Summary report on work package 3 "Types of Factors"

TRaffic Accident Causation in Europe

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Summary Report on Work Package 3 "Types of Factors"

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Abstract:

This summary report presents the main results of Work Package 3 "Types of Factors" of the TRACE Project. The work as performed in the tasks 3.1 (accident related factors), 3.2 (sociological and cultural factors), 3.3 (trip-related factors), and 3.4 (driving-task associated factors) and presented in the Deliverables 3.1 to 3.4 and an additional internal TRACE Report (Collection of Sub-Reports for task 3.3) is summarized and discussed.

The objective of defining relevant accident related factors first and the objective of analysing traffic accident causation

- from a factor's point of view while taking traditional views into account
- on different levels
- by using statistic methods for existing databases as provided by the Work Package 3 Partners and
- by using new (developed in Work Package 5 of the TRACE project) methods on new case analysis in order to gain new knowledge on accident causation was possible to reach.

The scope of the identified key aspects as found by the Partners in their work for the relevance in EU27 is discussed. In accordance, even further, appropriate suggestions for prevention of traffic accidents can be derived.

Keyword list: Types of Factors, Accident Causation, accident related factors, sociological and cultural factors, trip-related factors, driving task associated factors, risk factors, contributing factors

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1 Introduction

One TRACE idea is to analyse accident causation from different points of view. Different types of road users (Work Package 1) will face different problems, and in different types of situations (Work Package 2) distinguishable pattern of factors and characteristics of the road users and their interaction with the environment might show up. The view from different types of factors (Work Package 3) should reveal if typical situations and road users are inclined to typical accident related factors. The question "What is typical about an e.g. alcohol (or speed, inattention, and other factors) related accident?" is regarded in Work Package 3 of the TRACE project.

Factors are usually not used to classify different kinds of accidents, but to explain why an accident occurred. And the explanation of why an accident occurred will be answered differently by different experts. On the one hand technicians explain the physical dimensions like friction, timing, steering, braking, distance, and speed towards their contribution to the accident occurrence. Other experts explain the traffic participants' behaviours that describe the development of the accidents. Again others will explain why these behaviours showed up in the accident involved parties. Explanations on "why the accident happened" are manifold, but are true in the apt reference. Therefore factors from every research field are regarded in Work Package 3.

The first task of Work Package 3 (task 3.1 "Accident related factors") was meant to give a reference frame and classification scheme for different kinds of factors, and to find out, which factors are worth regarding more in detail. Relevant factors were then to be analysed towards the question why accidents happen in the following tasks 3.2, 3.3, and 3.4.

This was to be done by using existent accident databases of the Partners of Work Package 3, and by using aggregated data provided by further accident databases of the TRACE Partners. It turned out that new case analysis had to be added to use new methods in accident analysis.

The different types of factors for analysing traffic accident causation in TRACE were pre-positioned to be regarded either as sociological and cultural factors (task 3.2), trip-related factors (task 3.3) or driving task associated factors (task 3.4).

Starting with these outlines, Work Package 3 was concerned with task 3.1 "Accident related factors" for the first part of the project followed by operational work based on the conclusions from task 3.1 by implying methods from Workpackage 5 (Human functional failure analysis) and Workpackage 7 (statistical methods) on aggregated data and disaggregated data in the following tasks 3.2, 3.3 and 3.4.

2 Objectives

The objectives of Work Package 3 were:

1. To detect relevant factors which contribute to road traffic accidents with casualties.
2. To analyse these factors according to a multi-dimensional view of causation factors (Sociological, Infrastructure-related, Vehicle-related, Medical, and Psychological).
3. To analyse the frequency of these factors with regards to accident causation.
4. To understand the major influencing factors in road accidents.

The specific challenges and further expectations towards Work Package 3 were:

1. to provide a list of risk factors for Work Package 4 (task 3.1)
2. to develop a model for accident causation based on factors (task 3.1)
3. to define and classify accident related factors to sociological and cultural, trip-related, and driving task associated factors (in task 3.1)
4. to analyse these types of factors by three different methods in the tasks 3.2, 3.3 and 3.4 by the Work Package 3 partners
5. to use existing databases and aggregated data as provided by the TRACE Partners via Work Package 8
6. to "find new factors" and "innovative results" (all tasks)
7. to translate results to prevention suggestions by taking Work Package 4 and Work Package 6 results into account (tasks 3.3, and 3.4)
8. to give statements on EU27 level towards accident causation (in Deliverable 3.5)

In the following the methods used in Work Package 3 (chapter 3) and then the main outcomes from each task (chapter 4) are presented. A general discussion on the conclusions that were drawn in the tasks concerning prevention measures and on the methods is then presented in chapter 5.

3 Material and Methods

Partners in Workpackage 3 were BASt (Germany), CIDAUT (Spain), INRETS (France), LAB (France), LMU (Germany) and sub-contractor TUG (Austria), and VSRC (United Kingdom), each involved in varying shares in each task.

After screening literature and accident databases for task 3.1 to find, define and classify relevant factors, the results from Workpackage 5 and Workpackage 7 were also taken into account to decide how to proceed in Workpackage 3. It was decided for task 3.2, to follow the work begun in task 5.4 of Work Package 5 and analyse traffic accident causation with a feasibility approach for the sociological and cultural factors. For tasks 3.3 and 3.4 it was decided to analyse accidents where the following factors contributed by statistical database analysis and some of the factors also by in-depth case analysis:

- Alcohol
- Vigilance
- Experience
- Vehicle condition
- Road condition and layout
- Attention
- Sudden health problems
- Speed (including 'inappropriate speeding' and 'illegal speeding')
- Sudden technical defects
- Dazzling sunshine

Due to lacking data it turned out that the attempted analyses of the factors 'medical condition' and 'mobile phone use' were not as feasible as planned. A few aspects are presented in chapter 4.4.4, for further information see D3.3 and D3.4.

3.1 Definitions used in Work Package 3

For the work in task 3.1 of Work Package 3, definitions were initially developed to help avoid misunderstandings when discussing "factors", "risk", and "cause".

Contributing factors are defined as all imaginable entities that contribute to the accident occurrence. These factors can be material things, but also circumstances, situations, events, manoeuvres, ideas, attitudes, states, and conditions. They contribute to an accident in the sense that if they had not been present, the accident would not have happened.

Usually they are found by investigators and in-depth accident analysis. The idea is to apply a causal contribution to these factors on a single accident level. In accident databases they are collected and by database analysis frequencies on how often the factors are found in the accident samples can be derived.

Risk factors here are defined as all imaginable things that increase the chance for an accident to occur. They are found by statistical analysis on a sample level by estimating risk measures describing the increase in risk for an accident. A causal contribution to accidents is not necessarily given.

Risk estimates for traffic accidents can refer to individual participants, to certain sub-populations of traffic participants, as well as to more specified accident types, and are published most often as relative risks.

The cause for an accident is seen as a co-occurrence and combination of contributing factors.

3.2 Materials used in Work Package 3

The in-depth databases at hand for the Workpackage 3 Partners were: GIDAS (Germany north and east) used by BASt, DIANA (Spain central) used by CIDAUT, EDA (France South) used by INRETS, EDA (France central) used by LAB, ZEDATU (Austria) used by TUG, OTS (Great-Britain Midlands and Southeast) used by VSRC.

In general the national and in-depth databases used primarily for Workpackage 3 covered at least parts of the following catchment areas: Czech Republic, France (North), France (South), Germany, Germany (north and east), Great Britain, Great Britain (England (Midlands and Southeast)) Greece (South), Italy, Spain, Spain (Catalonia), and Spain (central).

Further information on the databases is given in D8.1 and D3.1 of the TRACE Project.

Databases provided by the Partners in Work Package 3 and all Partners in TRACE as represented in the Work Package 8 cover in-depth databases and access to national databases. All databases use different criteria for including accidents into their database. Inclusion and exclusion criteria range from geographic areas that are covered, via the extent of injury severity and the material damage, to types of vehicles or traffic participants, and are sometimes limited to a certain time when the accidents were collected. All databases use different variables for documenting the characteristics and circumstances for describing the accidents. Further, all databases use different variables for causation analysis. Even if the focus is set on comparable questions (traffic accident causation or injury causation or human functional failure analysis or accident preceding situation analysis) the system for documenting causal, precipitating, contributing, risk factors or explanatory elements differs. Even if the name for some factors is comparable, often the implied meanings covered or the parameter values differ.

3.3 Methods applied in Work Package 3

3.3.1 Literature review for task 3.1

It was decided to perform a sensitive search for risk factors for traffic accidents, so to be able to find all possible risk factors discussed in literature. Thus, it was more focus laid on what reliable risk factors exist, and not, how high the risk estimates for single factors were. The search was restricted to studies providing adjusted risk estimates for traffic accident occurrence, traffic accident involvement or traffic accident causation. Therefore risks for sub-populations like limitations towards certain road users, certain sites, certain types of accidents, or for traffic accident outcomes like injury severity are not regarded. The literature review already also included published studies based on databases which provide frequencies of factors' occurrences, and on accident causation theories (see D3.1).

3.3.2 Analysis of social factors in task 3.2

As developed in task 5.4 of Workpackage 5, social and cultural factors can be supposed to contribute, on an upstream level, to accident causation in specific cases. According to 5.4 results, “soft” factors, such as culture, social status or membership to specific social groups, have an identifiable influence on individual behaviour. On this background, road accidents can be understood as something that is the product of the interaction of individuals in a given social space. Regarding the specific set of a road accident, individuals are not neutral (in the sense that they do not only begin to exist when the accident occurs…) they are product of their specific history, they evolved in a specific cultural context and they are acting on behalf of their multiple social roles.

On this premise, the aim of task 3.2 was to analyze on the one hand on what level social factors can be identified in existing in-depth databases on accident causation, and on the other hand to which degree it is currently possible to analyze the specific impact of socio-cultural factors on accident causation.

As a basic condition for analyzing the impact of socio-cultural factors on the production of a road accident, corresponding variables must have been formerly integrated in the design of the in-depth analysis database. Therefore, the first step of task 3.2 was to identify existing socio-cultural variables in current accident causation databases. The following questions should hereby orientate the proceedings:

- Do the existing accident causation databases contain sufficient information that permit to perform complementary analysis, regarding the implication of social factors in the accident causation process?
- Which are the existing variables that do inform about social factor involvement in existing databases?
- What is the level of sociological analysis that is possible to perform with the existing data material?
- On the bases of the existing data material, what are the conclusions that can be obtained today from such analysis?

To answer these questions task 3.2 proceeded in three different steps:

- Four existing European databases (France, Germany, UK and Spain) were examined on behalf of their individual potential to identify existing socio-cultural factor variables.
- In a second step, identified socio-cultural variables underwent some frequency analysis (and some correlation analysis on selected variables), to determine their general impact on accident causation.
- The third step consisted in a qualitative analysis of four specific cases from the French EDA database. These four case studies are performed on the base of the in-depth interview, which was conducted by the accidentologists with accident drivers.

