Sétra
service d'Études techniques des routes et autoroutes

March 2007

Methodological guide

Road safety stake analysis

Interurban environment

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RÉPUBLIQUE FRANÇAISE
ministère de l'Équipement des Transports de l'Aménagement du territoire du Tourisme et de la Mer

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- help with the asset management;
- define, apply and evaluate the public policies;
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Methodological study

Road safety stake analysis

Interurban environment

This document is the translation of the work "Les etudes d'enjeux en sécurité routière" published in March 2005 under the reference 0503.

This document was prepared by a working group, steered by the Sétra (Centre for Safety, Transport and Highways - Transport safety office), with the cooperation of the following departments:

- Certu (*Centre d'études sur les réseaux, les transports, l'urbanisme et les constructions publiques,* Study center for networks, transport, urban planning and public real estate)
- CETE, Lyon; (*Centre d'études techniques de l'équipement,* Technical Engineering Centers for Infrastructure)
- CETE, Méditerranée;
- CETE, de l'Ouest;
- Direction Régionale de l'Équipement d'Ile de France
  - Laboratoire Régional de l'Est Parisien;
- Direction Régionale de l'Équipement d'Aquitaine;
- Direction Régionale de l'Équipement de Picardie;
- Direction Départementale de l'Équipement du Calvados;
- la Direction Départementale de l'Équipement des Landes.

Contents

Introduction

Combating road safety problems at a local level first of all involves knowledge of accident research. Understanding the malfunctions leading to the accident subsequently makes it possible to implement actions. One of the essential conditions for the efficiency of these actions is focusing on the correct targets. **The purpose of the stake analysis is to determine these targets on which actions may be conducted if required**.

This guide proposes a methodology to conduct a road safety stake analysis on the basis of the accident data analysis.

It essentially covers the interurban environment. A specific guide for the urban environment is currently being drafted by the Study center for networks, transport, urban planning and public real-estate (CERTU). The general methodology is the same for both environments, even though some specific aspects require the development of two different guides in terms of detail.

The methodological guide "Implication studies and the choice of stakes within the scope of the DGO" [17] was distributed by the General Department for Road Safety & Traffic Management (DSCR) to assist departments in drafting their General Guideline Document (DGO) 2004-2008. This work, although it was drafted at a later date, represents the basis, and covers a broad panel of stake analysis types.

Who is this guide for?

This guide is aimed at all units required to have a knowledge of accident research at local level: study manager in district-level operation and safety units, district-level technical units, engineering firms. Decision-makers will be able to find guidelines and a general framework for the methodology of safety studies, without going into technical details.

What is this guide for?

Local road safety policies are complex and require precision in the use of terms and accuracy in terms of analysis. There are many types of analytical data: accident files, surveys, etc. In order to answer the many question raised with road safety units accurately, technicians must be able to structure the information, perform the correct processing operations and analyze the results obtained. The purpose of this guide is to assist them in their work, whether it is within the scope of national procedures (General Guideline Document, etc.) or within the scope of individual procedures: is the road particularly dangerous? Are a lot of young people involved in accidents? etc.

This guide proposes a general approach to be adapted to a specific order. In addition, it specifies a terminology published by various working groups within the scientific and technical community after consulting local units.

How to use this guide?

In **part one**, this guide defines **the general approach for a road safety study** via its different stages:

- stake analysis;
- diagnosis and guidelines for actions;
- study and implementation of actions;
- follow-up and evaluation.

Part two only covers **the methodology of the stake analysis**. It is presented in a succinct manner and frequently refers to guides indicated by the symbol (🛠X). The most technical points of the stake analysis have been compiled in the **fact sheets** describing practical and specific aspects. The final **fact sheet** (🛠10) is a "definition" fact sheet.

Subsequently, **6 case studies** propose different types of implication studies illustrated by study excerpts.

Finally, the reader will find a **bibliography and the list of abbreviations**.

The **key points** are indicated by the symbol: 👁

Part 1 - Role of stake analysis in a road safety study based on accident analysis

This section describes the general framework for the implementation of a road safety study on the basis of accident analysis. This method ranges from the initial contract registered with the units to the assessment after the completion of the actions. The different stages are described in this first section.

The remainder of the guide covers the first stage: the stake analysis.

1. General framework

The figure hereafter describes the sequence of stages, identifying the terminology used. For each phase, the items give a succinct description of the breakdown of each stage, which is therefore not exhaustive.

This breakdown addresses several issues:

• clarifying the study approach: the term "safety study" was previously used to refer to all or part of this entire approach. This resulted in considerable ambiguity in terms of its content. The various stages of the framework are separate. Each of the phases is differentiated by the data processed, the methods used and (very often) the people responsible for the study.
Sometimes, a contract is placed directly for diagnosis on a specific target; in this case, it is desirable to propose an stake analysis to assess the stakes associated with the target in a more general framework.

• having a method that can be applied over a broad area: in order to formulate actions guidelines, in any theory it is necessary to diagnose, i.e. analyze, among other things, all the police reports (PV) on the entire study sector. Frequently, the task proves to be very difficult, due to the considerable volume of work and number of reports. The stake analysis phase is used to target the stakes on which a genuine diagnosis can reasonably be conducted. **The scales of the stake analysis and the diagnosis are different** as the purpose of the stake analysis is to determine the priorities on which the diagnosis/diagnoses will be performed.

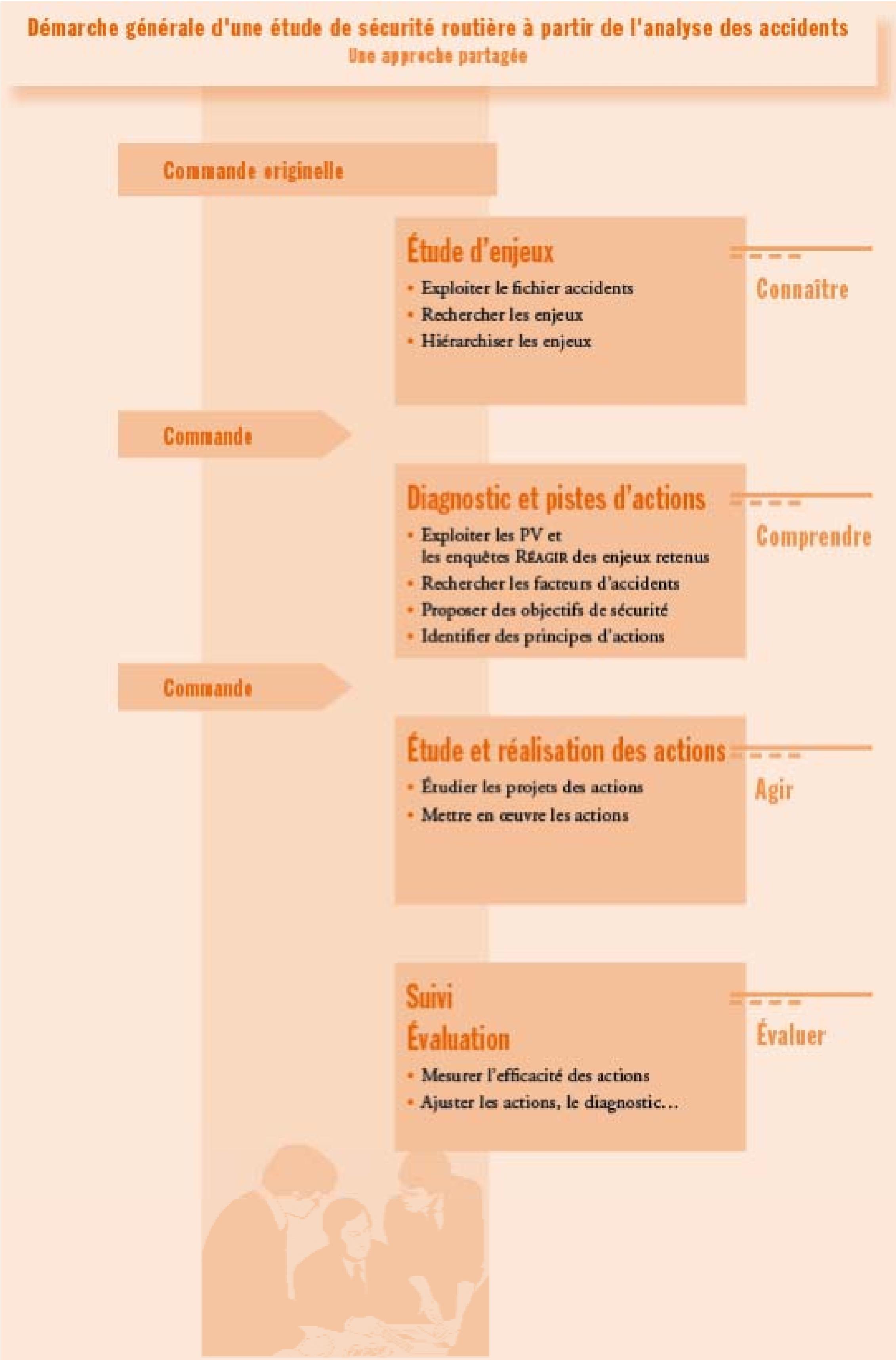
• while the follow-up and assessment are included in the final stage, they still require the upstream definition of indicators and data compilation. By focusing on actions and studies, they make it possible to obtain feedback for the future.

In addition to the technical aspect, the proposed framework indicates two essential conditions for the successful completion of the approach:

• **view sharing**: the relationship with all the partners (elected representatives, local residents, other DDE (*Direction départmentale de l'équipement* District-level offices for infrastructure) or DRE (*Direction régionale de l'équipement,* Region-level offices for infrastructure) units, local authority technical units, police, users, other authorities, etc.) must be studied and organized. Who should be involved, when and in which phase? Which type of involvement is the most appropriate (information, consultation)? View sharing makes it possible to enhance analyses, account for all the units' and partners' issues or constraints and, above all, share knowledge and understanding of accident research and the objectives of actions to be implemented.

• **the contract**: this should enable the sponsor to ensure that any uncertainties are done away with before starting the studies: to convey its expectations, negotiate the objectives and define the limits and constraints of the study. For this purpose, it is **up to the study manager to propose a comprehensive and in-depth formulation for the sponsor's approval**. The main benefits are a long-term gain in time and closer involvement of the road authority. In addition, the validation of a study phase should determine the initiation and contract for the next phase.

The road safety study should give rise to view sharing between the parties involved.



Démarche générale d'une étude de sécurité routière à partir de l'analyse des accidents	General procedure for a road safety study based on accident analysis
Une approche partagée	A shared approach
Commande originelle	Original contract
Etude d'enjeux	Stake analysis
Exploiter le fichier accident	Process accident file

Rechercher enjeux	Stakes analysis
Hiérarchiser les enjeux	Priorization stakes
Connaître	Determine
Commande	Contract
Diagnostic et pistes d'actions	Diagnosis and actions guidelines
Exploiter les PV...retenus	Process PVs and REAGIR investigations of selected stakes
Rechercher les facteurs d'accidents	Study factors in accidents
Proposer des objectifs de sécurité	Propose safety targets
Identifier des principes d'actions	Identify action principles
Comprendre	Understand
Etude et réalisation des actions	Study and implementation of actions
Etudier les projets des actions	Study action projects
Mettre en œuvre les actions	Implement actions
Agir	Act
Suivi	Follow-up
Evaluation	Assessment
Mesurer l'efficacité des actions	Measure the effectiveness of actions
Ajuster les actions, le diagnostic...	Adjust actions, diagnosis, etc.
Evaluer	Assess

2. The contract

The initial contract for the safety study may be very specific and very focused (e.g. propose improvements to solve individual infrastructure-related safety problems) or very general (road safety problem measures).

A distinction should be made between several forms of contract:

• a contract stemming from a **specific local or national context**. This is the case of "emergency" contracts, following strong outside pressure in terms of decision-making;

• a contract **following an accident research evaluation**. Management reports, evaluations, brochures, statistics, Local Accident Research Indicators (*Indicateurs d'Accidentologie Locale,* IAL) are published regularly; an analysis of these items may trigger a study. In this case, the technician needs to explain a specific contract: validation of a form of self-contract. This type of approach is very useful as it makes it possible to increase the awareness of decision-makers on the basis of objective information;

• a contract following studies within the scope **of national approaches** for road safety problem measures, for example within the scope of the General Guideline Documents (*Documents Généraux d'Orientations,* DGO) or Regional Safety Development Programs (*Programmes Régionaux d'Aménagements de Sécurité,* PRAS), resulting in specific budget lines;

• a contract stemming from a **project originally unrelated** to the safety aspect (environment study, town planning project, road project, etc.).

Depending on the contracts, the various stages of the safety study will not be developed in the same way However, the general methodology remains the same. The differences will essentially lie in the degrees of detail and the scope of investigation (infrastructure, behavior, etc.).

The contract should convey the road authority's expectations. The supervisor reformulates the contract, defines the targets with the road authority and aligns the limitations and constraints of the study. This approach is the first stage in the view sharing of the procedure. It is a guarantee of the success of the study. (1)

3. Stake analysis: know

The stake analysis frequently represents access to units other that those associated with road safety studies and to outside parties (elected representatives, users' association, etc.).

When should an stake analysis be carried out?

Ideally, all safety studies (carried out on the basis of accident data) should be started with an stake analysis.

In practice, safety studies are frequently triggered by very local contracts in response to the concerns of elected representatives or local residents. These local concerns do not always correspond to major road safety stakes but they should be taken into account, at least to assess the importance of the implication.

In sum, an stake analysis should be carried out:

- to place individual items in perspective in a more general context;
- to structure the essential information within the scope of the safety study intended to resulting in actions, more specifically when the number of accidents is very high.

Fact sheet

Name:

Stake analysis

Definition:

completion and analysis of accident research evaluation resulting in the determination and priorization of the stakes.

Purpose:

- assess the significance of the various targets in safety problems;
- detect the accident locations, victims or periods representing an abnormally high significance and determine the targets on which the safety problems or their development give rise to the most concern;
- target programs and structure priorities.

Procedure:

- conduct, essentially on the basis of the Personal Accident Analysis Report (*Bulletin d'Analyse des Accidents Corporels* BAAC), an accident research evaluation on the scope of the study with spatial, time and typological information (one possible tool is Concerto);
- analyze this evaluation in spatial, time and typological terms particularly with comparisons of the indicators with references (statistical tests): identify stakes;
- study the stakes in more detail by looking for additional information in the BAAC and completing the analysis with data other than accidents;
- priorization stakes with a multi-criteria analysis.

The stake analysis consists not only of the processing of accident data published in table, graph or map format. It analyzes processing operations to determine the stakes which are then studied in more detail and structured.

4. Diagnosis and actions guidelines: understand

The diagnosis follows the stake analysis: its guidelines and targets are specified in the road authority's contract. **The stake analysis results in priorities, which are the subject of the diagnosis contract**.

When should a diagnosis be carried out?

If the purpose of a study is to **propose solutions** intended to prevent accidents from occurring, a diagnosis must be carried out. The study to be carried out should at least include the diagnosis phase as an stake analysis does not give an indication of the source of accidents.

Fact sheet

Name:

diagnosis and actions guidelines

Definition:

understanding of malfunctions in the human-vehicle-environment system in order to define action principles.

Purpose:

Understand before acting. Identify, by means of a structured and thorough method, the simple or more complex actions to be implemented in order to prevent accidents from occurring or decrease their severity.

Procedure (example for route diagnosis):

- reformulate and validate the diagnosis contract;
- focus the study: study additional data with respect to accidents (environment, traffic, etc.) in order to clarify the context and decide on a breakdown of the route into homogeneous sections (these sections are not necessarily those of the stake analysis as they are frequently shorter and are based on other criteria);
- perform a sequential analysis of the accident reports, determine factors in accidents, aggravating factors and accident categories; validate them or not in view of the site inspections and additional studies;
- determine the safety targets and associated actions guidelines;
- systematically identify on the study area the infrastructural anomalies recognized as causing accidents (obstacles, junctions, bends, adherence, etc.) and the associated actions guidelines;
- propose a priorization of all the actions guidelines with a view to assisting the sponsor in drafting its action program (start of "study and implementation of actions" phase).

Once the road safety stakes of a district, route or area have been determined, it is necessary to understand the accident factors: this is the purpose of the diagnosis study.

5. Study and implementation of actions: act

For each of the stakes selected and structured, the diagnosis will have given a clearer understanding of the reasons for safety problems and thus clear the way for actions guidelines, which are focused on one or more areas such as:

- the infrastructure and its environment;
- communication, information; awareness;
- enforcement control;
- prevention and training.

Support on acquired knowledge and developments already assessed should serve as a basis for this stage. Projects need to be studied and estimated in terms of effectiveness, feasibility, costs, ease of implementation, etc.

Fact sheet

Name:

Study and implementation of actions

Definition:

define and implement the appropriate actions to improve and ensure the sustainability of safety.

Purpose:

- describe each action specifically;
- define the targets and assessment indicators for the action;
- associate the partners concerned by the action;
- implement the action.

Procedure for each action:

- determine the target: at whom or what is the action targeted;
- define objectives: clearly define the role of the action and the assigned objectives;
- determine with the sponsor(s) the targets of the evaluation of the action (design and/or implementation and/or effects of the action) and define the assessment with the indicators (data, tools and resources to monitor and determine the effectiveness of the action);
- study and associate correspondents and partners: organizations and structures liable to provide support or directly involved in the implementation of the action;
- prepare communication materials: precise description of the action and the type and resources implemented;
- assess the cost and plan: financial estimate, schedule of actions and possible coordination;
- implement the action.

6. Follow-up and assessment: assess

The assessment may relate to [30]:

- a policy (general document);
- a program (for example, motor-driven two-wheeler safety);
- an action implemented: (for example, in terms of communication (campaign targeted at young people between 14 and 18 years of age), in terms of infrastructure (junction design), etc. in terms of its effects and/or its design and implementation.

As a general rule, it is essential to carry out follow-up and assessment of all actions. This phase should not simply be approached at the end of a study. In particular, follow-up will require a compilation of data before the action (e.g. vehicle speed). It also requires objectives that are clearly identified beforehand to be able to measure the deviation.

Some specific scenarios

Some circulars require an evaluation following opening for service: This is applicable for:

- circular [27] No. 94-56 dated May 5, 1994 defining the procedures for the preparation, examination and approval of investment operations on the non-conceded national road network;
- circular [7] dated August 11, 1998 relating to Regional Safety Development Plans (PRAS);
- circular [10a] dated May 18, 2001 relating to the set-up of Road Project Safety Monitoring (*Contrôle de Sécurité des Projets Routiers,* CSPR).

Fact sheet

Name:

Follow-up and assessment

Definition

Assess the validity of an action in terms of trends and measure the deviation from the initial targets.

Purpose:

- capitalize on lessons learned;
- take corrective measures immediately, or without delay;
- improve the quality of the work completed.

Procedure:

- take the assessment indicators (in terms of quantity and quality) defined previously;
- draft data compilations relating to these indicators (the "before" data should be compiled before the implementation of the actions);
- compare and analyze results with respect to objectives;
- adjust the action implemented if required and if necessary resume the diagnosis;
- follow up and readjust if required;
- learn lessons from future procedures.

Assessment involves making a judgment of or evaluating the validity in terms of trends. Unlike an evaluation, the assessment is part of a dynamic approach.

Part 2
Stake analysis

Descriptive epidemiology* is one of the first stages in medical research. In parallel, in the field of road safety, before understanding the malfunctions causing accidents during the diagnosis, the first stage consists in ascertaining knowledge: which users are particularly involved in accidents? Are there any local specificities? Is a specific road particularly liable to accidents? The answers to these questions are not easy. Generally, there is no single answer. The accident file is a rich source of information that can help formulate answers. Indicators, methods and statistical tests are available to implement a pragmatic approach. They are described in this guide.

* [28] descriptive epidemiology aims at studying morbid phenomena repartition in populations and its variation in time, through statistics

1. Overview of the stake analysis

Definitions

A stake may be defined as follows: absolute or relative morbidity of a target (location, type of user, etc.). Therefore, the stake consist in a number of accidents or victims (broken down according to severity) associated with a target.

The target may be a location (junction, road section type, etc.) and also a set of users (young people, etc.), a period (night-time, etc.), an infrastructural typology (bends, etc.), a mode of transportation (two-wheelers, etc.)

This number of accidents or victims should be taken into consideration in absolute terms (number of accidents involving a two-wheeler, for example) and/or in relative terms (deviation with respect to a reference or number with reference to exposure such as the breakdown by age of the population). It is necessary to assess the significance (i.e. frequency) of accidents of the identified target in the overall evaluation.

The stake analysis is the analysis of the accident research evaluation which results in the determination and priorization of stakes .

This stage is used to identify the targets liable to be studied in a subsequent diagnosis. The purpose of the stake analysis is not to understand the causes of malfunctions; it simply needs to identify them. The accident database on which it is based is the most reliable BAAC type accident file possible (2).

The different stages of the stake analysis

An stake analysis is prepared according to three main stages:

- accident research evaluation of the existing situation;
- analysis of this evaluation and in-depth study of the stakes;
- prioritization of stakes.

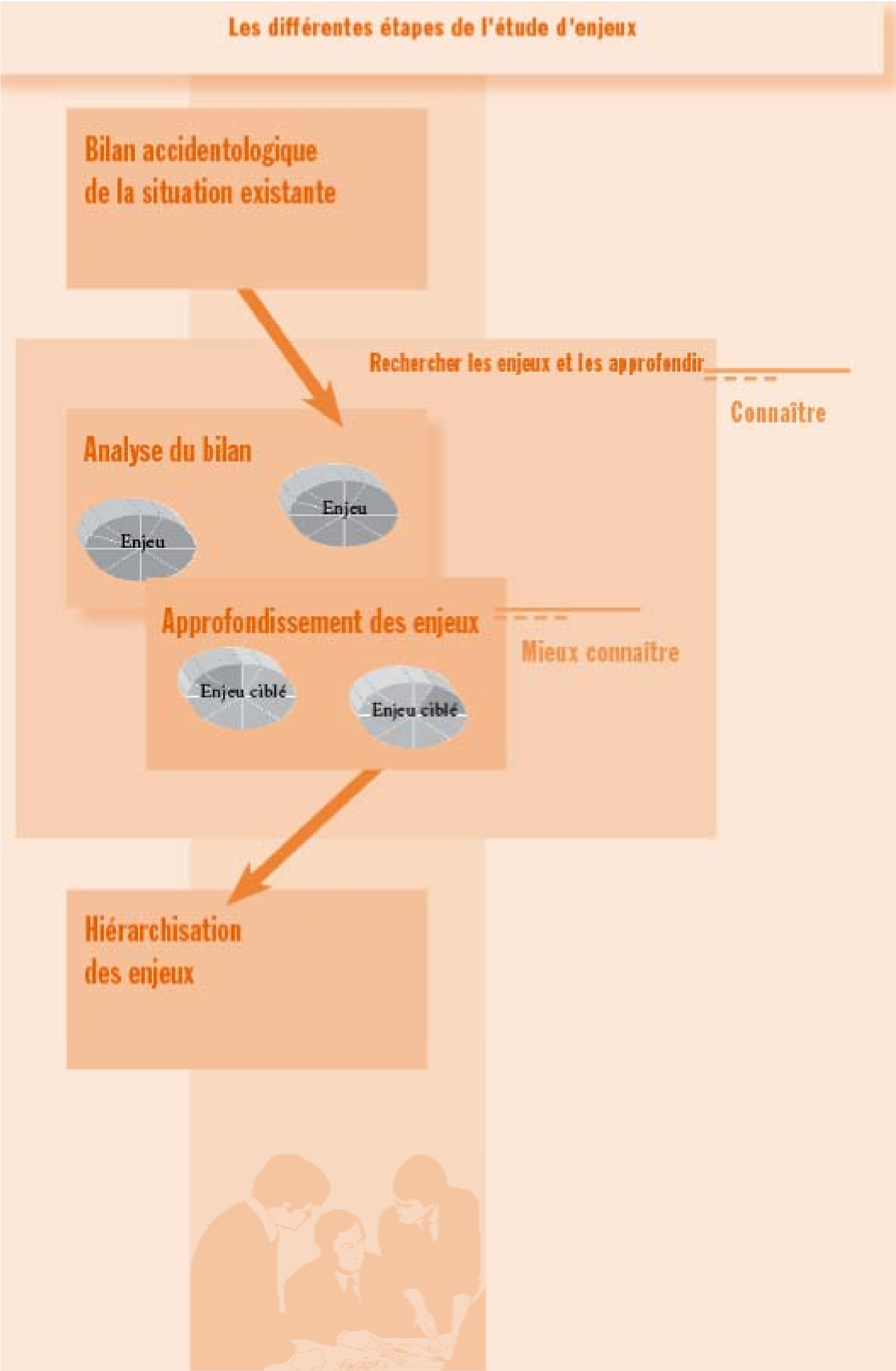
General stake analysis approach

Both stages, "evaluation analysis" and "in-depth study of stakes", have been grouped together given that they obey the same logic. **The procedure is iterative**. For example, the evaluation analysis will be used to assess the implication associated with accidents involving motorcycles; the in-depth study is a spatial, chronological and thematic analysis of the accidents involving motorcycles which, for example, will target motorcycle accidents at night. Within the scope of the in-depth study of the stakes, it is frequently necessary to combine processing of the accident file with exogenous data (other than accident data).

An stake analysis is not restricted to a mere accident research evaluation with no analysis. Spatial analyses, thematic analyses and chronological analyses provide essential information: comparison to references, priorization. The evaluation is a first phase, essential but not sufficient.

The stake analysis is the analysis of the accident research evaluation resulting in the determination and priorization of the stakes.

