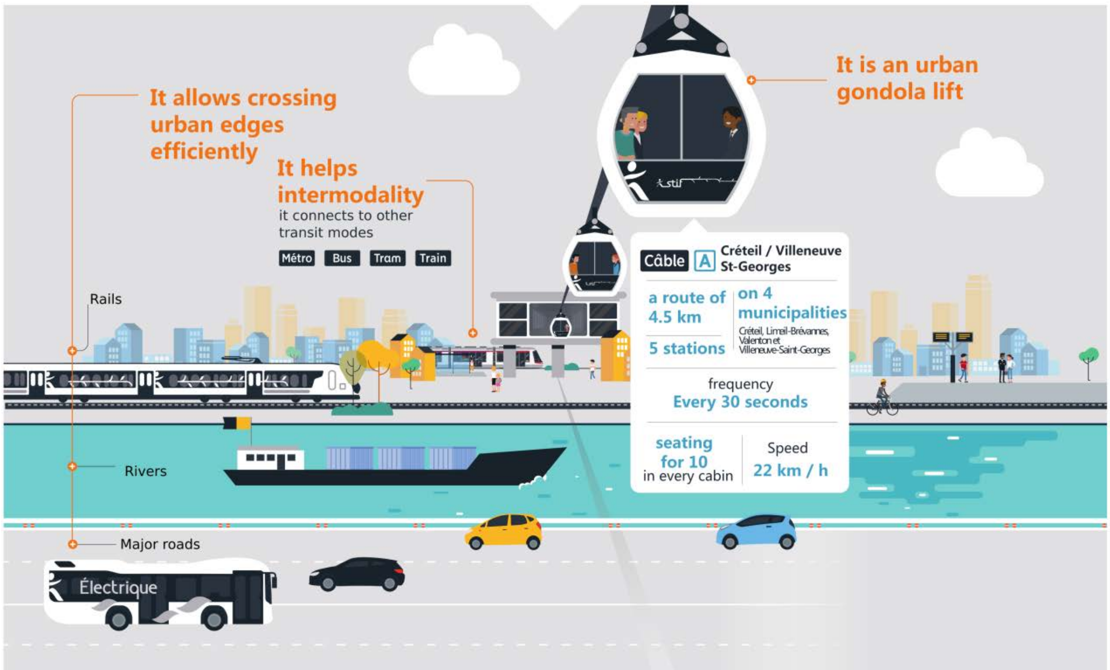
URBAN GONDOLAS IN ILE-DE-FRANCE: FORECASTING TRAFFIC ON A NEW MODE

Anne-Eole Meret-Conti
Laurence Debrincat
STIF
Marco Kouwenhoven
Cyrille Dupré-Gazave
Eric Kroes
Significance

1. CONTEXT

Everywhere in the world, gondola lifts are increasingly considered an acceptable option as a mass urban transit mode. In Ile-de-France, the first project of gondola lift – called "Cable A: Creteil-Villeneuve St Georges" – is located in the southeast nearby suburbs of Paris.

The project territory is located on a plateau where bus lines grant access to the major transit network (trains A and D, and metro 8). But a motorway, many railway tracks and a high tension electricity line prevent direct access from the plateau to the metro 8 station which connects to the new Grand Paris line. As a result, bus lines have to make long detours and provide poor level of service. In order to cross these barriers, a project of urban gondolas has been proposed and is currently being studied and evaluated by STIF.



It is difficult to forecast the patronage of such a project, as existing gondolas in France are operated in a completely different context (mainly ski-resorts). Therefore, STIF commissioned Significance to conduct a study to better understand urban traveller's perception of this new mode, both from a qualitative and quantitative point of view.

This paper presents the general methodology of the study (chapter 2); it summarizes the main results on the perception of gondola in an urban context (chapter 3) and provides route choice parameter for traffic modelling (chapter 4). The final two chapters present the conclusions and the planned follow-up given to the study (chapters 5 and 6).

2. A THREE PHASES STUDY: INTERVIEWS, WEB SURVEY AND ANALYSIS

The study was carried out between September 2015 and April 2016. It aimed to identify and prioritise the pros and cons of an urban gondola lift – in the context of the Ile-de-France transit system for the various segments of the population. Another aim was to estimate route choice parameters applicable in ANTONIN 3 – the STIF transport forecasting model[1]. The study was organised in three phases.

