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Processing Traffic and Road Accident data in two Case Studies of Road Operation Assessment

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Abstract

In recent years a change of paradigm in road operations development has emerged. Increasing congestion on the urban motorway networks has led stakeholders to test innovative practices of road infrastructure use, since strict budgetary constraints and the environmental requirements for sustainable mobility have raised the need not only to limit the building of new infrastructures but also to look for solutions to optimize the existing network. Therefore, on French motorways for instance, new road management schemes are being tested, such as allowing traffic on the hard shoulder during peak periods. Furthermore, recent directives in France on road safety, sustainable development and the preservation of the natural environment have driven local authorities to reduce speed limits on urban highways. Whatever the reasons for change, an exhaustive assessment of new schemes is essential, in order to know what the impact is in terms of traffic and road safety. This paper aims to give methods and results in ex-ante and ex-post safety assessment studies by combining data from various sources (traffic databases, police reports, accident files, weather stations and maps).

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1. Introduction

Recent directives in France on sustainable development and the preservation of the natural environment have led local authorities to reduce speed limits on urban highways. Furthermore, solutions to optimize the existing network have been driven by stakeholders in France, such as allowing traffic on the hard shoulder during peak periods. Whatever the reasons for change, an exhaustive assessment of new schemes is essential, in order to estimate their impact in terms of traffic and road safety. While ex-ante assessment considers potential benefits before the deployment of a new scheme, ex-post assessment checks the real effects of the operations.

Here, we give the method and results of two road operation assessments. The first one concerns a speed limit reduction on an urban motorway network, the aim being to reduce emissions, pollution and accident counts. In this case the ex-ante safety assessment is presented. The second one concerns a hard shoulder running operation on another urban motorway network, the aim being to reduce congestion. Here, the ex-post safety assessment is presented. In both cases, the data used comes from traffic databases, police report and accident files, and also weather data.

Section 2 explores a data driven approach for the ex-ante assessment of a speed reduction on motorways located in the North of France, around the city of Lille. Section 3 presents the before/after study of a road lane management operation, within the framework of the ex-post assessment of a road operation located on motorways around Paris. In both cases, it is necessary to describe the assessed site, the accident and traffic data, the traffic operation and the main results, in order to understand the reasons for and methods of the assessments.

The last section shows what assessment has actually been obtained, and what assessment could be expected, if the data were more exhaustive, and if the range of the experiments were longer in time and wider in space.

2. Safety ex-ante assessment of a French road lane management operation: data driven approach

This section presents an ex-ante assessment of a reduction in speed limit on motorways located in the North of France, around the city of Lille, on the ALLEGRO site. The site and the speed limit reducing operation are described in the first subsection, the data and assessment method are outlined in the 2nd and 3rd subsections respectively, and the results are presented at the end.

2.1. Description of the site and of the speed limit reducing road operation

The site considered in this study includes the Lille urban motorway network, which has two, three or four lanes in each direction. The authorities decided to limit speed, the aim being to preserve the natural environment and to decrease accident counts. Our purpose here is to give a prior estimation in terms of injury and fatality accident counts, i.e. to see whether or not the new measures increase safety.

The speed limit will decrease from 130km/h to 110km/h in three motorway areas: A (A25 motorway), C (A23), and D (A27); it will decrease from 110km/h to 90km/h in areas E (A25), F (A1), G (weaving section A22-A27-A23) and I (A22).

Figure 1: Speed limit reduction scheme near Lille
2.2. Description of data from various sources

Traffic data (6-minute flows, average speeds and occupancy) are available for 2009 and 2010 on a number of sections. Different speed-occupancy diagrams are derived, according to the speed limit and the lane.

The occurrence of rain is available (for every 6-minute period in 2009 and 2010), thanks to the rain gauge located in Lille airport at Lesquin (France); hourly human observation completes this information.

The percentage of running HGVs in the traffic flow has been provided by Egis Consultant. It is important to consider HGV traffic and rain occurrence because special speed limits apply for HGVs and during rain.

The French accident database BAAC (Bulletins d’Analyse des Accidents Corporels) provides the main characteristics of each accident (type of collision, location, date and time in minutes, factors linked to the driver, the manoeuvre, the infrastructure, the weather, severity). This database contains information for 345 injury or fatality accidents for the considered Allegro network during the period 2003-2010. Detailed police reports were available for only 32 accidents.

It was not possible to link an accident to the traffic conditions before, for two reasons: there were too few traffic stations available for this research, and the traffic data was limited to the period 2009-2010.