Accident research evaluation - stake analysis



Les différentes étapes de l'étude d'enjeux	The different stages of the stake analysis
Bilan accidentologique de la situation existante	Accident research evaluation of existing situation
Rechercher les enjeux et les approfondir	Determine stakes and study them in-depth
Connaître	know
Analyse du bilan	Evaluation analysis
Enjeu	Implication
Approfondissement des enjeux	In-depth study of stakes
Mieux connaître	know clearly
Enjeu ciblé	Targeted implication
Hiérarchisation des enjeux	prioritization of stakes

Data

Accident data

Various accident files are available. For the stake analysis, the source of accident data is the complete traffic injury file (🛠2). It is very strongly recommended to have **a reliable file, therefore verified and corrected if required**. A systematic return to the police report (PV) for the amendment may be a complex task but it ensures data reliability and therefore **improved stake analysis quality**. The verification and **corrections,** if applicable, of the accident file are a fundamental upstream phase in data preparation (see [8]).

The recommended study period is 5 years: this is generally both long enough to be statistically significant and short enough to group the five years together. In some cases in which the number of accidents is particularly high, three years may suffice. In any case, the homogeneity conditions need to be verified.

In the BAAC, an accident is described via:

Users and vehicles	Location	Time	Conditions
User type,	Junction,	Day/night,	Lighting,
Age, Sex,	Bend,	Month,	Roadway condition,
Maneuver, …	Obstacle, …	Time, …	Weather conditions, …

In fact, an accident involves users (with their vehicle) characterized by their age, number, etc. in a location characterized by the type of road, municipality, etc. at a time characterized by the time, day, month, etc., subject to lighting, weather conditions, roadway condition, etc.

The stake analysis examines these different factors in accidents. Without extending to statistical data analysis methods, combinations of accident data and additional data already make it possible to obtain conclusive results, particularly by means of electronic database management tools and Geographic Information Systems (SIG).

Additional data with respect to accident data

Depending on the studies, other types of data will be combined with the accident data, particularly for the in-depth study of the stakes: traffic data or demographic data (population according to age group, municipality, etc.), network-related information (road type, etc.), or behavioral data (speed, wearing of seat belt, etc.).

More detailed processing of some of these data will be performed within the scope of diagnoses.

Information from the Visage database may be incorporated by means of an SIG.

The stake analysis examines various items of information characterizing an accident: users, vehicles, location, time and conditions, separately and via combinations.

- remember to amend the Baac.
- the study period is generally 5 years.

Tools

In order to process these data, an accident database manager is required. The **Concerto** software was designed for this purpose. It makes it possible not only to amend the accident database (which is not the subject of this guide) but also to perform various processing operations and analyses: one or two-entry tables, statistical analysis, mapping representation and geographic analysis using the SIG installed.

Failing Concerto, the use of other database managers may be envisaged.

The **Road Information System** (SIR) offers a set of tools and data associated with road network management and operation. In particular, the SIR makes it possible to obtain the description of the road network and bollards using the Inter-Urban Reference Exchange Model (*Modèle d'Echange du Référentiel InterUrbain* MERIU). A road reference conforming with the MERIU (an InterUrban Reference, (*Référentiel InterUrbain*) RIU) proposes a geographic representation of the road network, generally based on BDCarto distributed by the National Geographic Institute (*Intitut Géographique National* IGN) and the information required for the location of road data by PR + Abscissas (reference point).

Irrespective of the phase in progress in the stake analysis (in-depth study or not), it is necessary to pay particular attention to the display modes of this entire analysis, which frequently takes on an important educational dimension if this phase is to be pooled and validated.

Remember maps and graphs (🛠 9).

2. Accident research evaluation of existing situation

Purpose:

- publish the data used in the form of mapping, graphs and calculated.
- answer the questions:
  - how many are involved?
  - who is involved?
  - where are they involved?
  - when are they involved?

Content:

compilation of processing results from BAAC data in table, map (location), graph and curve form.

Implementation (🛠 3):

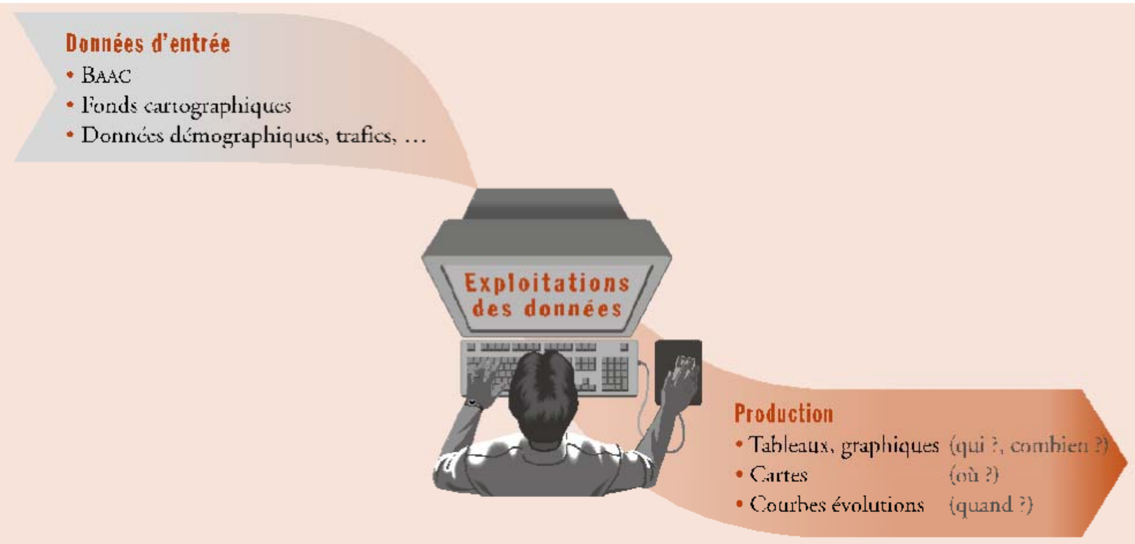
This consists of thematic accident counts, their spatial distribution, their chronological trends, etc. or already existing indicators (IAL).

Software programs such as Concerto offers automatic processing such as summary sheets, management charts. On-demand maps and tables complete the evaluation.

In the case of Accident Accumulation Areas (*Zones d'Accumulation d'Accidents* ZAAC), rates, densities and severities, these data may require additional compilations and combinations with exogenous data (rate calculation).

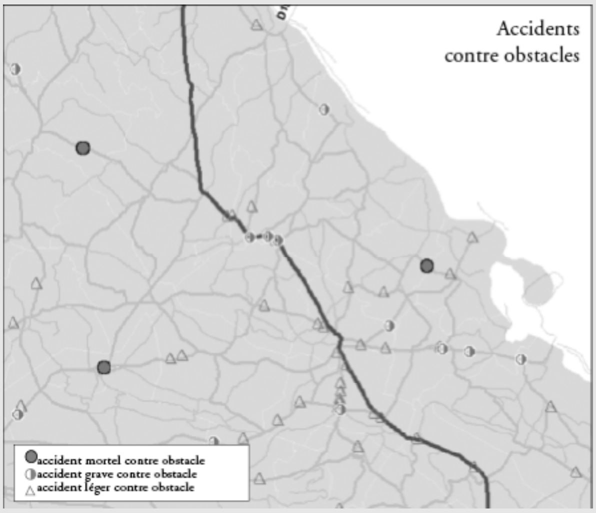
Precautions:

- the study period is general 5 years.
- for rate and density calculations, be aware of sectioning! (🛠 4)



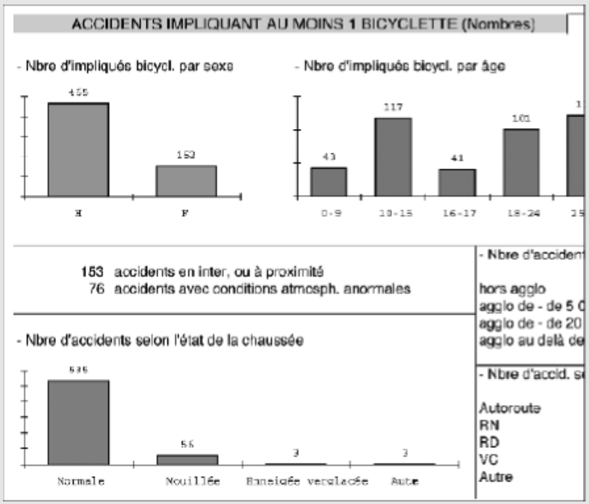
Données d'entrée	Input data
BAAC	Extraction of the police report containing detailed information on the vehicle, the driver and the infrastructure
Fonds Cartographiques	Cartographic backgrounds
Données démographiques, trafics, ...	Demographic data, traffic, etc.
Production	Production
Tableaux, graphiques (qui?, combien?)	Tables, graphs (who?, how much?)
Cartes (où?)	Maps (where?)
Courbes évolutions (quand?)	Trend curves (when?)
Exploitation des données	Data processing

Examples of constituent items in an evaluation



Source: Concerto (tables and maps)

Accidents contre obstacles	Accidents against obstacles
accident mortel contre obstacle	fatal accident against obstacle
accident grave contre obstacle	serious accident against obstacle
accident léger contre obstacle	minor accident against obstacle

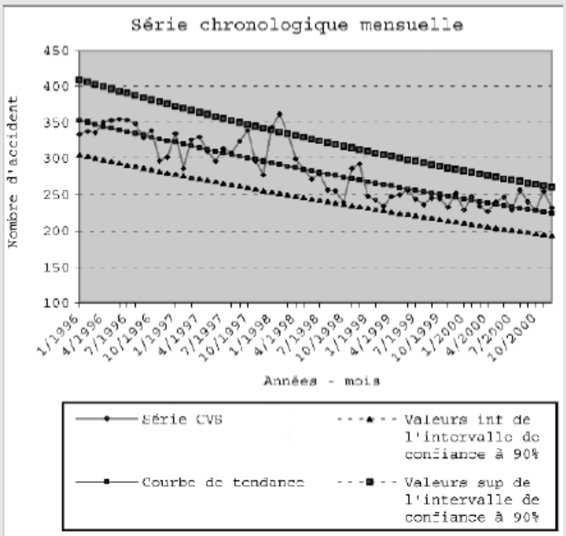


Excerpt of management chart

ACCIDENTS IMPLIQUANT AU MOINS 1 BICYCLETTE (Nombres)	ACCIDENTS INVOLVING AT LEAST 1 BICYCLE (Numbers)
Nbre impliqués bicycl. par sexe	No. involved with bicycle. by gender
Nbre impliqués bicycl. par age	No. involved with bicycle. by age
accidents en inter. ou à proximité	accidents at inter. or in vicinity
accidents avec conditions atmosph. anormales	accidents under abnormal weather conditions
Nbre accidents	No. accidents
hors agglo	outside built-up area
agglo de - de...	built-up area with <…
agglo au delà de	built-up area with over…
Nbre accidents selon l'état de la chaussée	No. accidents according to roadway condition
Normale	Normal
Mouillée	Wet
Enneigée verglacée	Snowy icy
Autre	Other
Autoroute	Motorway

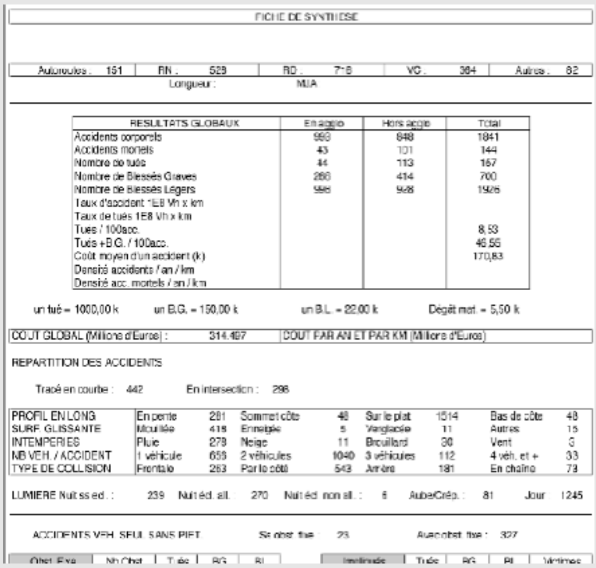
The evaluation is the processing phase for the **accident data**:

- alphanumeric (tables and graphs);
- spatial (maps);
- time (trend curves).



trend curve

Série chronologique	Monthly chronological series
Nombre d'accidents	Number of accidents
Années - mois	Years - months
Série CVS	corrected series exempted from seasonal variations and weather effet
Courbe de tendance	Trend curve
Valeurs inf de l'intervalle	Lower 90% confidence interval values
Valeurs sup de l'intervalle	Upper 90% confidence interval values



FICHE DE SYNTHESE

Autoroutes : 151	RN : 528	RD : 716	VC : 384	Autres : 82

Longueur : MJA

RESULTATS GLOBAUX	En agglo	Hors agglo	Total
Accidents corporels	993	848	1841
Accidents mortels	43	101	144
Nombre de tués	44	113	157
Nombre de Blessés Graves	286	414	700
Nombre de Blessés Légers	998	928	1926
Taux d'accident 1E8 Vh x km			
Taux de tués 1E8 Vh x km			
Tués / 100acc.			8,53
Tués +B.G. / 100acc.			46,55
Coût moyen d'un accident (k)			170,83
Densité accidents / an / km			
Densité acc. mortels / an / km			

un tué = 1000,00 k un B.G. = 150,00 k un B.L. = 22,00 k Dégât mat. = 5,50 k

COUT GLOBAL (Millions d'Euros) : 314.497	COUT PAR AN ET PAR KM (Millions d'Euros)

REPARTITION DES ACCIDENTS

Tracé en courbe : 442 En intersection : 296

PROFIL EN LONG	En pente	281	Sommet côte	48	Sur le plat	1514	Bas de côte	48
SURF. GLISSANTE	Mouillée	418	Enneigée	5	Verglacée	11	Autres	15
INTEMPERIES	Pluie	278	Neige	11	Brouillard	30	Vent	3
NB VEH. / ACCIDENT	1 véhicule	656	2 véhicules	1040	3 véhicules	112	4 véh. et +	33
TYPE DE COLLISION	Frontale	263	Par le côté	543	Arrière	181	En chaîne	73

LUMIERE Nuit ss ecl. : 239 Nuit écl. all. : 270 Nuit écl. non all. : 6 Aube/Crép. : 81 Jour : 1245

ACCIDENTS VEH. SEUL SANS PIET. Ss obst. fixe : 23 Avec obst. fixe : 327

Obst. Fixe	Nb Obst	Tués	BG	BL		Impliqués	Tués	BG	BL	Victimes

Summary sheet

IAL =1.2
IAL RN = 1.3
IAL RD = 1.05

IAL values

3. Analysis of evaluation and in-depth study of stakes

This phase is both essential and difficult. It does not consist in starting the diagnosis: it is necessary to remain at knowledge level (spatial, chronological and thematic breakdown) without attempting to understand the accident sequence. The analysis and in-depth study of the stakes fall within the scope of an iterative approach. The in-depth study of an implication is an analysis relating only to a specific subject (evaluation and analysis of this evaluation). Exogenous data may in particular be introduced for this in-depth study.
The added value of the study manager lies in the analysis of the tables, graphs, maps and statistical tests: comments accompanying the result should highlight the main feedback from the analysis.

Purpose:

- determine the significance of stakes associated with each target;
- obtain a comparison with references;
- clearly determine: the types, locations, time-related trends of the stakes.

Content:

- comparison of results of evaluation to references;
- combination with other characteristics:
  - time;
  - thematic;
  - spatial;
  - etc.

Precautions:

- the choice of the reference is essential as it affects the results and the conclusions (🛠5);
- the statistical tests are essential for the detailed interpretation of the comparisons (🛠7);
- for rate, density and severity calculations, be aware of sectioning (🛠4).

Implementation:

Each target will be analyzed. A target is a subset of accidents, relating to a theme (infrastructure, user type, accident type, etc.) or a spatial zone (routes, sections, junctions, municipalities, etc.).
The analysis is carried out in several stages:

- **stage 1**: record in the evaluation the number of accidents (according to severity) and the number of victims (according to severity) (🛠6). These numbers may be referenced to risk exposure measurements if required:
  - for road or route sections: the linear or route (🛠6); which requires sectioning (🛠4);
  - for the breakdown by age group: breakdown in the population;

• **stage 2**: define one (or more) reference(s) (🛠5);

• **stage 3**: compare the numbers from the evaluation to the selected references with a statistical significance test (🛠7):

– comparison of percentages (thematic analysis);
– rates and densities (spatial risk analysis);
– trends (chronological analysis).

• **stage 4**: perform combined thematic, chronological and spatial analyses:

4.1. for the analysis of the themes:

– observe and comment on the spatial distribution map (are there locations where the accidents stemming from the theme under study are particularly concentrated?);
– analyze the time-related trend of the theme (what is the trend?);
– analyze the breakdown of the theme items (breakdown of accidents against a stationary obstacle according to the type of obstacles);
– combine with other themes and other data.

4.2. for the spatial area analysis (sections, municipalities, routes, etc.):

– calculate the percentages of certain types of accidents;
– compare to references with a statistical test.

Three types of statistical analyses are used (7).

Thematic analysis

• highlights **the major themes** (predominant shares);

• studies some **local specificities with reference to reference values** by carrying out statistical tests.

Examples of questions addressed by the thematic analysis:
• is the % of night-time accidents on the route in question significantly higher than at district-level?
• is the % of night-time accidents significantly higher in built-up areas than in the open country?

Chronological analysis

This is used to:

• ascertain the **structural trend (fundamental trend)** and vary the study periods to determine how the trend evolves;

• ascertain the **cyclic trend** in order to highlight reversals of trends and the "recent" trend;

• **compare** chronological series from different themes.

Examples of questions addressed by the chronological analysis:
• What should be said about the trend of accidents on the site in question with respect to a reference?
• Is the number of accidents on the decline or on the rise?

Spatial analysis

This is used to:

• **detect hazardous areas, routes or spots**;

• analyze **the breakdown** of some themes.

The guide "Contribution of road safety statistics on a local level - Using the Concerto statistical tool correctly" [10] explains in simple terms these three types of thematic, chronological and spatial analyses (7).

• take care when dealing with small figures: statistical analyses must be performed with significance tests (7);
• take care with the choice of reference (5).
The evaluation analysis approach is iterative and makes it possible to target the stakes by studying them in-depth.

Example of in-depth study of analysis of accidents against stationary obstacles in the open country

Study period: 1996-2000

Study area: open country

Selected reference: same network on similar districts

In total, in the area under study: 4128 accidents

Definition: In this case, accidents against stationary obstacles are accidents in which a vehicle has struck a stationary obstacle including: tree, wall/building/pier, post and parapet.

Accidents against obstacles: 482 accidents, 101 deaths, 276 serious injuries and 407 minor injuries.

	No. of accidents against stationary obstacles	% of accidents against stationary obstacles	% of serious accidents among accidents against stationary obstacles
Study area	482	12 %	61%
Reference		8 %	50%
Statistical test		TS+	TS+

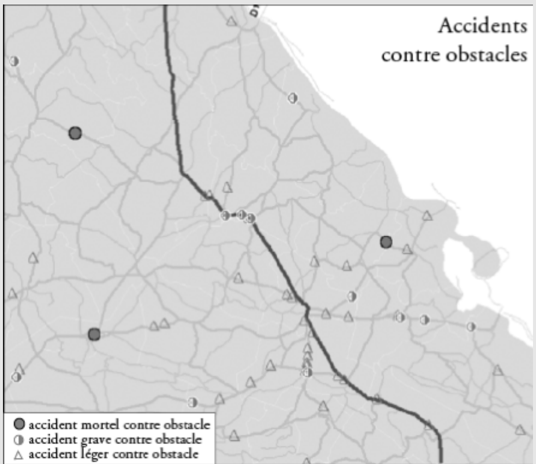
The % **of accidents against stationary obstacles is very significantly greater than the reference**, and the severity (expressed as a % of serious accidents).

Cost of accidents against obstacles in year 2000 value for the period 1996- 2000: 150 000 ke, i.e. on average 320 ke per accident against an obstacle.

Excerpt of map of breakdown of accidents against stationary obstacles:

A map of the location of accidents against stationary obstacles according to severity makes it possible to identify certain routes or sections where this type of accidents are particularly concentrated.

Visually, two areas appear to concentrate accidents against obstacles.



Accidents contre obstacles	Accidents against obstacles
accident mortel contre obstacle	fatal accident against obstacle
accident grave contre obstacle	serious accident against obstacle
accident léger contre obstacle	minor accident against obstacle

In-depth study:

1. type of obstacle:

Type of obstacle	No. of accidents on area under study - No. of serious or fatal accidents	% of accidents of this type (ref: reference %) - result of statistical test if significant	% of serious or fatal accidents (ref: reference %) – result of statistical test if significant
Wall	137 – 84	28 % (ref: 30%)	61 % (ref: 61%)
Tree	188 – 124	39 % (ref: 38%)	66 % (ref: 61%)
Post	**135** – 72	**28 % (ref: 23%) - TS+**	53 % (ref: 61%) S-
Parapet	22 – 12	5 % (ref: 9%)- TS-	55% (ref: 61%)

It was chosen to use the average severity on the area under study for accidents against obstacles as the reference for severity. Reading ("wall" row, "137 – 84" column): there were 137 accidents against walls, including 84 serious or fatal accidents. Reading ("wall" row, "28 % (ref: 30%)" column: the 137 accidents against walls represent 28% of accidents against obstacles while, for the reference, accidents against walls represent 30% of accident against obstacles. Reading ("wall" line, "61% (ref: 61%)" column: 61% of accidents against walls are serious or fatal accidents. Also, 61% of accidents against obstacles in general are serious or fatal accidents.

Comments: 4 out of 10 accidents against obstacles occur against a tree, a similar proportion to the reference proportion. Accidents on posts are proportionally more frequent than the reference, but slightly less serious.

2. Combination with other themes:

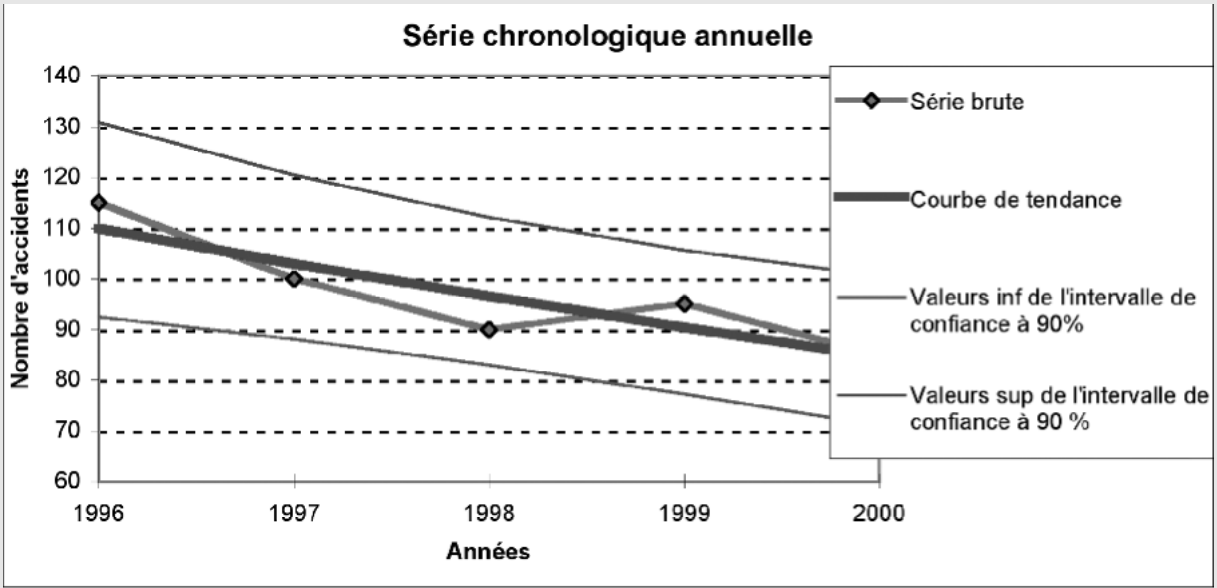
Accidents relating to theme and against obstacles: number, % of accidents against obstacles, result of statistical test if significant		
Theme	Area under study	Reference
In bend	175 - 36 %	33 %
vehicle only with no pedestrians	**409 - 89 % - TS+**	63 %
Involving heavy goods vehicles	9 - 2 % - TS-	9 %
On wet road	130 - 27 %	26 %
Involving motorcycle	25 - 5 % - TS-	9 %

Reading ("vehicle only with no pedestrians" row, "area under study" column): there were 409 accidents against obstacles involving a vehicle only with no pedestrians. These accidents represent 89% of accidents against obstacles, which is very significantly higher than the reference.

Comments: nine out of ten accidents involve a vehicle only with no pedestrians. This proportion is markedly higher than the reference.

3. Trend in number of accidents against obstacles in the last 5 years.

The model used is a multiplicative model.



Série chronologique annuelle	Annual chronological series
Nombre d'accidents	Number of accidents
Série brute	Unprocessed series
Courbe de tendance	Trend curve
Valeurs inf de l'intervalle de confiance à 90%	Lower 90% confidence interval values
Valeurs sup de l'intervalle de confiance à 90%	Upper 90% confidence interval values

The trend of downward: there is **a very significant decline of 6% on average per year** over the period 1996 – 2000.

4. Priorization of stakes

This is the final phase of the stake analysis. It requires a multi-criteria analysis on technical aspects. The final priorization will be the result of discussions between the parties concerned (8). It will provide the information required for the diagnosis contract. The technical part represents a significant decision-making item for the final priorization: it is a significant decision-making tool.

Purpose:

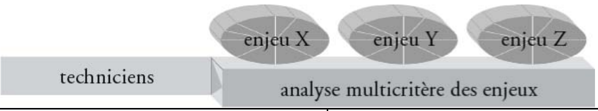
- summarize the previous analysis;
- define a priorization of stakes which obtains the support from the various parties involved and the validation of the decision-maker;
- form an essential item for the diagnosis contract;
- set calculated and measurable safety targets.