The results and conclusions of the performed analysis were presented for each of these parts.

Expected results of task 3.2 were to show the potential and the limits of the existing accident causation databases and on this background, to propose elements that can contribute to improve accident causation analysis and public prevention strategies.

3.3.3 Data requests 3A and 3B to Work Package 8

3.3.3.1 Data request 3A

Data request 3A aimed at getting an overview on the data material of the TRACE Partners and their modes of coding and classifying variables and factors for accident causation analysis for task 3.1. Frequencies of parameter values of their contributing factors within their data material were requested.

The accident samples requested from the Partners should cover all kinds of accidents in their databases (no restrictions in criteria) and should cover all collected accidents of the year 2004, if this was feasible. In addition the same request was restricted to fatal accidents only, to have one characteristic for improving the comparability of the results.

Based on the absolute frequencies also relative frequencies were calculated and given as a percentage. The relation to which the absolute frequencies of the contributing factors were set was on the one hand the sum of all applied factors, to get an idea on how frequently this factor is occurring in the data material of the database. This was presented by providing the Top Ten Factors of each database.

By setting the actual frequencies in relation to the expected frequencies (which assumes that all factors are equally relevant and of detail level) important contributing factors of a database will be those where the "Relative Risk of being coded" is higher than the assumed "1". E.g. if a database provides 50 different factors, allows to code one factor per accident and contains 1000 accidents, then every contributing factor should be coded 20 times. As this is not the case, some factors prove to be more relevant within a coding system. Either some overrepresented factors cover a range of different underlying causes, or, this factor is a frequent factor contributing to accidents. These results are provided in the Annex III of the report TRACE-D.3.1-V3 and serve for reference.

On the other hand the absolute frequencies of the contributing factors were set in relation to the number of accidents they were applied to. This answers in which share of accidents the factor is found. Databases that allow coding of only one factor for one accident show equal figures for both relative frequencies. These results are pictured in lists in D3.1 for a variety of factors that share comparable meanings.

3.3.3.2 Data request 3B

For tasks 3.3 and 3.4 the data request 3B aimed at screening for certain associations between contributing factors and explanatory variables. Therefore cross tabulations of the selected contributing factors with a selection of explanatory variables with suggested parameter values was requested.

Only Partners were contacted who were able to provide at least a few of the suggested contributory factors and were able to perform this cross tabulation on a database structure level where only one participant (in one vehicle) for one factor in one accident can be regarded without major effort in database preparation.

The selected contributing factors were "alcohol", "vigilance", "experience", "vehicle condition", "road layout", "speed", "attention", "mobile phone use", "sudden health problems" "sudden technical defects" and "dazzling sun".

The selected explanatory variables and the suggested parameter values comprised:

a) person characteristics:

- Gender (male/female)
- Age group (<25/25-44/45-64/>65)
- Occupation (worker, employee/student/pensioner/unemployed/other)

b) traffic participation:

- Vehicle group (Car, Van <3.5t/truck >3.5t/PTW/pedestrian/bicycle/Other)

c) accident characteristics:

- Impact type multiple vehicle collision (frontal/side/rear/Other)
- Crash type single vehicle (running off the road/hitting object (immobile)/hitting object (mobile -e.g. animal)/rollover)
- Manoeuvre (going straight/overtaking/turning/crossing/merging/other)

d) site characteristics:

- Location (Rural/Urban)
- Road type (Autobahn, National road/Country road/Other roads)
- Speed limit zone (<50/50-100/>100 km/h)

e) time characteristics:

- Light conditions (dark/dusk, dawn/day)

- Time of day (0-7:59/8-15:59/16-23:59)

Replies were received from Czech Republic (national database – further called "Czech national"), France (in-depth EDA databases, further called "INRETS" and "LAB"), Germany (national database – further called "BASt", and in-depth GIDAS database – called "GIDAS"), Great Britain (in-depth OTS database – called "OTS"), Italy (in-depth database SISS - further called "ELASIS"), Spain (in-depth database DIANA – further called "DIANA").

3.3.4 *Statistical analysis methods and testing in task 3.3 and 3.4*

In tasks 3.3 and 3.4 it was tested whether explanatory variables (as objective information without subjective interpretation of a researcher on the site necessary) are able to characterize circumstances where typical factor related accidents occurred.

The method applied was discussed with statisticians from Work Package 7 and is comparable to the idea presented in D7.3, Chapter 6.3.3 "Comparison of risk factor-specific and reference accident type".

The "Statistical Method" of analysing the selected factors for tasks 3.3 and 3.4 is based on the idea of comparing accidents that are influenced by the factor of interest with those accidents where this factor had not been contributing to the accident. The question is whether the accidents differ from each other.

The differences can be described by explanatory variables which comprise road users characteristics and their participation in traffic, crash types, vehicle characteristics, manoeuvres, situations, locations, times, scenarios, and other characteristics describing or being connected to an accident.

At first the databases are prepared to assign a dichotomised variable to each accident indicating, if in this accident a certain contributing factor was contributing to each accident or not.

These accidents are then compared by the help of explanatory variables (e.g. by cross tabulation/contingency tables) to see if not neglectable associations exist between a contributory factor and an explanatory variable. Chi square tests, Hosmer Lemeshow tests, Pearson and Spearman correlation coefficients, and Mutual Information Content testing were used to test homogeneity hypothesis or find associations between variables and factors. The selection of explanatory variables in the first was either performed by mutual information method as developed by Work Package 8, or by the given limited number of available variables and expert knowledge.

The circumstances of accidents as described by explanatory variables comprise time (e.g. advice when to intensify prevention efforts), place (e.g. sites for controls in general, sites for infrastructural improvement), situations/manoeuvres/scenarios (which active safety device could be apt) and target groups (drivers and vehicles).

After this screening the explanatory variables that show associations are used for modelling a logistic regression model.

The remaining variables in this logit model for accidents with the contributing factor of interest compared to accidents without this contributing factor, describe a certain pattern that goes along with this type of accident, but not typically for accidents, where this factor was not contributing.

Depending on the used database, different explanatory variables are at hand for the analysts.

For the usage of the 3B data request (requesting cross tabulations of contributing factors with selected explanatory variables comparable to the first steps in tasks 3.3 and 3.4) Odds Ratios (OR) with 95% Confidence intervals were calculated for screening of significant associations due to the restriction to aggregated data only.

3.3.5 *In-depth case analysis by using Human Functional Failure Analysis in tasks 3.3 and 3.4*

Basis for this kind of analysis is the work as presented by INRETS in Work Package 5, and the Deliverables D5.1, D5.2, and D5.3.

The Work Package 3 Partner INRETS used their implemented method and database for analysing the factors vigilance and attention for this operational Work Package 3. Previous work on the subject of "human error" in accidents has led to the development of an operational analysis grid. This grid shows the functional failures involved in the various stages of performing the activity (cf. TRACE D5.1): **perception, diagnosis, prognosis, decision and execution** of the action, and on an **overall** level of the individual's psycho-physiological and cognitive abilities. Its use provides a systematic analysis of the role played by the human component in the multi-causal breakdown of situations. Once identified using this model, "accidental errors" are distributed into **prototypical scenarios** (cf. D5.3) explaining the generic contexts of their appearance and the mechanisms that produce them. It has to be underlined that the deliverable D5.3 not only provides a pre-established scenarios list but also the method to build them if thought necessary, following the aggregation process of similar accident patterns. Then, an analysis of the scenarios enables the researcher to observe homogenous sets of situations in which drivers encounter difficulties, to define patterns of explanatory elements for these difficulties and to pinpoint the functional failures that they cause as well as the repercussions that these failures have in the breakdown of the situation.

The Work Package 3 Partner VSRC used this method for the first time and applied it to their data on the factors alcohol impairment, road layout and speed (inappropriate speeding and illegal speeding). Only small samples of cases for each factor were analysed using the Work Package 5 methodology, due to the detailed re-coding of cases that was required and further time-consuming in-depth analysis of each individual case that was necessary to try and identify the main 'failures' in each accident and the factors (as defined in Work Package 5) which led to these failures occurring. The aim was to try and identify some typical failure generating scenarios from each small sample and identify whether these are 'typical' scenarios already identified in TRACE D5.3 or whether new scenarios can be identified.

4 Main Outputs of performed work

4.1 Task 3.1 Accident related factors

According to Elvik (2005), a variety of theories on accident causation exists and up until today no synthesis has emerged. Theories and models are reflecting peoples' views on reality to explain complex relations in simplified ways. The motivation lies in the belief that every accident can be prevented, if the causes for this accident can be eliminated. Accident Models shall help to understand the occurrence of traffic accidents and give answers to questions on how and why accidents happen, where and when they take place, and who is involved, and furthermore to find according preventive measures.

Epidemiological studies can reveal risk factors for crashes that increase the chance for an accident to occur or the chance for someone to cause, or just be involved in an accident. Additionally, in-depth accident research identifies factors that contributed to a specific accident and are able to explain the occurrence of the accident. This is done by applying causality to certain factors that led to the accident. Most in-depth accident databases provide a list of factors, from which the investigator can choose the factors that contributed to the accident. Some investigation classifications code key events or triggering factors in addition, to also consider the most important factors, or the last factors, that finally caused the accident in the causal chain in time, respectively.

Of course, usually one factor cannot cause an accident. Most often a combination of contributing factors, forming a sufficient cause, leads to the accident (Mackie, 1974, Rothman, 1976).

4.1.1 Classification of factors and accident causation model

The idea of a time scale will most often be found in models of accident causation. Also the idea that accidents are the unwanted outcomes of interactions of the Human with its Environment. These two ideas serve as the basis for the accident model and the classification of factors suggested by Work Package 3.

The traffic accident causation model based on factors takes results from literature for accident causation into account, and it serves the idea of TRACE to regard accident related factors on hierarchical levels from background factors, via trip-related factors to driving task associated factors indicating at what stage of the accident causation process certain factors are occurring. Further, it takes current data coding and classification methods into account that separate factors to the origin they stem from, namely the "human", the vehicle, and the environment.

In this model the ideas of mediating and proximal causes (Cross, 1974) being extended by not limiting them to the human component, the systemic latent failures idea of Reason (1988) and the static and dynamic components idea by Kieliszewski (2005) are reflected.

The model implies the following assumptions and prepositions:

- A multitude of possible accident related factors exists.
- They are present or show up at particular times on a background level, on a trip level, or on a driving task level.
- They stem from an environmental "component", a vehicle component or a human component.
- The cause of an accident is always a combination of factors.
- Each factor by itself is not sufficient to cause an accident.
- Interactions and associations between factors exist.
- There are only two (trivial) necessary factors for a road traffic accident, namely the "roadway and traffic system" and the "participation in road traffic".