2.3. Description of the ex-ante safety assessment method

In order to carry out an ex-ante assessment, a traffic model is required so as to be able to predict the changes in speed and density brought about by the new scheme. Two relationships, the first between the accident count and speed, and the second between the accident count and density, are also required, in order to express the predicted changes in speed and density in terms of changes in the accident count.

The safety ex-ante assessment of a road operation consists of four steps:

1) accident analysis for the prior period, in order to distinguish between accidents independent of the traffic conditions, speed-related accidents and density-related accidents;
2) linking these accident counts to the traffic conditions (average speed and occupancy) observed before the introduction of the road operation. Assuming that there exist some relationships (validated elsewhere) between average speed and speed-related accident count, or between occupancy and density-related accident count, it is then possible to adjust the location coefficients of these relationships for the assessed site.
3) predicting the traffic conditions with the new scheme (assuming the availability of a traffic model);
4) in conjunction with the predicted traffic conditions, using the relationships (now adjusted for the site) between average speed and speed-related accident count, or between occupancy and density-related accident count in order to predict the speed-related accident count and the density-related accident count.

We have studied the changes in the accident count prediction, in the light of different assumptions.

2.3.1. Accident analysis for the prior period

Golob [Golob et al., 2004] have shown strong links between accident counts (by type of accident) and traffic conditions. The first step of our method was to simplify his approach by considering only two traffic variables (speed and density) and by classifying the 345 earlier injury or fatality accidents on the network into just three types:

- Type1. Some (46) accidents are mainly due to the driver suffering from fatigue or falling asleep, to alcohol, or to a vehicle failure. Let us consider here that the number of such accidents is independent of any speed limit.
- Type2. Other accidents (99) are linked to a high speed (run off the road, rollovers); they occur in a low traffic flow and concern a single vehicle. Let us consider that changes in speed affect only these single-vehicle accidents.
- Type3. The remaining accidents (200) concern several vehicles (side collisions, rear-end collisions, multi-vehicle collisions) and are linked to a high relative speed, a high traffic density or a lane change. Let us consider that these accidents, concerning two or more vehicles, are affected only by the changes in traffic density.

2.3.2. Adjusting the relationship linking speed to speed-related accident counts, and the relationship linking occupancy to density-related accident counts

Driving at an inappropriate speed contributes to the occurrence of road accidents. A number of authors have used traffic conditions and accident databases to analyse the relationship between accidents and speed [Golob, 2004],
The relationship between speed limits and accidents has been analysed from national accident databases before and after the setting of new speed limits [Nilsson, 2004], [Elvik, 2009, 2013], [Pauw, 2013], who suggested and used the power model, relating the before/after ratio of accident counts to the speed limit ratio. Complementary to this study, we calibrated two relationships from the traffic and accident data of a French motorway network (the Marius network made up of urban motorways near Marseille):

- the first one links accident count (Type2) to average 6-minute speed. A power model with a coefficient $\alpha=2.3$ links the accident count to the speed:

$$\text{Type2 Accident Count Marius}=\beta_{\text{Marius}} \cdot (\text{Speed Marius})^\alpha \quad (1)$$

where Type2 Accident Count Marius and Speed Marius are the accident counts and average speed observed on the Marius network.

The coefficient $\alpha$ will remain unchanged for the application on the Allegro Network, whereas the coefficient $\beta_{\text{Marius}}$ depends on the location and is replaced for the Allegro network by a coefficient $\beta_{\text{Allegro}}$ adjusted as follows:

$$\beta=\frac{\text{Type2 Accident Count Allegro}}{(\text{Speed Allegro})^\alpha} \quad (2)$$

where Type2 Accident Count Allegro and Speed Allegro are the accident counts and average speed observed on the Allegro network.

- the second one links accident count (Type3) to 6-minute density: two risks were calculated, one for low density, the second for high density (density $> 24$ vehicles/km/lane).

Assuming the density distribution on the Marius and Allegro networks to be equivalent, we divided the 200 Type3 accidents into 60 low density crashes and 140 high density crashes. This leads to computing a low density risk ($=60/\text{Nb low density vehicle km}$) and a high density risk ($=140/\text{Nb high density vehicle km}$).