Content:

- technical summary (multi-criteria analysis with indicators);
- consultation and view sharing resulting in a priorization of the stakes validated by the sponsor and in safety targets.

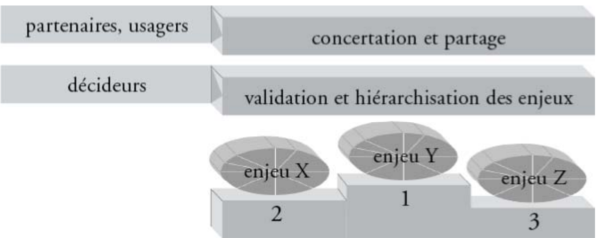
Implementation:

Part 1: technical



techniciens	technicians
enjeu	implication
analyse multicritère des enjeux	multi-criteria analysis of stakes

Part 2



partenaires, usager	partners, users
concertation et partage	consultation and view sharing
décideurs	decision-makers
validation et hiérarchisation des enjeux	validation and priorization of stakes

Precautions:

- The choice of indicators must be based on arguments, purely technical arguments and/or arguments including specific guidelines from the decision-maker (*see* 1.2);
- Calculated tables do not always represent suitable material for view sharing. However, maps, graphs and curves generally represent an effective form of communication (9).

It is advisable to communicate the results of the determination of the stakes to decision-makers: it is their responsibility to initiate consultation with users to obtain a pooled structure of the stakes.

Decision-makers' constraints frequently extend outside the scope of safety per se. Therefore, other factors should be taken into consideration: appropriateness within the scope of other operations, acceptability by users, financing, etc.

The multi-criteria analysis is a summary of the previous stages. A number of technical criteria are often taken into account:

- accident research indicators (thematic %, rate, density, severity);
- difference with respect to reference;
- cost of safety problems, potential cost savings.

Depending on the study, several structures may be proposed: one for themes, one for areas liable to accidents.

For the non-technical part, other criteria will be taken into account. The contract should specify who is responsible for this final stage. Non-technical criteria (to be evaluated with specialists in the areas concerned) may be of the following type:

- national policy, local policy;
- financial opportunity;
- social acceptability;
- pressure from society, etc.

At the stake analysis stage, while no solution has been proposed, social pressure may exist, for example for improved inclusion of motorcycle accidents.

Each implication selected may be associated with a safety target.

Examples of safety targets:

- eliminate a ZAAC;
- refer to a reference: bring back the severity of heavy goods vehicle accidents to the average severity of heavy goods vehicle accidents in the region;
- halve the number of pedestrian deaths;
- decrease the number of accidents against obstacles by 30%;
- bring back the rate for a route to the average rate for the district.

Conclusion

The stake analysis is the first essential stage in a road safety study. It provides the decision-maker with an accurate view of the accident research for the region on the basis of observed and objective information. According to his/her expertise, resources and interests, the decision-maker structures the various stakes determined and initiates the second phase with a contract for a road safety diagnosis.

Quick references

Quick reference 1
How to handle the stake analysis contract?

It is not possible to draw up a standard contract specifications document. Each stake analysis has its own specific aspects. This quick reference firstly summarizes the general principles about the order and then suggests items for the drafting of an stake analysis specifications document.
The problem of the in-depth study of the stakes essentially arises. In fact, in general, at the time of the study contract, it is not known which stakes will need to be studied in-depth, as sometimes only the stakes selected by the decision-maker will be studied in-depth. The methodology to be followed should be specified in the specifications.

1. Preliminary principles for contract formulation

The study "director" is, in this case, referred to as the study manager.

Identify the source of the contract:

- the reasons leading to this contract (media campaign following an accident, national contract, request from local authority, etc.);
- the owner for the study, its explicit or implicit motivations.

Explain the purpose of the contract:

- they must be clearly specified by the owner, to avoid any ambiguity and propose a suitable approach.

Define the scope of the contract, handle constraints:

For this purpose, the study manager must define:
- the geographic and thematic perimeter;
- the availability, accessibility of data and BAAC data quality;
- the "approach / resources" suitability (human, material, expertise, data, etc.);
- the verification of consistency with the contract's targets.

Reformulate the contract:

- the study manager reformulates the request as precisely as possible in suitable technical terms, particularly accounting for the constraints and initial targets;
- the sponsor validates this new formulation which then becomes the contract.

Identify the parties involved and partners:

- this consists of listing, from this stage, and as exhaustively as possible, the parties and partners concerned by the study (Municipality, district technical units, elected representatives, associations, etc.) and the stages at which they should be contacted.

Draw up an estimated schedule and a budget:

- phasing of stop points and association of parties involved;
- funding.

Specify the type of report expected and the methodology to be followed:

- this consists in both the content of the final report, but also the study process.

2. Items for drafting specifications

This information is given as an indication and must always be adapted to each study.

Context

The (*sponsor of the study*) concerned by road safety problems (*specify area*), has decided to set up a plan of action to reduce the number of road traffic accidents and their victims. Prior to the implementation of concrete actions, and in order to render them more relevant and more effective, the (*sponsor of the study*) wished to know the most significant stakes on which to focus its actions.

Purpose of study

The purpose of the study is to conduct an stake analysis, used to determine road safety problems (*specify area*) during the period xxxx-xxxx, and propose information to the sponsor enabling it to structure the stakes and select those on which it feels it would be most appropriate to act by subsequently carrying out an in-depth diagnosis in order to build a plan of action.

Parties involved (or partners)

The study will be conducted by (*quote unit*) under the ownership of (*sponsor of the study*). The various partners concerned by road safety problem measures that the (*sponsor of the study*) has wished to associate with its approach will be informed of the various stages of the study and informed of its results. These parties will be associated in the form of a (*follow-up committee, steering committee, AGM, individual interviews, etc.*). These partners are: (*list of partners*)

Content of study

The stake analysis to determine road safety problems comprises:

- processing of the electronic road traffic accident file (BAAC file) during the period xxxx-xxxx;
- processing of exogenous data such as: traffic, population, vehicle fleet, etc;
- study and determination of stakes;
- priorization of stakes.

In this section, it will probably be necessary to reproduce the items in the section "Items to be provided by the sponsor of the study or to be prepared by the engineering firm" (page 34) **relating to the existing data:**

- **data supplied by the sponsor (with their quality),**
- **what is expected from the contractor in terms of data: amendment of accident file (only of the location of the accidents at zero PR or all PRs), compilation of demographic data, construction of references, etc. Also, if a specific method is recommended, it should be specified: are statistical tests required on the thematic analyses, structural, economic chronological analyses, etc.?**

Study overview

At the end of the study, the (*quote the study contract holder unit*) will submit a detailed report in x copies, including 1 reproducible copy. In addition, a copy of all the data compiled will be forwarded to (*quote sponsor or study*).

The report will follow the following outline:

- study context
- purpose of study
- parties involved (or partners)
- content of study
- stake analysis
  - processing of data
  - data analysis
  - thematic analysis
  - chronological analysis
  - spatial analysis
  - in-depth study on some themes
- summary
  - list of stakes
  - priorization of selected stakes
- appendices
  - working documents used: maps, tables, etc.

Meetings

It is important, from the outset, to plan meetings with a schedule and their precise content (provide details in the specifications). For example, the following meetings may be planned:

- a study presentation and start-up meeting;
- a stage meeting with the partners for the presentation, validation of the analysis of the evaluation and the choice of indicators for the multi-criteria analysis;
- a priorization stake presentation and validation meeting;
- a study report meeting with the partners.

The secretarial role for these meetings will be carried out by (specify person).

Items to be provided by the sponsor of the study or to be prepared by the engineering firm

Naturally, this list depends on the area covered by the stake analysis; however, these items may include:

- the updated BAAC file for the study period. Clearly specify if it has already been amended, if it needs to be amended, if applicable, how, which sections, etc.;
- the studies already completed;
- the Road Data Base (*Banque de Données Routières,* BDR);
- the various drawings and maps required;
- the traffic data;
- the network sectioning;
- the exogenous data: which? Who should research them?...
- the various projects in progress liable to relate to traffic or road safety problems;
- the references - clearly specify which need to be selected, those in existence and those to be constructed.

For each of these data items, it must be specified whether they are to be provided by the sponsor or, on the other hand, to be compiled, drafted, constructed by the study manager. **In any case, it is essential to attach particular importance to:**

- **data specifications;**
- **the quality of the data supplied and their media;**
- **the work expected from the engineering firm on these data in terms of compilation, amendment and usage.**

Deadlines

To be specified

Study total and payment terms

To be specified

Termination of contract

To be specified

Intellectual property

To be specified

Quick reference 2
Accident file for stake analysis

Within the scope of the stake analysis, the accident file to be used is the BAAC (Traffic Injury Analysis Report) type file. It consists of a categorized summary of accidents based on the accident reports.
Each section of the BAAC is completed by the police. For the majority of the sections, it is necessary to check the relevant option (for example, for the vehicle type, the following options are available: light vehicle, bicycle, side-car, etc.). For some sections, the information to be entered is free: time of accident, date, road number, etc.
In view of the changes in progress on the accident file at the time of writing of this guide, additional information will need to be compiled at a later date.

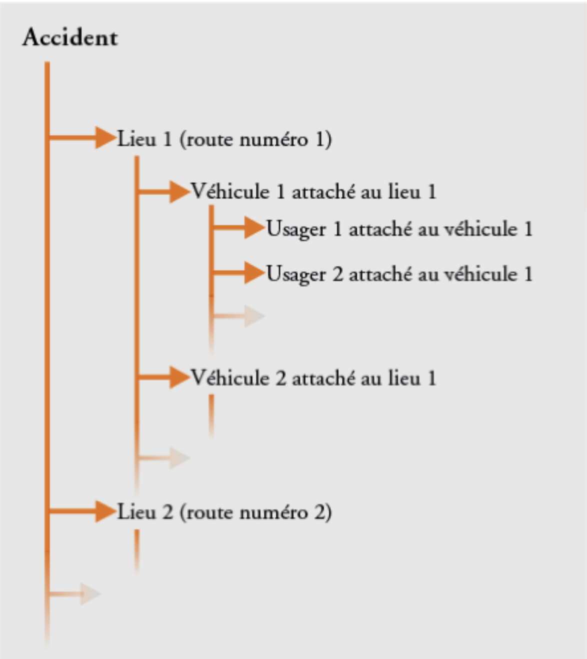
1. Up to December 2003, two BAAC file formats ("BAAC 93")

Two formats were encountered: the complete file (also referred to as 102 characters as each accident is encoded over several lines, with each line being 102 characters long) and the simplified file (also referred to as 370 characters as each accident is encoded over a 370-character line). **The complete file must have absolute priority**: in fact, in contains more information and does not involve any drawbacks for processing. The use of the simplified file has impacts in some processing operations: locations, users, vehicles, will be missing.

The simplified file only describes 2 locations, 3 vehicles and 4 users (plus 1 pedestrian) but its "summary" (total number of victims of accidents specified in one section) is complete. As a result, during a processing operation relating to the age of the users for example, only 4 user ages are described for each accident. If more than 4 are involved in an accident, only 4 ages will be accounted for. In this case, errors will be observed in some totals.

Therefore, the files are names as follows:

- **complete Baac 93** (or BAAC 93 - 102 characters);
- **simplified Baac 93** (or BAAC 93 - 370 characters).



Accident	Accident
Lieu 1 (route numéro 1)	Location 1 (road number 1)
Véhicule 1 attaché au lieu 1	Vehicle 1 associated with location 1
Usager 1 attaché au véhicule 1	User 1 associated with vehicle 1

2. Since January 2004, "BAAC 2002"

Within the scope of an accident file upgrade project, **since January 1, 2004**, the police input accidents in a new type of file, referred to as "**Baac 2002**". The distinction between 102 characters and 370 characters no longer applies. The description is still made on 4 levels (characteristics, locations, vehicles, users), but some variables have been removed, others amended and others added.

3. BAAC file description

The content of the BAAC selected for input from January 1, 2004 is presented below.

Some variables are qualified as "priority"; below, "non-priority" variables are marked in *italic type*. For the other sections, the police have the option of contenting themselves with non-exhaustive information for **very minor accidents**. This is conveyed, in the input program, with an option, for minor accidents, not to complete these sections not marked "priority". Quality follow-up to determine the actual completion trend for these sections is in progress at the time of writing of this guide.

The other changes are indicated by △ (changes other than the "priority" characteristics). These various changes are given at the end of the list. The variables removed are not given.

The single **identifier** for each accident recorded consists of:

- the issuing organization (state police, Paris police headquarters, CRS, Air and Frontier Police, Public Safety);
- the issuer's Unit Code;
- the police report (PV) number.

The **characteristics** section consists of general fields:

- the date, day of the week and time;
- *the brightness at the time of the accident;*
- the INSEE numbers of the district and municipality;
- the general location of the accident (outside or in built-up area, size of built-up area);
- *the intersection code (outside or in intersection and intersection type);*
- the weather conditions;
- the type of collision (head-on, rear-end, etc.);
- the geographic coordinates △.

The **locations** section enables a description of the locations of the accident (for junctions, at least two locations are described):

- the road and street category (motorway, state highway, district, municipality roads, etc.);
- the road or street number in urban environments, road number in interurban environments;
- *the traffic conditions (one-way, two-way, etc.);*
- *the total number of traffic lanes;*
- *the existence of special lanes △ (cycle track, bus lane, etc.);*
- *the longitudinal section;*
- the Reference Point in intercity environments and the distance to this PR;
- *the horizontal alignment;*
- *the width of the roadway and the central reserve;*
- *the surface condition (normal, wet, icy, etc.);*
- *the type of infrastructure design (tunnel, slip road, etc.);*
- *the location of the accident (on roadway, path, shoulder, etc..);*
- *the proximity of a school point △.*

The **vehicles** section specifies the following items for each vehicle:

- *hit-and-run driver or vehicle △;*
- *the direction of traffic (with respect to PRs);*
- the administrative category (light vehicle, commercial vehicle, heavy goods vehicle, motorcycle, etc.);
- *the vehicle registration district and the licensing date;*
- *the vehicle ownership;*
- *details of special vehicles (ambulances, fire engines, etc.)*

- *the accident factors potentially associated with the vehicle itself △;*
- *insurance validity;*
- stationary obstacles struck;
- *moving obstacles struck △;*
- *the initial point of impact (head-on, right rear-end, etc.);*
- *main maneuver prior to the accident;*
- the specific vehicle type (CNIT code)△;
- *for public transport, the number of people transported.*

The **Users** section consists of 15 items used to determine, for each user involved:

- *the position occupied in the vehicle;*
- *the responsibility of the user, if applicable;*
- the category △ (driver, passenger, pedestrian, skater);
- the severity of the injuries (death, serious injury, minor injury or no injury);
- the socio-professional group △;
- the gender;
- *the district of residence;*
- the date of birth;
- *the accident factors associated with the user's condition (faintness, tiredness, etc.);*
- the blood alcohol concentration and blood alcohol concentration level △;
- *drugs (type of screening and result) △;*
- *the license type △ and date of issue;*
- *the type of journey (home-work, etc.);*
- the existence and use of safety equipment (seat belt, helmet, etc.);
- *for a pedestrian accident:*
  - *the precise location of the point of impact (proximity of pedestrian crossing, pedestrian crossing signaling, on footpath, etc.);*
  - *the action in progress (direction of route, crossing, etc.) and accompanying measures.*

List of changes associated with △:

- the geographic coordinates section is new;
- the existence of special lanes: previously, the reference was "special lane";
- the proximity to a school point: the relevant section in the BAAC 93 was "environment" and had other options;
- hit-and-run driver or vehicle: in the BAAC 93, only the section "hit-and-run vehicle" existed;
- vehicle-related factor: the "fire" option has been added; - moving obstacle struck: in the BAAC 2002, a distinction has been made between the two options "wild animal" and "domestic animal", while they were grouped together in the BAAC 93.
- the vehicle type (CNIT code): this section did not exist previously under the encoding format;
- the user category: the "skater" option is new;
- the socio-professional group: the "student" option is new;
- the blood alcohol concentration and blood alcohol concentration level: in the BAAC 2002, the level must be entered even for blood alcohol concentrations below 0.5g/l;
- the drugs section is new;
- driver's license: there is a new option, accompanied driving.

These many changes will necessarily result in processing bias: for example, no accidents prior to 2004 will be entered with the student section as the "student" option did not exist.

Therefore, it is absolutely necessary to be very careful in any processing and analyses relating to the sections that have been amended or created.

4. The accident file has limitations

The quality of the completion is very variable and, therefore, some sections are to be processed with caution. There are problems on two levels: non-completion and incorrect completion. The main reasons are as follows:

• the options relating to severity (death, serious injury, minor injury) require the police to know the victims' status six days[1] after the accident;

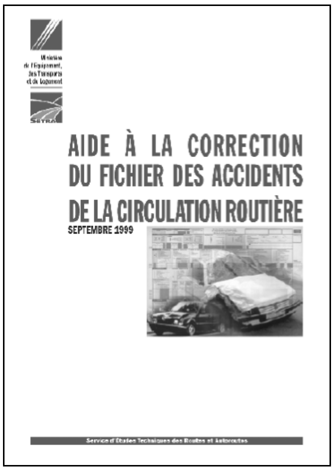
• the categorization is pre-defined and may sometimes be difficult to assess: for example, when does heavy rain change to light rain? During processing operations and their analyses, it is essential to take precautions with respect to the completeness and accuracy of the file. For example, if the horizontal alignment section is poorly completed for minor accidents, significant bias may be introduced. As a general rule, on both the BAAC 93 and BAAC 2002, it is necessary to know the completion rates for the various sections.

5. Amending the accident file

The BAAC production sequence is relatively complex and the final file obtained contains errors. Therefore, it is **necessary**, for most applications, **to verify this file and correct any errors**. In particular, the location of the accidents is frequently approximate or not entered [5]. For a large number of processing operations, it is necessary. For this reason, the road number, road category and PR sections must be verified and amended if applicable. If the police have not completed the PR section, it is automatically set to zero. **This amendment of the location** is essential to any processing such as the rate, density, or simply the cartographic reproduction of the accidents (only exception: breakdown by municipality). How is it possible to determine accident accumulation areas if the location is not reliable?

The purpose of the guide [8] is to assist units in amending the accident file.

Studies in progress on the location using geographic coordinates represent a potential improvement. Communication on a local level between the study managers and police staff should also be given priority.



6. Other accident data

Other sources of accident data are available: Accidents, Deaths, Injuries (ATB[2]), PVs, REAGIR investigations, or data from other partners (Ministry for Health, CRAM, etc.).

ATB reports

ATB[2] (accidents, deaths, injuries) reports represents a rapid reporting system, restricted to figures for personal injury accidents, deaths and injuries. This system, which was set up during 2000, makes it possible, pending the consolidated data, to obtain an inventory of the situation, only a few days after the end of the period in question. These data, which are now generalized and available in county halls and nationally, are used to publish a monthly accident research barometer. These quick indicators are not the subject of verification. This system makes it possible to determine the numbers of accidents, deaths and injuries more rapidly than the BAAC, but it is not as reliable.

[1] Since 2005, severity degrees have been modified to : death, hospitalization, minor injury ; death being recording within 30 days after the accident ; hospitalization being declared after 24 h hospital admission including actual medical care and minor injury definition being unaltered

[2] Since 2005, ATBH (accidents, deaths, hospitalizations)

Police reports

The PV (Police Report) is much more comprehensive and particularly contains information on the circumstances of the accident, the factors via statements from the parties involved and witnesses, and the diagram of the accident. These are essential data for the drafting of the diagnosis.

REAGIR investigations and "understand in order to act"

The "Response via Investigations on Serious Accidents via Initiatives to Remedy the situation" investigations (REAGIR) can complete the information from the PVs as they are frequently more comprehensive. Conducted on the instruction of the county hall by a multidisciplinary team of IDSR (*Inspecteurs Départementaux Sécurité Routière,* District-level Road Safety Inspectors), the purpose of the REAGIR investigation is to determine the causes of the accident (listed in a questionnaire and in a report). The IDSR are investigators appointed by the county hall who have received specific training. This system was created in response to road carnage in 1983 to make up for the deficiencies of the BAAC in terms of factors causing the accident. A database compiles all the Reagir investigations completed. **They are not used frequently within the scope of implication studies**. The REAGIR program became "Agir pour la Sécurité Routière" (Act for Road Safety), on October 1, 2004, with a view to obtaining more detailed knowledge of road safety problems on a local level with the "Understand in order to act investigations" program (*Enquêtes Comprendre Pour Agir,* ECPA), and increased mobilization of the local parties involved.

Link and consistency between data and tools

A number of tools and methodological approaches have been developed and devolved for these different data items. To provide a link between these data, the data layers inter-communicate via the accident identifier. In this way, when searching for the police reports corresponding to a selection from Concerto, the latter may be used to export the list of identifiers which will serve as a query in a software program called COPRA (Accident Procedure Consultation) to locate the corresponding police reports, or vice versa. As a result, the accident identifier is a very important item of information for communication between data.

Quick reference 3
Some tips for carrying out an evaluation

Preliminary note: it is necessary to determine the quality of the file on which the evaluation is performed and account for the limitations involved for the completion of the evaluation.

1. How to start?

With Concerto, some outputs are automatic. This is the case particularly of the summary sheets and topic sheets. Although they do not cover all the themes, they ensure that the majority are addressed. The Concerto user can then prepare as many tables as required on request.

As a general rule, the list of the following outputs can be drawn up. This **non-exhaustive** list initially makes it possible to cover a set of accident characteristics:

- the IAL for each network;
- an accident location map (according to severity, for example) and possibly thematic maps (pedestrian accidents, accidents against obstacles, accidents with alcohol, etc.);
- the Concerto summary sheets (general throughout the study area or specific to some locations or themes);
- the Concerto management charts (decision-maker and technician);
- the list of ZAACs with their representation on a map;
- the rates, densities and severities of the various sections with maps;
- the number of accidents per municipality (with the spatial representation);
- the numbers of accidents on some junctions.

Quick reference 6 (🛠6) summarizes the definitions of the various indicators. However, it is clear that the contract will guide the evaluation: by focusing it on some points, themes, or extending it to other items.

2. Questions to ask to avoid pitfalls

- *How confident of my data can I be? Which sections do I know to be generally unreliable? Has the location (PR) been verified?*

Answer:
  - amend the road numbers and the zero PRs;
  - if accidents remain at PR 0, remember to exclude them in the cartographic representations (in linear terms) and specify this;

- *Is the period on which I am working correct?* Answer: take 5 years if possible, identify the major changes over this period (infrastructural developments, opening of new lane, etc.). In some cases, a 3-year period may suffice (case of regions in which the number of accidents is very high).
- *Is it easy to find one's bearings in the evaluation proposed?*

Answer: avoid long-winded lists of tables; remember the maps and to compile the items in major themes; clearly mention the set of accidents the processing operation relates to (time period, road section, accident type). **If no information can be obtained from a processing operation, it is not necessary to provide the raw information**.

- *Is the sectioning correct?*

Answer: (🛠4) excessively short sections should be avoided (particularly if the accident location is not reliable).

Quick reference 4
Road network sectioning

1. Why sectioning?

Sectioning is performed for the rate, density and severity calculation on road sections (🛠6).

It is essential to:

• obtain homogeneous sections: so as not to aggregate a 2-lane section with a 2 x 2-lane section (rate, density, severity calculations and also for thematic analyses);

• subsequently make comparisons to references on the same type of road (🛠5).

2. How to section?

The criteria to be taken into account are as follows:

• traffic (type, quantity);

• urban environment / open country;

• cross-section.

On the national network, the Visage and Histo bases contain this information.

Generally, these data are sufficient to determine the sectioning but sometimes other criteria can be envisaged (speed limitation, landscaped environment, etc.)
The location is determined in terms of PR and abscissa.

In general, in order to obtain significant figures, **the lengths of the sections must be greater than 10 kilometers**.

Two methods are possible:

• use the traffic file in HIT format (with the Adonhis tool for Concerto) and adapt the sectioning to the field of road safety (criteria above);

• completely redo the sectioning on the basis of a map, identifying the changes in lane width and large built-up areas (small built-up areas may be included in the section and the percentage of accidents in built-up areas can be calculated as an indicator). The PR map is required in this case to determine the ends of the sections.

If the traffic is not known for several years (the rates, densities and severities are calculated over five years), it will be possible to work with an average traffic over the selected study period.

3. Precautions

• Avoid excessively short sections: in any case, avoid going below **3 or 4 kilometers**. It is advisable to have **at least 10 accidents** per section;

• What is the reliability of the data used for sectioning? Site landmarking may be necessary to identify the entries and exits of built-up areas and changes to cross-sections;

• In the case of works resulting in changes to the sectioning, the post-works period will be selected (for standard "before-after" studies, the reader may refer to [18]);

• For the district-level network, it is not necessary to work on the entire network. Only **the structuring network** (category one network, primary network) will be retained for the rate calculation;

4. With Concerto

Why does Histo sectioning pose a problem?

The sectioning used for counts sometimes changes from one year to another. This is not handled easily in Concerto. An Adonhis tool has been created to help solve the problems encountered. Firstly, it can break down the basic sections into identical subsections for all the years; secondly, it is used to form a file in Histo format "manually" very simply using Excel. This second solution may prove to be very useful as it makes it possible to combine several sections in order to comply with the sufficient section lengths. It consists of an easy-to-use macro in Excel.

Quick reference 5
References

1. Why compare?

The purpose of the stake analysis is to identify any accident research abnormalities on the road network studied on the basis of the data in the BAAC file. Abnormalities are defined as being types of accidents that are **abnormally frequent** on the network under study. They are declared as such compared to **a reference**. This abnormality is assessed statistically.

In this way, the analysis of the data will consist in comparing the types of accidents in the file under study with those of a reference.

This reference is selected by the author of the study. **The entire difficulty lies in its choice**. However, this choice is essential as it determines the relevance of the accident research analysis. The references may relate to accident typologies or indicators (rate, density, severity).

