Variable speed limit and ramp metering assessment using FCD

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Context

On one hand, traffic management strategies allow operators to make better use of available capacity and to reduce congestion, delays, and travel time variability. On the other hand, Floating Car Data (FCD) become available and offer new insights to traffic flow analysis.

Objectives

The objective of this paper is to develop and test a methodology of traffic management assessment based on FCD. Traffic management concerns the simultaneous implementation of ramp metering (RM) and variable speed limits (VSL). The assessment includes criteria related to travel time for both private cars (PC) and commercial motor vehicles (CMV), travel time variability, greenhouse gas and CO2 emissions.

Methodology

The proposed methodology is a cost-benefit analysis introducing the added value of directly implementing FCD in order to estimate associated benefits. The variables used in the analysis are described in Table 1.

Name	Description
$VEHKM_{k,t}$	Number of vehicle*km travelled over the site per year k=0,1,…, n and per vehicle type t=1 if PC, t=2 if CMV
$T_{k,t}$	Total travel time per year k=0,1,…, n and per vehicle type t=1 if PC, t=2 if CMV
$\Delta T_{k,t}$	Travel time variability per year k=0,1,…, n and per vehicle type t=1 if PC, t=2 if CMV
ACC_k	Number of crashes
EGG_k	Grenhouse gas emissions per year k=0,1,…,n
ELP_k	Local pollutants per year k=0,1,…,n

Table 1: Variables used in analysis

Site and Data

The proposed methodology was tested using one-year data from the A25 highway in the proximity of the French city of Lille (Figure 1). The A25 suffers from severe congestion during peaks and traffic composition includes 10% of CMVs. The Average Annual Daily Traffic (AADT) is estimated at 80.000 veh/day.

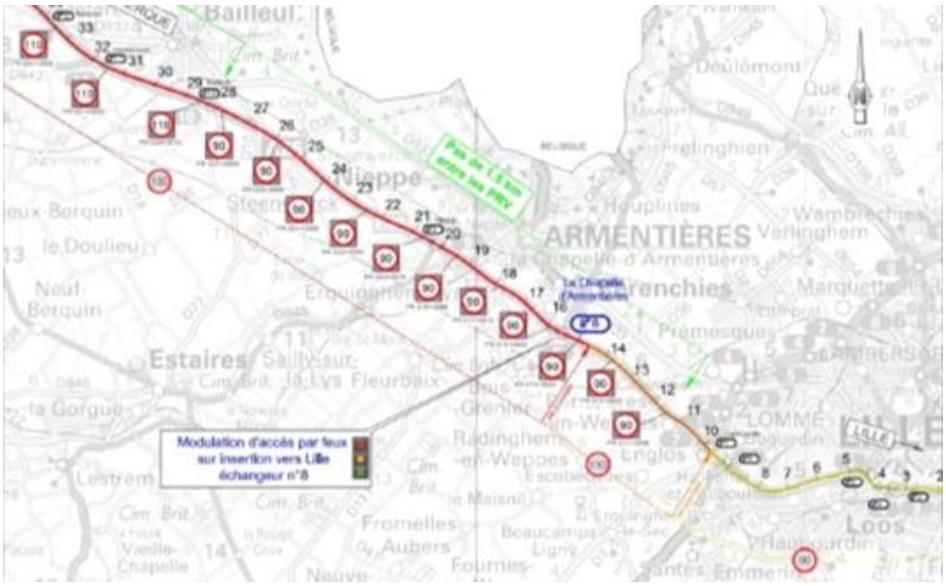

Figure 1: Section of A25 towards Lille subject to variable speed limits

Two traffic management strategies were implemented simultaneously in March 2016: (i) VSL over 23 km, direction to Lille, with a reduction step of 20 km/h (from 130 to 90 km/h) and (ii) RM at ramp number 8.

The FCD used concern the periods before and after the implementation of traffic management strategies. They provide direct travel time estimations for vehicles moving along the site of interest (23 km from Meteren to Englos). We create samples of travel times for the morning peak hours (6h30-10h30) on working days. We combine these data to information provided from the operator on incident occurrences, planned works, and so on. The corresponding time periods were excluded from the analysis.

Results

Results show significant gains in terms of both travel time (TT) and travel time reliability (TTR) as shown in Table 2. The monetary gains of TT and TTR are almost equivalent.

Section A25 – Meteren-Englos - morning peak		
Vehicle type	PC	CMV
Travel time (s) without traffic management	1048	1187
Travel time (s) with traffic management	877	1051
Standard deviation (s) without traffic management	530	429
Standard deviation (s) with traffic management	238	174

Table 2: FCD travel time data

After obtaining travel time data, we proceed to cost-benefit evaluation for the first year of operations and find a net benefit of 4,73 million euros due to travel time gains and variability reduction. On the contrary, environmental gains appear to be far less significant.

The initial investment was estimated at 6,3 million of euros. The investment breaks even at the 16th month of operations even if only considering travel time and travel time variability.

REFERENCES

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