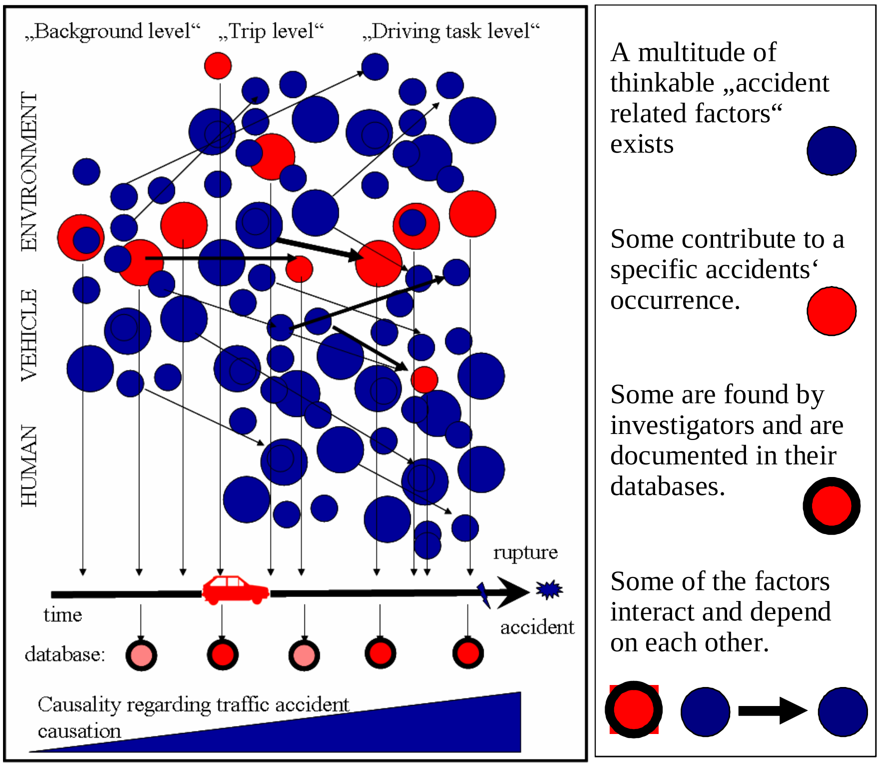

Figure 4-1: traffic accident causation model based on factors (Schick S., 2007)

As pictured in the figure 4-1 some contributing factors of an accident will not be represented in a database. Reasons are either that the coding of this factor is not possible (not included in a given evaluation scheme) or up until now the factors are not discovered yet. So it has to be assumed that also by combination of all documented factors for one accident a sufficient cause can still not be pictured.

By the model the classification of accident related factors is two dimensional. One dimension is expressing the time (accident process) by levels, and the other dimension reflects the origin from where a factor stems from (from a "traditional view") by components. Generalised examples are used in the following figure to visualize the classification of factors.

Levels and Components	Background factors	Trip related factors (task3.3)	Driving task associated factors (task 3.4)
Environment	Modes of Transport, Climate	Road characteristics	Road and light condition
Vehicle	Vehicle fleet, safety standards	Vehicle type and maintenance status	Vehicle condition and performance
Human	Transportation politics, Socio-demographic characteristics (task 3.2)	Physical and mental state	Actual behaviour and performance

Table 4-1 classification of accident related factors (Schick S., 2007)

One axis distinguishes factors that stem from the components Environment, Vehicle and Human. This is done due to practical reasons of existing classifications. The second axis distinguishes factors that stem from different levels on a time scale from {years to months} via {weeks to hours} to {minutes to seconds}. The levels are "background", "trip-related" and "driving task associated". This theoretical classification provided by Work Package 3 is pictured as a three by three table distinguishing 9 different cells.

Factors that stem from the lowest level "driving task associated" are thought to be closest to the accident, thus on the proximal end of the accident causation process. They are directly and causally contributing to the accident occurrence, are very specific and detailed, are short-term lasting or dynamic in nature, and refer to the actual conditions of the components.

The background factors are thought to be further away from the actual accidents on a time scale (on the distant end of the accident causation process), are pre-existing and providing the circumstances for traffic and roadway systems in interaction with the participants and might therefore not easily be seen as causally contributing to an actual accident. As well, because they can be conditions leading to other effects besides the influence on traffic accidents they might be regarded more as risk factors.

The in-between trip-related factors can be effects of the background factors (intermediate factors) or independently exist on this level. In any case they are thought to influence the conditions that are then found on the driving task level. Trip-related factors might not directly causally contribute to an accident but might be contributing factors for the actual driving task associated factors. They are thought to be constant during a trip, long-term lasting and are more focussing on certain states of the components in contrast to the actual conditions of the components.

4.1.2 Relevant factors

The relevance of a factor depends on its attributed risk increase but also on its prevalence in traffic and accidents, respectively.

The most important risk factors for traffic accidents as defined by their implicated adjusted risk estimates found in the literature review have to be accepted to be speed, alcohol, fatigue, male gender, cell phone use. Further risk factors might apply not to traffic accidents in general, but only show risk increases for certain sub-populations (e.g. risk factors for rear end impacts, risk factors for accidents on highways and other sub-groups). Further, for many thinkable risk factors the problem of exposure is often not regarded, or, due to study sample restrictions still differing results are found. The following table summarizes the results from the literature review on risk factors.

Possible Risk Factor	Result from risk studies found by literature review (see D3.1)
Speed	**enough evidence for increased risk at higher speeds**
Alcohol	**enough evidence for increased risk for crashes**
indicators for fatigue	**enough evidence for increased risk for crashes**
gender/male	**enough evidence for increased risk for crashes (esp at fault)**
Cell phone use	**enough evidence for increased risk (hand hold and hands-free)**
Age	higher risk for young drivers, contradicting results for old drivers
Variance of speed	tendency for increased risk
Anxiety	tendency for increased risk
depression	tendency for increased risk
stress	tendency for increased risk
rain	tendency for increased risk
urban area (vs rural)	tendency for increased risk
Poor road user eyesight	tendency for increased risk
foreign driver	tendency for increased risk
poverty	tendency for increased risk
Benzodiazepines	tendency for increased risk, especially for long-acting B. and during first weeks of use
low education level	tendency for increased risk
Poly-drug use	hints for increased risk
curves	hints for increased risk
carrying passengers	hints for increased risk
vehicle technical defects	low evidence due to sparse studies, hints for lack of mainentance (defective brakes) as risk for large commercial trucks
road condition	low evidence due to sparse studies, tendency for increased risk on wet and slippery condition
vehicle colour	low evidence due to study quality, hints for preventive effect of light colours
Other drugs	low evidence due to sparse studies, mixed effects
number of lanes	low evidence due to sparse studies, mixed effects
Medicinal drugs	not enough evidence except Benzodiazepines
traffic volume	contradicting results, hints for increased risk
night/day	contradicting results
Cannabis	contradicting results, no proof of increased (or decreased) risk

Table 4-2 : Result from literature review on risk factors for traffic accidents (risk for individual crash involvement, causation, or for general crash occurrence)

Some of these factors can also be found by accident investigators and are then documented in their databases as "contributing factors". The contribution to the accident causation or just the presence of a factor has to be analysed by expert knowledge. Some databases provide an option to indicate the probability of the contribution for the accident for the found factors. But, in Risk studies also variables can be found, that go along with an increased risk for traffic accidents, whereas usually no "causal contribution" is assumed for these variables (e.g. male gender can be a risk factor, but is usually not regarded as being a contributing factor in accident causation).

The most important contributing factors for traffic accidents as found by their representation in the databases of the TRACE Partners that perform accident causation analysis have to be accepted to be: alcohol, speeding, distraction and inattention, followed by careless and risky driving, automatic driving, road overfamiliarity, view obstructions, road condition and layout and by inexperience and insufficient safety distance.

To compare absolute frequencies of factors between databases is not feasible as different sampling and coding procedures and variable categories are used (see D3.1). Therefore keywords were developed that cover meaningful concepts for the contributing factors in the different databases. Keywords were: alcohol, attention, careless, drugs, exceeding speed limit, experience, health status, inappropriate speed, road layout, road surface condition, safety distance, traffic offence (priority), vehicle condition, vigilance, visibility and view obstruction, weather condition. Sometimes re-grouping of aggregated data results was performed for providing comparability. The following table lists only the number one factor of databases providing relevant overrepresentations of contributing factors.

Database, all accidents (2004, except indicated)	country	Contributory factor reported in accident database	key word	relative over-representation and 95% Confidence Interval	% of accidents
GIDAS_in-depth	Germany (north and east)	inappropriate speed	inappropriate speed	12,3 [8,4;22,0]	12,5
Czech_national (2001-2004)	Czech Republic	visibility	visibility and view obstruction	9,4 [9,1;15,1]	37,5
BASt_Germany_national	Germany	unadopted speed in other cases	inappropriate speed	12,2 [12,0;18,4]	28,0
CIDAUT_in-depth	Spain (central)	Other distraction in/on vehicle	attention	12,3 [1,1;1284,3]	35
Stats_GB_national (2005)	Great Britain	Failed to look properly	attention	24,3 [23,5;31,7]	31,5
SISS_Italy_in-depth	Italy	Driving with exceeding speed	exceeding speed limit	18,0 [16,1;25,5]	8,8
INRETS_in-depth	France (South)	Automatic driving: low attention level due to high experience of the trip (or its monotony)	attention	7,1 [2,2;40,7]	46,5
OTS_in-depth	Great Britain (Midlands and Southeast)	Inattention	attention	6,8 [4,7;15,1]	12,6
LAB_in-depth (1990-2004)	France (North)	Excessive speed	exceeding speed limit	5,8 [3,9;14,0]	33,8
IDIADA_Catalonia_national	Spain (Catalonia)	Inappropriate speed for conditions on the road	inappropriate speed	4,6 [4,3;9,3]	7,1
CIDAUT_Spain_national	Spain	Distraction	attention	4,6 [4,5;8,9]	37,7

Table 4-3 : List of the most frequent contributing factor in each database

The Top Ten list for the most frequently coded factors as well as the share of accidents that are caused by the contributing factors for each database is presented in D3.1, as well as the overrepresented factors.

Frequencies indicate that the vehicle in terms of maintenance or mechanical failures only seldom contributes to accidents. Also, the Environmental influences on the accident causation are not regarded enough by the existing data collection methods that mix factors from different levels with interactions of components. Still the Human "factors" are mainly regarded in traffic accident causation analysis.

Combining the findings for accident related factors by risk increase and frequency of contribution to accidents the conclusion can be drawn that the most relevant factors for accident causation are:

"alcohol", "speed", and "inattention (and distraction)".

4.2 Task 3.2 Social factors

4.2.1 Reminder

Why should a focus and analyses of social and cultural factors inside the accident causation process bring any new information?