With the new speed limits, the number of high and low density periods differs, which induces (assuming that the risk by density level is constant) new Type3 accident counts for low and high density.

| Type3 Accident | Low density vehicle-km (predicted) | High density vehicle-km (predicted) |
|---------------|-----------------------------------|-----------------------------------|
| a) Low density | $c \times e$                       | $d \times f$                      |

Figure 2: Breakdown of Type3 accidents, according to the density level on the Allegro network

### 2.3.3 Prediction of the traffic conditions

We predict what the traffic conditions will be (using a traffic model based on Fundamental Diagrams (FD)), or what they should be (according to the compliance level).

#### 2.3.3.1 Prediction of what the traffic conditions will be

One way to obtain the relationship between speed and density is to classify the traffic flow, then to divide each class into two sub-classes (one congested, the other not) and to assign a sub-class to each 6-minute period according to its traffic flow. The FD speed is the average of speeds by sub-class.

Empirical speeds are analysed in two components:

- FD speed;
- A deviation round the FD, because the FD is valid only on average and not at every single moment. These deviations are different at each 6-minute period. Let us consider that they do not depend on the speed limit.

On some parts of the ALLEGRO network, the 90km/h, 110km/h and 130km/h speed limits are already implemented, which makes it possible to build the three FDs (see Figure 3).
In the central and fast lanes, capacity is the same whatever the speed limit; in the slow lane, capacity is the same at 110km/h and 130km/h, but decreases at 90km/h.

Let $V_{FD}(q)$ be the FD giving the speed corresponding to the traffic flow $q$. The empirical speed is split here into two components, the first given by the FD, the second being the deviation from the FD.

For every six-minute period $i$, let $q_i, v_i, k_i$ be the empirical traffic flow, speed and density:

$$v_i = v_{FD\_speed\_limit}(q_i) + \left(v_i - v_{FD\_speed\_limit}(q_i)\right)$$

(3)

The relationship $q_i=k_i v_i$ implies that an average 6-minute speed decrease leads to an increase in density $k_i$. For the non-congested branch of the FD, provided the new density (after the speed limit implementation) remains lower than the critical density, the traffic demand $q_i$ goes through. If not, the period passes into congestion, with a queue that needs to be managed. However, in the simulation study carried out on the same subject, (Cohen, 2014) has shown that the increase in congestion was negligible. In addition, capacity was virtually maintained (see the FDs Fig. 3), except for the slow lane, when the new speed limit is 90km/h. When the demand is greater than the supply, the FD congested branch is not impacted by the reduction of the speed limit (Fig. 3). Let us therefore assume that after the implementation of the new speed limit, the traffic flow and the traffic state (congested or not) remain constant by 6-minute period. The new speed is obtained by adding to the empirical one the change in FD:

$$v_{FD\_new\_speed\_limit}(q_i) - v_{FD\_old\_speed\_limit}(q_i)$$

(4)

Thus the traffic density is deduced from the equation $Traffic\ flow = Speed.Density$. The variability of the speed and density is conserved, since empirical 6-minute deviations from the FD are taken up again.

**2.3.3.2 Prediction of what the traffic conditions should be**

In 2.2.3.1, the new empirical FD takes into account actual compliance with the new speed limit where already implemented. Computing the ideal result of the speed limit reduction (with full compliance) requires another model, where the empirical speed (when higher than the new speed limit) is replaced by the limit (or by a function of the limit, in the case of partial compliance). Compliance is said to be partial either when the rate $\tau$ of compliant drivers...
or periods is less than 100%, or when the speed decrease is only $\rho (V_{\text{old\_lim}} - V_{\text{new\_lim}})$, ($0 < \rho < 1$). The empirical speed $v$, when greater than the new speed limit, is changed to $v'$ or $v''$:

$$v' = (1 - \tau) v + \tau V_{\text{new\_lim}}, \quad 0% \leq \tau \leq 100\%$$

for $\tau = 100\%$ or $50\%$ \hspace{1cm} (5)

$$v'' = \max\{V_{\text{new\_lim}}, v - \rho (V_{\text{old\_lim}} - V_{\text{new\_lim}})\} \quad \text{for} \quad \rho = 50\%$$

2.3.3.3 Models linking traffic conditions to accidents

The power model, based on new predicted speeds, gives Type 2 accidents.

The predicted Type 3 accident counts in low density (respectively in high density) are obtained by multiplying the predicted number of vehicle-kilometre travelled in low density by the risk in low density, (respectively by multiplying the predicted number of vehicle-kilometre travelled in high density by the risk in high density (see Table 1). The Type 3 accident count is the sum of Type 3 accident by low density and by high density.