2.1. Phase 1: Open-ended interviews to collect possible pros and cons

The aim of phase 1 was to understand how potential users of the gondola lift looked at the new system, what sorts of issues played a role and what kind of language could best be used to describe the different options. In this phase 1 20 open-ended interviews were conducted with various travellers with different age, sex, location, and use of transport modes. Each interview lasted about two hours. At each step, the interviewee was asked about what could be the advantages and disadvantages of a gondola lift in an urban mass transit system. This was done in the following order: first a short presentation was given on how the gondolas lift could be operated in normal condition, and reactions were asked. Then the possibility of an accident was discussed, and again reactions were asked. And finally a comparison was made between the gondola lift and all existing public transport modes, and reactions were asked again.

In addition to making a large list of pros and cons of the gondola lift, the interviews were used to understand what characteristics of the system could be unclear or misunderstood, and how the presentation of the stated-preference web survey could be optimised.

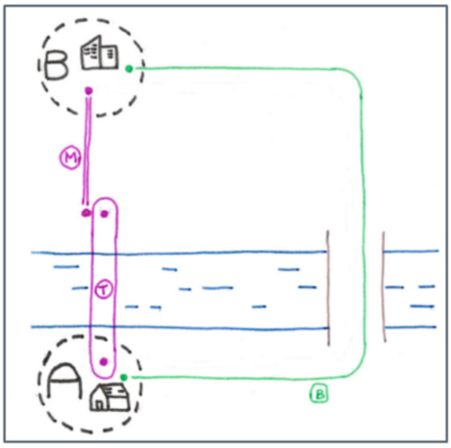
2.2. Phase 2: Web survey – perception and stated-preference questions

The second phase of the study consisted of a web survey of 1,353 inhabitants of Ile-de-France. In first instance the aim was to recruit respondents living in the area where the new Cable A was planned. This was done by interviewers recruiting people at the railway station and at bus stops. In second instance a more general group of inhabitants of Ile-de-France was recruited through an internet panel, in this case the Toluna panel. The web questionnaire asked questions on the respondent (personal characteristics and mobility behaviour), perception questions (characteristics of urban gondola lift and its pros or cons) and stated preferences (SP) questions organised in three experiments:

- SP1: Route choice between two routes using both and exclusively gondola lift. Six choices were presented. The aim of this experiment was to measure as accurately as possible the preferences of potential users for the different characteristics of the gondolas, and particularly the trade-offs involved. This enables the modeller to accurately estimate the utility functions. The following attributes were included in the experiment:
    - Travel time (in minutes), at 5 levels;
    - Frequency of service of the gondola (interval time in seconds/minutes), at 3 levels;
    - Level of crowding of the gondola (seat availability, neat to wait a number of minutes), at 4 levels.
- SP2: Route choice between one route using exclusively gondola lift and one route using exclusively a bus line. Seven choices were presented. This experiment forces the potential users to compare the new gondola mode with its most directly competing transport mode in a route choice context. That is the context that will be used to represent the new transport mode in the ANTONIN 3 transport model, and for which mode specific constants are required. The following attributes were included in the experiment:
    - Travel time (in minutes), at 7 levels;
    - Frequency of service of the gondola and the bus (interval time in seconds/minutes), at 4 levels;
    - Level of crowding of the gondola and the bus (seat availability, neat to wait a number of minutes), at 4 levels.
- SP3: Route choice between one multimodal route using gondola lift for the access to the major transit network and another multimodal route using existing transit modes. Eight choices were presented. This experiment was included to be able to measure mode specific utility effects in a multimodal context, for instance the combination of metro and gondola. For many users that type of combined transport would be the natural alternative that would be made possible by creating the gondola lift. The following attributes were included in the experiment:
    - Total travel time (in minutes), for all modes, at 7 levels, with in-vehicle time specified by mode, interchange time and egress time;
    - Frequency of service of the first mode (interval time in seconds/minutes), at 4 levels;
    - Level of crowding 1 level (always enough seats).

The presentation of SP3 is shown below:

Please think of a recent trip you made, from home to the nearby suburbs.



To make this trip with your usual transport title, what route do you prefer ?