Road accidents are today very much seen as individual problems (human failure), - a fact that surely occurs for a great number of cases. Nevertheless, a part of accident cases do imply factors that can be qualified as being social and cultural, and those factors do not occur on the individual level, but are produced by society on a structural level – which means, they are latent, pre-existent and triggered by the accident. For example, in the context of child safety, the misuse of Child Restraint Systems (CRS) is an important issue: there are many cases where a child, who was killed or severely injured in a road accident, could have been saved if properly installed, in an adequate CRS. The proper use of the CRS and the selection of an adequate CRS are in the parents' responsibility – but, what is their knowledge on child safety needs, what are their criteria for choosing the right seat, etc.? All these are social, cultural or socio-economic factors that are prior to the immediate situation of the road accident and they co-determine the outcome of it.

Another example could be "drink driving": the driver who has an accident while under the influence of alcohol did consume it prior to the accident. What are the reasons for it? What do we know about social context that tends to encourage drink driving? When we better understand the reasons why someone decides to drive under the influence of alcohol (maybe with passengers), we have better possibilities to do more efficient prevention work.

4.2.2 Leading Questions

Task 3.2 inside Work Package 3 “types of factors” is about the identification of social and cultural factors in existing European accident databases. By applying an analysis methodology that was introduced in the methodological oriented Work Package 5 on “Human Factors”, task 3.2 proceeds according to the following leading questions:

- Do the existing accident causation databases contain sufficient information to permit an analysis to be performed regarding the implication of social factors in the accident causation process?
- Which are the variables that do inform about social factor involvement in existing databases?
- On what level is it possible to perform sociological analysis with the existing data material?
- On the bases of the existing data material, what are the conclusions that can today be obtained from such analysis?

4.2.3 Proceeding

To perform an analysis regarding the existence as of social and cultural factors in existing European accident databases, four databases were examined: the German database GIDAS (BASt), Spanish DIANA database (CIDAUT), OTS from Great Britain (VSCR) and EDA for France (LAB). Regarding the operability of the once identified variables, frequency analyses were performed for EDA and GIDAS variables. To compare the identified variables with the trends inside the greater European space, European databases (CARE and UNECE database) were examined on behalf of the prevalence of the identified social and cultural variables. Finally, four individual case studies were performed, on the base of interviews with accident drivers.

4.2.4 Results

1. The overview of four European databases EDA, GIDAS, DIANA and OTS shows the very limited possibilities to access background information on behalf of socio-cultural content for a more substantial analysis on social and cultural factors inside the accident causation process. More precisely, today, regarding the four compared databases, the existing, common topics of socio-cultural interest, are **"age", "gender", and "alcohol consumption"/ "drink driving".**

2. From **the frequency analyses of the selected variables with socio-cultural background**, which were performed with data from the EDA and the GIDAS databases, few results were obtained. Given the current database situation, a specific social sciences approach does not give any new information. On the selected topics, the following conclusions can be drawn:

- The most important part of accident drivers are young men, coming from the age group of 18-25 years. This result confirms a well known trend which was treated in the bibliographic overview in D5.4. The reasons for this result are commonly seen in a lack of driving experience and sensation-seeking behavior.
- Alcohol consumption concerns mainly the same demographic group of young male drivers.

As a general conclusion, the current data situation does not appear sufficiently complete to perform an in-depth analysis on socio-cultural factors in the GIDAS and EDA databases.

3. A brief review of the public accident statistics for the European Community shows that socio-cultural accident causation factors do also appear as being limited on Age, Gender and Drink Driving, which corresponds to the conclusions of the review of the four databases, cited priory.

- In comparison to the analysis of the EDA and GIDAS databases, the European data shows not only the higher exposure of young drivers, but do also put in evidence the higher road accident risk for elderly drivers.
- According to the results published in the CARE database[1], the European trends regarding the socio-demographic variables age and gender confirms the general trend regarding a specific exposure of young male drivers in road accidents. Also, significantly more men are killed in road accidents than women.
- The population of elderly drivers appear as strongly exposed according to the CARE database. UNECE [2] accident statistics confirm the trend of proportional higher exposure of young drivers' and elderly drivers to road accidents. Regarding the socio-cultural factor of 'Drink Driving', UNECE data show the importance of this variable in accident causation.
- It appears that for some countries, the rate of Drink Driving related accidents is much higher than for others, for example, comparing Germany and Great Britain (2002) to Italy (2002). In general, the much lower number for Italy in comparison to Germany and Great Britain is an indicator for a culturally different attitude towards alcohol consumption and its integration in a given cultural framework. Besides this cultural background, it also reveals a very different attitude on the social acceptability of Drink Driving in a specific country.

Drink Driving is maybe one of the most interesting socio-cultural factors that today is systematically investigated in accident causation statistics, but it does not appear, if these data are sufficiently exploited, regarding their socio-cultural content.

4. The four individual case studies (cases 1 to 4, see D3.2 for detailed information) chosen by random illustrate different aspects regarding the interference of social and cultural factors in accident causation. Especially two cases, one with alcohol and social exclusion factors (case 1) and the second with relation to the rule problematic (case 3), complete the understanding of the accident by indicating the relevance of the socio cultural factors to the accident causation process. The other two study cases

[1] Cf. http://ec.europa.eu/transport/roadsafety/road_safety_observatory/care_reports_en.htm

[2] http://www.unece.org/trans/main/wp6/pdfdocs/RAS_2004.pdf

(cases 2 and 4), which show interesting examples for "human failure" as accident causation factors [3] which are completed by additional socio-cultural information.

- Usually the "human failure analysis" can certainly contribute to understand fully the accident causation process – for these two specific cases (cases 2 and 4) the analysis of social and cultural factors can be considered as complementary. However, the situation regarding case 3 and more specifically case 1 is quite different: in both cases the socio-cultural factors are the key factors for the complete analysis and understanding of what has happened.
- The four cases, selected by random choice, are very typical accident causation scenarios, where common people meet common, every-day traffic situations. The fact that in each of these average scenarios, one or several social factors can be decrypted and be situated in the social spheres analysis scheme (as developed in D5.4) shows the relevance of a regular integration of socio-cultural factor analysis in accident causation research.
- An important point is the source of information: the in-depth interview is the only procedure that allows the collecting of socio-cultural background information; it is today the only instrument where such qualitative data can be investigated.
- The four cases illustrate clearly that some accident causation factors are socially constructed; sometimes their origins lay very much in the past so that one can consider that the road accident is in fact the result of a long-term social construction with a multitude of actors involved and a social structure that facilitates such accidents to happen.

4.2.5 *Conclusions / Recommendations*

The study for task 3.2 shows that the existing European databases are incomplete on behalf of a sociologic perspective.

- As a general recommendation regarding the European databases, the diverse age groups for younger as well as for elderly drivers should be reorganized and put in an explanatory framework. The explanatory framework hereby should refer to sociological / social psychological background information on mobility patterns, life styles or socio-cultural information (cf. TRACE report D5.4) that could contribute to a more systemic view on accident causation factors and so help to improve road safety policies.
- Regarding the topic Drink Driving, the European databases reviewed show that this social phenomenon is an important one regarding its relationship to accident causation, which is an argument for further in-depth investigation. In particular, research on cultural differences among European countries regarding their "habits" of alcohol consumption culture and, even more important, their diverse degree of social acceptability of drink driving should be further investigated.
- The "social dimension" of road safety that is illustrated by the case studies, presents - from a social scientist's perspective - a much-underestimated dimension in accident causation analysis. A more important investigation of the social and cultural accident causation factors can give useful information in some scenarios that could help especially for prevention strategies.
- A typical "young driver" accident causation scenario wherein inexperience and in-adapted driving behavior are the key factors (cf. case 2), do illustrate an acknowledged problem[4], but the phenomenon still risks to be repeated at the scale of the "old" and new European countries (EU 27). A constructed analysis framework for social and cultural factors in accident causation can contribute to improve prevention strategies and road safety management for those new European countries.

[3] Van Elslande, P., Fouquet, K., (2007a). Analyzing 'human functional failures' in road accidents. Final report. Deliverable D5.1, WP5 "Human factors". TRACE European project.

[4] For example, SARTRE 3, "Les conducteurs européens et le risqué routier"; Vol 1, rapport sur les principaux résultats, INRETS, 03/2005;

The problem is, some of the research that could prove useful for road safety will take time, the data collection procedures have to be adapted, and the accident investigators have to be trained to collect those "soft" data. In addition, in-depth accident research would profit by a more interdisciplinary approach and more flexibility regarding the evolution of its investigation tools. The "human factor" in accident causation is still the most important one, but to understand it to its full extent, more complex human and social sciences approaches have to be applied and more longitudinal studies on risk groups and on the origins of risk attitudes and behaviour should be encouraged.

4.3 Task 3.3 Trip-related factors

The analyses performed for task 3.3 were aimed at achieving more knowledge on certain types of accidents, namely, accidents that are caused by selected trip-related factors. The following contributing factors on a trip level were chosen:

- alcohol
- vigilance
- experience
- vehicle condition
- road condition and layout.

The expected results should give an idea how the accidents can be characterised and on the other hand on how to prevent these accidents. Prevention measures can always be on an educational and regulatory (control and law enforcement) level including target groups as defined by social characteristics e.g. (see also D3.2), on a vehicle level (active and passive safety features, see also Deliverables D6.1 (Barrios et al., 2007) and D4.1.5 (Van Elslande et al., 2008) of the TRACE Project) and on an environmental (infrastructure and traffic) level.

By analysing explanatory variables as circumstances for the selected contributing factors more focussed prevention efforts can be recommended. The Partners' analyses are discussed and compared with the findings from data request 3B.

Depending on the results only limited but reliable suggestions can be given for most of the analysed factors. The active safety systems suggested are taken from the list as presented and evaluated by the Deliverables D6.1 and D4.1.5 of the TRACE Project.

4.3.1 Alcohol

In the combination – high risk and high frequency – alcohol is regarded as a relevant and important accident related factor by increasing the risk and contributing to the occurrence of accidents (see also D3.1). Aleady on a legal level (depending on country) below 0.5g/dl BAC (Blood alcohol concentration) the crash risk was found to be up to 3 times increased. Depending on the database alcohol was found in 4% up to 19% of accidents in the national databases available to the TRACE Partners and in 0% up to 13.7% in the according in-depth databases of those countries.

To prevent accidents caused by alcohol some general suggestions are well-known e.g. Alcolock systems to prevent drunk driving in the first. In D4.1.5 a response efficiency of 98.5% was estimated for this feature. Another general prevention recommendation is to conduct more controls for drunk driving by the Police. The results of task 3.3 show, that controls would be especially effective in certain circumstances. Educational effort by e.g information campaigns to change behaviour and reduce the habit of drunk driving can be focussed on certain target groups, in which the social norm accepts drunk driving (see D3.2).