2. Possible references

There are different types of references:

- administrative reference: a district, a region, France as a whole;
- geographic reference: a sector consisting of several comparable departments;
- reference according to the environment: built-up area, open country;
- reference according to the road network: by road type (2-lane, 2 x 2-lane, 3-lane), category (state highway, district road).

These references may be combined (e.g. state highways in the open country in the Rhône-Alpes region). For references according to the environment or network, **the comparison must relate to identical sets** (the **2-lane roads** from the file under study compared to the **2-lane roads** in France for example or the state highways in the file under study compared to the state highways in the region, etc.).

3. Choice of reference

To make a comparison, there is a wide selection of references. **It is necessary to select the most relevant reference**; i.e. that which will enable the best characterization of the accident research on the road network under study.

Data availability is a decisive factor in the choice of reference (see section 4). In any case, **the reference must be of the same type as that of the sample under study**.

Example: in order to characterize accidents on wet roadways in the road network under study (state highways located in the open country):

- the type of reference is determined from the outset:
"accidents on wet roadways on state highways in the open country";
- the reference scale is up to the user's choice: district, region, France.

4. Sources of information

References can be extracted from various documents, in particular:

- annual reports published by the National Interdepartmental Road Safety Observatory (*Observatoire National Interministériel de Sécurité Routière* ONISR) [19];
- regular management charts from the Regional Road Safety Observatories (*Observatoires Régionaux de la Sécurité Routière,* ORSR);
- accident statistics on state highways and intercity motorways from 1970 to 2000 (working documents provided by the Sétra);
- ONISR/Sétra working document [20].

These documents are sometimes difficult to use as they only contain some of the references required for comparison purposes.

To be able to use all the references, it is essential to construct them and calculate them on request, on the basis of the BAAC file data for the selected reference:

• for example: on the basis of a set of so-called "reference" accidents (state highways in the Rhône-Alpes region, outside built-up areas with more than + 5000 inhabitants), the references are constructed (e.g. % serious accidents, % accidents on wet roadway, etc.).

5. Specific case of junctions: predictive models

Models defined by the National Research Institute on Transport and Transport Safety (*Institut National de Recherche sur les Transports et leur Sécurité,* INRETS) propose predictive numbers of accidents by junction type. They are used to measure the difference between a number of accidents on a junction and the predictive number of accidents. This predictive number of accidents will form the reference. The procedure is the same as with the accident rate. The formulas are as follows [6]:

Roundabout	Number of accidents $= J \times 0.15 \times 10^{-4} \times TE \times Fc$	J = No. of years TE = Incoming traffic as annual daily average Fc = coefficient defined below
Level junction	Number of accidents $= J \times 2.73 \times 10^{-5} \times Ts^{0.62} \times Tp^{0.51} \times Fbra \times Fvoie \times Fc$	J = No. of years Ts= secondary road traffic as annual daily average Tp = main road traffic as annual daily average Fbra = 2.18 in case of 4 arms, 1 in case of 3 arms Fvoie = 1.63 in case of 2 x 2 lanes, 1 otherwise Fc = coefficient defined below

The formula giving Fc is:

$$Fc = \frac{\text{median annual rate for study period}}{23.88.}$$

From 1995 to 2002, the values of Fc are as follows:

Year	1995	1996	1997	1998	1999	2000	2001	2002
Value of Fc	0.63	0.591	0.572	0.56	0.512	0.485	0.453	0.401

These formulas are applicable for level junctions located on main roads outside built-up areas.

6. Rate and density references (calculated on 1998-2000)

The references below were calculated on a national level on state highways (RN) and in the open country only (excluding motorways). These references were calculated on the basis of the accident files amended by the District-level Offices for Infrastructure (DDE) and count data based on the national road network traffic census. These are Sétra references.

RN in open country	2 lanes ≥ 7 meters	3 lanes ≥ 10.5 meters	2X2 lanes ≥ 14 meters
Rate (in 10^{-8} acc.veh^{-1}.km^{-1})	12.0	9.7	5.5
Density (in acc.km^{-1} per year)	0.35	0.43	0.43
% fatal accidents	17.60%	19.10%	13.30%
% serious accidents (no. of acc with at least one death or one serious injury/no. of acc)	51.50%	53.10%	39.10%

RN in open country Outside Intersection	2 lanes ≥ 7 meters	3 lanes ≥ 10.5 meters	2X2 lanes ≥ 14 meters
Rate (in 10^{-8} acc.veh^{-1}.km^{-1})	9.1	7.3	4.7
Density (in acc.km^{-1} per year)	0.27	0.33	0.37
% fatal accidents	19.80%	21.70%	13.50%
% serious accidents (no. of acc with at least one death or one serious injury/no. of acc)	54.50%	55.60%	39.60%

Quick reference 6
Road safety indicators

For the statistical analyses, it is necessary to work on indicators calculated on the basis of the ***number of accidents*** (the number of victims depends on the occupancy of the vehicles and the statistical laws used are not very suitable for statistical tests). In this case, in terms of communication, the figures are frequently given as a number of victims. Frequently, the use of an indicator alone has little relevance.

1. Unprocessed indicators

What is their purpose? Unprocessed indicators are used to quantify stakes in absolute values. Retaining an implication for which the thematic percentage is on the rise, significantly greater than the average, but only relates to very few accidents is irrelevant from a quantitative point of view (however, a political decision-maker may select it for other reasons).

The definitions are specified in quick reference ten (10). The following will be mentioned here:

- the number of personal injury accidents;
- the number of minor accidents;
- the number of serious accidents;
- the number of fatal accidents;
- the number of deaths;
- the number of serious injuries;
- the number of minor injuries.

Caution: in some studies, a **serious accident is considered to have resulted in at least one serious injury or one death**. In other studies, a **serious accident is considered to have resulted in at least one serious injury but no deaths**. For this reason, it is necessary to summarize the definitions used at the start of each study and verify that the selected indicators are the same as the references used.

2. Local Accident Research Indicators (IAL)

What is their purpose? IAL are used to situate a district with respect to the French average, accounting for network differences. In addition, they make it possible to compare the district's research overall according to network types.

The local accident research indicator compares the results of a district to their values if the district had the same risk level as France as a whole on these different networks. A distinction is made between five networks: the urban environment, motorways, state highways, district roads and other networks. The IAL for each district is defined with the following formula:

$$\text{IAL} = \frac{\text{No. of deaths}}{\begin{array}{c}\text{No. of deaths that district would have had if it had the same risk levels}\\ \text{as the national average while retaining local exposure}\end{array}}$$

In urban environments, the exposure is the population. In the open country, the exposure is the route.

The following simplified example enables a clearer understanding:

The exact compilation and calculation conditions for this indicator are given in the document [11].

Network indicators are also calculated. For example, for motorways, the formula is as follows: motorway IAL: no. of deaths on motorways in the district / no. of deaths that district would have had on motorways if it had the same risk level as in France as a whole while retaining local exposure.

The selected reference is the national level and the unprocessed indicator is the number of deaths per network type. The IAL are indicators with no possible statistical test for which the degree of uncertainty is not specified.

	Motorways	State highways	District roads	Total
No. of deaths in district	29	158	363	550 = 29+158+363
Travel in district (in 100 million vehicles.km)	56	48	113	
Risk rate for district	$0.52(=\frac{29}{56})$	$0.52(=\frac{158}{48})$	$0.52(=\frac{363}{113})$	
Rate for France as a whole for 100 million vehicles.km	0.50	2.08	2.1	
Deaths in district if rate for France as a whole	28(=0.5x56)	100(=2.08x48)	237(=2.1x113)	365 = 28+100+237
Relative risk of district (=risk of district / risk of France as a whole)	$0.52(=\frac{0,52}{0,50})$	$0.52(=\frac{3,29}{2,08})$	$0.52(=\frac{3,21}{2,1})$	

Result: Ial = 550/365 = 1.51

3. Severity indicators

What is their purpose? Severity indicators are used to assess the severity of a set of accidents and compare to a reference with statistical tests (thematic analysis).

Severity

This is the indicator used to assess the secondary and tertiary safety of an infrastructure, i.e. the consequences of accidents occurring in it.

There are **several definitions of severity** depending on whether the accidents or the victims are being studied. None of the definitions are more "accurate" than the others. It is simply important to note that, for statistical tests, it is necessary to work with numbers of accidents, even though the decision-makers take more interest in data in terms of numbers of victims. Moreover, working only on fatal accidents (or deaths) uses a relatively reliable data item as a basis but involves the handling of small figures. Working on serious accidents (deaths and serious injuries) uses a less reliable data item as a basis but the numbers of accidents are higher and, therefore, the statistical uncertainty is lower.

Calculation method:

Severity of a set of accidents: number of serious accidents or number of victims per 100 accidents. This indicator is expressed as a %.

With respect to accidents

$$G1 = \frac{100 \text{ x number of serious accidents}}{\text{number of personal injury accidents}}$$

The definition of a serious accident being an accident resulting in at least one serious injury or one death.

$$G2 = \frac{100 \text{ x number of fatal accidents}}{\text{number of personal injury accidents}}$$

With respect to victims

$$G3 = \frac{100 \text{ x number of (deaths + serious injuries)}}{\text{number of personal injury accidents}}$$

$$G4 = \frac{100 \text{ x number of deaths}}{\text{number of personal injury accidents}}$$

$$G5 = \frac{100 \text{ x number of (deaths + serious injuries)}}{\text{number of victims}}$$

$$G6 = \frac{100 \text{ x number of deaths}}{\text{number of victims}}$$

4. Risk indicators (rate, density and ZAAC)

What is their purpose? Risk indicators are used to determine locations abnormally liable to accidents. They should be combined to help determine the locations requiring an in-depth study. They are compared to references using statistical tests.

Accident density

The density of personal injury accidents (or serious accidents or fatal accidents) is used to assess the risk for the community represented by accidents on the infrastructure under study. The density is associated with the traffic volume (the higher the traffic, the higher the risk is liable to be). Knowledge of the average densities makes it possible to position with respect to the national or regional or district average in the case of roads with the same levels of traffic.

Calculation method:

Density of accidents (personal injury accidents or serious accidents or fatal accidents): number of accidents (personal injury or serious or fatal) per km per year.

$$D = \frac{N}{(L \text{ x } n)}$$

Where:
N = number of personal injury accidents in n years on the section L = length of section in km
n = number of years of the period under study

Accident rate

The rate of personal injury accidents (or serious accidents or fatal accidents) is used to assess the primary safety of an infrastructure, i.e. the risk for the subject of having an accident. In fact, it represents the operation (in terms of safety) of a lane or network and it can be compared to the reference value of the identical road type. If the value observed is significantly greater than the reference, the infrastructure under study can be considered to see its safety improved by developments.

Calculation method:

Personal injury accident rate: number of personal injury accidents per 100 million km traveled i.e.:

$$T = \frac{N \text{ x } 10^8}{(AADT \text{ x } L \text{ x } 365 \text{ x } n)}$$

Where: N = number of personal injury accidents observed in n years on the section; AADT = Annual Average Daily Traffic (in veh/day in both directions in case of single roadway); L = length of section in km; n = number of years of the period under study

Caution: in comparisons to references, pay attention to the reference units.

Which risk indicator should be selected?

It is recommended to select the rate, density and severity. These three indicators each have their own meaning and validity (🛠7). Quick reference 8 (🛠8) proposes methods for the multi-criteria analysis. On roads and streets subject to low traffic levels, the rate will only provide a little information in general if it can be calculated.

ZAACs (Accident Accumulation Areas)

ZAACs are defined in the circular [7]. There are two methods to determine these areas and several levels for each one. these methods are automatic in Concerto.

The "DSCR" method (previously referred to as the MARION method)

The "DSCR" method defines the three ZAAC levels as follows:

- Level 3 ZAAC: at least 10 personal injury accidents and 10 serious victims (death or serious injury) in 5 years over 850 meters
- Level 2 ZAAC: at least 7 personal injury accidents and 7 serious victims (death or serious injury) in 5 years over 850 meters;
- Level 1 ZAAC: at least 4 personal injury accidents and 4 serious victims (death or serious injury) in 5 years over 850 meters.

The "statistical" method (previously referred to as the IZAAR method)

The "statistical" method uses statistical tests automatically. It searches areas in which the **accident density is significantly higher than on the reference**.

The **density reference** may be either the traffic section, or the road, or the network, or a reference defined by the user.

The process determines all the areas (with a minimum accident threshold) where the density is higher than on the reference. This method offers the advantage of performing statistical tests. In addition, using the section as the reference, the study is performed for constant traffic and therefore the density calculation is the same as for the rate.

However, using the section as a reference involves drawbacks. Take the case of a low-traffic road where the density and the rate are markedly lower than the national average. The statistical method runs the risk of determining subsections where the density is higher than on the entire section but always lower than the national average. For this reason, it is advisable to use **the accident density on sections where the traffic is similar as the reference** (entire route in case of traffic continuity, construction with other sections with similar traffic, etc.).

Moreover, this method can combine two ZAACs. It can also include an additional, relatively remote, accident in a ZAAC.

As for the other indicators, the study period is generally five years (sometimes 3 years).

Which method should be selected?

Each of the two methods has its advantages and disadvantages:

	"DSCR" method	"statistical" method
easy explanation	+	0
inclusion of traffic	--	++ to – (depends on reference selected)
statistical rigor	--	+
inclusion of severity	+	-
inclusion of accidents and not victims	0	+

Given the drawbacks of the "DSCR" method, it is recommended to use the "statistical" method.

In any case, ZAACs detected then need to be analyzed in more detail, even for the stake analysis: are intersections, crossings through built-up areas involved? How are the accidents distributed in the ZAAC?

An additional criterion for the analysis is the scope of the network covered by these accumulation areas. For example, level 3 "DSCR" ZAACs represent approximately 0.33% of the French network.

Other methods are currently under development; they combine traffic and severity in particular.

5. Typological indicators

What is their purpose? Typological indicators are used to assess the significance of the theme in the overall evaluation. They are compared to references with statistical tests.

A typological indicator is used to assess the frequency of a type of accident and compare it to a reference frequency.

Calculation method:

Typological indicator calculation: number of accidents of a given type with reference to the total number of accidents expressed as a percentage.

The definition of the typological indicator should be the same in the study and in the reference. For example:

$$\text{\% head-on collision accidents} = \frac{\text{number of head-on collision accidents x 100}}{\text{number of personal injury accidents}}$$

Examples of typologies:

Sequence of accidents: vehicle only, 2 vehicles, left-turning maneuver, etc.

Type of parties involved: age group of parties involved, gender, mode of transportation (pedestrian, two-wheeler, light vehicle, etc.), origin (local or not), etc.

Infrastructure: intersection, bend, wet roadway, obstacles, etc.

Location: type of road, size of built-up areas, etc.

Time-related breakdown: day, night, day of week, month, time, etc.

6. Economic indicators

What is their purpose? Economic indicators can be used to combine the unprocessed indicators and severity. They can also be used in economic profitability calculations

They are used to combine the severity and the number of accidents. They should be used with caution. The costs taken into account the year of value of the figures should always be specified.

Overall cost of personal injury accidents calculated on the basis of victims

The costs below are those stipulated by a working group of the General Planning Commission (source: [34]) according to the **reference year 2000**.

death =	1,000,000 Euro
serious injury =	150,000 Euro
minor injury =	22,000 Euro
material damage =	5500 Euro

For the definitions of deaths and serious injuries, the deaths at 6 days and serious injuries at 6 days are taken into account.

The cost of a set of accidents is then determined on the basis of the above material and human costs. In the Concerto summary sheet, this cost is specified.

For example, the cost of an accident causing two deaths and one serious injury is as follows (reference year 2000):

2 x 1,000,000 + 1 x 150,000 + 5500 = 2,155,500 Euro

reference year 2000.

The total cost of accidents for the community can be broken down into an average cost per personal injury accident or into an average cost per inhabitant.

In principle, this cost should be updated every year according to the per capita household consumption, excluding inflation, which makes it possible to remain in constant currency (Euro value in 2000).

For a study over several years, it is recommended to use the value for the year 2000 as the cost value.

Cost of personal injury accidents weighted with severity – PRAS calculation

Within the scope of the Regional Safety Development Plans (PRAS [7]), costs of accidents per section are required. This calculation is performed on the basis of the number of fatal, serious non-fatal and minor accidents in which a national value of the cost is given. This calculation, like any cost calculation accounts for all accidents (implication concept) but gives more weight to the more serious accidents as their economic cost is higher (severity concept). This calculation also offers the benefit of attenuating random effects such as accidents with an excessive number of victims.

Calculation method:

Weighted cost per km of accidents on a section (Cp):

$$Cp = \frac{(C_l \times N_l + C_g \times N_g + C_m \times N_m)}{L}$$

Where:

C_m = *Average cost of a fatal accident*
(given on national level)

C_g = *Average cost of a non-fatal serious accident*
(given on national level)

C_l = *Average cost of a minor accident*
(injuries but no serious injuries or deaths)

These values are given on a national level in the PRAS circular.

N_m = *Number of fatal accidents on section*

N_g = *Number of serious (and non-fatal) accidents on section*

N_l = *Number of minor accidents on section*

L = *length of section in km.*

Cost savings - method 1

The number of accidents that can be saved can be calculated in monetary terms. In this case, the method is as follows [31]:

• calculate the number of preventable accidents, by calculating the difference between the number of accidents observed and the number of accidents that would have occurred if the rate on the section was calculated with reference to the national reference (for intersections, the reference is a theoretical number of accidents given by the model in quick reference 5 (🛠5), section 5);

• calculate with the references available and this number of preventable accidents obtained above, the numbers of preventable deaths, preventable serious injuries and preventable minor injuries;

• apply the monetary value to the numbers of preventable accidents and victims on the basis of the costs specified above.

Cost savings - method 2

• identify all the sections where the rate is significantly greater than the reference (with a statistical test);

• for these sections, calculate the number of preventable accidents by calculating the difference between the number of accidents observed and the number of accidents that would have occurred if the rate on the section was calculated with reference to the reference:

$$N_{preventable} = N_{observed} \times \left(1 - \frac{\tau_{reference}}{\tau_{observed}}\right)$$

- calculate for each identified section the cost savings using the following formula:

$$C_{preventable} = N_{preventable} \times \left(C_m \frac{N_m}{N_t} + C_g \frac{N_g}{N_t} + C_l \frac{N_l}{N_t}\right)$$

With the following notations:

$N_{preventable}$*: number of preventable accidents on section*

$N_{observed}$*: number of accidents observed*

$\tau_{reference}$*: reference rate for section*

$\tau_{observed}$*: accident rate observed on section*

N_t*: number of accidents observed on section*

N_m*: number of fatal accidents observed on section*

N_g: *number of non-fatal serious accidents observed on section*

N_l: *number of minor accidents observed on section*

C_m: *cost of a fatal accident (given on national level)*

C_g: *cost of non-fatal serious accident (given on national level)*

C_l: *cost of minor accident (given on national level)*

This method may also be applied:

- to junctions, by replacing the accident rate by a number of theoretical accidents obtained using a model;
- to themes, by replacing the rate by a reference percentage.

Which cost should be used?

Within the scope of national procedures, the cost to be used may be defined (case of PRAS, Existing Road User Safety approach (SURE)). In other cases, the study manager can have their choice validated by the sponsor.

The use of costs, while it makes it possible to incorporate severity, has a major specificity: the cost is extremely closely correlated with the number of deaths (or fatal accidents): **the cost of one death is approximately 7 times higher than the cost of a serious injury, which is in turn 7 times higher than the cost of a minor injury**. This weighting of the severity highlights locations or themes with deaths, even though a small number of accidents are concerned. This point should always be borne in mind during the studies.

For example, in a junction with a fatal accident (with a single death), the cost amounts to 1,005,500 Euro (reference year 2000). In a junction with 20 minor accidents (each with a single minor injury), the cost amounts to: 20 x (22000+5500)=550,000 Euro. Therefore, if both junctions are compared, the cost on the first junction (with one accident) is twice as high as the cost on the section junction (with 20 accidents).

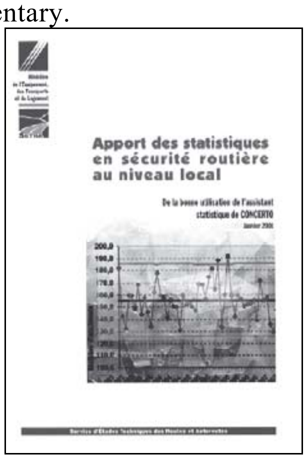
Quick reference 7
Local statistical analyses

In an stake analysis, it is not possible to merely provide an evaluation of unprocessed figures; it is important to interpret them and comment on them. Statistics represent a tool in the analysis of these figures to determine the priorities of actions and structure them. A methodological guide [10] *Contribution of road safety statistics on a local level* enables optimal use of the Concerto statistical tool. **It offers the advantage of being comprehensible for a "non-statistician" and being operational** for the use of analysis models (chronological, thematic, at-risk area, before-after study) before commenting on the data (**is the result significant or not?**). It is strongly recommended that each study manager uses it for the studies.

This quick reference is no substitute for said guide.

An accident is a complex phenomenon; the number of accidents on a site is a **random variable**. The obvious facts stemming from observations are sometimes deceptive. Statistics do not offer a miracle cure but offer assistance in the analysis of figures.

Various laws of probability govern the occurrence of road accidents. Depending on whether the percentage of accidents for a specific theme (for example, the number of accidents involving a subject under 25 years of age), the trend over time (trend) or the location (number of accidents on a section, accident rate) is being studied, different laws apply. For this reason, a distinction is made between three types of analyses: the thematic analysis, chronological analysis and spatial risk analysis. These analyses are complementary.



It is necessary to point out some preliminary requirements:

- Firstly, the validity of a study depends on the **validity of the data**.
- In road safety, **the statistical event is the accident**. It is either fatal, serious or minor. It can then be broken down according to the target (user, location, time type, etc.). The Concerto statistical tool **allows analyses on the numbers of accidents. The numbers of victims does not observe the same laws of probability; they cannot be used for thematic analyses, for rates and densities, or for trends with confidence intervals, but only for chronological series not accounting for confidence intervals**.

Typical question	Analysis
In view of the trend of my number of accidents, is it downward or upward? I have 10% more accidents this month than last month; which precautions do I need to take to announce this result? How is the accident trend on the site under study situated with respect to the reference?	Chronological analysis
I have more accidents of this type (night-time for example) on state highway X, with two lanes, under study, than on all the 2-lane state highways in my district. Can I state that this road is hazardous for this type of use (night-time traffic)?	Thematic analysis
What should I do when analyzing the risk on a site (*) for an accident typology (e.g. two-wheeler accidents)? What should I compare it to (choice of reference)? What should I account for in my analysis?	Thematic analysis
Is the site I am studying more hazardous than another one? Is it more hazardous than "normal" (choice of reference)?	Risk analysis (spatial)
How can I compare accidents occurring in a region in June to those in May? to those in December? to those for the entire year?	Chronological analysis

(*) *A site may be a region, district, road portion, junction, quarter, etc.*

• For comparison purposes, it is also necessary to define **a reference** (5). The reference concept may be the national, regional average, or any other results liable to be used as a reference. It is important that the reference result is obtained on the basis of a much greater number of accidents. The reference represents the "normal" safety target for a site of the same type and it is used to compare it and detect the stakes. In order to enable reliable comparisons, it is necessary to provide all the information required (definition of variables, indicators, methodology applied, data validity) to avoid ambiguity.

1. Thematic analysis

The study consists of selecting themes and analyzing the breakdown of accidents according to the themes. It consists in themes relating to:

- users (gender, age, etc.),
- infrastructural characteristics (bends, gradients, obstacles, etc.),
- conditions (weather, lighting, etc.)
- etc.

The percentage of accidents for the theme under study (number of accidents for theme x 100 / total number of accidents) is compared using a statistical test to a reference. For each characteristic of the accident, the question is the same: is the percentage of accidents for the theme significantly different to another? The other is a reference (5).

A result is said to be significant when there are more than 95 chances out of 100 of being correct when stating that there is a specificity on a local level (compared to the reference).

The analysis is used to compare the numbers of accidents and not the numbers of victims; in order to account for the severity, the percentages of serious or fatal accidents will be studied.

Using the thematic analysis with small figures, the results are frequently non-significant. In this case, it is recommended to group variables; for example: age groups or user types.

2. Chronological analysis

The data for the year n can be compared to the year n-1 or to the last 5 years; however, they should be considered **simply as a trend calculation.**

For an stake analysis, it is advised to **work on a period of at least five years.** Unprocessed trends are not sufficient, only **the chronological analysis** can enable the **interpretation of the accident research trend.**

Firstly, this separates the three components: the general trend, the seasonal variations and the occasional variations. The chronological analysis makes it possible to highlight either a **structural trend**, or an **economic trend**. To determine the trend curve, the Concerto statistical tool simply needs to use the regressions or moving averages. The regression determines the structural trend and plots a line whereas the moving average determines the economic trend. **The Concerto statistical tool makes it possible to determine whether the increase or decrease in the trend is significant**.

As an example on these different types of analyses, the table below, taken from [10], displays the corresponding

3. Risk level analysis

In Concerto, this analysis is called: risk analysis.

It consists in the spatial breakdown of the accidents, either all the accidents or some accident typologies. It is necessary to use indicators such as the rates or densities (🛠6).

