



Transportation Networks: *Mathematical Tools*

Transportation is a very old activity – one of the oldest in mankind's history – and, as such, it is often treated in a very empirical manner. Our task is therefore to try to define the indicators which will allow an objective view. One should define the indicators first and come up with a solution only after that: this is common sense.

Usually, any transportation network has three players: the Collectivity which decides (for instance a city), the Company which operates the network, and the Community of users. So, we need three types of indicators; they are often contradictory!

1. For the Collectivity

- Investment expenses.
- Working expenses.
- Environmental aspects.

2. For the Company

- Data which are needed to submit an offer, in the selection procedure.
- Data which are needed for the daily operation, such as number of people in each bus, number of delays, and so on.
- Financial data.

3. For the users

- Time required for transportation.
- Proximity of the stations.
- Regularity of the trains, buses, and so on.
- Waiting time.
- Quality of service.
- Security.
- Cost of the ticket.

Of course, all these indicators must consider all uncertainties (one never knows exactly how many people are in a bus) and the use of private cars. It may happen that the use of private cars is more flexible and less costly than a public transportation network.

On such subjects, our Company brings a scientific assistance. We realize critical analyses, study scenarios, comparisons, and our contribution is a comparative study: this type of solution has these advantages and these disadvantages, and so on. We usually give a quantitative information, in terms of costs and benefits. We study all situations, including the rare ones, and we come up with recommendations which are motivated, not just politically correct.

Our recent realizations

- 2005-2009, Veolia Transport: Definition of a transportation network; application to a critical analysis of the network in the city of Amiens (north of France).
- 2008-2013, Réseau Ferré de France (French Railways): Study about the causes for the delays of the trains in the Paris Region; analysis of the investments which are needed.
- 2008, Société Vinci: Analysis and simulation of employment and living in a city, depending on the time for transportation.
- 2011, SNCF (French railways): Planning of investments.
- 2011, le Métro du Grand Paris (Metro in the Paris Region): White Paper for decision.
http://scmsa.eu/archives/SCM_Metro_Grand_Paris_2011_06_29_V2.pdf
- 2011, Auto Plus (newspaper): number of deaths in car accidents, as a function of regulations.
http://scmsa.eu/archives/Rapport_SCM_AutoPlus_2011_05_24.pdf
- 2012-2015 IFSTTAR and Ministry of Transportation: Improving GPS positioning in an urban environment.
- 2012, Agence d'Ecologie Urbaine, Ville de Paris (Agency for Urban Ecology): Critical analysis of a software for the evaluation of air quality.
http://scmsa.eu/archives/SCM_AEU_Rapport_Aria_2012_12_10.pdf
- 2013, Speed of cars and CO2 emissions, by Sara Bisbe (Ecole d'Ingénieurs de la Ville de Paris), Damien Raffanel and Bernard Beauzamy (SCM SA)
http://scmsa.eu/archives/SCM_Vitesse_et_CO2_2013_08.pdf
Article by Auto Plus about this study (07/09/2013):
http://scmsa.eu/archives/AutoPlus_SCM_2013_09_09.pdf
- 2015, Ministère de l'Environnement, Direction Générale Energie Climat, Bureau Qualité de l'Air (Air Quality): Probabilistic links between traffic and air quality.
http://www.scmsa.eu/archives/SCM_resume_DGEC_2016_01_25.pdf
Article published by Auto Plus:
http://www.scmsa.eu/archives/AutoPlus_SCM_2016_02_12.gif
- 2016, RATP: Scientific assistance for the planning of replacement of critical equipment.
- 2016, SNCF: Analysis and comparison of various scenarios for the definition of a new train line.
- 2016, Voyages & Business: Critical analysis of a software for "transportation on demand".
- Taxis G7, 2016: Critical analysis of planning algorithms
- RATP, 2016-2017: Analysis of the behavior of trains in critical situations
- RATP, 2017: Simulation tool for logistics

- SNCF/Transilien, 2017-2018: Analysis of general transportation needs near the "Paris La Défense" area.
- RATP, 2018: Safety analysis.
- Atlandes, 2018 (Highway, south of France): Counting the cars on an exit of the highway
- Home Office, General Secretary for Administration, East Region, 2018: Tools for the management of crises.
- RATP, 2018-2019: Probabilistic study, connected with speed increase and decrease of the underground railways.
- Transportation Company, 2019: Statistical analyses about the GPS position of containers.
- Atlandes, Highway A63, 2020: Statistics concerning trucks.
- SNCF, 2021: Critical analysis of safety demonstrations relating to the "Fuel Cell" (hydrogen).
- RATP, 2022-2023: Stability of old embankments, Archimedes' approach.
- Atlandes SA, 2022: Statistical analysis of HGV journeys.
- RATP, 2023: Estimated project costs
- SNCF, 2023: Definition of an equipment inspection plan
- CMA-CGM, 2023: Critical analysis of methods in operations research