# The Individual Daily Mobility Simulation Model "*MobiSim*".

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*The simulation model, named MobiSim, was elaborated on the demand of the French Ministry of Transport. The objectives are to provide a relevant assistance in strategic decision making on the collective transportation and the daily individual displacement in their relationships (interconnections) with the territory development. MobiSim contains 6 submodels:* ***Population****,* ***Housing****,* ***Job****,* ***Transportation****,* ***Displacement*** *and* ***Environment****. The model approaches the daily mobility by* **m** *essential motives of displacement (***m** *= 3) : "house - work", "shopping", "displacements for educational needs"; into and between* **z** *zones (***z** *= 3) : City - Centre, Suburbs and zone of Periphery, for the population of* **s** *socio-professional categories and* **a** *age groups. The structure of job is represented by* **s** *categories of jobs and* **e** *types of enterprise activity (industry, enterprise service, household service). The model approaches the* **d** *modes of displacement (by car, by route collective transports, by railway collective transports); and* **l** *categories of housing, corresponding of the household's size. The model was established with the* ***Vensim*** *simulation software and consists near 6 000 equations. The interface understands currently 17 screens, allowing to establish scenarios and to collect some output results, describes the daily individual mobility evolution*

## INTRODUCTION

The simulation model, named *MobiSim*, was elaborated on the demand of the French Ministry of Transport. The objectives are to provide a relevant assistance in strategic decision making on the collective transportation and the daily individual displacement in their relationships (interconnections) with the territory development.

In the current context, the daily mobility is one of the fundamental questions in any action of adjustment of the territory. All actors of these actions of adjustment of the territory have to take in to consideration the totality of determinant vectors and various aspects of this complex problematic, such as : policy, social, economic, technological and cultural.

The decision concerning an act of adjustment (for example : development of a transportation system; implantation of an activity etc.), the organisation or the

management (for example : tarification policy, regulation), would have to be based on the knowledge and the comprehension of complex interactions between the components of each vectors intervening in the decision and their evolution in the time. In this context, the risks linked to this kind of decisions are the strategic risks for the whole society because of implications that they will produce in the long term.

The principal objective of present research consists to provide a realistic representation linked to the daily mobility in France in 20 years, on the one hand, and to demonstrate the feasibility of an operational simulator, on the other hand. It represents the first step that could have be considerably refined and could have be enriched by ulterior cases studies.

From the very beginning the project have been oriented to the creation of an explanatory, comprehension and learning tool of "visions by anticipation" type. It is different from "reactive visions" type, which is often used as one of supporting principles in transportation systems simulation.

*MobiSim* is different from other models in the sense that it constitutes a tool of strategy evaluation and non of projects evaluation. The classic models don't take in accounts sufficiently some interactions, for example: between transportation system and urbanisation processes. To be sufficiently realistic and relevant, the evaluations of transportation policies to the long term would have to be established according to the principle of long term development in order to deduce some political, technical, environmental, economic and social consequences.

In the area of transport, the mobility evolution is partly conditioned by the policies implementation in the form of regulation measures : fiscal or tarification, or in the form of the transportation infrastructure development projects. It depends equally on the policies or feather changes in such areas, as the demography, the town planning, the accommodation or the social organisation, so many elements introduced in the model.

#### ***MobiSim* MODEL**

The project developed by ATN and KBS lean on the theory of Systems Dynamics that partners apply in their works. The model takes in account many variables, parameters and data, interconnected and mutually influencing: technical, financial, economic, commercial, sociological, political, etc. The numerous interconnections create inevitably the feedbacks that render the behaviour of the studied system difficult to analyse and to understand. This fact justifies the realisation and the utilisation of the simulation model, tool both for comprehension and for assistance to reasoned decision making.

*MobiSim* contains 6 submodels: **Population**, **Housing**, **Job**, **Transportation**, **Displacement** and **Environment**.

The model approaches the daily mobility by ***m*** essential motives of displacement (***m*** = 3) : "house - work", "shopping", "displacements for educational needs"; into and between ***z*** zones (***z*** = 3) : City - Centre, Suburbs and zone of Periphery, for the population of ***s*** socio-professional categories and ***a*** age groups. The structure of job is represented by ***s*** categories of jobs and ***e*** types of enterprise activity (industry, enterprise service, household service). The model approaches the ***d*** modes of displacement (by car,

by route collective transports, by railway collective transports); and ***l*** categories of housing, corresponding of the household's size.