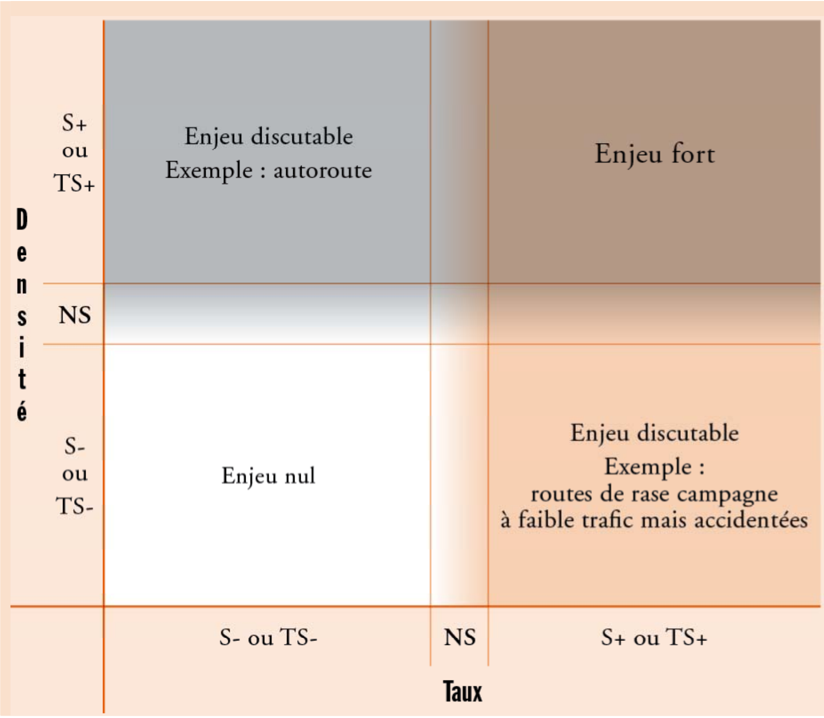
The more reliable the location, the better the analysis will be. While it is not generally possible at the stake analysis stage to obtain a positioning that is as precise as for the diagnostic phase, it is however, essential to determine the limitations of the file used (see 🛠2 on data). The PR 0 accumulation areas are a well-known standard error in the unprocessed file

To facilitate quicker rate calculations on a route or sections, it is necessary to use the amended DDE and the network traffic file (HIT amended in Adhonis). Particular attention should be paid to sectioning.

The Concerto statistical tool and Metods carry out confidence interval and significance calculations.

The rate analysis and density analysis are complementary as shown in the table below **[10].**

reference rate	density	*Example*: some secondary roads in the open country.



S = significant

TS = very significant

+ = indicator statistically greater than reference

- = indicator statistically lower than reference

Densité	Density
S+ ou TS+	S+ or TS+
Enjeu discutable	Debatable implication
Exemple: autoroute	Example: motorway
Enjeu fort	Strong implication
NS	NS
Enjeu nul	Zero implication
Exemple: routes de rase campagnes à faible trafic mais accidentées	Example: roads in open country subject to light traffic, but which are subject to accidents

Quick reference 8
Multi-criteria analysis for priorization stakes

This consists in finding a means to structure stakes on the basis of quantitative or qualitative criteria. A distinction should be made between two stages:

- the technical structure which is proposed by technicians;
- the final structure which is validated by the decision-maker.

For the technical criteria, different indicators have been calculated. Each indicator can be broken down according to:

- its unprocessed value: in number of accidents, percentage, rate, etc.
- the significance of the deviation from the reference: non-significant, significant, very significant;
- the extent of the deviation from the reference, with reference to the number of accidents (number of accidents gained or lost if calculated with respect to the reference).

Quick reference 6 (6) demonstrates the large possible number of indicators. The indicators are increasingly relevant and **it is clear that, depending on the indicators used, the classification will differ**. In principle, there is no reason to only retain one indicator, particularly if studying by road section where a selection only using the rate or density or severity may be subject to criticism. The decision-maker may have an opinion on this point.

Economic indicators are frequently used as they make it possible to incorporate both the numbers of accidents and their severity. However, quick reference 6 (6) specifies that several cost calculations exist.

The table in quick reference 7 (7) on the rates and densities may help with the multi-criteria analysis.

Cost for each theme (fictitious example)

	Theme	% of overall cost of accidents
Infrastructures	Accidents at bends	42.3
	Accidents against obstacles	29
	Accidents in intersections	16.3
Behavior	Accidents with alcohol	9.2
Users (accident involving at least one ...)	Young driver	39
	Elderly pedestrian	4
Conditions	Rainy conditions	27
...	…	

This type of table consists of weighting the accidents with the severity (see quick reference 6 (6) on the cost calculation). Maps can also be used as the material for a multi-criteria analysis, provided that particular attention is paid to the semantics used. In addition, it is possible to calculate the cost savings with respect to the reference.

Within the scope of research on sections liable to accidents, economic indicators may be selected, or indicators such as those below may be created:

- I_1 = number of themes in which the percentage is significantly greater than the average.

- $I_2 = a \times X + b \times Y + c \times Z$

where

- $X = \dfrac{\text{section rate}}{\text{average rate}}$
- $Y = \dfrac{\text{section density}}{\text{average density}}$
- $Z = \dfrac{\text{section severity}}{\text{average severity}}$
- a, b and c are weights: they weight the rate, density and severity. For example: a=1, b=0 and c=2.

This indicator has no statistical rigor, but has sometimes between used in studies. It would appear to be preferable to use indicators such as those proposed in quick reference 6 (🛠6) on economic costs

With regards to the final structure validated by the decision-maker, criteria not relating to safety problems and which are frequently not calculated are used. For example, they may consist in social acceptability, funding, studies in progress, decision-makers' preferences, etc.

A table system may be used as follows: the targets may be themes or locations. In this case, symbols (++, +, 0, -, --) or colors will frequently be used. As a general rule, to back up the technical study, the numbers of corresponding victims may be specified systematically.

	Number of accidents of target	Criterion 1	Criterion 2	Criterion 3	
Target 1					
Target 2					
…					
Average or total					

Quick reference 9
Some tips for mapping

A successful map should enable an **immediate and easy overall reading**. Therefore, it is necessary to make strategic choices in the results display mode so that the signs used are effective and suited to what the creator of the map wishes to show. The table below lists the essential items to produce a quality map. This summary sheet contains guideline information for the reader to refer to, particularly the reference [9].

A map is used to locate (basic data, network, route), analyze (analysis of located data: correlations, comparisons, trends), assist with management and decision-making (in SIGs) and communicate. The map is an image which makes use of visual language and its rules, i.e. **graphic semiology**.

Producing a map takes time and frequently requires several trials. It is always necessary to remember that the signs to display map data are not selected in a random way. Design remains an essential parameter in visual communication, the message is clearer if the map is pleasant to look at (successful choice of signs and colors).

Themes	Requirements	Comments
Overall reading of map	Immediate and easy	
Information	Convincing	
Title	Strict, clear and consistent with the caption	In a title block with a white background
Caption	Well written, structured and comprehensive	All the information contained in the map is explained clearly (in a title block with a white background)
Design	Balanced	
Location	Precise	
Colors	Not too many, selected with discernment	
Signs	Easy to identify, memorize, expressive	
Nomenclature	Sufficient but not excessive	
Territorial contrasts	Clearly highlighted	
Scale	Present, in graphic form (segment)	At bottom of map
Source and dates of data	Specified	Close to caption
Signature, copyright, contact	Specified	At bottom of map

As a general rule, upper case letters should not be used indiscriminately. In fact, lower case letters make it possible to save space and improve legibility. A legible font should also be given priority, for example, the Arial font.

1. Memo guide

Publishing format

From the outset, it is necessary to consider the publishing format (display on screen, print format, color, black & white photocopy, etc.) as the items below are dependent on it. The graphic charter should also be borne in mind. The pdf format may be used and replace photocopies.

Theme

To ensure that the map is as clear as possible, the creator should select only one theme per map. It is preferable to produce several maps (with the same background) than only one map with several themes. It is however possible to represent two themes: one for individual data and another for continuous or zonal data.

Map background

The creator must select the most appropriate map background according to the subject covered or the scale of the map. He/she should apply a strict selection of the items in the map background and remove any superfluous details liable to impair the legibility of the document. For example, Scan 25 is too detailed for a small-scale map. Therefore, the database has a scale. It also has a log; updates are required.

Remember to specify the name of the roads with PRs and some names of locations used to locate the data.

The three representation modes

- **Point mode** when the data item applies to a point (accidents involving pedestrians);
- **Linear mode** when the data item applies to a section (traffic, ZAAC);
- **Zone mode** when the data item applies to an area (geographic breakdowns of accidents by municipality).

Labels may be combined with the different representation modes.

Point thematic analysis

Quantitative information (number of accidents, population, number of items of infrastructure, etc.) is generally represented by a **proportional symbol** and not by an area.

The following sign types are recommended as they are clearly contrasted: ◑ = ⊙ ✚ ★ ◇ ▲ ▯ ⊠ ✪ ⬭
These signs have different visual significances, signs can be read selectively.

The following sign types should be avoided as they are not sufficiently contrasted: ■ ▲ ● ★ ○ □ △ ⬠.
These two groups of signs have the same visual significance; it is not possible to read the signs selectively: the image is confused, therefore difficult to read and ineffective.

Linear thematic analysis

It is recommended to contrast the types of lines as much as possible. For example, traffic is represented by variable size in the linear layout. In addition, the thickness of the lines does not always enable a satisfactory quantification. In this case, it would appear to be advisable to specify the figures corresponding to the most noteworthy arrows.

Zone thematic analysis

Zonal superimposition requires the use of various representation techniques. As a general rule, zoning is represented by area and linear layouts (perimeter outlines). In this type of exercise, **particular attention should be paid to the legibility of the map.**

Category thematic analysis

To ensure that the map is legible, **a color or size variation category (symbols or lines) thematic analysis should be limited to 4-5 categories.**

Choice of colors

Color is a visual variable that is difficult to apply and to be avoided if possible, based on a few usage rules. The colors used should:

- be **low in number and contrasted**;
- **express the data structure** (range of colors limited to 4 shades);
- apply **the opposition between warm colors** (positive phenomena, growth, etc.) and cold colors (negative phenomena, declines, etc.).

Maps for subsequent **black & white** photocopies should produced, **whenever possible, in black & white**.

Chronological maps

On maps used to compare the same phenomenon between two dates, it may be of interest to include a graph to display the trend quickly.

Map harmonization

In order to be able to compare maps covering the same subject or the same area, it is advisable to harmonize the various maps, particularly by means of:

- precise formatting rules (font, character size, box size, etc.);
- retaining the same scale;
- retaining colors, symbols, etc. (a customized thematic analysis template should be saved);
- etc.

2. Further mapping details

"Size" visual variable

The size variable is the only means that can be used to represent quantities in absolute values (e.g.: numbers of accidents, AADT).

size variable in point layout

the size variable in a point layout can be represented:

- either by the length (bar chart);
- or by variable signs via the area (proportional to the square roots of the numbers of the statistical series): the sign is a solid area;
- or by the volume (proportional to the cubic roots of the numbers of the statistical series): the sign is a volume.

There are two possible scenarios:

  – **the signs are grouped into size categories**. In this scenario, the sign must be proportional to the central value of the category;
  – each sign is **proportional to a value** of the statistical series.

Note: Proportionality is not always observed correctly by software (in this way, Mapinfo does not handle proportional sizes well). It is essential to verify some data values at the risk of creating a completely incorrect map.
Graphic restrictions also exist:

  – the signs must not be too big or too small;
  – the range should be adapted to the space available.

For this, it is necessary to perform several trials to obtain the most balanced design. Other item: small circles should appear in front of the larger ones and avoid figurative signs of variable sizes as they are not very legible in detail. It is preferable to select the simplest figures (circles, squares, very sober logos).

size variable in linear layout

the size variable in linear layouts makes it possible to represent flows.

Example: traffic maps. Ministry for Infrastructure applications are available that enable linear layout size variable representations in Mapinfo.

"Color" visual variable

Color is a difficult variable to use correctly in maps. The reproduction of colors on a map depends on the rigor in the choice of shades applied by the creator and the printer used. These choices are guided by:

- the future use of the map (technical map, communication, etc.);
- the media for which it is intended (paper map, screen display, slides, video projector, Internet, etc.).

The parameters defining a color are:

- **the shade or tone** (i.e. the color: red, blue, green);
- **the value** (light to dark);
- **the saturation** (i.e. the level of purity and brightness of the color).

The main qualities of color **are its strong "differential" and "separating" capacity**. They distinguish between a large number of shades and **its esthetic value** when it is used correctly.

The main rules to be followed for correct use of color:

- Observe the **visual progression ranging from light to dark** so as not to distort the information. The ranges of colors must be devised either in a monochromatic scale (light blue 20%, medium blue, dark blue (100%) or in a polychromatic scale (pale yellow, orangey, red, dark brown);
- Express the structure of the data via the choice of colors: map background (background, neutral color), theme (foreground, bright colors);
- Limit the number of colors: **too many colors kill the effect of color;**
- Observe **standard and conventional colors** (e.g. types of state highways, motorways, waterways);
- Apply an opposition between warm colors and cold colors:
  - warm colors (yellow, orange, red) indicate progression, danger, positive phenomena;
  - whereas cold colors (blue, green) indicate decline, negative phenomena;
- Limit ranges of the same color: do not exceed 4 shades particularly for maps broadcasts via telematics;
- Make proper use of neutral colors to be given priority for map backgrounds and transition phenomena;
- Beware of the pitfalls of the color yellow: firstly, in black and white photocopies, the data item disappears, in point layouts and in zone layouts on a white background, it is difficult to distinguish it.

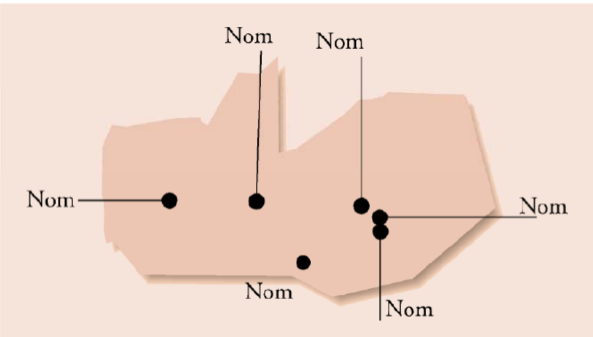
Place name rules

Select some place names used to locate data. In statistical mapping software such as Concerto, the style is imposed and is not necessarily satisfactory, it is preferable to create a place name table.

Establish a visual balance between the place names and the design. Too many place names will quickly make a map illegible and hides the essential information which relates to the theme.

Select proper graphics, structure place names, refer to IGN or Michelin mapping.

Avoid replacing names by figures or numbers. It is recommended, when the locations are too similar or too numerous, to go outside the map frame, joining them with a linking line. Observe the layout of place names according to the figure opposite.



Nom	Name

Formatting rules

Choice of page orientation: this will be determined by the shape of the area in landscape or portrait layout.

Margins

Provide for a 2 to 3 cm margin around the map to space out the document (more on the left edge of the pages, if the document is bound).

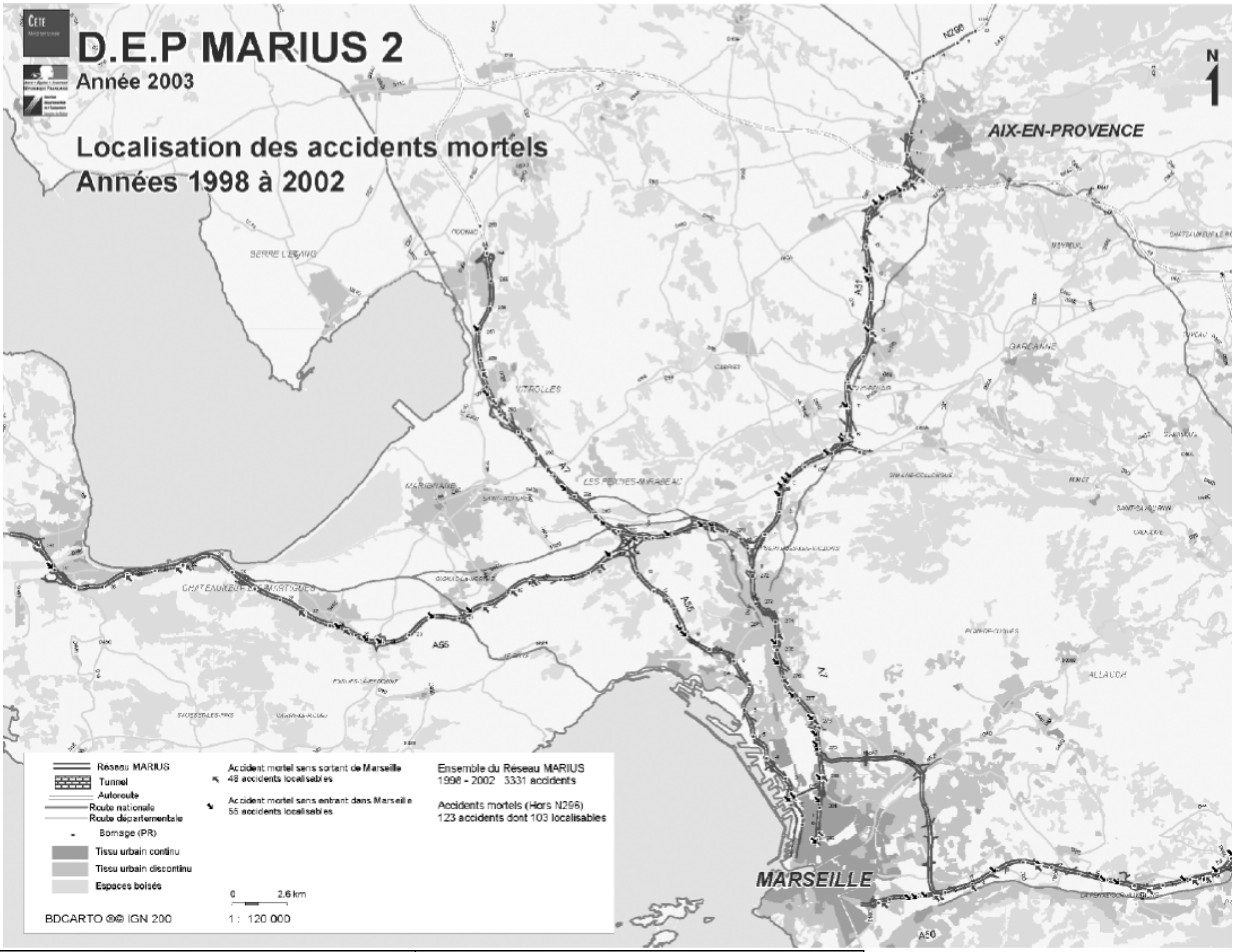
Borders

It is recommended to border a map. Also, in order to prevent the area covered from becoming an island, the lines in the map background should be extended to the map border.

Exploded view

For dense areas, an exploded view of the area(s) may be given. For example, this is the case of the Paris region road network on a national map.

3. Example of map (CETE Mediterranean)



Année 2003	Year 2003
Localisation des accidents mortels	Location of fatal accidents
Années 1998 à 2002	Years 1998 to 2002
Réseau MARIUS	MARIUS network
Tunnel	Tunnel
Autoroute	Motorway
Route nationale	State highway
Route départementale	District road
Bornage (PR)	Demarcation (PR)
Tissu urbain continu	Continuous urban fabric
Tissu urbain discontinu	Discontinuous urban fabric
Espaces boisées	Wooded areas
Accident mortel sens sortant de Marseille	Fatal accident in direction leaving Marseille
...accidents localisables	….locatable accidents
Accident mortel sens entrant dans Marseille	Fatal accident in direction heading into Marseille
Ensemble du Réseau MARIUS	Entire MARIUS network
accidents	accidents
Accidents mortels (Hors N296)	Fatal accidents (Excluding N296)
123 accidents dont 103 localisables	123 accidents including 103 locatable

Quick reference 10
Definitions

Road traffic personal injury accident

A (fatal or non-fatal) Road traffic Personal Injury accident:

- causes the **death** or **injury** of one or more subjects;
- occurs on a roadway open to **public traffic**;
- involves at least one **driving** or **moving** vehicle**;**
- **excluding voluntary acts** (voluntary homicides, suicides, etc.) and natural disasters.

Therefore, any damage-only accidents and personal injury accidents not involving a moving vehicles are excluded.

A personal injury accidents involves a certain number of users.

Among the **parties involved**, a distinction is made between:

- **victims:** parties involved who died or received medical care;
- **uninjured parties:** parties involved who are not victims.

Up to December 31, 2004, the following distinction was made between victims:

- deaths: victims who died immediately or within six (6) days following the accident;
- serious injuries: injured parties whose conditions requires more than six (6) days of hospitalization;
- minor injuries: injured parties whose condition requires between zero (0) and six (6) days of hospitalization of medical care.

Since January 1, 2005, among **victims**, a distinction is made between:

- **deaths:** victims **who died immediately or within thirty (30) days** following the accident;
- **hospitalized injuries**: victims admitted as patients to a hospital for more than 24 hours;
- **non-hospitalized injuries**: victims receiving medical care, **not hospitalized** or admitted as patients to a hospital for **less than 24 hours**.

Among personal injury accidents, a distinction is made between:

- **fatal accidents**: accidents resulting in at least 1 death
- **serious accidents**:
  - 1st definition: accident resulting in at least 1 serious injury or 1 death
  - 2nd definition: accident resulting in at least 1 serious, but non-fatal, injury
- **minor accidents**: accidents not resulting in any death or any serious injury

Adhonis

Excel macro tool associated with Concerto. Enables Excel to work on network sectioning with the corresponding traffic.

Concerto

Local accident research knowledge software program. Equipped with an SIG and supplied with the accident file and a cartographic frame of reference, this program offers numeric and cartographic processing operations.

Accident density **(personal injury accidents or serious accidents or fatal accidents)**

Number of accidents (personal injury or serious or fatal) per km per year on section.

$$D = \frac{N}{(L \times n)}$$

Where:
N = *number of personal injury accidents observed in n years on section* L = *length of section in km*
n = *number of years of period under study*

Stake

Absolute or relative morbidity associated with a target (location, user type, etc.)

Severity of a set of accidents

Number of serious or fatal accidents or number of victims per 100 accidents. This indicator is expressed as a percentage. In the denominator, the number of accidents refers to all the accidents under study.

With respect to accidents

$$G1 = 100 \times \frac{\text{number of serious accidents}}{\text{number of personal injury accidents}}$$

The definition of a serious accident being an accident resulting in at least one serious injury or one death.

$$G2 = 100 \times \frac{\text{number of fatal accidents}}{\text{number of personal injury accidents}}$$

With respect to victims

$$G3 = 100 \times \frac{\text{number of accidents (deaths + serious injuries)}}{\text{number of personal injury accidents}}$$

This indicator is preferable to that below provided that the number of victims is greater than the number of deaths. However, the qualification of the injury as serious or minor is sometimes incorrect.

$$G4 = 100 \times \frac{\text{number of deaths}}{\text{number of personal injury accidents}}$$

$$G5 = 100 \times \frac{\text{number of (deaths + serious injuries)}}{\text{number of victims}}$$

$$G6 = 100 \times \frac{\text{number of death}}{\text{number of victims}}$$

Metods

Accident data statistical analysis software program.

Urban environment **(or built-up area)**

Environment located between built-up area entry signs (EB10) and exit signs (EB20), pursuant to traffic regulations.

Morbidity

Number (absolute or relative) of patients in a given group and over a specified time. In road safety, the term patients is replaced by the term victims.

Journey

Expressed as vehicles.kilometers, the journey is the product of the traffic by the length. The journey is specific for a length of time: the annual journey is the AADT multiplied by the length and multiplied by 365.

Open country

Environment located outside built-up areas, pursuant to traffic regulations.

Primary safety

Accident frequency limitation.

Secondary safety

Impact severity limitation.

Tertiary safety

Improvement in handling of accident victim (development of emergency services and their quality).

Accident rate **(personal injury accidents or serious accidents or fatal accidents)**

Number of accidents per vehicle kilometer on section. In general, rates are expressed as a number of accidents for 10^8 vehicles.kilometers. In this case, the formula is as follows:

$$T = \frac{N \times 10^8}{(AADT \times L \times 365 \times n)}$$

Where:

N = *number of personal injury accidents observed in n years on section* AADT = *Annual Average Daily Traffic (in veh/day in both directs in case of single roadway)*

L = *length of section in km*

n = *number of years of the period under study*

Visage

Road management assistance tool used to compile a road database and query and manage it in extremely diversified contexts.

Case studies

1. Determination of locations liable to accidents
2. Study on a specific theme
3. Stake analysis prior to a route diagnosis
4. Observatory type study
5. DGO stake analysis
6. SURE stake analysis

Important note: some of the case studies are illustrated as examples of studies. We preferred to propose actual studies which are not always "perfect" rather than construct these examples. In addition, we chose to present only excerpts. For this reason, these examples should be considered as illustrative in spite of their slight imperfections.

Case study 1
Determination of locations liable to accidents

1. Case application context

Typical question: which locations are "abnormally hazardous"?

This sheet proposes an approach to follow when determining locations liable to accidents. This study may be followed by route or specific point diagnoses. It frequently consists in an infrastructure-related concern.

Overlap with other case studies :

- Case study 3 (study prior to a route diagnosis): case study 3 develops the stake analysis prior to a route diagnosis: the route is selected and it is necessary, before the diagnosis, to determine the general accident research while the purpose of case study 1 is to determine the routes or points for which studies should be continued in priority.
- Case study 6 (SURE approach): SURE is a national approach applicable to state highways and observes a specific methodology. Case study 1 is more general but can, of course, by enhanced with the SURE sheet.
- Case studies 4 and 5 (Observatory and DGO type study): Case studies 4 and 5 are very general. They include case study 1, although they contain less details than this sheet.

2. Case specificities

Which data are necessary?

For any cartographic representation or rate, density calculation and accumulation area determination, the unprocessed accident file will not be sufficient and it is necessary to adjust the location of the accidents (in particular, accidents at the zero PR need to be corrected). The exogenous data that can be used are those required for the sectioning and rate calculation: road type, urban/interurban environment, and traffic.

Are there any particularly suitable indicators?

For road sections: rate, density and severity, ZAAC determination. For junctions: numbers and severity of accidents.

How far should the in-depth study go?

The in-depth study is not necessary if it is simply to detect locations liable to accidents. However, this determination is not an end in itself; it will generally be followed by a route diagnosis which requires a thematic in-depth study: refer to case study 3 in this context.