Table 1: Observed and Predicted (according to two methods) Type 3 accident counts by density level

| Density    | Observed | Predicted (with FD approach) | Observed | Predicted (with FD approach) |
|------------|----------|------------------------------|----------|------------------------------|
| Type 3 accidents | 140      | 137.8                        | 60       | 68.7                         |
| Vehicle-km (for 8 years) | 5222.4 (*) | 5135.2                       | 572 (*)  | 656                          |
| Risk(**)   | 2.68     |                              | 10.48    |                              |

(*) estimated from the traffic observed in 2009-2010
(**) For 100 million vehicle-kilometre

Table 2: Observed and Predicted (according to two methods) accident counts by type of accident

| Accident count               | Before | Fundamental diagrams | Full compliance |
|------------------------------|--------|----------------------|-----------------|
| Type 1. Default (driver or vehicle) | 46     | 46                   | 46              |
| Type 2. Single vehicle       | 99     | 85.9                 | 88.5            |
| Type 3. Accident             | 200    | 206.5                | 200.7           |
| Total                        | 345    | 338.4(-1.9%)         | 335.2 (-2.8%)   |

The overall accident counts (see Table 2) decrease by:

- 1.9%, assuming that new speeds derive from Fundamental Diagrams for 90km/h and 110km/h speed limits;
- 2.8% (full compliance with new speed limits).

3. Safety ex-post assessment of a French road lane management operation: statistical before/after method

This managed lane road operation consisted in Hard Shoulder Running (HSR), i.e. opening a supplementary or auxiliary lane to traffic at peak periods. It was located on a 2.3km motorway weaving section near Paris, and began in the autumn of 2005. The safety ex-post assessment of this operation is presented here and is a before/after observational study. The site and the operation are presented in the 1st subsection; the data (traffic and accidents) are presented in the 2nd subsection for the period before the installation (2000-2002, Period I) and for the period after the installation (2006, Period II) of the managed lane. The safety ex-post assessment method is presented in the 3rd subsection, and the assessment results at the end.
3.1. The site and the implementation of the managed lane

In the east of Paris, two urban motorways (A4 and A86) share a 2.3-kilometre-long weaving section. As the traffic flows of the two motorways are added (but not the number of lanes), traffic is particularly dense at certain times on the weaving section.

In order to reduce the congestion, the French road operator DIRIF dynamically allows traffic on the hard shoulder during periods of high demand. Moveable barriers were installed at an angle on the right side of the auxiliary lane, which can be either open or closed. In order to show drivers the specific nature of the zone, the auxiliary lane has special road markings and a light-coloured surface. Dynamic vertical signing consisting of Variable Message Signs (VMS) and Lane Assignment Signals (LAS) placed one above the other warns users of the opening or closure of the additional lane. Safety monitoring has been improved by the installation of automatic incident detection cameras. In the event of an incident or accident when the lane is open, stationary vehicles on the hard-shoulder lane can be detected and the lane closed. Additional safety is provided by speed control radars on the A4 highway in both traffic directions.

3.2. Description of data from various sources

Traffic databases
Average 6-minute speed and occupancy are available every six minutes on the 2.3km weaving section and on 2.4 kilometres upstream and downstream. During daytime, there were approximately 320 million vehicle-kilometres per year in Period I, and 309 million in Period II.

Police reports, accidents files
According to the French accident database (BAAC), in 2000-2002 (called Period I, before the implementation of the system) 144 (respectively 170) injury accidents occurred on the weaving section (respectively upstream and downstream); in 2006 (called Period II, after the implementation of the system), the accidents counts were 27 on the weaving section and 29 upstream and downstream. Police reports are much more detailed - only 198 and 39 police reports were available on the whole site for Periods I and II. During daytime (5 am to 9 pm), 221 accidents occurred on the whole site in Period I and 50 in Period II.

Weather data
As the accident rate is multiplied by two during rainfall, it is essential to check if there is a difference in rainfall during the before and after periods. A weather station, located at Melun, provides rain occurrence and quantity every six minutes. This is completed by an hourly human observation. In Periods I and II, rain occurred during 8.8% and 7.8% of the 6-minute periods.