Variations of population and consequently of householders in the different zones are the result both of demographic process of population (birth, death, maturation), and of multiple migrations between different zones of the territory (inter zones rates, arrivals and departures). Variations of the number and categories of householders in each zone determine demand of the housing.

Inter zones rates, arrivals and departures, are the complex functions of attractiveness of the different zones for householders. The attractiveness depends on several factors: cost of housing, environmental quality, supply and quality of transportation services (frequency, comfort, ratification).

Actually the combination of factors of household location determines a strong decentralisation of the habitat,. This fact impact on the distance of displacement and on the motorization of householders. Without any determined policy, a present tendency of delocalisation of the park of habitat is going to continue to the horizon of 15 - 20 years.

On the agglomeration scale, the City - Centre loses jobs to the profit of the Suburbs for the majority of the types of activities. In the decentralisation of the enterprises, as in the decentralisation of the habitat, the new supply of the transportation system plays an important role. For some categories of activities (especially linked to household's services), the density of population in the same zone of location and activities, plays a role of stabiliser in the process of habitat's decentralisation.

The emergent tendency puts in obviousness the fact that geographically the jobs are much more concentrated that habitat. This contradiction is an essential determinate that characterises the increase of distances of displacement "house - work".

Investments into construction and / or into modernisation of transportation infrastructures increases the supply of transportation system and therefore a possible distance of displacement and the maximal speed. This fact increases the number and the distance of displacement. By means of feedback loop, the decentralisation of habitat and activities, and the usury of transportation infrastructure, increase the investments.

Demand of displacement by objective and by zone on the basis of the offer of transports (possible distance of displacement and maximal speed) generates the flux of persons. The intensity of the flux, as compared to the capacity of the system, modifies the speed of displacement in the senses of a diminution. The increase of the travel time is an important determinate of the modal choice of displacement (by car, by route's collective transports, by railway's collective transports).

The quality of the environment is partly linked to the mobility, to the displacement and flux intensity. These factors affect the occupation of the space by habitat and transportation infrastructure; and the quality of the air (due noises and atmospheric pollution to the flux of transports).

**SCENARIOS EXPLORER**

The model was established with the Vensim simulation software and consists near 6 000 equations. The interface understands currently ten screens, allowing to establish scenarios and to collect some output results, describes the daily individual mobility evolution, using some basic indicators:

1. Displacement demand (persons by purpose et by mode)
2. Supply of transportation system (capacity and services level of transportation infrastructure, in cars and travellers maxi a day)
3. Displacement distance and times
4. Route traffic and congestion
5. Car's pollutions

The scenarios simulation or prospective analysis with simulation model consists to take some estimations of probable ruptures in current trends. Non to predict the future, but to endow with a framework of intelligibility capable to put in light :the potential mutations in constraints that impact on the individual mobility, on the one hand, and the levels on which the public policies could act to take into account this news gives, on the other hand. In this frame, the exercises of prospective is generally translated into the constitution and simulation analysis of scenarios. Their main interest is not in predictive capacity, but in the political dimensions corresponding to double sense of this term: the policy as a place of determination of the large collective orientations concerning urban mobility, and the politics as a program of action in the choosing area.

On this basis, we have retained two categories of scenarios levels, which could characterise the public policies (policy) and collective choice (politics). The first is linked to the chosen objective type in face of a growing pressure in profit for a durable mobility. Two different possibilities appear in this context: to maintain the access to a strong mobility, perhaps growing as it is the case since tens of years? Or to discount in cause of this "volume" mobility.
The second category of scenarios links with the different means used to reach the objectives. There are also two possibilities : to privilege a preferential recourse to collective process and organisations, or, on the contrary, to privilege the individualistic tendency and the individual incentives.

**CONCLUSIONS**

*MobiSim* was passed several tests of calibration: sensitivity of parameters, reactivity and temporality of different feedback loops, stability of behaviours etc., that allow to insure that the model functions logically and correctly in its large lines. Nevertheless, the model remains again a tool more for reflection than for forecasting. It is an instrument for thorough comprehension of complex relationships between urban space and development of the transportation systems, inducing the daily displacement evolution in French agglomerations of average size. After the thorough validation of the model using one case of a French agglomeration, *MobiSim* will allow the relevant exploration of different scenarios.

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