Priorization

This is to be defined with the owner.

3. Practical implementation

Preliminary stage

Define a sectioning of the network under study (🛠4) and, for each section, record the exogenous data (traffic, length, urban environment/open country, road type, cross section).

Evaluations

Sections

The evaluation specifies for each section:

- the morbidity: number of accidents and victims (according to severity);
- the rate, density, severity, cost of safety problems for each section;

• the presence of ZAACs.

Cartographic representation: rate map, density map, severity map, ZAAC map.

Junctions

Record the junctions subject to the most accidents and, for each, the number of accidents and severity. Create a map of the number of accidents per junction.

Evaluation analysis

Sections

• Choice of references

Select a reference for each indicator (rate, density, severity) and for each type of road. Of the possible references:

– calculate on the area under study, the average rate, the average density and the average severity for each type of road (cross section).

– take the national rates (or regional rates) for each type of road.

• Comparison with references

For each section and for each indicator (rate, density, severity), perform a statistical comparative test with respect to the reference.

Cartographic representations of sections with a significant deviation: one map per indicator.

• In-depth study of stakes (if required)

For each section, calculate the accident percentages of some typologies (e.g.: number of accidents under rainy conditions, number of accidents involving a pedestrian, number of accidents in intersections, etc.). Take the percentages throughout the territory as the reference. Perform a statistical test (thematic analysis) between the percentages for each section, each theme and the reference. For each ZAAC: run a dominant search.

Junctions

• Choice of reference

Calculate, for junctions subject to accidents, the number of accidents given by the INRETS model. It is possible to limit oneself to junctions in which more than five accidents occurred (in total over five years). The threshold of five accidents is arbitrary.

• Comparison with reference

Perform a statistical comparative test with respect to the reference for each junction selected.

Represent on a map junctions in which the difference is significant. This representation can identify specific routes.

Priorization of stakes

This merely consists in the technical part of the priorization of the stakes.

Several methods can be envisaged. It will essentially be necessary to manage to combine the different indicators.

Sections

• Combination 1: Record for each section the number of abnormally high indicators (rate, density, severity). Categorize the sections according to this number.

• Combination 2: Draft a score and categorize the sections according to this score. This score will be the weighted sum of the rate, density and severity. For example:

$$\text{Score} = \frac{\text{rate}}{\text{average rate}} + \frac{\text{density}}{\text{average density}} + \frac{\text{severity}}{\text{average severity}}$$

The same importance is given to the rate, density and severity.

Or

$$\text{Score} = \frac{\text{rate}}{\text{average rate}} + 2x\left(\frac{\text{severity}}{\text{average severity}}\right)$$

The density is not taken into account. The severity is attributed double the importance of the rate.

It can be seen that it is possible to construct a large number of scores. The technician must make the choice in agreement with the study sponsor.

Junctions

Categorization of junctions according to the number of accidents

Categorization of junctions according to deviation with respect to reference (when the deviation is significant).

It is also possible to use the economic indicators described in quick reference 6 (🛠6).

A table of the following type may be completed: the sections will be categorized in increasing order of the accident rate.

Identification of section						Observed on site					Reference			Statistical test		
Road No.	PR o	PR end	length	secti on	ave AADT	No. acc	No. deaths	Acc rate	Acc density	Severity	Rate	Density	Severity	Rate	Density	Severity

With Concerto – for sections

- determine the sectioning;
- import the traffic files or create traffic sections manually in Adhonis;
- perform rate, density and severity calculations with the selected sectioning;
- select one (or more) rate, density and severity reference(s). When the cross section changes, one reference per section type is selected;
- perform a statistical test for each section and each indicator;
- list the section particularly liable to accidents according to any of the indicators;
- produce cartographic reproductions: value of the indicators (rate, density and severity), sections where the deviation is significant;
- select some typologies with the corresponding references and calculate the thematic percentages for each section;
- compare with a statistical test;
- list (table and map) the sections with specific themes.

This table must be annotated.

Case study 2
Study on a specific theme

1. Case application context

Typical question: what can be said of the accident research on the 12-25 year age group in the district?

The purpose of this sheet is to provide guidance, in technical terms, in the procedure to follow during the accident research study on a specific theme. The procedure may be "urgent" e.g. following an accident receiving extensive media coverage involving a heavy goods vehicle, a status report on heavy goods vehicle accident research in general), but also in-depth studies on conventional themes or theme determined by a sponsor.

The aim is to determine the significance of the theme in the overall evaluation and the specificities of the accidents of this typology.

Overlap with other case studies:

- Case studies 4, 5 and 6;
- Case studies 4, 5 and 6 are more general.

2. Case specificities

Which data are necessary?

The useful exogenous data are specific to the theme under study. For example, for a theme on age groups, the breakdown of the population according to age (INSEE data) should be studied. For a study on two-wheeler vehicles, the modal breakdown may be used.

Are there any particularly suitable indicators?

The indicators will be the typological indicators (accident percentage), severity and cost.

How far should the in-depth study go?

The theme under study should be studied in-depth as it is the purpose of the contract. This in-depth study may be very thorough.

Priorization

Given that there is only one theme, there is no automatic priorization. There may be priorization on stakes studied in-depth.

3. Practical implementation

Preliminary stage

Define the theme under study. For example, in the case of young people, determine the age group studied.

Compile additional data: breakdown by age group, modal breakdown, breakdown of number of inhabitants per municipality, etc.

Within this scope, it may also be relevant to group the various existing studies (prior studies, conducted by other local, national units) on the same theme.

Evaluation

- Significance of accidents of typology among all the accidents in the sector under study over five years: number of accidents, victims, geographic distribution, annual trend for theme and all accidents;
- for the theme: combination of the number of accidents (and severity) with other variables.

Evaluation analysis

Choice of references

National or local references (sometimes expressed with respect to exposure values).

Comparison with references

For the percentage of the theme under study (e.g. the percentage of accidents involving a heavy goods vehicle): the significance of the deviations. If several references are used, several tests will be performed.

In-depth study of stakes

For each combination (heavy goods vehicle by day/night, heavy goods vehicle severity, heavy goods vehicle built-up area/open country, etc.): comparison with statistical tests with respect to references, analyzed spatial distribution map, calculation of trends over time.

The calculated data may be presented in a table of the following type:

		Observed in district					Reference		Statistical test		
		No. accidents (ser acc)	**No. deaths BG, BL**	**Severity**	**% acc for theme**	**Cost of acc**	**% for theme**	**Theme severity**	**On %**	**On severity**	**Trend**
Typology	Condition 1										
	Condition 2										
	…										
Total											

For example, the typology may be day/night. Condition 1 is day, condition 2 is night.

All the figures are taken over **a five-year period**. The reference is the national reference for the median year.

The **severity** is expressed as the number of serious accidents (with at least one serious injury or one death) per 100 accidents.

The **cost** is expressed in k€, reference year 2000 (or other to be specified).

The **percentage for the theme** is the number of accidents for the condition per 100 accidents.

This table should be annotated**.**

4. Example

This excerpt is taken from a study on motorcycle accidents in the Greater Paris region [38]. The stake analysis was continued by a diagnosis on accidents involving a motorcycle on urban expressways (VRU).

After the contents of the final report, three excerpts are proposed: the risk assessment associated with motorcycle use, a typological analysis and the conclusion (which is not the entire summary). It was not possible to reproduce the format of the original document in this guide.

Study excerpt

Contents of stake analysis

Excerpt of study

4. Risk assessment associated with motorcycle use

The risk of a mode can be ascertained by comparing the number of victims and accidents concerned to the exposure to risk associated with the mode. This exposure to risk is generally expressed as vehicles x kilometers. The estimation of the number of journeys on a motorcycle or in a passenger car is probably more accurate than those of the number of kilometers traveled in the region in each mode. However, the mileage is a more natural value to characterize exposure to risk. However, on the assumption that the distances traveled per journey are similar on a motorcycle and in a passenger car (this assumption results in an underestimation, albeit slight, of the exposure of passenger cars with respect to that of motorcycles[3]), either of the values can be used to compare the motorcycle risk to that of passenger cars.

In any case, the estimations of the risks associated with motorcycle use with respect to passenger cars given below are of the same order of magnitude for both values (journey and mileage). This supports the assumptions and they can be considered as a range.

Risk of accidents for different modes (by definition, the risk is taken to be equal to 1 for passenger cars)	Motorcycle	Passenger Car	Bicycle
Fleet (as fraction of passenger car fleet) [4]	5%	100%	-
Journeys:			
- in thousands per day	400,000	17,000,000	408,000
- as fraction of passenger vehicle journeys	2%	100%	3%
Average annual kilometers covered[5]	4950	14000	-
Number of personal injury accidents[6]	6442	27480	1333
Number of deaths[5]	136	350	23
Number of injuries[5]	6568	15,900	1234
Risk of accident			
• per vehicle	5	1	
• per journey	10	1	1.6
• per km	13	1	
Risk of death			
• per vehicle	8	1	-
• per journey	16	1	2
• per km	22	1	-
Risk of injury			
• per vehicle	8	1	-
• per journey	18	1	2.6
• per km	23	1	-

[3] *Such an assumption is clearly incorrect for bicycles.*

[4] *Sources: MOTOSTAT, 2000. 5 See section 2.2.*

[5] *Sources: SOFRES; 1999*

[6] *Annual average 1997-2001*

While motorcycles represent 5% of the passenger vehicle fleet, barely over 2% of passenger vehicle journeys, and approximately the same distance covered by passenger vehicles[7], they are involved in 35% of accidents in the region. In addition, the risk associated with motorcycle use appears to be considerable in the Greater Paris region, in view of their share in traffic. In this way, the risk of having a motorcycle accident is approximately 13 times higher than with a car. Worse again, the risk of being injured or killed on a motorcycle is approximately 20 times higher than in a passenger vehicle (for an equivalent distance covered).

The risk of having a personal injury accident on a motorcycle is 10 to 13 times higher than with a passenger vehicle. That of being killed or injured on a motorcycle appears to be even higher: approximately 20 times higher on a motorcycle than in a passenger vehicle (as opposed to 14 times higher for France as a whole).[8]

[7] On the basis of the average mileage of the different vehicle types and the fleet composition, the total distance covered on a motorcycle is estimated at 1.8% (1.8 km traveled on a motorcycle, per 100 km in a light vehicle).

[8] The risk of being killed on a motorcycle is estimated as 14 times higher for France as a whole (1997) (Sétra Guide, 2000).

Excerpt of study

7.3. Accident circumstances

a) Brightness

72% of motorcycle accidents occur by day and 23% by night. However, 37% of motorcyclists are killed at night (when the traffic flows more freely!). Collisions against obstacles represent 44% of deaths in night-time accidents.

b) Weather

The vast majority of motorcycle accidents take place when the weather conditions are normal (83%, as opposed to 13% in rainy weather). However, it is difficult to come to the conclusion that no specific weather-related problem exists, as motorcycle traffic is probably lower on days when the weather is poor and in the wrong season.

c) Roadway condition

This point is linked directly with the previous one. A relatively low proportion of accidents occur on wet roadways (16%). Icy or snowy roadways pose very marginal problems (<0.3%). The analysis of the accident file does not reveal any roadway degradation problem (grit, deformation), but the file reliability is low in this regard.

d) Location

The proportion of accidents at intersections is high: 41% of accidents. This is essentially explained by the mainly urban nature of motorcycle road safety problems in the Greater Paris region. In order 60% of cases, a collision with a passenger car is involved (see section 5.3.).

e) Environment

Accidents outside built-up areas represent one quarter of motorcycle accidents and one third of motorcyclist deaths. Impacts against obstacles represent 20% of these accidents and 37% of deaths. Small built-up areas represent a marginal proportion with 2% of accidents, but the severity is higher.

f) Motorway accidents (3% of linear distance in Greater Paris region excluding Paris)

Each year, approximately 500 motorcycle accidents on motorways are reported. This number represents:

- 16% of personal injury accidents and 11% of fatal accidents in the Greater Paris region excluding Paris;
- 21% of all accidents on motorways in the Greater Paris region.

Collisions against obstacles represent one fifth of these accidents, but represent half of motorcyclist deaths on motorways.

Excerpt of study

Some key figures to guide actions (including additional studies)

Accident types and configurations

• Collisions in intersections: 41% of accidents

• Collisions with obstacles: one third of deaths and high severity in particular:
– metal rail impacts
– impacts with individual obstacles (trees, posts, masonry, supports, etc.), which are not a problem specific to motorcycles

• Night-time accidents: 37% of deaths

• Side collisions in standard sections: 56% of collisions with several vehicles outside intersections, i.e. almost 30% of all motorcycle accidents

Accident locations / areas

The motorcycle accident is a very diffuse phenomenon in the Greater Paris region. The vast majority of personal injury accidents are located in built-up areas.

Paris alone represents over half of accidents, but "only" 22% of motorcyclist deaths

Expressways:

• Motorways (urban or not) which represent 3% of the linear distance, but 16% of accidents.

• The ring road (BP), one of the largest homogenous entities in the region alone represents 6% of the victims in the region (but over 35 km). The frequency of motorcycle accidents is at record levels on the ring road. Moreover, almost half of the deaths occurring on the ring road are motorcyclists.

• Some roads or road sections should be added, particularly grade-separated state highways and district roads and dual carriageways. However, these sections are not identified as such in the accident file. Determining the associated implication would require a specific in-depth study.

• As a general rule, urban expressways, whether they are motorways or not, have particularly high density and risk levels.

Accidents in the open country (excluding on motorways) represent only 11% of accidents, but 38% of deaths (17% and 44% respectively, excluding Paris).

Case study 3
Stake analysis prior to a route diagnosis

1. Case application context

Typical question: Before starting a diagnosis on this route, what can be said about the accident research?

The route may be determined on the basis of an stake analysis (such as case study 1), but also within the scope of a direct diagnosis contract.

The purpose of this study will be, firstly, to situate this route with respect to the adjacent routes and, secondly, determine the locations (sections, junctions) on the route in question that are particularly liable to accidents and the specific accident typologies.

Overlap with other case studies:

• case study 1 (determination of locations liable to accidents): this case study 3 focuses on a route, which may have been defined following a study such as case study 1. In this case, this case study 3 represents the in-depth study of case study 1;

• case study 6 (SURE approach): the overlap between this case study 3 and case study 6 follows the same logic.

2. Specificities of this case

Which data are necessary?

For any rate, density calculation, any determination of an accumulation area or any cartographic representation, the unprocessed accident file will not be sufficient and it is necessary to adjust the location of the accidents (particularly accidents at zero PR must be amended). For the diagnosis (subsequent phase), the accidents should be located precisely; therefore, the amendment of the location of all accidents is required. The necessary exogenous data are those required for sectioning and the rate calculations: road type, urban/interurban environment and traffic.

Are there any particularly suitable indicators?

For road sections: rate, density and severity and ZAACs. For each junction: number of accidents and severity. The typologies will above all be associated with the infrastructure: obstacle, wet roadway, type of collision, intersection, etc.

How far should the in-depth study go?

It is necessary to have an in-depth study: accident typology, dominant characteristics of ZAACs, etc. Take care not to work with figures that are too small.

Priorization

This study is carried out above all prior to a diagnosis. The decision to work on this route has already been made. As such, the route will be divided into sections. Therefore, the priorization may consist of a priorization of the sections, a priorization of the junctions and a priorization of the typologies. It will depend on the length of the route and the contract with a view to the diagnosis envisaged.

3. Practical implementation

Preliminary stage

• Verify the reliability of the file and amend the location of the accidents at PR 0.

• If the route is sufficiently long, sectioning will be mandatory (quick reference 4). In this case, note that the sectioning is not as precise as that used for a diagnosis;

• Verify that there has been no recent development on the area under study over the last five years. Otherwise, this should be taken into account in the study.

Evaluation

- Work on the last five years.
- Determine the number of accidents on each section according to the severity with the number of victims.
- Calculate the severity as a percentage of serious accidents.
- Calculate the rate, density.
- Calculate the same indicators for parallel routes or for the entire district, along with the average for the entire route.
- Determine the presence of ZAACs.
- Identify the junctions that have concentrated more than three accidents and record the number of accidents, the severity (percentage of serious accidents) and the traffic on the main road and on the secondary road.

Propose cartographic representations of the various items of the evaluation.

Evaluation analysis

Choice of references

It is possible to take the national rates, densities and severities or local data (district-level) if they are available. Take care to use references relating to the same type of network (2 x 2-lanes, 3-lanes, etc.).

For a junction, use the predictive model (subject to being in the open country on a main road) to determine the reference (🛠5).

Comparison with references

For each section and for each indicator, perform one (or more) statistical tests with the reference(s).

For junctions, perform a statistical test for the comparison.

Make cartographic representations for the various indicators (value of indicator and result of significance test) and a ZAAC map. Identify the junctions in which the number of accidents is significantly above the reference.

In-depth study of stakes

For each spatial entity (section and junction), calculate the percentage of accidents of some typologies (accidents against obstacles, accidents on wet roadways, accidents involving a pedestrian, etc.). A statistical test may be performed with national or local references but the numbers of accidents are liable to be low and the tests are frequently non-significant.

4. Example

The example below is an excerpt of the safety study on the N 532 in Isère [37].

It was not possible to reproduce the format of the original document in this guide. Only the "stake analysis" section is presented here. In the contents, it consists more precisely of the items in chapter 2, "Accidents types" section.

Study contents
N 532 in Isère

Accident types

Analysis method

The following analysis related to personal injury accidents that occurred between 1996 and 2000 between PR 0 and PR 44 of RN532 (national state police network). These accidents were compared to those of the other state highways in Isère occurring between 1996 and 2000 in the open country, including built-up areas with less than 5000 inhabitants, excluding the RN532 studied.

Evaluation 1996 to 2000

	Personal injury accidents	Fatal accidents	Deaths	Serious injuries	Minor injuries
RN 532	102	19	21	55	133
Other RN in Isère	1388	126	147	576	1757

Location See map

Excerpt of study

Safety indicators on RN532 and on other state highways in Isère

1996 to 2000	RN532	Other RN in Isère(3)	RN France
Accident rate(1) PR0 to PR 34+500 PR 34+500 to PR 44	 12.8 16.8	10.3 to (5) 12	13.1
Density (2)	0.46	0.53	0.49
Deaths/100 accidents	20.6	11.3	16.3
Deaths+BG/100 accidents	74.5	52	52
Average cost of accident in KF	1093	701	

Specific accident typology

Evaluation

	% accidents with reference to total	
1996 -2000	RN53	Other RN in Isère
In bends	35	2
At intersections	33	18.5
With lane change or exit	50	26
At night	41	35
With alcohol	18.5	9
Sundays and public holidays	28.5	19
With a pedestrian	2	5.5
With a two-wheeler	16	23
% with reference to total number of deaths		
Deaths on obstacle	9.5	27

Characteristics

Some types of accidents are **more frequent** on RN532 than on other state highways in Isère in a statistically very significant fashion. They are accidents **in bends** (x1.25), **at intersections** (x1.75), with **lane change or exit** (x2), **at night** (x1.2); **with alcohol** (x2); **on Sunday and public holidays** (x1.5). Some types of accidents are **less frequent** on RN532: they are accidents with **two-wheelers;** with **a pedestrian**. **Deaths on obstacles are three times less frequent**.

Excessive accident severity

Evaluation

The severity of the accidents on RN532 is excessive:
- the number of deaths per 100 accidents is **double** that of other state highways in Isère
- the proportion of fatal accidents is **double** that on other state highways in Isère (18.6% and 9.5% of accidents respectively)
- the cost of an accident is **1.6 times higher** than that of the other state highways in Isère

Location

A distinction is made between three homogeneous sections (in terms of characteristics, traffic, accidents, etc.).

On the section "RD71 to Cognin les Gorges", the accident are excessively serious, see map No. 2.

Sections	Number of accidents	Number of serious accidents / No. of accidents
From La Croisée junction (RD71) to Cognin les Gorges	**25**	**0.76**
From Cognin les Gorges exit to Saint Quentin sur Isère (RD45)	**40**	0.32
From Saint Quentin sur Isère (RD45) to Veurey - Voroize	37	0.54

(1) The accident rate is the number of accidents recorded per 100 million kilometers covered; (2) The accident density is the number of accidents recorded per year and per kilometer of road. It does not account for traffic; (3) Personal injury accidents on state highways in Isère – in the open country and in built-up areas with less than 5000 inhabitants - on the national state police network – excluding RN532; (4) In the open country (i.e. outside built-up areas) - source National Interdepartmental Road Safety Observatory; (5) Accident rate according to average traffic taken into account: 14,000 vehicles/day (AADT 1998) – source CDES 38, 12,000 vehicles/day (AADT 1998) – estimation accounting for the urban nature of some sections of traffic accounted for by the CDES 38

Case study 4
Observatory type study

1. Case application context

Typical question: How to characterize accident research in the region, district?

Annual "evaluations" are published by local units. An important source to obtain a calculated compilation of the road safety problem situation, they rarely present an analysis of the area's stakes.

Therefore, this sheet is applicable to situations in which an analysis of the annual "evaluation" is required.

The purpose of this study is to determine the safety problems of the area under study in general.

Overlap with other case studies:

- Case study 1 (determination of locations liable to accidents): case study No. 4 is very general and contains some of the items in case study 1, but will go further as it is not restricted to locations.
- Case study 2 (Study on a specific theme): within the scope of an observatory type study, some items may be focused on according to the scope of case study 2.
- Case study 5 (DGO): there are obvious similarities in technical terms. The differences lie in the political and organizational context of an "Observatory" study which remains general and the DGO which has a clearly defined organizational scope.

2. Specificities of this case

Which data are necessary?

Accidents are taken over a 5-year period.

For any cartographic representation, rate or density calculation, the unprocessed accident file will not be sufficient and it is necessary to adjust the location of the accidents (in particular, accidents at the zero PR need to be corrected).

The exogenous data that can be used are varied and will depend on the theme under study. They include:

- INSEE data on the population breakdown by age group, municipality or group of municipalities;
- infrastructural data: if rate and density calculations are provided for, it will be necessary to determine the type of road, traffic. In more modest terms, obtaining the linear distances of district roads, state highways and routes will be very useful

Are some indicators more suitable than others?

All the typologies may be presented. The Concerto technician management chart covers a broad panel of typological indicators.

Rate, density and severity calculations will be welcome.

ZAACs will also be studied.

In addition, breakdown maps by municipality, route or network type may be presented.

How far should the in-depth study go?

All the themes may be covered: infrastructure, parties involved, vehicles, breakdown over time.

Trends are much awaited in these cases: trend over the last ten years, comparison with reference trend.

And priorization?

A technical priorization may be proposed at the end of the study.

3. Practical implementation

This type of study, in the practical implementation of the technical part, is very dissimilar to the studies conducted within the scope of the DGO. Therefore, the reader may refer to case study 5.

4. Example

This example is not a conventional observatory type study as it falls within the scope of the DGO.

However, during the drafting of this guide, numerous examples of DGOs are used to illustrate both this case study and case study 5.

This example is an excerpt of the stake analysis on the state highways in Haute-Savoie prior to the General Guideline Document [40]. After the contents of the final report, two excerpts are proposed: a typological analysis (night-time accidents) and the conclusion (which is not the entire summary).

It was not possible to reproduce the format of the original document in this guide.

Excerpt of stake analysis prior to Haute Savoie DGO

Contents of report

To obtain a short expression, the list "Definition, Trend over time, Frequency and Severity, Characteristics" has been replaced by: "Def, Trend, Fre and S, Charact".

A. General

1. Introduction

Purpose of study: DGO, remainder of study, understanding the stakes Statistical foreword

2. Haute-Savoie district

Physical and economic geography

Specificities and local stakes: Population, Employment, Tourism, Travel and migrations

B. Overall indicators in Haute-Savoie

All the road networks in Haute-Savoie: Scope of study, overall safety implication, Breakdown by network

C. Haute-Savoie national network

1. Introduction:

Scope of study, overall safety implication, Characteristics

2. Spatial analysis

-Rates and densities

-Rates, densities, traffic and cross sections

-Accident accumulation areas

-Spatial analysis summary

3. Typological analysis: overall data

-Introduction to typological analysis

-1213 accidents: Def, Trend, Fre and S, Charact

-Serious accidents: Def, Trend, Fre and S, Charact, Trend in serious accidents with respect to minor accidents, unit costs

-Accidents over time

-Number of vehicles involved

-Age of drivers

-Vehicle occupancy rate

-Isolated vehicle accidents with no pedestrians: Def, Trend, Fre and S, Charact

4. Accident types

-Collisions between several vehicles: Breakdown of different types of collision

-Accidents with head-on collision: Def, Trend, Fre and S, Charact

5. Conditions

-Night-time accidents: Def, Trend, Fre and S, Charact

-Accidents on wet roadways: Def, Trend, Fre and S, Charact

-Saturday night accidents: Def, Trend, Fre and S, Charact

-Friday night accidents: Def, Trend, Fre and S, Charact

-Accidents in built-up areas: Def, Trend, Fre and S, Charact

-Accidents in the open country: Def, Trend, Fre and S, Charact

6. Behavior

-Accidents with alcohol: Def, Trend, Fre and S, Charact

7. Infrastructure

-Accidents at intersections: Def, Trend, Fre and S, Charact

-Accidents against stationary obstacles: Def, Trend, Fre and S, Charact, Comparative severity of main obstacles

-Accidents in bends: Def, Trend, Fre and S, Charact

8. Parties involved

-Motorcycle accidents: Def, Trend, Fre and S, Charact

-Light two-wheeler accidents: Def, Trend, Fre and S, Charact

-heavy goods vehicle accidents: Def, Trend, Fre and S, Charact

-Pedestrian accidents: Def, Trend, Fre and S, Charact

-Young driver accidents: Def, Trend, Fre and S, Charact

9. Summary

High severity

Main accident characteristics

Conclusion

Annexes

List of accident accumulation areas, List of sections grouped into traffic categories and cross sections, Statistical and accident research items

Excerpt on "night-time accidents" section.