	Gondola lift + Metro	Bus
First line	*10 minutes*	*35 minutes*
Transfer	*2 minutes*	
Seconde line	*25 minutes*	
Total trip	**37 minutes**	**35 minutes**
First line runs	**every 3 minutes**	**every 15 minutes**
For all lines :	**many seats are available**	**many seats are available**

◉ **Option A** ○ **Option B**

Note that the level of comfort ("many seats are available") is the same in both options and unchanged during the experiment SP3.

2.3. Phase 3: Analysis and model estimation

Answers to the web survey were analysed in three steps.

Firstly, basic statistics were calculated, to find and highlight significant differences between different segments of the population. Secondly, a data clustering analysis on individuals was performed using the responses to the opinion questions. This analysis involved the choice of individuals for the modelling set, use of multiple correspondence analysis (MCA) and the k-means clustering method to define the clusters, and finally a factorial discriminant analysis (FDA) to generalise clusters to the whole web sample. The main results of those two processes are presented in chapter 3.

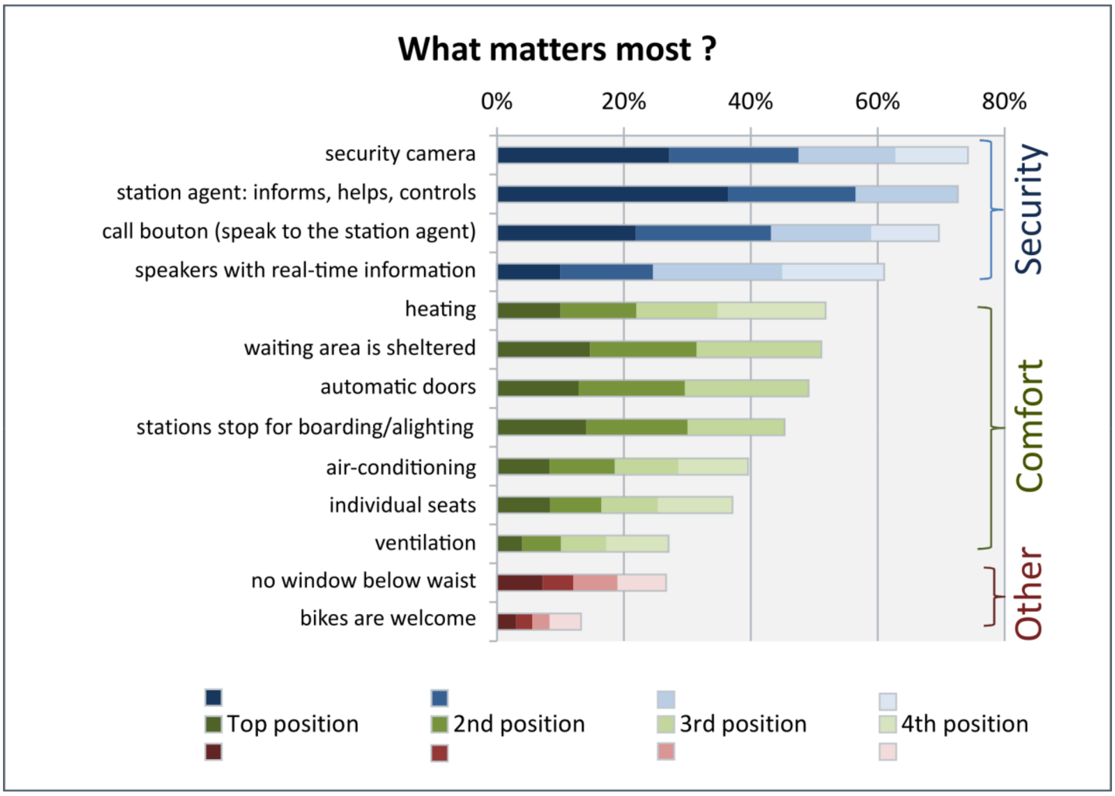
The third step consisted of the modelling of stated-preferences – the estimation of the best model for each experiment, the generalisation and bias reduction, and then the estimation of route choice parameters for traffic modelling. The main results and final parameters are presented in chapter 4.

3. UNDERSTANDING GONDOLA LIFT'S PROS AND CONS FOR VARIOUS SEGMENT OF THE ILE-DE-FRANCE POPULATION

3.1. A positive image of gondola lift – as long as security standards are high

More than 3/4 of all people were willing to use a gondola lift for making daily trips; this ratio is common to all segments in the population – whereas people are familiar with this mode or not.