3.3. Description of the ex-post assessment method

3.3.1 The observational Before/After Studies in Road Safety
The method for assessing the safety impact of a managed lane strategy is based on the work of Hauer [Hauer, 1997]. It requires accident and traffic data for a period before the installation of the assessed system and a period after this installation. The method consists of four steps:

1. **Defining the assessed site.**

Some authors such as Bauer [Bauer K., 2004] think that, for HSR operations, a downstream migration of congestion and accidents is possible. Therefore the impact on safety must be assessed on the weaving section, supplemented by downstream sections. We also added upstream sections, possibly concerned by congestion moving backwards. The assessed site is thus the set of the weaving, downstream and upstream sections.

2. **Defining Period I before and Period II after the implementation of the system.**

3. **Defining a reference site,** this being useful to detect the “time effect on accidents” independently of the site that we want to assess. Wherever this trend is significant (for instance due to stricter speed enforcement, as happened in France at the same time as the managed lane operation), some types of accident (those due to speeding) will be reduced more than others.

   As this weaving section was the most congested site in France, it was difficult to select another reference site, the evolution of which would have been a basis for predicting the evolution of the weaving section, had no change been made. We decided to define the reference site by the weaving section itself (plus upstream and downstream sections) at the hours when the auxiliary lane is closed:
   - for the reference site, “Period II” is the set of hours in 2006 when HSR was effectively closed,
   - for this reference site, “Period I” is the set of hours in 2000-2002 which correspond to the hours in 2006, where HSR was effectively closed (same hour and minute in the day, same day in the week, same week in the year).

   So we split 2000-2002 into fictitious “closed” and “open” hours, the first ones are in the reference site, the second are in the assessed site.

   However, since the traffic is lighter during the hours when HSR is closed, a traffic scenario approach is needed in order to avoid biases.

4. **Predicting the number of accidents** which would have occurred during Period II on the assessed site had no change been made. This prediction is based on the accident data of Period I (assessed site), the traffic trend, and the “time effect on accidents” which was determined from the reference site. Finally, the results of this prediction are compared with the accidents which actually occurred.

| Observed (number of accidents on the) assessed site, *after* |
|----------------------------------------------------------|
| HSR effect |
| Predicted, assessed site, *after* | Observed, reference site, *after* |
| Observed, assessed site, *before* | Observed, reference site, *before* |

Figure 6: Prediction of the number of accidents on the assessed site, had no change been made

Note: “*Before*” corresponds to Period I and “*After*” corresponds to Period II.

3.3.2 **The scenario approach**

For Golob [Golob et al., 2003], accident risks depend on lighting, weather and traffic conditions including density. [Golob et al., 2004] established that on motorways, risks are lower in fluid traffic than in dense traffic. We have defined two traffic scenarios (fluid and dense) according to occupancy. Traffic is said to be “dense” if occupancy on at least one lane is greater than 17%, or if the average occupancy (on all lanes) is greater than 13.5%. This scenario approach is needed because not only is the “time effect on accidents” not the same in both scenarios but also because the managed lane operation has an impact on the scenario distribution. In addition, the managed lane operation may have an impact on the risk by scenario.
3.4 The effect of the managed lane operation on the accident counts

We computed by scenario (fluid and dense), period (I and II) and site (reference and assessed), the number of accidents per vehicle-kilometre (risk). The variations between Period I and Period II of the risks by scenario for the reference site quantify the “Time effect on accidents” between Periods I and II; they are used in the prediction of the number of accidents on the assessed site, had no change been made. The following risks have been obtained:

Table 3: Daytime accidents and risks before and after the HSR implementation, according to HSR opening and traffic fluidity

| HSR        | BEFORE (2000-2002) | AFTER (2006) |
|------------|--------------------|--------------|
|            | Fluid  | Dense | Fluid  | Dense |
| CLOSED     |        |       |        |       |
| Accidents  | 27.7   | 28.4  | 19.0   | 18.0  |
| Risk**     | 17.6   | 27.7  | 11.0   | 24.3  |
| %vehicle+  | 60.0   | 40.0  | 69.9   | 30.1  |
| OPEN       |        |       |        |       |
| (*** )     |        |       |        |       |
| Accidents  | 5.9    | 11.8  | 4.0    | 9.0   |
| Risk**     | 27.6   | 29.7  | 8.6    | 59.6  |
| %vehicle+  | 35.0   | 65.0  | 75.5   | 24.5  |
| TOTAL      |        |       |        |       |
| Accidents  | 33.5   | 40.2  | 23.0   | 27.0  |
| Risk**     | 18.8   | 28.3  | 10.5   | 30.2  |
| %vehicle+  | 55.6   | 44.4  | 71.0   | 29.0  |

(*) per year  
(**) unit: accident/100 million vehicle-kilometre  
(+) percentage of vehicles according to the density  
(***) the “open” hours in Period I (2000-2002) are fictitious.