Conditions

Night-time accidents: 477 accidents, i.e. 39.3% of accidents

Definition

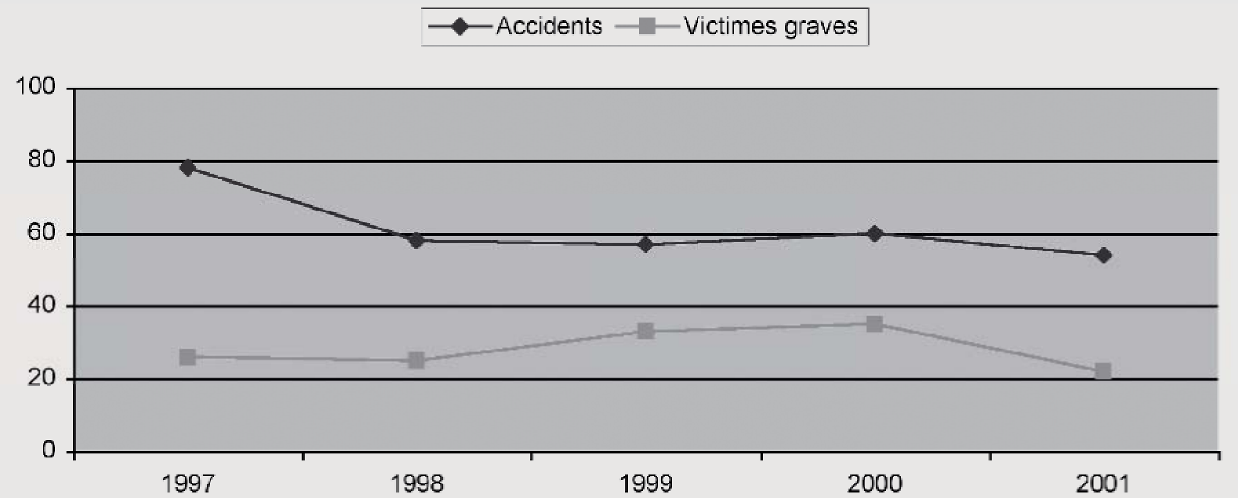
A night-time accident is an accident occurring at dawn, dusk or during the night, with or without public lighting on.

Trend over time

a) Number of accidents between 1997 and 2001

	1997	1998	1999	2000	2001
Haute-Savoie RN	93	118	97	84	85
Rhône-Alpes RN	789	790	680	620	544

Trend of proportion of night-time accidents between 1997 and 2001



Accidents	*Accidents*
Victimes graves	*Serious victims*

In the last 5 years, the proportion of night-time accidents has remained constant overall on the entire Rhône-Alpes national network. On state highways in Haute-Savoie, the trend is not as clear and the proportion of night-time accidents remains clearly greater than that of the reference.

Frequency and severity

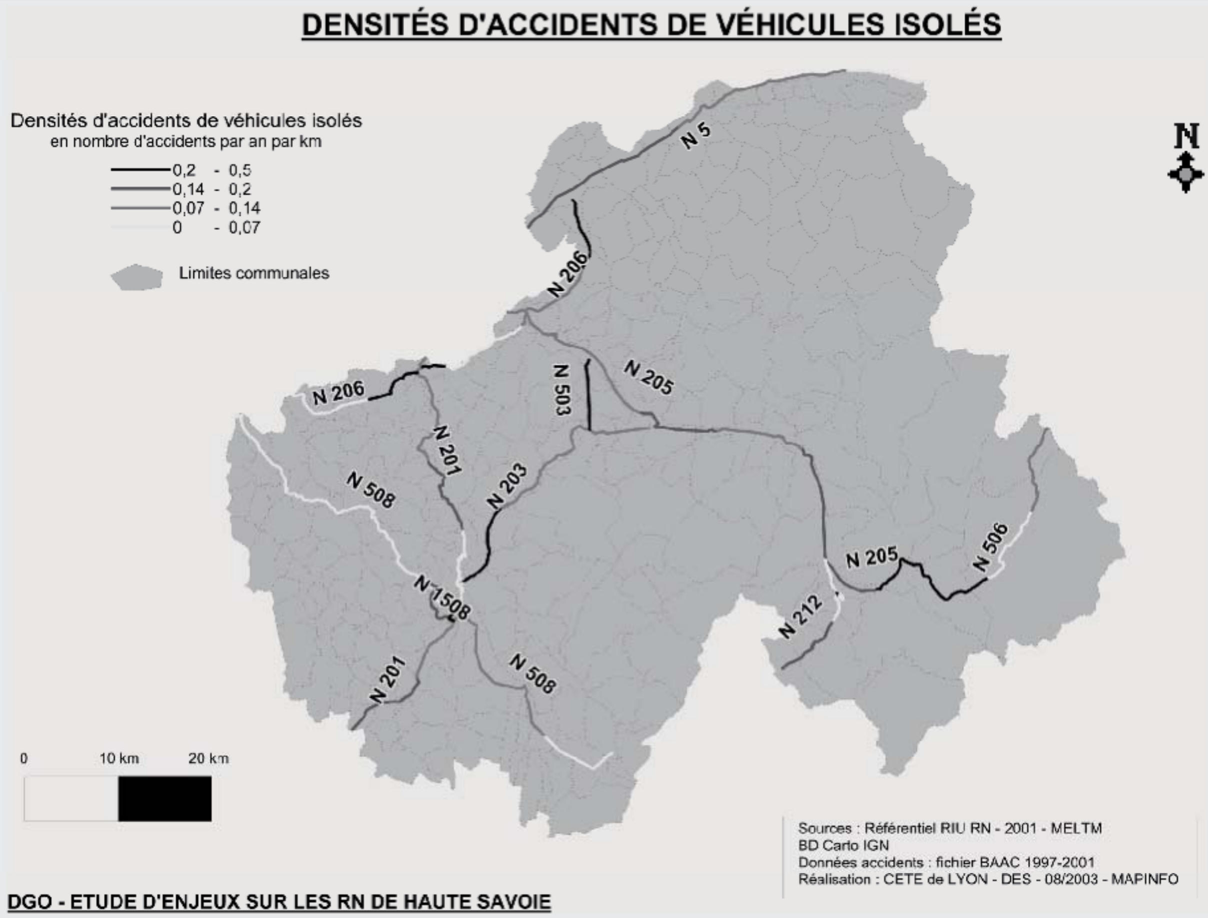
	Haute-Savoie RN	Rhône-Alpes RN
Frequency	39.3% (TS)	35.6%
Serious accidents	60.4% (TS)	42.4%
Deaths per 100 accidents	19 (TS)	15
Deaths and serious injuries per 100 accidents	79 (TS)	56
Average cost of accidents	**314 K€**	**250 K€**

Night-time accidents are both more frequent and much more serious on state highways in Haute-Savoie.

Characteristics

	Haute-Savoie RN		Rhône-Alpes RN
Outside built-up areas	312	65.4% (TS)	60.2%
Head-on collision	99	20.8% (TS)	14.6%
Involving an heavy goods vehicle	18	3.8% (TS)	7.3%
Multiple collision	29	6.1% (TS)	10.2%
Rear-end collision	24	5% (TS)	9.6%
With alcohol	102	21.4%	19.6%
Involving a young driver	189	39.6%	42.2%

Night-time accidents cause more frequent head-on collisions and accidents outside built-up areas on state highways in Haute-Savoie. On the other hand, they tend to involved less heavy goods vehicles and cause less multiple collisions and rear-end collisions.



DENSITÉS D'ACCIDENTS DE VÉHICULES ISOLÉS	ISOLATED VEHICLE ACCIDENT DENSITY
en nombre d'accidents par an par km	in number of accidents per year per km
Limites communales	Municipal boundaries
DGO - ETUDES ENJEUX SUR LES RN DE HAUTE SAVOIE	DGO - STAKE ANALYSIS ON STATE HIGHWAYS IN HAUTE SAVOIE
Sources: Référentiel RIU RN - 2001 - MELTM	Sources: RIU RN frame of reference - 2001 - MELTM
BD Carto IGN	IGN map BD
Données accidents: fichier BAAC 1997-2001	Accident data: BAAC file 1997-2001
Réalisation: CETE de LYON - DES - 08/2003 - MAPINFO	Produced by: CETE LYON - DES - 08/2003 - MAPINFO

Excerpt of summary

Conclusion

Therefore, the stakes to be selected are finally:

- a very high severity (668 accidents i.e. 55%)
- weekend accidents (446 accidents i.e. 37%)
- accidents involving vulnerable users: pedestrians, light two-wheelers (in total 273 accidents i.e. 22%)
- motorcycle accidents (232 accidents i.e. 19%)
- night-time accidents (477 accidents i.e. 39%)
- head-on collisions (230 accidents i.e. 19%)
- accidents with alcohol (145 accidents i.e. 12%)

Note that an accident may belong to several types (night-time accident with alcohol and head-on collision for example). The sectors considered to have the highest stakes, already indicated in this report, are:

- N508 south of Annecy (PR 42 to 49)
- N1508 and N501 forming the Annecy bypass
- N206 (PR 10 to 16) and N201 (PR 40 to 52) arriving at St Julien en Genevois
- N205 between Cluses and St Gervais (PR 40 to 50)
- N5 between Douvaine and Thonon les Bains (PR 6 to 20).

Case study 5
DGO stake analysis

1. Case application context

In their joint circular in 2003 and its supplement [17], the Ministries of the Interior and Infrastructure requested the Prefects to mobilize the State authorities and all the local parties involved with them for the implementation of the local road safety policy and the drafting of its General Guideline Document for the years 2004 to 2008.

The drafting of the DGO involves a sequence of stages, including that of the stake analysis. It is carried by the DDE for the State, and by the technical units of the local authorities, essentially on the basis of the analysis of the accident data. It provides district managers with the technical arguments essential for selecting stakes.

A specific guide "Implication studies and the Selection of stakes within the scope of the General Guidelines Document - Methodological Guide" [16] was published by the DSCR in April 2003. It is based on the same methodology as that developed in this document. This sheet does not reproduce all the items, particularly in terms of policy, relating to the General Guideline Document, but briefly presents the **technical part** of the DGO stake analysis and is illustrated by excerpts from the study carried out by a pilot district.

Each party involved can work on a different area: the DDE is responsible for an overall study on the entire district, the municipalities are limited to their area of action.

Overlap with other case studies

The purpose of the DGO is to be a general document describing the accident research on a district and defining the main stakes:

- Case study 2 (study on a specific theme): within the scope of the DGO, some themes may be focused on. The reader can refer to case study 2.
- Case study 4 (Observatory type study): the difference between these two case studies essentially lies in the organizational context. The DGO falls within a defined political and institutional approach. Naturally, any item in an observatory study may be reproduced for the DGO and vice versa.
- Case study 6 (SURE): even though the SURE approach is exclusively associated with infrastructure problems

2. Specificities of this case

Which data are necessary?

The necessary data in addition to the accident data are as follows:

- some demographic data (breakdown of population by municipality, breakdown of population by age group);
- the necessary data for network sectioning (for the interurban environment only) and the corresponding traffic.

Are there any particularly suitable indicators?

- General status: IAL, trend;
- Thematic studies: percentages of accidents relating to themes, severity, costs;
- Interurban risk spatial studies: rate, density, severity, ZAAC.

How far should the in-depth study go?

Within the scope of the DGO stake analysis, there is no actual in-depth study. In fact, this in-depth study is a part of the second stage of the DGO, except if it is necessary to specify the stakes by means of some combined classifications, in some cases.

Priorization

The choice of stakes selected by the State and by each of the local authorities involved makes it possible, within the scope of the consultation set up, to identify the stakes liable to lead to a partner-based approach and those specific to each of the parties involved. The choice will be made on the basis of technical arguments and also accounting for the priority guidelines of the State and local authorities, the specificities of the district and the scope of the jurisdiction of each.

The choice of stakes will be made definitive following the presentation and discussion with all the partners at the District-level Prevention Council.

3. Practical implementation (technical part only)

Preliminary stage

Determine the themes to be studied. they include:

- age groups (define the age groups selected);
- vehicle type (light vehicle, heavy goods vehicle, two-wheelers, etc. determine which groups are selected);
- time slots (day/night, day of week, time);
- alcohol;
- environment (built-up area/open country, depending on size of built-up area);
- obstacles (which stationary obstacles should be selected);
- etc.

Define a sectioning of the network under study and identify, for each section, the exogenous data (traffic, length, urban environment/open country, road type, cross section).

Identify the developments on the area under study over the last five years.

See quick reference 4 (🛠4) on sectioning.

Within the scope of the DGO, the workload on sectioning should be limited, at least initially. It would not be foreseeable to systematically undertake detailed sectioning of the entire network. The priority of the DGO is not the sectioning of the road network.

Evaluation

- General data: IAL, network length, population, number of accidents and severity over the last five years;
- Accident data on themes: number of accidents according to severity with the number of victims, cost, exposure value, spatial distribution (map);
- Accident data on locations: calculation of rates, densities and severity per section, determination of ZAACs.

Analysis

- General data: accident trends may be the subject of structural and economic trend calculations, comparison with data for France as a whole;
- Thematic data: percentage of each theme and severity, comparison with statistical test to national reference, annotated maps. For some themes (age), population data will be introduced;
- Accident data on locations: annotated maps of rates, density and severity on main network, ZAAC.

Section identification						Observed on site					Reference			Statistical test		
Road No.	PR o	PR end	length	Secti on	Ave AADT	No. acc	No. deaths	Acc rate	Acc density	Severity	Rate	Density	Severity	Rate	Density	Severity

For the interurban environment: rate, density, severity by road section	A table of the following type may be completed: The sections will be categorized in increasing order of the accident rate **This table should be annotated.**

4. Example

The data below are taken from the study conducted by the District-level Operation and Safety Unit (*Cellule Départmentale d'Exploitation et de Sécurité*, CDES) of the District-level Office for Infrastructure (DDE) of the Landes district (40). After the contents of the final report, some excerpts are proposed.

Contents of DGO stake analysis final report for the Landes district

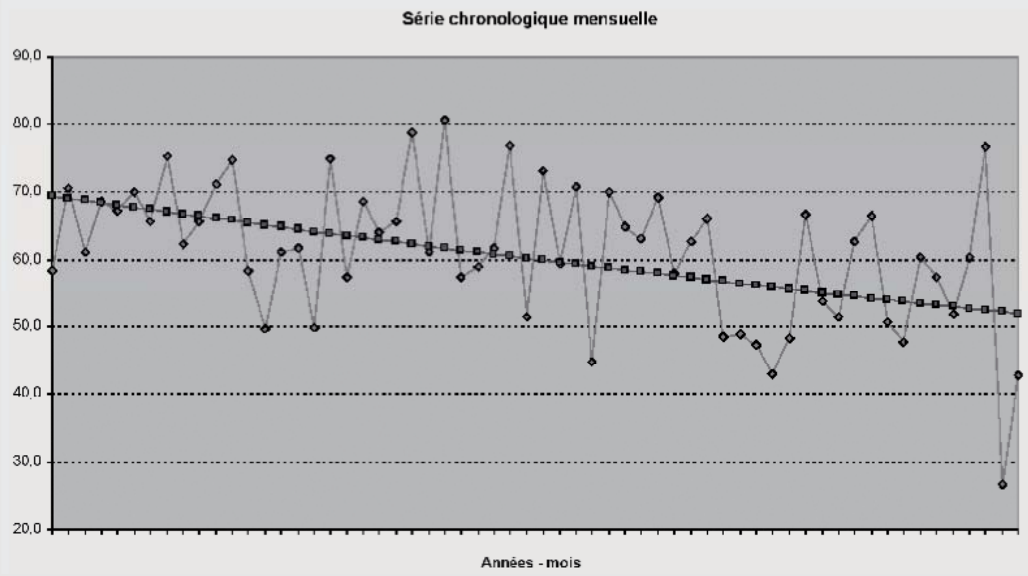
Excerpt of study

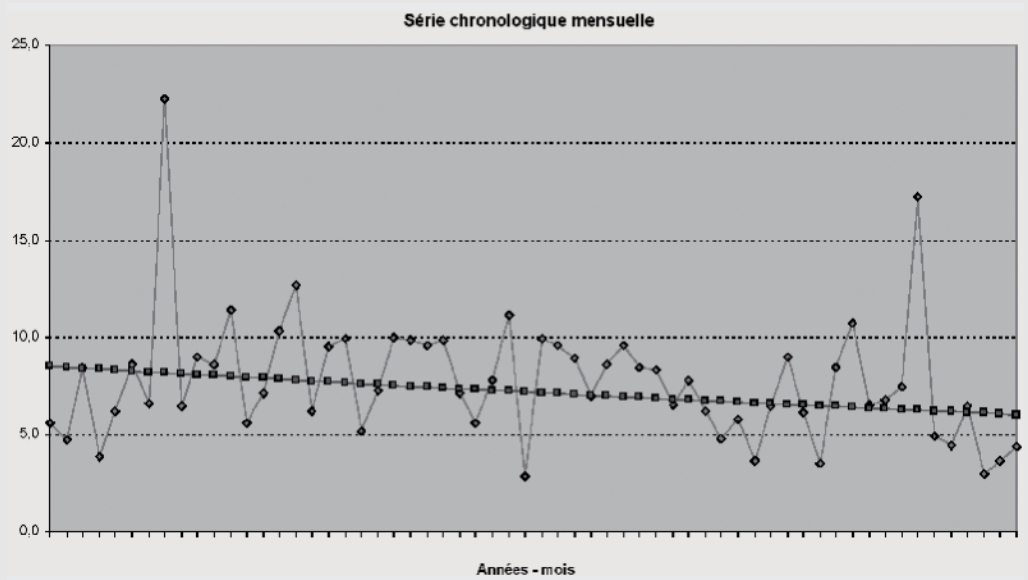
3.1 Overall

Between 1997 and 2001, the following were recorded: 3723 accidents, causing 472 deaths, 1654 serious injuries and 3533 minor injuries. This gives on average per week: 14 accidents 2 deaths 20 injuries

3.2 Trend

The trend curves are used to measure the structural trend, i.e. the genuine trend observed over these five years. The curve on the left shows the trend followed by the monthly number of accidents corrected for seasonal variations, that on the right that followed by the number of deaths.



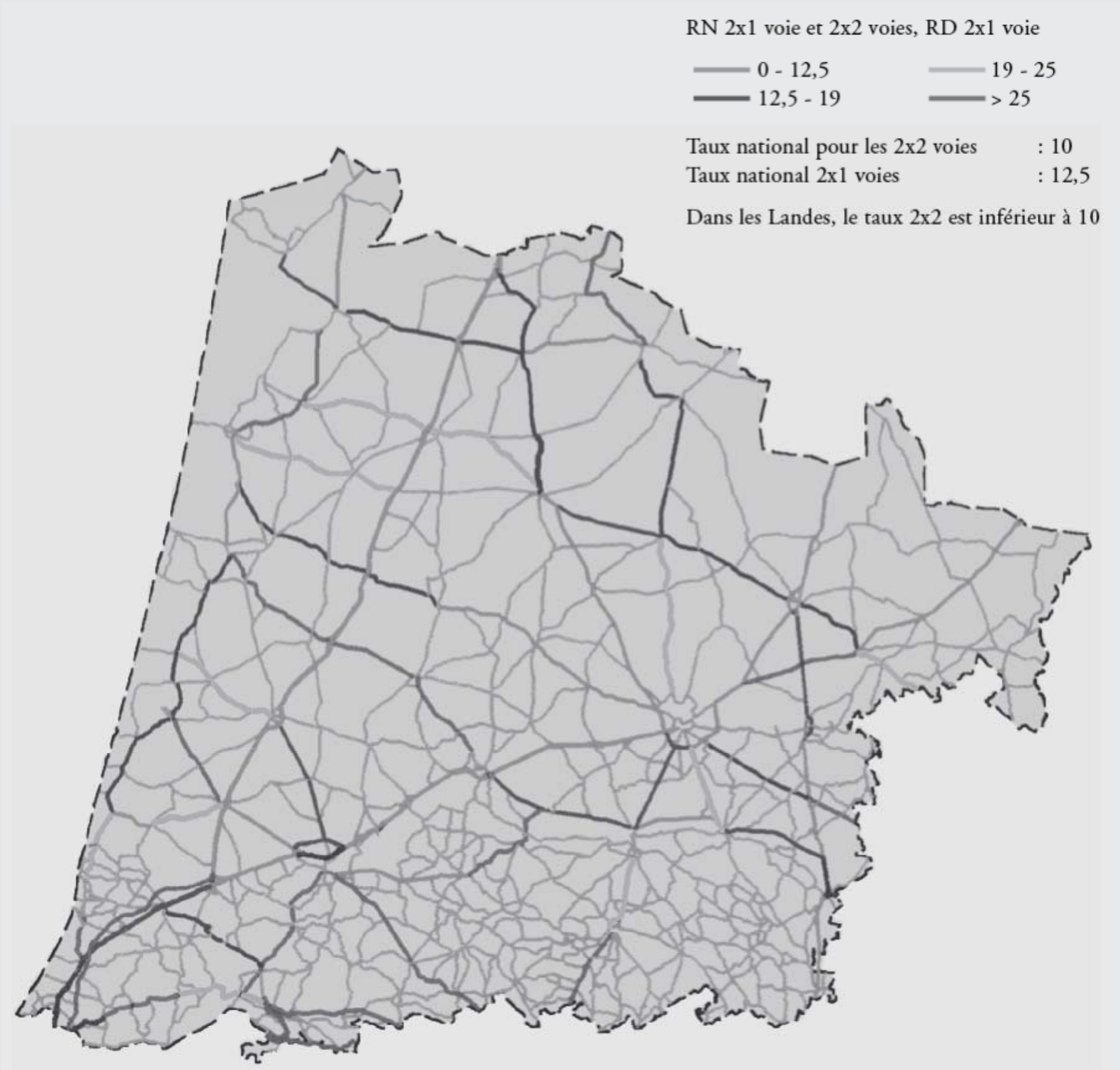


Série chronologique mensuelle	Monthly chronological series
Années - mois	Years - months

Accidents fell by 5.7% a year on average (as opposed to –1.6% for France). Deaths fell by 6.8% on average a year (as opposed to –1.5% for France). Therefore, the downward trend for the accident research in the Landes region over the 1997-2001 period was 3 to 4 times greater than that of the accident research for France.

Excerpt of study

6.2 Rate map



RN 2x1 voie et 2x2 voies, RD 2x1 voie	RN 2x1 lane and 2x2 lanes, RD (District road) 2x1 lane
Taux national pour les 2x2 voies	National rate for 2x2-lane roads
Taux national 2x1 voies	National rate for 2x1-lane roads
Dans les Landes, le taux 2x2 est inférieur à 10	In the Landes district, the 2x2 rate is less than 10

The entire national 2x2-lane network has a rate below the national reference.

For the national two-way network, RN 117 has a markedly higher rate (between 19 and 30 depending on the sections) along with the RN 124 section (Mont de Marsan – Grenade) with a rate of 20.

On the district network, a large proportion of the sections display a higher rate than the reference. The highest are RD 6 (Dax – Ste Marie), RD 16 (Léon – Magescq), RD 32 (Monfort – Mugron) and RD 947 (Dax – 64 district boundary) which have both a rate over three times higher than the national average and a significant number of accidents (greater than 10) over the 1997-2001 period.

RD 41 (St Julien – Tartas), RD 626 (Pontenx – Mimizan entrance), RD 652 (Capbreton -Labenne), RD 933 N (St Justin – Le Caloy) and RD 933S (Hagetmau – 64 district boundary) are sections with strong stakes in which the rate is over two times higher.

Excerpt of study

9. Accident research by age group and by gender

9.1 Accident research by age group and user type

Breakdown according to age group and user type

		00-13 years	14-17 years	18-24 years	25-59 years	>=60 years	Total
Pedestrians	Deaths	2	2	3	12	15	**34**
	BG	17	5	9	39	37	**107**
	BL	29	12	19	54	62	**176**
Bicycles	Deaths		2		6	14	**22**
	BG	16	11	3	35	18	**83**
	BL	23	14	12	52	31	**132**
Mopeds	Deaths		7	1	6	6	**20**
	BG	2	92	41	39	7	**181**
	BL	11	235	86	57	14	**403**
Motorcycles	Deaths		4	3	20	1	**28**
	BG		5	42	128	3	**178**
	BL	4	8	51	104	4	**171**
Passenger cars	Deaths	17	7	70	165	84	**343**
	BG	52	39	251	518	163	**1023**
	BL	140	130	549	1236	358	**2413**
heavy goods vehicle	Deaths				5	1	**6**
	BG	1		1	23		**25**
	BL		1	5	44	3	**53**
Other	Deaths		1	3	8	7	**19**
	BG	1		10	37	9	**57**
	BL	25	22	13	99	26	**185**
Total	**Deaths**	**19**	**23**	**80**	**222**	**128**	**472**
	BG	**89**	**152**	**357**	**819**	**237**	**1654**
	BL	**232**	**422**	**735**	**1646**	**498**	**3533**
Total victims		340	597	1172	2687	863	5659
i.e. in %		6.0%	10.5%	20.7%	47.5%	15.3%	100.0%
population %reminder		14.5%	48.0%	6.7%	46.6%	27.4%	100.0%

This table can be read in three ways: in rows, in columns and with reference to the population.
• the number of pedestrian victims is almost as high in the 25-59 age group as for senior citizens (>60 years), 33% and 36% of all pedestrian victims, respectively. Practically the same situation applies for bicycles (39% and 27%, respectively). Over one out of every two moped drivers is between 14 and 17 years of age, one out of every five between 18 and 24 years of age. Of the motorcyclist victims, 67% are between 25 and 59 years of age and 25% between 18 and 24 years of age. Finally, one out of every two motorist victims is between 25 and 59 years, one out of every four between 18 and 24 years of age and one out of every six over 60 years of age.
• Of the victims under 13 years of age, three out of every five are in cars. For the 14-17 age group, 56% are on mopeds and 30% in cars. The 18-24 age group is more particularly concerned by cars (74%) than by motorcycles (11%) and mopeds (10%). For the over 25, 70% of victims are in cars, and for senior citizens, 13% of victims are pedestrians.
• Calculated with reference to the population of each age group, these data demonstrate, in the Landes district, an exposure that is two times lower for the 0-13 age group and senior citizens (6% and 15% of victims for 15% and 27% of the population, respectively), but two times greater for the 14-17 and 18-24 age groups (10% and 21% for 5% and 7% of the population, respectively). The 25-59 age group represents 50% of the population and 50% of victims.