A set of thirteen characteristics of the cabins and the stations was presented online and people were asked to prioritise them as (1) most important, (2) second most important, (3) third most important and (4) fourth most important. The results are indicated below.

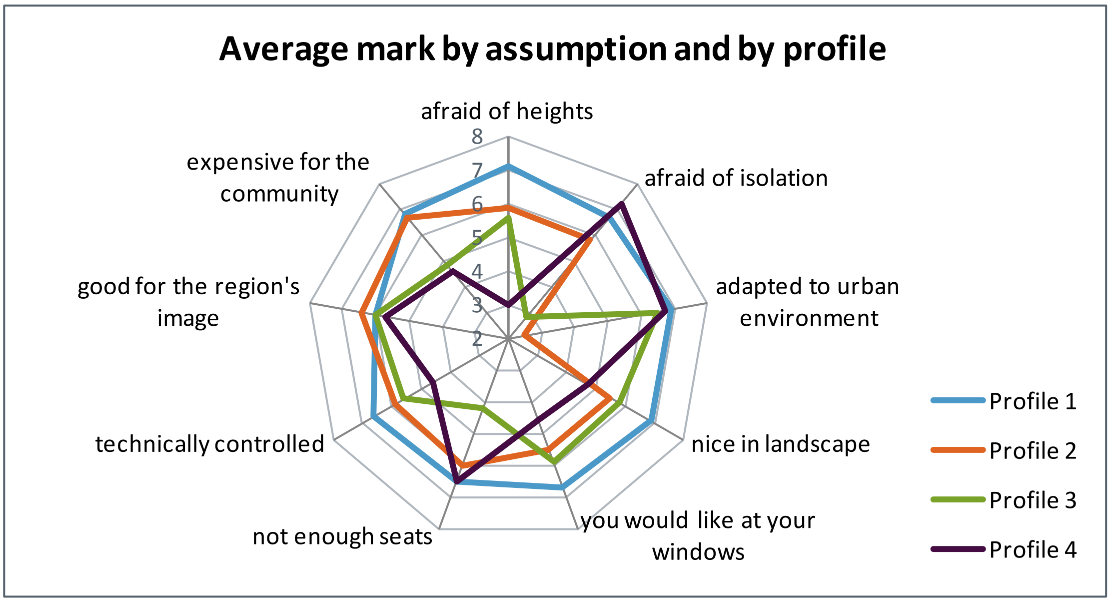


Security items all arrive at the top of the list: as the system is new, safety standards are expected to be high to reassure travellers. Most respondents fear safety-threatening encounters and operating incidents, as they might be isolated in the cabin.

3.2. Four profiles: what characteristics of gondola lift divide the Ile-de-France population?

A list of 18 opinion questions (statements) relating to the gondolas[1] was presented to the respondents, and they were asked to express their agreement or disagreement with the statement by giving a mark from 0 to 10. It turned out that there was broad agreement among all respondents about the following elements:

The answers to other opinion questions turned out to have more discriminatory power between different groups of respondents. These were used to cluster individuals into distinct groups, which resulted in the following four profiles.



- Profile 1 is called “Afraid of the unknown but attracted to novelty”: they expect the system to be reliable and attractive, but they fear the unknown (heights, being isolated in a cabin).
- Profile 2 is called “Vacation in the city”: they appreciate the gondola lift they know from their holidays, but consider it quite unfit for urban trips.
- Profile 3 is called “Indirect profit”: they are distinguished by a low transit mode share. They hope the gondola lift, which they consider efficient,

[1] These were based upon the results obtained in the qualitative research.

will reduce road congestion (modal shift, and replacement of bus lines) and, in this way, improve their travels.

- Profile 4 is called “Fear of unreliability”: they are mainly concerned by incidents and operating breakdown – as the system is new, they fear it will be off regularly and they will be penalized in their daily trips.

4. FORECASTING TRAFFIC ON URBAN GONDOLA LIFTS

4.1. Generalised model for all three SP experiments and bias reduction

Separate models were estimated using the SP responses to SP1, SP2 and SP3. Then combined analyses were done using all three SP’s simultaneously, to get the best model. In this phase some coefficients had to be constrained to get optimal results. Below the final combined model estimation results are presented, scaled with respect to the InVehicleTime variable, so that all values are expressed in equivalent minutes of travel time.