Three Partners of Work Package 3 analysed this factor and compared the results with those from data request 3B according to the methods described for task 3.3.

The analysis of the factor alcohol by BASt (in-depth German data (GIDAS), passenger cars only, 6621 cases, 1999-2005) showed that typical accident circumstances and person characteristics were overrepresented in alcohol related accidents compared to the accidents where alcohol was not involved. From this analysis it can be concluded, that in Germany alcohol related vehicle accidents would be best prevented by controls on weekends, sites for controls should be before "leaving the road accidents" can occur (recommendable is within city limits or close to discotheques etc.) and the target group for controls should focus on males. From the vehicle side active safety features preventing running off the road would be beneficial to prevent alcohol related accidents, especially Intelligent Speed Adaption (ISA) on a mandatory level, but maybe also Lane Keeping Assistance and Electronic Stability Program (ESP) are suspected to be of benefit here. Prevention campaigns could focus on male unemployed persons. In Germany 8.3% of the accidents show the contributing factor alcohol, although this factor is usually not coded as a primary causative factor. Comparable suggestions can be given for the Czech Republic, France, Italy, and the UK because of the results of the bivariate analysis of data request 3B.

The analysis of the factor alcohol in fatal accidents by TUG (ZEDATU database, Austria, fatalities only, only male drivers, 655 cases, 2003) revealed a number of findings: In Austria fatal alcohol related accidents of males would be most effectively prevented by controls during the early evening hours (after 4 pm during daylight). The most effective sites were not country roads or motorways but other roads. Controls could effectively focus on cars/vans. A specific target group could not be worked out, except that males should be addressed by educational efforts. Further, no specific manoeuvres or situations were found thus no recommendation on active or passive safety features in vehicles can be recommended to prevent alcohol related fatal accidents from this analysis point of view. 11.9% of the fatal accidents in Austria are contributed by alcohol, showing the importance of prevention action. Comparable suggestions might especially apply to the Czech Republic and Italy.

The analysis of the OTS database by VSRC (in-depth UK data, 3216 cases, 2000 - 2007) showed that alcohol related accidents happen to occur more often on minor, urban, single carriageway roads with low speed limits (30mph/48kph) especially in bends, leading to single car collisions or car vs. pedestrian collisions with frontal impacts where no manoeuvre was undertaken; with the traffic participants being involved being more often car drivers or pedestrians; also male drivers, at night, and during light density traffic conditions, when compared to other accidents.

The results of the in-depth human functional failure analysis of cases derived from the OTS database revealed that there was not one typical failure generating scenario for the road users who were alcohol impaired in the accidents. However, from the accidents analysed, it was found that alcohol impairment can affect a driver's or pedestrian's ability to correctly judge the road ahead and also make the correct decisions while driving/attempting to cross the road. Alcohol impairment was also found on occasions to be the overriding factor in the accident (i.e. if the road user was not impaired by alcohol, there would have been no functional failure and the accident would not have occurred). Typical failure generating scenarios were also identified for many of the non primary active road users in the accidents, who are defined as the road users who did not cause the initial 'disturbance', but for some reason did not or were unable to avoid the resulting impact. For the non primary active road users the scenarios mainly related to a failure to detect the primary active road user, who was either in plain view or out of view.

From this analysis we learn that alcohol controls for preventing traffic accidents in the UK would be most effective if focussing on minor urban roads, in particular during more quiet times during darkness. As alcohol related accidents are more frequent in low speed limit zones, in bends and are more often single car accidents without specific manoeuvre also the suspicion arises that unadapted speed might have additionally contributed. Again ISA on a mandatory level, Lane Keeping Assistance, and ESP might have prevented these accidents. Further, the characteristics "single car accidents", "car vs. pedestrian accidents" and "frontal impacts" might give rise to the suggestion that Brake Assist, Active Cruise Control (ACC), and Collision Avoidance could be of benefit. Also here comparable suggestions might be transferable partly to Germany, to France, the Czech Republic and Italy.

In addition the in-depth case analysis by the VSRC shows that alcohol related accidents often also concern drunken pedestrians. In-depth analysis of fatal pedestrian accidents for Work Package 1 task 1.4 also showed for Germany that alcohol plays a major role here. So further suggestions for prevention is necessary, like e.g. better road safety education for pedestrians when out at night and alcohol impaired or better separation of traffic for different road users. Further, from the vehicle side pedestrian detection & avoidance systems like SAVE-U (Vulnerable Road Users Protection) or even also Night Vision could help to reduce these kinds of accidents. From the OTS analysis for task 3.1 it is known that in 7.8% of the accidents alcohol was contributing.

Although different pattern are found in different databases some general conclusions can be drawn: The factor alcohol occurs predominantly in accidents with males, unemployed, and pedestrians, on urban and on other/minor roads, on weekends, after 16:00, in darkness conditions, (but fatal accidents at daylight conditions), and further characteristics are that alcohol is seen in combination with leisure trips, with leaving the road accidents, with bends, with no specific manoeuvres, with unadapted speed in low speed limit zones, and usually overall failures occur when alcohol is contributing. For prevention it can be transferred where and when controls could be intensified; and for active safety systems in vehicles the systems alcolock, ISA, LKA, ESP, BA, ACC, CA, SAVE-U, and NV can be suggested.

4.3.2 Vigilance

Vigilance is influenced by alcohol, so the analysis of vigilance itself as a contributory factor is of importance in regard to preventive measures. Most often vigilance is viewed in terms of low vigilance and especially fatigue, although an alteration in "normal vigilance" can also comprise a state of hyperexcitation, which also reduces the driving capability. As shown in D3.1, "Fatigue" as a risk factor is found in literature to increase the risk for accidents of about 2 to 5 times; the frequency of "Fatigue" as contributing factor in databases available to the TRACE Partners lies between 0.1% and 15% of accidents.

Two Partners of Work Package 3 analysed this factor each by one method (statistic method and application of Human functional failure analysis).

From the CIDAUT analysis (DIANA database, Spain, 250 accident drivers) of the factor vigilance it has to be concluded that vigilance related accidents are predominantly a problem on monotonous roads like highways without intersections during the light condition of dawn. No statistic association was found for characteristics like "driver type" (e.g. professional drivers) or "traffic participation type" (like truck or bus drivers). Also, no specific age, gender, employment type or nationality of drivers is more frequently involved in vigilance related accidents than in other types of accidents. Active safety systems that were already installed in the vehicles were not able to prevent vigilance related accidents, but seemingly other types of accidents. Proposed measures refer to educational campaigns to promote safety habits related to trips, such as the time for travelling, the necessary rests, an adequate judgement of their own state considering drowsiness and the subsequent decisions. For preventive measures by information/education like campaigns especially highways might be a site most effective. This doesn't focus on a specific target group, as no typical addressees could be established by person characteristics. Also from an infrastructural prevention approach highways might bear the highest benefit if monotony could be reduced by geometry and layout and lighting improved. Here also speed limit changes provided by variable message signs of traffic management systems (that usually only coordinate traffic flow) might be helpful. From active safety measures in vehicles Drowsy Driver Detection systems can clearly be recommended, but Lane Keeping Assistant and Night Vision and Advanced Adaptive Front Light System might also be beneficial. Best transfer of these results is possibly applying to the UK.

The "Work Package 5-method" as applied by INRETS (EDA database, France, 1,106 accident cases, 1999-2007) reveals that for vigilance related accidents some typical scenarios can be established. Vigilance related accidents are occurring due to drowsiness, faintness, states of reduced vigilance and alcohol intake, psychotropic drugs and narcotics. Usually these accidents occur because of the human functional failure encountered, which is classified as an "overall failure". For this failure twelve prototypical scenarios could be elaborated of which 5 relate to the alteration in abilities (29.2%), 6 scenarios related to the loss of psycho-physiological abilities (28.5%), and one scenario related to the failure of overwhelmed processing abilities (5.3%). In addition some vigilance related accidents occur due to failures in diagnosis (underestimating a passing road difficulty - 5.5%), decision (deliberately disobeying a safety rule - 7.6%) or execution of a task (poor control of an external disturbance - 4.7%) that are represented in another 4 prototypical scenarios. For these scenarios different prevention measures might apply.

The in-depth analysis of vigilance related accidents by INRETS shows that alcohol is of important influence for those kinds of accidents. So, there is little surprise that for preventing vigilance related accidents Alcolock Key can be recommended as well. Further, the analysis reveals that prevention of vigilance related accidents is not limited to active systems like Driver Drowsiness Detection. The different scenarios found give hints that features like ISA, ESP, and Lane Changing Assistance might also be apt for preventing vigilance related accidents. Target groups for educational campaigns should clearly separate one group of younger drivers with alcohol involvement in a festive context, a second group of around 40 year olds with chronic alcohol consumption problems, and elderly people with cognitive slowdown and fatigue. As in about 20% of the accidents of the database low vigilance shows up as an explanatory element, the importance of prevention efforts is clear. The statistical data of the data request 3B from Italy give an indication for possible transfer of these suggestions.

4.3.3 Experience

The analysis on the factor "experience" was undertaken by CIDAUT (250 cases). The explanatory variables in the DIANA database more associated to experience related accidents are the variable age group (18 to 25 year olds), driver type (private driver) and employment (student driver). But, experience related accidents don't show up primarily in certain traffic situations, on specific types of roads, in certain vehicles or all other explanatory variables. In addition experience related accidents are not typical for one gender only.

Unfortunately here no new suggestions could be extracted. Experience is obviously a factor for young drivers. Intensifying of driving licence driving lessons and some graduated driver licensing programs are thought to be beneficial in general, but not specifically for this type of accidents only. As experience is contributing in around 4% of the accidents in Spain, and between 1.3% and 6.6% of the national databases available to the TRACE Partners (see D3.1) and also in 12% of in-depth analysed Truck Accidents more research would be necessary where to put effort in preventing experience related accidents.

4.3.4 Vehicle Condition

The cross tabulation results calculated by CIDAUT (250 cases) show an association between vehicle condition and vehicle power on one hand, and on the other hand between vehicle condition and day of week. The analysis indicates that controls as well as maybe more regular mandatory checks would be efficient if focussing on commercial trucks. Interesting is the fact that a certain day of the week was found to be overrepresented for accidents where the vehicle condition contributed. Assuming regular voluntary checks this might indicate that either distance travelled or time since check need to be reduced for frequency of more regular checks.