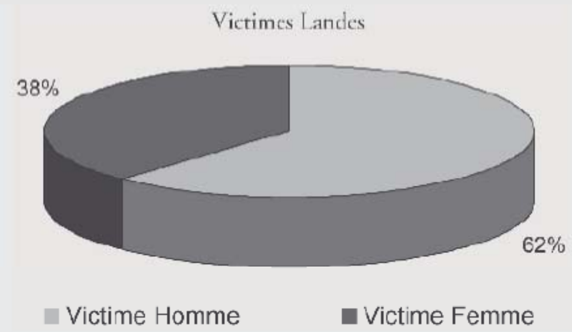
Excerpt of study

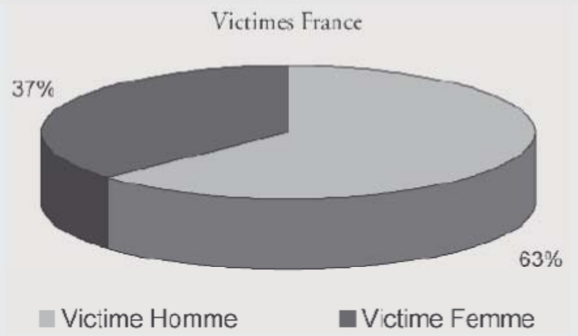
The table below gives the number of serious victims per 100,000 of the age group, to enable a comparison of exposures to risk of population of the Landes district with reference to the French population.

	00-13 years	14-17 years	18-24 years	25-59 years	Over 60 years
Landes	227	1120	1999	682	407
France	113	599	784	331	227

Overall, the population in the Landes district is exposed to twice the risk for the French population, with even a factor of 2.5 for the 18-24 age group.

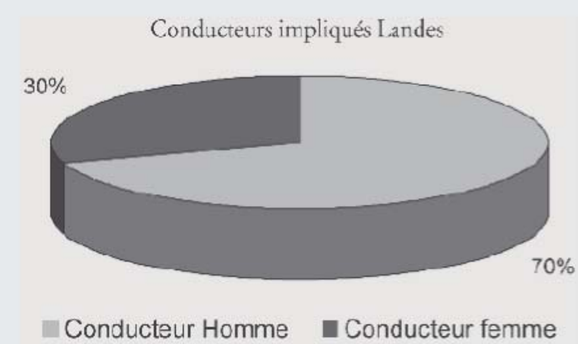
9.2 Accident research by sex

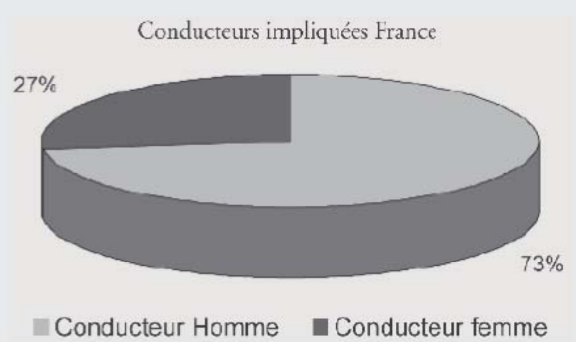




Victimes Landes	Victims Landes
Victimes France	Victims France
Victime Homme	Male Victim
Victime Femme	Female Victim

The number of male victims and female victims in Landes and in France is proportionally equal.





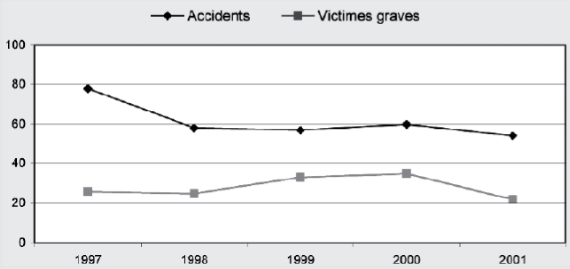
Conducteurs impliqués Landes	Drivers involved Landes
Conducteurs impliqués France	Drivers involved France
Conducteur Homme	Male Driver
Conducteur femme	Female driver

Proportionally, there are slightly more female drivers than male drivers involved in accidents in the Landes district than in France. Despite the relatively small difference in percentage, this difference is statistically very significant.

Excerpt of study

12. Pedestrian accident research

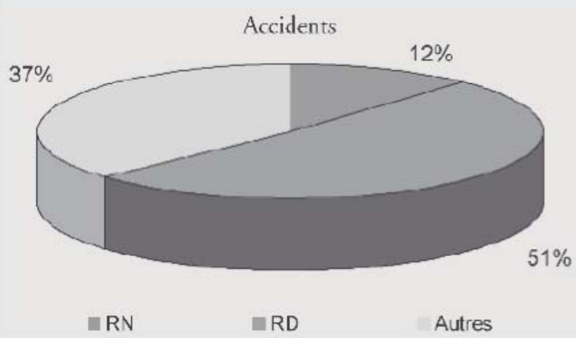
	Accidents	Deaths	BG	BL
1997	78	3	23	51
1998	58	6	19	34
1999	57	10	23	28
2000	60	13	22	30
2001	54	2	20	33

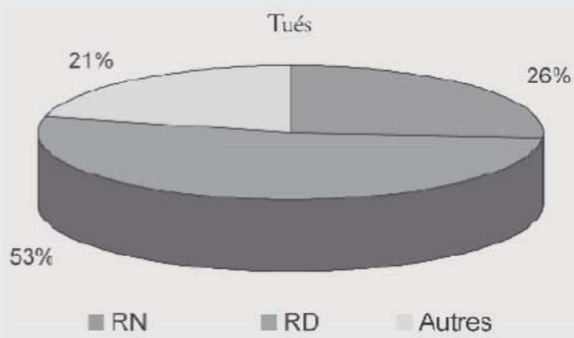


Accidents	Accidents
Victimes graves	Serious victims

On average, in the Landes district every year, 61 accidents involving a pedestrian are recorded, causing 7 deaths and 57 injuries.

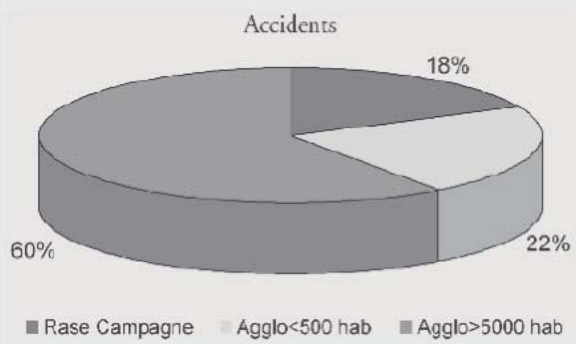
This accident research has remained relatively stable since 1998, with a substantial increase in severity in 1999 and in 2000.

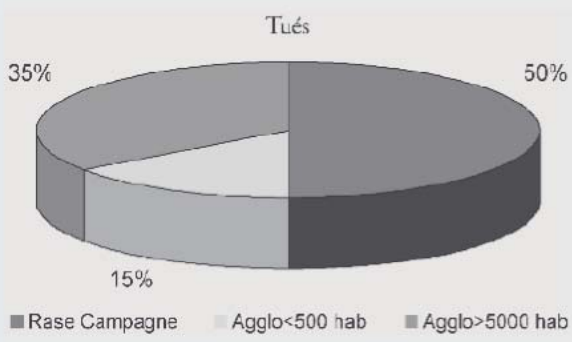




Tués	Deaths
Autres	Other

In terms of accidents, pedestrians are particularly exposed on departmental and municipal networks (88% of accidents), however, the severity is higher on the national network (26% of deaths).

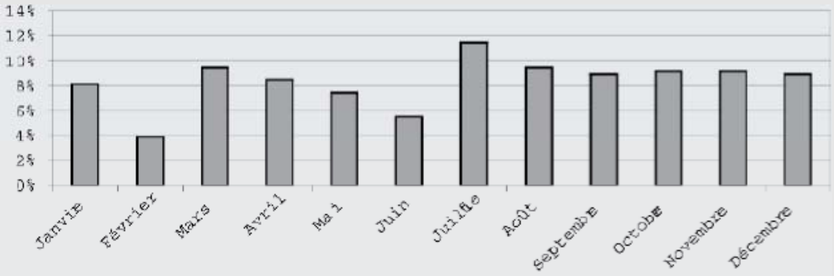




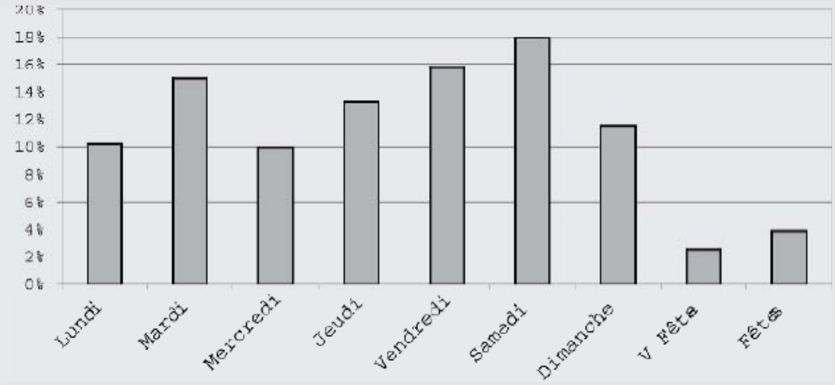
Rase Campagne	Open Country
Agglo... hab	Built-up area… inhab

82% of accidents occur in built-up areas, the majority of which in built-up areas with over 5000 inhabitants; however, one out every two deaths is recorded in the open country.

Excerpt of study



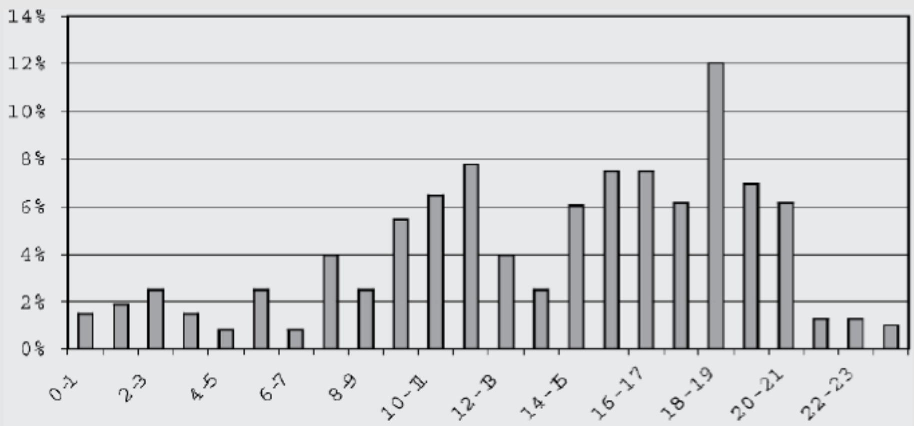
Accidents according to month



Accidents according to day of week

The summer peak is less marked for pedestrian accident research than for all the accidents in the Landes district. The second half of the year is subject to more accidents than the first.

The weekend and particularly Saturday are subject to more accidents than the other days.



Accidents according to time

Pedestrians are generally victims of accidents during the day, with peaks between 10 am and 12 pm and between 2 and 9 pm. The period between 6 and 7 pm is particularly affected (almost one out of every three accidents).

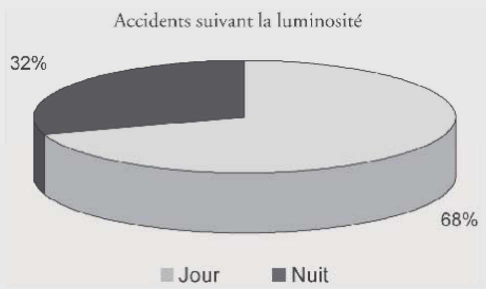
	00-13 years	14-17 years	18-24 years	25-59 years	>=60 years
Deaths	2	2	3	12	15
BG	17	5	9	39	37
BL	29	12	19	54	62

Almost one out of every three victims and one out of every two deaths is over 60. This is an implication in the Landes district. 15 % of victims are under 13.

Janvier	January
Février	February
Mars	March
Avril	April
Mai	May
Juin	June
Juillet	July

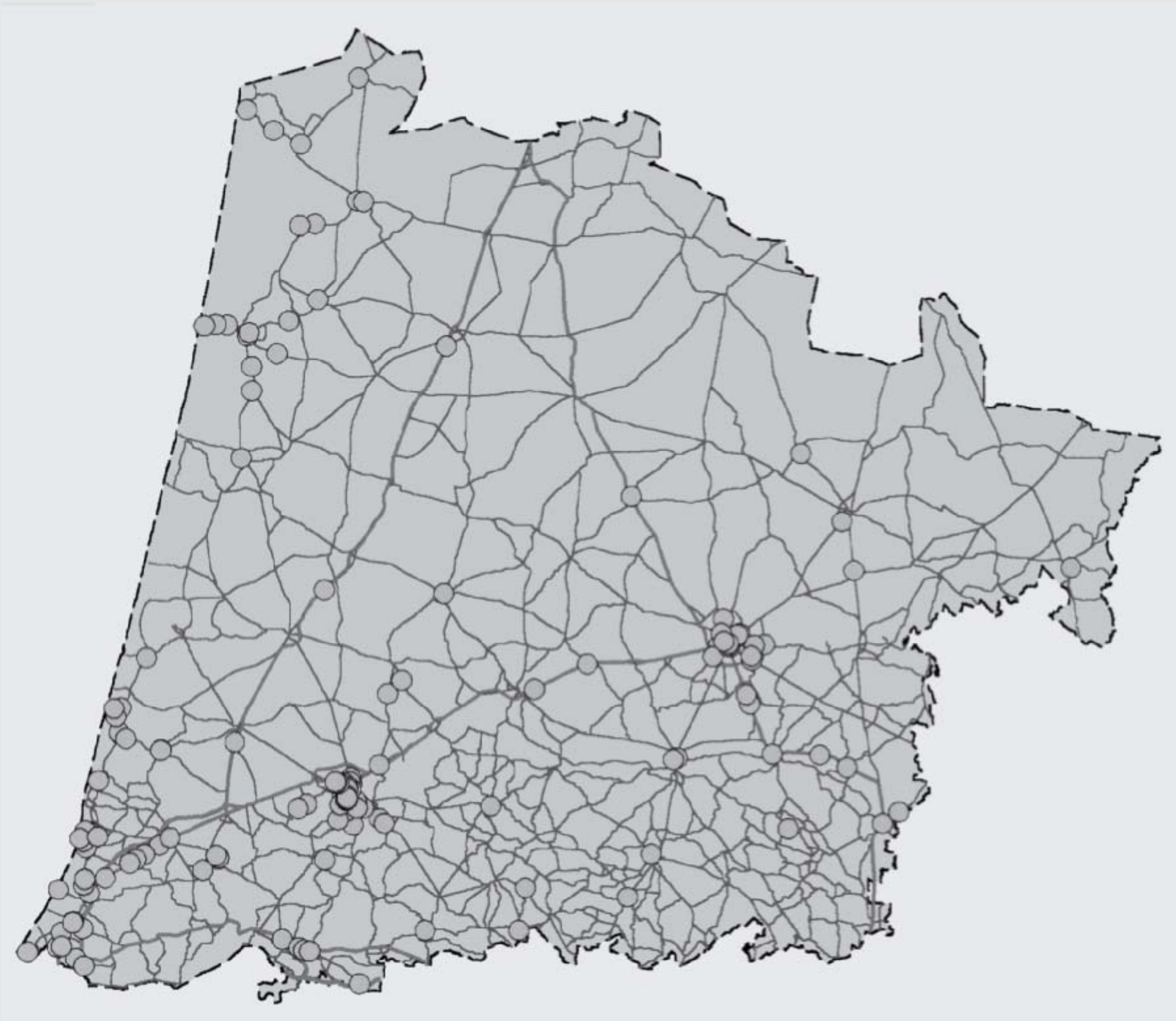
Août	August
Septembre	September
Octobre	October
Novembre	November
Décembre	December
Lundi	Monday
Mardi	Tuesday
Mercredi	Wednesday
Jeudi	Thursday
Vendredi	Friday
Samedi	Saturday
Dimanche	Sunday
V Fête	Eve public holidays
Fêtes	Public holidays

Excerpt of study



Accidents suivant la luminosité	Accidents according to brightness
Jour	Day
Nuit	Night

Pedestrians are subject to the same number of accidents at night than all other road users. One out of every three accidents involving a pedestrian occurs at night.



Accidents involving a pedestrian are essentially concentrated in the built-up areas of Mont de Marsan and Dax, on the Southern part of the coast and the Mimizan sector.

Excerpt of study

20. Stakes

20.1 Stakes based on accident file analysis

• Accidents during summer period
• Accidents during weekends
• Accidents against trees or posts
• Accidents in South-West area of district
• Accidents on RN 117 and on main district roads
• Accidents on radial roads in Dax and Mont de Marsan
• heavy goods vehicle accidents on RN 10 and on "Lot et Garonne – Pau"
• Light two-wheeler accidents in built-up areas
• Motor-driven two-wheeler accidents at intersections Car-only accidents
• Accidents of 14-17 age group with light two-wheelers
• Accidents of 18-24 age group, especially at night, weekends or during summer
• Accidents of over 60s at intersections
• Accidents of pedestrians over 60 years of age

20.2 But also if applicable...

• Local holidays
• Alcohol
• Speed
• Seat belt
• Wild animals, etc.

Case study 6
SURE stake analysis (priorization of routes)

1. Case application context

This sheet **briefly** describes the process to be implemented for the SURE approach stake analysis. In SURE, the stake analysis is essentially intended to structure the routes. This sheet is not a substitute for the detailed method but simply explains the main stages.

2. SURE process

Preliminary technical stage

The location section in the BAAC should be amended on the basis of the police reports .

Study

Route determination

The routes (to be the subject of a diagnosis) to be studied are selected, before any other analysis, on the basis of center to center links or between major intersections.
In this stage, it is particularly necessary to ensure that the length of the routes or the number of accidents recorded does not make them too complex to study. If one of these cases is established, it will be necessary to produce a functional breakdown of said links on the basis of the knowledge of intermediate urban centers, major junctions, etc. In this way, the priorization of the network may comprise spatial entities referred to as "route sections" including one or more study sections.

Network sectioning

The stake analysis is carried out using accident data over 5 years. Its methodology is particularly based on the accident rate calculation. This calculation involves using the traffic data for the 5 years of the study as a basis, making a distinction between the road types. It requires verifications of the traffic section limits, which are not always the same from one year to another: developments may have been made and the cross sections and alignment, in particular, may have changed. Similarly, police, maintenance or operation measurements modifying the usage conditions of the road or street may have been implemented.
The purpose of this stage is to obtain a specific "traffic" file that can be used to study the accident research. The edited traffic file may then be imported to the software program used to process the data adapted to the SURE stake analysis.
The study sections, which are frequently different from the traffic sections, must be determined on the basis of the following main criteria:

- be homogeneous particularly in terms of traffic and cross section over the entire study period;
- account for built-up area crossings;
- be sufficiently long for statistical reasons (on average 10 km, without falling below 3 to 4).

Detection of locations subject to accidents

The determination of personal injury accident accumulation areas (ZAAC) and abnormal at-risk study sections (*Section d'étude de risqué anormal,* SRA) is performed on the basis of the BAAC accident file for the last five years. The detection of ZAACs consists in identifying, using a statistical method, accumulation areas involving at least five accidents.
That of SRAs consists in identifying the study sections with an accident rate significantly greater than the reference for the same road type.
At the end of this stage, the ZAACs and SRAs are selected.
The following will be excluded, according to the developments carried out over the 5 years taken into account in the study, in progress or under study:

- areas or sections in which works are carried out or in progress (to be examined separately according to the developments carried out or in progress);
- areas or sections under study (they will be the subject of an analysis in order to ensure that the developments have been proposed within the scope of a safety study).

It is necessary to see whether ZAACs and SRAs are neutralized by developments carried out, in progress or for which works are scheduled in the very short-term (1 or 2 years). This "field" feedback is very important. It makes it possible to identify any changes on the routes during and after the study period and, on that basis, to amend the list, based on the calculation methods, of SRAs and ZAACs. Therefore, these lists will be completed by comments identifying the operations involved, the type of development, the completion date, the affiliation program.

Priorization of routes

This is defined according to the preventable costs calculated on the SRAs and ZAACs. The "preventable" costs are calculated according to the method in quick reference 6, section 6 – method 2.
The safety potential of a route is the sum of the preventable costs of its SRAs and ZAACs divided by thetotal length of its constituent study sections. However, when an SRA and one or more ZAACs overlap, only the highest preventable cost between the SRA and the sum of the ZAACs is selected.

In this case, the categorization is defined according to the safety potential of each route.

NB: Within the scope of the diagnosis, a more in-depth stake analysis is performed on the basis of a fully amended file by reading all the PVs. This study will determine the ZAACs, SRAs and infrastructure-related themes.

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Abbreviations

Agglo: Built-up area (Agglomération) (see definition of urban environment)

APS: Outline draft (Avant Projet Sommaire)

ATB: Accidents, Deaths, Injuries (Accidents, Tués, Blessés)

BAAC: Road traffic personal injury accident analysis report (Bulletin d'Analyse des Accidents Corporels de la circulation routière)

BDR: Road database (Banque de Données Routières)

BG: Serious injury (Blessé Grave)

BL: Minor injury (Blessé Léger)

CNIT: National Type Identification Code (Code National d'Identification du Type)

DDE: District-level Office for Infrastructure (Direction Départementale de l'Équipement)

CDES: District-level Operation and Safety Unit (Cellule Départementale d'Exploitation et de Sécurité)

CETE: Public Works Regional Engineering Offices (Centre d'Études Techniques de l'Equipement)

CERTU: Study center for networks, transport, urban planning and public real-estate (Centre d'Études sur les Réseaux, Transports, l'Urbanisme et les constructions publiques)

CSPR: Road Project Safety Monitoring (Contrôle de Sécurité des Projets Routiers)

COPRA: Accident Procedure Consultation (COnsultation des PRocédures d'Accidents)

DGO: General Guideline Document (Document Général d'Orientations)

DRE: Region-level Office for Infrastructure (Direction Régionale de l'Équipement)

DSCR: Road Safety and Traffic Office (Direction de la Sécurité et la Circulation Routières)

IAL: Local accident research indicators (Indicateurs d'Accidentologie Locale)

IDSR: District-level road safety inspector (Inspecteur Départemental de Sécurité Routière)

IGN: National Geographic Institute (Institut Géographique National)

INRETS: National Research Institute on Transport and Transport Safety (Institut National de Recherche sur les Transports et leur Sécurité)

INSEE: National Institute of Statistics and Economic Studies (Institut National de la Statistique et des Etudes Economiques)

MERIU: Inter-Urban road Reference Exchange Model (Modèle d'Echange de Référentiel routier InterUrbain)

NS: Non-Significant (Non Significatif)

ONISR: National Interdepartmental Road Safety Observatory (Observatoire National Interministériel de Sécurité Routière)

ORSR: Regional Road Safety Observatory (Observatoire Régional de Sécurité Routière)

PDASR: District-level Road Safety Action Plan (Plan Départemental d'Actions de Sécurité Routière)

PL: Heavy Goods Vehicle (Poids Lourds)

PR: Reference Point (Point Repère)

PRAS: Regional Safety Development Plan (Plan Régional d'Aménagements de Sécurité sur le réseau national)

PV: Police Report (Procès-Verbal)

REAGIR: Response via Investigations on Serious Accidents via Initiatives to Remedy the situation (Réagir par des Enquêtes sur les Accidents Graves et par des Initiatives pour y Remédier)

RIU: Inter-Urban road Reference (Référentiel routier InterUrbain)

RD: District Roads (Routes Départementales)

RN: State Highways (Routes Nationales)

S: Significant (Significatif) (*)

Sétra: Technical Department for Transport, Roads and Bridges Engineering and Road Safety (Service d'Études Techniques des Routes et Autoroutes)

SICRE: Road Network Knowledge Information System (Système d'Information Connaissance du Réseau Routier)

SIG: Geographic Information System (Système d'Information Géographique)

SIR: Road Information System (Système d'Information Routier)

SURE: Existing Road User Safety (Sécurité des Usagers des Routes Existantes)

VL: Passenger Car (Véhicule Léger)

VRU: Urban Expressway (Voie Rapide Urbaine)

VU: Commercial Vehicle (Véhicule Utilitaire)

TS: Very Significant (Très Significatif)(*)

ZAAC: Personal Injury Accident Accumulation Area (Zone d'Accumulation d'Accidents Corporels)

(*) **+** after Ts or S: *(very) significantly above the reference for a risk analysis or a thematic analysis, or on the rise for a trend.*

- after Ts or S: *(very) significantly below the reference for a risk analysis or a thematic analysis, or on the decline for a trend.*

Detailed

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This guide proposes a methodology to carry out a road safety stake analysis on the basis of the accident data analysis. It essentially covers the interurban environment.

Firstly, this guide defines the general approach via its different stages:

- stake analysis;
- diagnosis and action guidelines;
- study and implementation of actions;
- monitoring and assessment.

The second part only covers the stake analysis methodology, referring, for the most technical items, to practical and more specific quick references.

Finally, case studies illustrate different types of stake analysis.

This document is available and can be downloaded on Sétra website:
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