Number of observations	21 961		
Log-likelihood	-11 205		
Rho^2 (0) :	0.264		
Scale			-0.122
InVehicleTime (factor)		1	(-)
WaitingTime (factor)		0.6873	(-19.4)
Discomfort_Gondola (penalty)		4.357	(-14.8)
Discomfort_BusLv2 (penalty)		5.316	(-7.3)
Discomfort_BusLv3 (penalty)		5.122	(-7.1)
Discomfort_BusLv4 (penalty)		11.4	(-13.6)
Boarding_Gondola (penalty)		-1.494	(-2.6)
Transfer_Gondola-Metro (penalty)		-2.149	(-2.2)
Transfer_Gondola-Train (penalty)		4.79	(-5.8)
Transfer_Gondola-Bus (penalty)		4.36	(-4.9)
Transfer_Gondola-Tram (penalty)		5.049	(-4.1)

From this we concluded that the *boarding* penalty of the gondola is equivalent to -1.5 minutes of bus travel time, which is very much better than any of the other modes. The *transfer* penalties from gondola to other modes are significant, and have values around 5 minutes of bus time except for metro; there the penalty is -2 minutes. In combination with the (negative) boarding penalty of the gondola this gives a seemingly extremely attractive combination.

The *waiting time* is valued at about 0.7 minutes of bus travel time, and discomfort due to *crowding* is valued at around 5 minutes equivalent bus travel time for gondola and for bus crowding levels 2 and 3. The highest bus crowding level is valued at 11 minutes of equivalent bus travel time.

Having obtained the coefficients of the final model, we realised that the responses to the SP questions had suggested an unrealistically high level of demand for the gondolas. This is not uncommon, and has been observed before in similar SP studies in France (and elsewhere). So a procedure had to be designed to eliminate uncredible optimism bias. The following procedure was developed for this:

- A re-estimation was done using only those respondents that actually traded (thus eliminating the respondents that always chose gondola or bus);
- A higher weight was given in the re-estimation to the respondents who lived not in the immediate catchment area of the gondola (the idea being that those living near the gondola might express policy bias, while the panel members might also be overly positive about this new technology as had been observed before);
- We thought the very low (negative) penalty for the combination gondola-metro was suspect, and replaced it for application by the transfer penalty for gondola-train (which should normally have been about the same size).

4.2. Route choice parameters for urban gondola lift in Ile-de-France

The final results of the route choice parameters for urban gondola lift in Ile-de-France as they have been retained for application are presented below, again in terms of equivalent in bus travel time:

InVehicleTime (factor)	1 * BusIVT
Discomfort_Gondola (penalty)	1.31 min
Boarding_Gondola (penalty)	3.9 * BusIVT
Transfer_Gondola-> (penalty)	
Metro	4.9 * BusIVT
Train	4.9 * BusIVT
Bus	4.1 * BusIVT
Tramway	4.4 * BusIVT

So the in vehicle travel time in the gondola lift is set equal to that of the bus, and the discomfort due to crowding in the gondola leads to a crowding multiplier value of 1.3 (so that perceived travel time in a crowded gondola system gets 30% more onerous than when the system is not crowded).

The boarding penalty of the gondola is set at 3.9 minutes bus travel time, and the transfer penalties for combining the gondola with metro, train, bus and tramways range from 4.9 to 4.1 minutes equivalent bus travel time.

