models shows good performance (adjust, significance, etc). Although the errors are significant
- The use under a differential approach (difference of the situation with and without project), subtracts the absolute estimation error, giving validity to the measure of the effect of a project or plan.

THANKS FOR YOUR ATTENTION