Accidents where the vehicle condition contributed have also been analysed by BASt for Germany (6621 cases). The analysis showed that the road type "motorways" was significantly overrepresented in accidents related to vehicle condition. The reason could be that only at high velocities a vehicle defect resulting from maintenance problems leads to a severe accident. At low velocities the driver can keep control of his vehicle. This is confirmed by the finding that urban roads are significantly underrepresented in the group of vehicle condition related accidents. Prevention measures in Germany seemingly don't have to focus on more regular checks for older cars. Obviously the existing mandatory checks are sufficient in this view, as a specific age group of the vehicle was not overrepresented in these types of accidents. A target group for campaigns picturing the need for regular technical checks, especially for the tyre condition, might be unemployed drivers, where the probable lack of financial capacities might be the reason for not keeping the vehicle maintained. In general, which is also mentioned in the efficiency analysis in D4.1.5, the educational advertising has to picture the dangers stemming from bad vehicle conditions and tyre conditions, respectively. Regular traffic checks by the police might possibly be intensified for also checking the maintenance status of the vehicle, and not only focus on drunken driving/license/safety equipment. The site for controls with this focus might be before the entering of highways and other roads with higher speed limits.

For both analyses it can be stated that from the vehicle side, tyre pressure monitoring and warning systems can help to prevent accidents where the tyre condition was contributing. In up to 8% of the accidents analysed by the TRACE Partners (see D3.1) a bad tyre condition was contributing.

A transfer to the other countries as represented by the data request 3B is not possible.

4.3.5 Road Condition and Layout

The investigation of the trip related factor of the environment component "road condition" by BASt (6621 cases) showed that urban locations are highly underrepresented in the group of accidents related to road condition. Improvement of road maintenance efforts should focus especially on rural sites without traffic regulation. Furthermore, the type of accident "driving accident" was overrepresented in the group of accidents where road condition was contributing. Driving accidents are normally single vehicle accidents, which result from unadapted behaviour of the driver with regard to the circumstances of the accident scene. In the case of road layout related accidents, this means that, for example, the driver failed to adapt the speed to the bad road condition. As "road condition" implies a variety of different variables (road layout, maintenance of infrastructure etc.) no specific recommendation for vehicle active safety systems can be derived. As no specific age/gender/driver group is particularly affected by road condition as an accident factor it would not be effective to focus on educational information to certain target groups only (like informing about the difficulties and influences of road condition contributing to accidents e.g. during driving lessons).

A possible solution to improve the situation and reduce the number of accidents related to road condition could be driver education or more warning signs, if appropriate, advising the driver of upcoming bad road conditions. Also driver assistance systems to warn the driver of bad road conditions could be beneficial for these types of accidents. As the databases of the TRACE Partners (see D3.1) have shown that bad road conditions contributed to up to 24% of the accidents, the need for improvement of road layout and road maintenance is given. Partly the pattern might be possible to transfer to Czech Republic, Italy and the UK.

For cases where road layout was a contributory factor, the statistical overview by VSRC (3216 cases) revealed that road layout was more likely to be causative when one of the following parameter values was present: high-speed, minor, rural, single carriageway roads with low density traffic at night, not at an intersection, involving a single car with a young driver who was not undertaking a manoeuvre, but going ahead on a bend with a degraded road surface (defects or contaminants).

The in-depth results revealed that the most frequent typical failure generating scenarios for the primary road user involved either taking an intentional risk (failure in decision making) when negotiating a bend or not correctly evaluating a bend (failure in diagnosing situation). For the "non primary active road user" (includes all traffic participants involved in an accident, apart from the primary active ones, independent of their contribution to the accident or their chance for avoiding the accident by any interfering (re)actions) the scenarios were mainly related to their pre-defined expectations of the primary active road user's manoeuvres (or lack of) who was in plain view.

This analysis reveals a target group of young drivers (<25years) for information campaigns on the danger of bends/steep hills and narrow roads. Sites for more signage and information would be most efficient for warnings and speed limit reductions in approaching of bends on minor, rural roads. As decision-making failures and diagnosis failures are most frequently found in accidents related to the road layout, Driver Assistance Systems in vehicles can also be effective. In particular, Brake Assist, Collision avoidance, Collision Warning, ESP, ISA but also ACC, Night Vision, and Lane Keeping Assistance might be beneficial. As up to 12% of the accidents analysed by the TRACE Partners for task

3.1 show bends and view obstruction as a contributing factor, the need for improvement is given, for the infrastructure and the roads' maintenance as well as the vehicles' and drivers' interaction possibilities with the difficulties met. The findings of the in-depth VSRC analysis might only be partly possible to transfer to the Czech Republic and Italy.

4.3.6 Remarks to the output of the work performed for task 3.3

The following tables summarize the outcomes and preventive suggestions of the analysis of the selected trip-related factors as contributing to accidents performed for task 3.3

contributing factor	who is predominantly affected	where is it predominantly contributing	when is it predominantly contributing	other circumstances predominantly occurring/present
alcohol	males, unemployed, pedestrians	urban (and rural), other/minor roads	weekend, after 16:00, darkness (but fatals at daylight conditions)	leisure trip, leaving the road, bends, no specific manoeuvre, unadapted speed in low speed limit zones, overall failures
vigilance (overview)	A) 28 to 31 year olds with alcohol consumption, B) 37 to 41 year olds with chronic alcohol/drug addiction, C) elderly with cognitive slowdown, D) overall	A) tendency for countryside, B) anyplace C) intersection, D) highways	A) night, B) anytime, C) daytime D) night	A to C) detailed scenarios - see INRETS report, D) high speed limit zones
experience	novice drivers	anyplace	anytime	anyhow
vehicle condition	trucks, tendency for unemployed, more than 1 passenger in passenger cars	highways/high speed limit zones	Indication for certain day of the week	main problem: tyres
road condition/lay out	<25 years old	rural, speed limit between 60 and 100km/h	winter, nighttime	driving accident, frontal impacts

Table 4-4 summary of characteristics for trip-related factors contributing to accidents

contributing factor	prevention by education/law enforcement (human) (target groups/sites/times)	prevention by (active) safety measures (vehicle)	prevention by improvement of infrastructure/ "environment"	% of accidents in databases available to the TRACE Partners affected by contributory factor
alcohol	A) controls on weekends, within city limits/close to places of alcohol consumption, of males; B) controls of males in passenger cars/vans from 16:00 until darkness on other roads than highways or country roads; C) at nights, minor inner-city streets, pedestrians	alcolock, ISA, LKA, ESP, BA, ACC, CA, SAVE-U, NV	speed limits more to be pronounced (reduced/warnings) before bends	up to 19%
vigilance (overview)	on highways, on countryside, different target groups	alcolock, DDD, ISA, ESP, LCA, AAFS	reduce highway monotony and improve lighting	up to 15%
experience	Graduated Driver Licensing Systems, increase driving lessons	no suggestions possible	no suggestions possible	up to 7%
vehicle condition	trucks, regular checks for tyre condition, controls before high speed limit zones	TPM	no suggestions possible	up to 8%
road condition/layout	tendency for target group of younger drivers information campaigns	BA, CA, CW, ESP, ISA, ACC, NV, LKA	improvement of road maintenance in rural sites	up to 12%

Table 4-5 summary of preventive measures for trip-related factors contributing to accidents

Legend: ISA: Intelligent Speed Adaption, LKA: Lane Keeping Assistance, ESP: Electronic Stability Program, BA: Brake Assistance, ACC: Active Cruise Control, CA: Collision Avoidance, SAVE-U: Vulnerable Road Users Protection, NV: Night Vision, DDD: Driver Drowsiness Detection, LCA: Lane Changing Assistance, AAFS :Advanced Adaptive Front light System, TPM: Tyre Pressure Monitoring and Warning Systems, CW: Collision Warning

For interpretation issues the data materials on which the analyses are performed have to be taken into account. For differing results between partners when analysing the same contributing factor, multiple explanations can be given. There may be real existing differences in the circumstances of accidents where certain trip-related factors contributed. This might be due to differences of the countries the databases stem from including different laws, law enforcement habits, vehicle fleet, geography, and other explanations. Another explanation is coding instructions of variables, definition of factors, and sample criteria. E.g., obviously fatal accidents differ from "all kinds" of accidents, and accidents with "all kinds" of traffic participants to "vehicle accidents only". Especially on the trip level the factors covered might be too general, covering a mixture of depending driving-task related factors. For example, this can be seen by the multiple scenarios that are connected to vigilance related accidents.

On a trip level the factors not only comprise multiple scenarios, but also, interrelations between multiple factors are to be expected. For example, evidence for alcohol, vigilance, speed and bends as showing up as combinations is found in task 3.3, even if trying to separate the factors for analysing accidents.

This also leads to the question if by all the suggested countermeasures, accidents with certain trip related factors can be prevented at all. They might happen in cases like in alcohol induced hypovigilance situations, where for example, alcohol could be eliminated (e.g. by alcolock key) but, nevertheless due to fatigue, risk taking and speeding or unadapted speed in curves a share of those accidents might happen still.

The idea to analyse factors on a trip level was expected to lead to answers about whether certain trip related factors are typically occurring in certain objective accident circumstances as defined by person, vehicle, site, time and situation characteristics. If special characteristics were obtainable then special prevention measures would apply. This could only be confirmed partly.

Often the information of interest is either not available in the database, especially background factors like socio demographic information to focus on certain risk populations for prevention efforts, but also vehicle information like equipment is often not collected in the databases.

On the other hand it has to be accepted that accidents that are caused by certain trip-related factors are very often not that different from other accidents that are caused by other factors. This is of course due to the trip level which is too far away from the actual accident, but also due to the variety of other contributing factors necessary for causing an accident. Maybe by combinations more typical accident pattern will be found.

4.4 Task 3.4 Driving task associated factors

The aim of the analysis performed in TRACE Task 3.4 was to gain a better understanding of the characteristics of accidents that are caused by driving task-associated factors, that is, factors which are 'directly and causally contributing to the accident occurrence, very specific and detailed, are short-term lasting or dynamic in nature, and refer to the actual conditions of the components' (TRACE D3.1).

From the numerous driving task-related factors identified in Task 3.1 of TRACE, the following factors were chosen for analysis:

- Attention
- Speed (including 'inappropriate speeding' and 'illegal speeding')
- Sudden health problems
- Sudden technical defects
- Dazzling sunshine

The results of the analysis undertaken by each partner within Work Package 3 identified the main characteristics of accidents where each of these factors were contributory and also gave suggestions for ways to prevent these sorts of accidents from occurring. The type of methods of prevention varied from education methods, regulatory methods (e.g. control and law enforcement), vehicle-related methods (active and passive safety features, see also D6.1 and D4.1.5) to road infrastructure and traffic-related methods.

By analysing the explanatory variables as circumstances for the above contributing factors, more effective prevention efforts can be recommended. Depending on the results only limited but reliable recommendations can be given for most of the analysed factors. However, the most detailed results (due to data availability and frequency) were given for the driving task-related factors 'attention' and 'speed'.