5. CONCLUSIONS

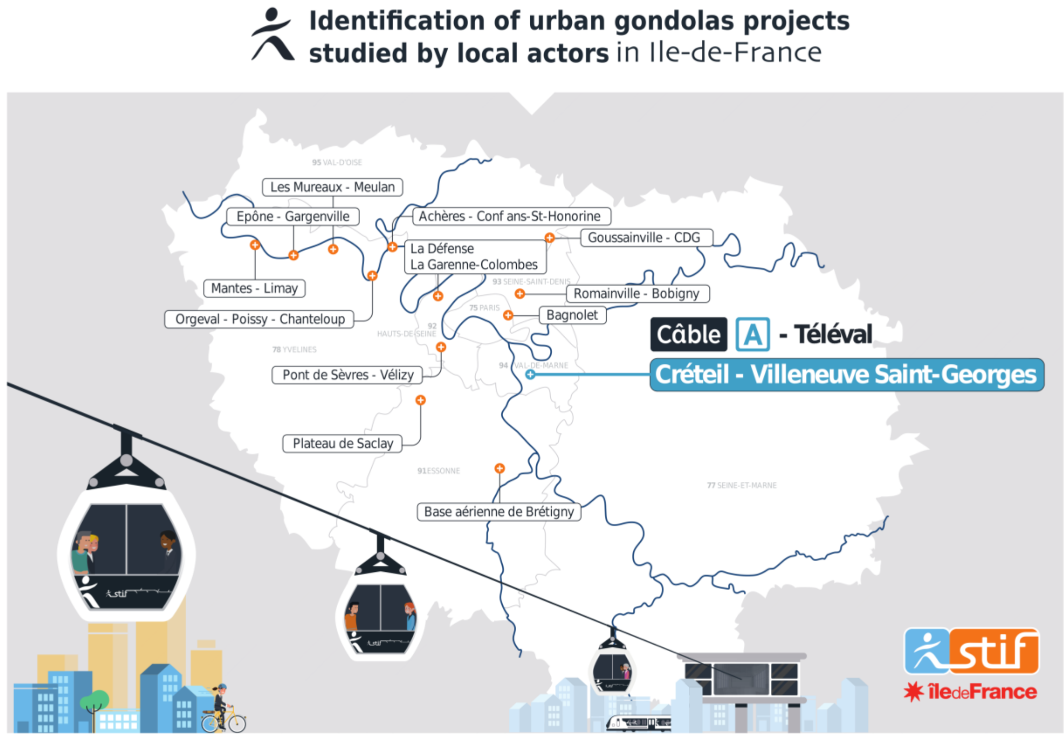
This paper has briefly presented the gondola lift project for Creteil- Villeneuve St Georges, together with the study that was conducted to understand how Ile-de-France residents are likely to perceive and use the new public transport system. The most important findings were:

- Generally travellers in Ile-de-France have a positive attitude towards gondola lifts as a mode of transport to cross barriers;
- Ensuring security through staff presence or use of cameras is the key requirement for the potential users when it comes to the gondola lift;
- There are four quite distinct profiles of potential users: (1) People afraid of the unknown but attracted to novelty, (2) People who see the gondola as part of a vacation in the city, (3) People hoping for reduced congestion as an indirect profit, and (4) people who are afraid for unreliability of the system.
- The SP responses suggest that travellers are attracted rather strongly by the gondola lift as compared with other public transport modes.
- However, it was found that the SP responses contained optimism-bias, which had to be removed before meaningful parameters could be derived for application in the ANTONIN 3 transport demand model.
- Route choice parameters have been implemented in the ANTONIN 3 forecasting model and will be used to estimate traffic and to evaluate costs and benefits of the project.

6. CONTINUATION: BUILDING THE STIF STRATEGY ON URBAN GONDOLA LIFT PROJECTS

This study provides relevant matters for designing the project “Cable A: Creteil-Villeneuve St Georges”: the public consultation will be designed so that the line characteristics are understandable by everyone, and so that advantages and disadvantages of the gondola lift are correctly outlined.

In 2016, STIF identified 12 potential other urban gondola projects in Ile-de-France, which are currently studied by local actors of the region. The results of this survey will help during the preliminary studies and will provide balanced materials for approximating the user benefits of each project.


Identification of urban gondolas projects
studied by local actors in Ile-de-France
Les Mureaux - Meulan
Epône - Gargenville
Achères - Conf ans-St-Honorine
Goussainville - CDG
La Défense
La Garenne-Colombes
Mantes - Limay
Orgeval - Poissy - Chanteloup
Romainville - Bobigny
Bagnolet
Câble A - Téléval
Créteil - Villeneuve Saint-Georges
Pont de Sèvres - Vélizy
Plateau de Saclay
Base aérienne de Brétigny
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NOTES

[1] ETC 2015 paper: Antonin 3, an Up-to-date Transportation Planning Model for the Ile-de-France Region (Tuinenga, Meret-Conti, Pauget)

[2] Values for route choice parameters in ANTONIN 3, including in-vehicle factor by mode, were estimated from the regional mobility survey EGT 2010. Urban bus stands for busses operated by RATP in the nearby suburbs. In the ANTONIN 3 model, BusIVT = 1.