Looking at the periods where the HSR is closed, and therefore can be considered to have no effect, Table 3 shows that in the after period, the risk decreased much more in fluid traffic than in dense traffic. This is due to the speed enforcement policy, which decreased run-off accidents (due to speed) occurring mostly in fluid traffic.

This policy had no particular impact on other types of accidents (rear-end accidents, due to a high relative speed or accidents due to a lane change) which occur during dense traffic. On that urban motorway, risks are lower in fluid traffic than in dense traffic. This matches Golob’s results [Golob et al, 2003, 2004]. However, Wang [Wang, 2009] did not find any relation between accidents and congestion on the M25, in England. As HSR increases traffic fluidity a decrease in accidents is expected.

Looking at the periods where HSR is open, this expectation is partially confirmed: fluidity increased – this is the main effect of HSR - and therefore the number of accidents decreased, since the risk of accidents during fluid traffic is lower than during dense traffic. Moreover the risk decrease in fluid traffic was even greater than during closure. This positive effect is partially offset by an increased risk in dense traffic; complementary results show sideline collisions with motorcycles just downstream of the weaving section. Globally, there was a non-significant decrease of 3% in the number of accidents due to HSR (with the method and assumptions developed in Aron [Aron et al., 2010].

The different elements of the method (the reference site for determining the time effect; the use of upstream and downstream sections) are necessary; the following table show how the final HSR effect is determined.

Table 4: The assessment results in percentage of accidents (daytime)

| Elements taken into account | Spatial       | Evolution in accidents |
|----------------------------|---------------|------------------------|
| Accidents                  | Weaving section | -25%                   |
| Time effect                | Weaving section | -17%                   |
| HSR effect                 | Weaving section | -8%                    |
| HSR effect                 | Weaving section=downstream=upstream | +5%                    |
| HSR effect (taking into account traffic scenarios) | Weaving section=downstream=upstream | -3%*                   |

* Insignificant due to small sample
Assessment requires the use of a reference site in order to capture the time effect, but if this time effect varies according to the elements (traffic conditions, infrastructure, type of vehicle), a scenario approach is needed for avoiding biases, with a prediction by scenario of what would have occurred had no change happened and with a final weighting of the scenarios. The number of scenarios which can be identified is limited because the number of accidents of the reference site is too low to be able to adjust a large number of parameters.

4. Conclusion and Perspectives

Ex-ante and ex-post assessments are crucial for decision making, for compiling the experimental results, and finally for identifying the best operations and practices. Accident and traffic data are required for ex-ante and ex-post safety assessments. In addition, ex-ante assessment requires a traffic model and safety relationships between accident occurrence and traffic conditions.

Traffic operators were happy – or at least they gave us that impression - with the results of both safety assessments that we presented. It is nevertheless essential to go further, in order to validate the traffic model and the safety relationships, and to obtain narrow confidence intervals around the accident counts, which is not currently the case in France where the range of the experiments is not very broad in terms of time and space.

Hopefully, today the context is particularly conducive to a huge increase in knowledge, and in traffic models and applications, thanks to the combination of significant progress in a number of areas:

- in "big" data processing, in computing performance and computer science,
- in mathematical analysis, in analytical resolution of certain traffic models which could make validation more powerful, and in new models based on network fundamental diagrams [Daganzo, Geroliminis, 2008],
- in validation [COST TU0903 Multitude]
- in traffic data, quantitatively and qualitatively:
  - trajectory data was obtained at TU-Delft and at IFSTTAR-LICIT, which will provide information about the number of lane changes; and floating car data (FCD) will become available at much higher ranges in time thanks to the deployment of connected vehicles. All of this will make traffic model validation possible,
  - FCD will become available everywhere. Thus relationships between accidents and traffic conditions will be established on junctions, on local roads, on curves and slopes, etc.,
  - detailed data on the mobility of Power Two-Wheelers (PTW) or of pedestrians is lacking, thus making it impossible to compute risks by user or by vehicle-kilometre. New sensors for PTW are now available, and also for pedestrians.

The amount of available accident linked to traffic data will make it possible to determine and process relevant scenarios, combining road characteristics, users, traffic conditions and weather data (much more information using meteorological radars). This will result in new safety relationships, in the enhancement of traffic models and their calibration and, in turn, in the enhancement of safety assessment and therefore in piling up the experiments?

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