4.4.1 Attention

The driving task-related factor 'attention' was studied by CIDAUT using Spanish data (DIANA database, 250 cases) and the results implied that monotonous situations (i.e. not at an intersection) were more likely to lead to poor attention in the driver. Also, drivers were more likely to be undertaking an illegal manoeuvre when attention was low. As the data does not specify whether this illegal manoeuvre was intentional or not, it could be a possibility that the illegal manoeuvre was a direct result of the lack of attention. For example a driver is not paying attention to the road and overshoots a junction or crosses into the opposing carriageway or even turns the wrong way up a one-way road.

In addition, drivers who had active safety systems in their vehicles were more likely to be inattentive when involved in an accident. This implies that an active safety system in a vehicle leads to a greater likelihood of a driver being less attentive, which is possible if the driver believes they don't have to concentrate as much on the aspect of the driving that the active safety system undertakes. This is a behavioural adaptation issue. This may also be another reason why illegal manoeuvres are more likely with inattentive drivers, because they believe they can take more risks because the active safety system will help them control their vehicle. Alternatively, it should be considered that active safety systems will be fitted mostly in new and recent vehicle models which may be driven by people who have a different, possibly lower risk taking propensity to the drivers of older vehicles. These suggestions regarding active safety systems are therefore speculative and because of the lack of detail regarding the type of active safety systems involved in these accidents, this result should be considered with caution, as it is highly likely that the benefits of the presence of active safety systems outweigh these possible side effects.

It was also possible, using the results of the TRACE Work Package 5 analysis of the factor 'attention' by INRETS (1106 cases), to identify the typical failures experienced by road users in accidents where attention problems were experienced. In over half of the accidents studied, attention-related problems were found to contribute to the accident. Overall, perception (detection) failures were found to be most vulnerable to problems with attention, being either directly or indirectly causative, where 'focalised acquisition of information' was the most frequent failure in detection. Unlike vigilance problem (see D3.3), failures when attention is a contributory factor occur in combination with other explanatory elements (attention-related and non-attention-related). Of the three types of attention analysed, inattention was found to be the most contributory and was mainly found to affect the information acquisition (detection) stage and the road difficulty diagnosis stage. 'Competition for attention' mainly resulted in perception (detection) failures involving the focalised acquisition of information and 'distraction' mainly resulted in perception (detection) failures or failures when taking action, in both cases where the driver has taken their eyes of the road due to the distraction, resulting in the driver becoming aware of an impending 'situation' too late to be able to avoid it.

When supplementing this information with the aggregated data related to 'attention' accidents supplied from across 5 European countries, the type of road users, vehicles, locations, accident/impact types and the time of day varied across the data sources. The main reason for this is probably due to the varying nature of 'attention' itself, as found in the analysis of French data using the TRACE Work Package 5 methodology. Therefore, it is important to ensure that when investigating accidents where attention was thought to be a cause, that the variations found in this analysis are investigated separately, and that when trying to decide on potential solutions to the problems of attention, that all types are considered.

Because attention is strongly related to the human in the system, the most effective solutions to reduce problems in attention when driving must be aimed at the driver. Drivers need to be supported and where possible educated to increase their awareness of and minimise risks from the dangers of driving while not fully being attentive on the task in hand and to be aware of the ways in which low attention of the driving task can manifest itself (e.g. when the driver has a lot on their mind or when they are distracted by another task/person/object not directly related to the driving). Competition for attention is not a problem of a low attention on the driving task, but more a problem with the complexity of the multiple tasks that the driver is sometimes faced with when on the road. Competition for attention could be between two aspects related to the vehicle (e.g. looking at the dashboard lights while trying to demist the windscreen), the external environment (e.g. trying to look for directions while also trying to follow the curve of the road) or a combination of both.

Where there is a risk of one driving task taking over the attention of another part of a driving task, systems which take over one of these tasks for the driver would alleviate the problem for the driver so they can concentrate on the other. In both the in-vehicle and external environment, competition for attention can also be reduced by improved design of both the vehicle and the highway itself (making roads and vehicles more supportive and 'self-explanatory'), to reduce the chances of competition for attention occurring in the first place. In addition, consideration should also be given to the increased introduction of eSafety and information systems into vehicles, which could carry potential for competition for attention and distraction, depending on whether or not it is related to the driving process.

4.4.2 Speed

Speed was investigated in total by 3 TRACE Work Package 3 partners: CIDAUT (Spain, 250 cases) and LMU (TUG – Austria, 801 cases), using the logistic regression analysis to investigate accidents involving speed as a cause in general and by the VSRC (UK), giving a statistical overview but mainly using the TRACE Work Package 5 methodology to investigate inappropriate speeding and illegal speeding separately. Road users will travel at high speeds both intentionally and unintentionally. The intentional reasons could include because the road user is in a hurry to reach their destination or they enjoy driving fast (ERSO, 2007) and it can unintentionally happen because of either the design of the road or the vehicle. The analysis undertaken by the TRACE Work Package 3 partners investigated these issues further.

Motorcycles less than 6 years old and curves (bends) were found to have the greatest link in accidents involving speed as a causation factor in the Spanish data. It is not surprising that speed accidents involving newer vehicles were found to be more likely than in accidents where speed was not involved, in particular motorcycle accidents, as advances in technologies have led to higher performance vehicles, which means that vehicles are capable of travelling at greater speeds, even if it is against the law. These reasons are often due to the road user feeling more 'comfortable' at the wheel of their vehicle, so they feel like they are travelling slower than the really are. Also, if a road user is already travelling at a high speed (whether illegal or inappropriate), the added factor of negotiating a bend in the road is only going to increase the risk of the road user losing control. It is often the presence of the curve itself which makes the speed the road user is travelling at suddenly become too fast. The design of roads could also make a driver feel like they are driving slower than they are (i.e. speed inciting), which leads them to approach a curve too fast.

In the logistic regression analysis undertaken using Austria data (TUG), the characteristics most likely to be involved in an accident where speed was contributory were male drivers under the age of 45, with darkness conditions and cars/vans also associated but to a lesser degree. Here, different types of characteristics were associated with speeding, and more related to the road user themselves and the environmental conditions. However, slightly conflicting results were found with the type of vehicle. Whereas in the Spanish (CIDAUT) research, motorcycles were more involved in speeding accidents, in this research, it is cars and vans.

In the aggregated data analysis of 7 European data sources from 5 European countries, the results appeared to complement the results of the individual analyses. There was found to be a general split between either motorcycles or cars/vans having the most significant link with speeding accidents, which were the two main types of vehicles found in the individual analyses. Male drivers of all ages under 45 were most prevalent, while smaller (i.e. not major) roads were most involved, which involved bends, and occurred during darkness.

The main aim of the analysis of UK OTS data undertaken by the VSRC was to compare accidents involving inappropriate speeding with those involving illegal speeding using an overall statistical analysis of data (3216 cases) and also an analysis of a sample of 20 cases using the TRACE Work Package 5 methodology. In the statistical overview, many of the typical characteristics found in the logistic regression analysis undertaken using Austrian and Spanish data were found for both types of speeding (e.g. male drivers (although <25), cars, bends, darkness). In addition, differences were found between two types of speeding, these being that environmental conditions and high speed roads were more prevalent in inappropriate speeding accidents, whereas low speed roads were more prevalent in illegal speeding accidents. This implies that driving over the speed limit is more likely to occur on roads with lower speed limits and it appears to be 'easier' for road users to go over the speed limit when it is low, especially if it is unintentional (i.e. not looking at the speedometer). However, on high speed roads, road users are more likely to lose control because of environmental conditions, before even reaching the speed limit, which explains the inappropriate speeding.

The Work Package 5 methodology analysis showed that inappropriate speeding occurs most often in accident scenarios involving a detection (perception) failure, especially in a situation where an encounter was not expected. For example, a typical scenario might involve a road user who was travelling close to the speed limit when the vehicle in front starts to brake because they are turning into a private driveway The road user does not initially detect the vehicle braking because they weren't expecting a vehicle to brake suddenly at this point in the road, so by the time they start to brake, it is too late to avoid a collision. As can be seen from this example, inappropriate speeding appears to more often occur in situations where the road user is not expecting to encounter a 'conflict', therefore when a conflict does occur, they do not detect it (because they are not searching for it) until it is too late to avoid.

Illegal speeding was more often involved in accidents scenarios where the road user failed to diagnose a situation correctly. In these scenarios, the road user often failed to diagnose the situation correctly, often the road layout (e.g. bend) ahead. Therefore, as opposed to road users who are speeding inappropriately, road users who are illegally speeding have detected a potential conflict but fail to correctly judge this conflict, so are unable to safely deal with it (mainly due to the excessive speed) once they do encounter it.

Interestingly, differences were also found between road users in inappropriate and illegal speeding accidents who were not the speeding drivers (i.e. the 'non primary active road users'). Those who encounter a road user who is speeding inappropriately fail to predict the actions of this road user (i.e. assume the other road user will take regulatory action), while those who encounter a road user illegally speeding failed to detect the speeding road user until it was too late too avoid (i.e. was not expecting a 'conflict' so didn't search for one).

The overall view of a 'typical' speeding accident was one involving a male motorcycle rider or car/van driver under the age of 45, with a relatively new vehicle, travelling on a bend (curve) of a non-major road at night. When travelling too fast for conditions the road user, who was travelling on high speed roads in degraded conditions, often failed to detect an unexpected potential conflict, while those travelling above the speed limit failed to correctly evaluate a potential conflict while travelling on low speed roads.

To reduce the risk of an accident occurring in these types of conditions, education of drivers about the dangers of both illegal and inappropriate speeding would again be the simplest but not always the most effective preventative measure, mainly due to many drivers' unchanging attitude towards speeding. A considerable challenge is therefore to achieve a change in the driving culture so that speeding is no longer considered to be acceptable. Such a change in culture has been shown to be possible with regard to alcohol in some countries and the challenge is now to make a similar change for speeding. Elements of a wider policy on cultural change might include police patrols of 'high risk' locations (i.e. where speeding appears to occur the most) and stricter penalties would help to deter those who consistently illegally speed. For road users who want to avoid unintentional speeding, in-vehicle systems could be used to warn drivers or even take control when their speed is either over the legal limit or unsafe for the external conditions, as well roadside signage advising on appropriate speeds. Technology could help to keep control of the vehicle in 'accidental' inappropriate speeding on bends and poor road conditions. However, in order to prevent drivers who intentionally drive fast, more obtrusive measures would have to be applied, such as speed limiters, in particular on roads where illegal speeding is more frequent (i.e. on urban roads with low speed limits). Collision avoidance devices would help other road users to avoid errant speeding vehicles, whether it be inappropriate or illegal. As with attention, although these active safety devices can help in reducing the likelihood of a collision or loss of control, consideration should also be given to the potential of systems inspiring greater driver confidence, which in itself may encourage greater speed.

4.4.3 Sudden health problems

The driving task-related factor "sudden health problems" was investigated using German GIDAS data by the TRACE partner BASt (6621 cases). Using the 119 accidents that were identified with sudden health problems as a contributory factor, it was found that there was more likely to be older road users (>65 years old) who had pre-existing health problems, who were originally travelling at a velocity of greater than 60kph on motorways, which resulted in their vehicle running off the road. Most of these characteristics are directly linked to the sudden health problem itself and probably increase the risk of the sudden health problem occurring in the first place (i.e. older drivers who have a pre-existing medical condition). Run-off the road accidents are inevitable because the road user would not be able to keep any control over their vehicle once their sudden health problem had taken effect and even if the road user was physically able to try and control their vehicle during the sudden health problem, the likelihood of being able to keep control would be reduced on high speed roads such as motorways.

Additional to these characteristics, the aggregated data analysis using data from 3 European countries provided by 3 TRACE partners also found that accidents where sudden health related problems were a cause involved bicycles, 'going ahead' manoeuvres, which led to impacting an immobile object, and occurred during daylight. It is not clear why accidents involving bicycles were found to be more prevalent in sudden health-related accidents. One suggestion could be that as drivers get too old to drive, they travel by bicycle as an alternative. However, no other clear reasons could be given, apart from that possibly there are two typical scenarios involving sudden health problems. One involving an older driver on a major road who is unable to control their vehicle at the high speed when their conditions starts to deteriorate, so the vehicle runs off the road The second involves an older cyclist in an urban location who suffers from a sudden health problem and is also unable to control his/her cycle and therefore runs off the road.

Two main prevention measures were identified for sudden health problems in accidents. Regular health checks for drivers above the age of 65 would help to identify potential health risks while driving before they occur, while in-vehicle systems which would assist a driver to stop in the event of losing control due to a health problem.

4.4.4 Mobile phone use

Analysis of mobile phone use as a driving task-related factor was also undertaken by the TRACE partner BASt using German GIDAS data (6621 cases). Using the 72 accidents where mobile phone use was contributory factor, a bivariate analysis was undertaken, but from this, the only accident characteristics which were found to correlate highly with mobile phone use were related directly to the mobile phone use itself (e.g. driver profession, purpose of journey). Therefore, because of this, and because of the low number of accidents in the aggregated data from other European countries, mobile phone use was not considered further in this study. However, due to the nature of mobile phone use, in that it is a form of distraction, many of the findings of the analysis of accidents where attention was a factor could also be associated with mobile phone use as well.

4.4.5 Sudden technical defects

"Sudden technical defects" as a driving task-related factor was another factor analysed by BASt using German GIDAS data (6621 cases). Using 31 accidents which had sudden technical defects as a contributory factor, the logistic regression analysis undertaken showed that presence of sudden technical defects were more likely to occur in accidents on motorways when the defect was a tyre defect, where the vehicle ended up leaving the road. In addition, the bivariate analysis of aggregated data of 3 data sources from 3 European countries additionally revealed that males, drivers of HGVs, between the ages of 25 and 44, those who were travelling straight but ended up running off the road during daylight hours were overrepresented.

It is interesting to note that the main result of the sudden technical defect was a faulty tyre, which in many cases will be a maintenance issue that is trip related rather than task-related. This is one good example of where one trip related factor can lead to another factor which is more related to one part of the driving task rather than the trip as a whole. Behind many driving task-related factors, there will be a more deep-rooted causal factor either at the trip level or even further back at the societal level.

As a sudden technical defect is a maintenance issue, this would be the most effective way of reducing these sudden defects while driving. Regular inspections of vehicles, in particular company goods vehicles when on long journeys involving high speed roads, including tyre maintenance, should be essential and even enforced (if not already) to ensure vehicles are fully roadworthy before starting the journey. Where sudden defects occur which are not maintenance-related (e.g. tyre blowout due to sharp object), driver assistance systems which aid the driver in keeping control of their vehicle in such a situation would also help. It should, however, be borne in mind that accident investigations for research are inherently more likely to record externally visible vehicle defects, such as tyre or lighting problems, rather than internal defects such as faults with brake or steering, due to time and resource limitations. It is therefore possible that results shown here may underestimate such problems.

4.4.6 Dazzling sun

Analysis of "dazzling sun" as a driving task-related factor was undertaken by BASt using German GIDAS data (41 cases out of 6621 cases) and found that dazzling sun was overrepresented in accidents at intersections, where the road user's sight was obstructed and where the opponent road user was a vulnerable road user. Additional results from the bivariate analysis of aggregated European data of 3 countries from 4 TRACE partners where dazzling sun was most prevalent included the road user being female, older than 45 years, in a car or small goods vehicle, impacting a mobile object, going straight and on urban roads during twilight or daylight.

As this analysis shows, dazzle from sun can result in drivers not being able to see road users who at best are not always easy to detect, these being pedestrians, cyclist and motorcyclists. This is mainly an issue when drivers are crossing an intersection, whether they have right of way or not, and are further impaired by poor visibility caused by roadside objects or vehicles blocking the view.

As it is difficult to stop glare from sun in the first place, indirect countermeasures to the problem of dazzling sun would possibly be the simplest method of reducing the risk. Countermeasures such as improved road design, in particular at junctions with poor visibility issues, and also in-vehicle detection systems which can detect pedestrians and other vulnerable road users in the vicinity of the vehicle, would help to reduce the chance of an impact in the event of dazzle by sun. Technologies to reduce the effect of dazzle on windscreens would also be of benefit. Further research might usefully investigate if dazzle from the sun is a common problem at specific road locations with a view to making recommendations for road safety audit procedures and guidelines for infrastructural modifications at high risk sites.

4.4.7 *Conclusion of the work performed for task 3.4*

The following two tables shall give a general overview of the characteristics of accidents that are caused by the analysed driving task-related contributing factors and, in following on from this, suggestions for countermeasures to prevent accidents where these factors are contributory.

contributing factor	who is predominantly affected	where is it predominantly contributing	when is it predominantly contributing	other circumstances predominantly occurring/present
Attention	Male/Female <25, 45-64 years Cyclists Pedestrians Car/small goods vehicle drivers	Not at intersection Rural/Urban Major roads High/low speed limits (<50->100kph)	Daylight/ darkness, 0000-1600	Frontal/other impacts, run off the road, hitting immobile object, going straight, illegal manoeuvre, active safety system **Functional Failures:** ***Inattention:*** 'Detection' or 'Diagnosis' ***Competition for attention***: 'Detection' ***Distraction***: 'Detection' and 'Taking Action'
Speed (including *Inappropriate* and *Illegal*)	Motorcyclists, Car/Van drivers, Male, <45 years	Bends, Rural, Non-major roads *Inappropriate:* Rural high speed roads (97kph) Degraded road surface, *Illegal:* Low speed roads (48kph)	Darkness, 0000-0800, *Inappropriate:* Degraded weather	Vehicle <6 years old Frontal impacts, Hitting immobile object, Rollover, Run off the road accident, Overtaking, Going ahead, **Functional failures:** *Inappropriate:* 'Detection' (perception) *Illegal:* Diagnosis
Sudden health problems	>65 years Pre-existing medical condition, Unemployed/ pensioner, Cyclist	Urban, Motorways	Daytime, 0800-0000	Run off the road accident, Hitting immobile object, Going ahead, Other impact (not front/side/rear)
Sudden technical defects	Male, 25-44 years, Truck driver (>3.5t)	Rural, Motorway, Roads with speed limits >50kph	Daytime/Not daytime, 0800-0000	Vehicle with faulty tyres, Run off the road accident, Going ahead, Other impact (not front/side/rear)
Dazzling sunshine	Female, >44 years, Employed, Car/small good vehicle driver	Intersection, Urban, Non-major road, 50-100kph speed limits	Daytime, Dusk/Dawn, All hours	Opponent road user is vulnerable road user, Frontal impact, Hitting mobile object, Going ahead, Sight obstruction

Table 4-6 Summary of characteristics for driving task-related factors contributing to accidents

contributing factor	prevention by education/law enforcement (human) (target groups/sites/times)	prevention by (active) safety measures (vehicle) and vehicle design	prevention by improvement of infrastructure/ "environment"	% of accidents in databases available to the TRACE Partners affected by contributory factor
Attention	Educating better awareness of dangers of poor driving habits related to different types of attention, in particular monotonous and dangerous situations	Improved vehicle design so that controls and displays are 'self explanatory' to reduce likelihood of competition for attention, Automated systems in vehicle to reduce competition for attention, Collision Warning, Collision Avoidance, Intelligent Speed Adaptation.	Improved road design (i.e. 'self explaining') to reduce competition for attention	Inattention: Up to 40% Distraction: Up to 37%
Speed (including Inappropriate and Illegal)	Means to bring about cultural changes. Driver education to highlight dangers of both illegal speeding and inappropriate speeding, Stricter enforcement of speed limits, in particular patrols at 'high risk' locations for young (<45) males in cars and on motorcycles (i.e. low speed roads)	Driver assistance systems which inform the road user of the appropriate speed to travel for the terrain. Intelligent Speed Adaptation, Lane Keeping Assistance, Electronic Stability Control, Brake Assistance, ABS Active Cruise Control Collision Avoidance for road users encountering an errant speeder Night Vision	Clear roadside signage to warn drivers of impending bend in road and advise on safe travel speed	Illegal: Up to 14% Inappropriate: Up to 41%
Sudden health problems	Regular health checks for risk group: elderly drivers and drivers with relevant pre-existing medical conditions.	System which can help to 'take over' and 'guide' a vehicle to a safe stop in the event of a detected 'drift', similar to 'Driver Drowsiness Detection' Lane Keeping Assistance Brake Assistance Electronic Stability Control	On motorways: guard rails for preventing running off the road accidents	Up to 5%
Sudden technical defects	Frequent inspection of vehicle condition with focus on tyres Educating drivers on the importance of regular vehicle maintenance	Tyre Pressure Monitoring and Warning Systems Other 'vehicle condition' warning systems Lane Keeping Assistance Brake Assistance Electronic Stability Control	No suggestions possible	Tyre failure: Up to 5% Vehicle failure: Up to 12%
Dazzling sunshine	Raise public awareness towards the problem to increase driver attention in these situations.	'Anti- dazzle' on windscreens 'Vulnerable Road Users Protection' system Collision Avoidance Collision Warning Brake Assistance	Intersection design: good visibility in locations with high usage of vulnerable road users	Up to 3%

Table 4-7 Summary of preventative measures for driving task-related factors contributing to accidents

Many of the findings given in this study will often be related to the exposure of the road user to these situations. Another aim of this study was to try and locate exposure information relevant to the results found in the in-depth analysis of driving task-related factors so that an attempt could be made to evaluate the risk of the different situations identified. For example, as many of the driving task-related accidents occurred on specific types of roads (e.g. speed accidents on rural roads), relevant information was sought. However, no directly relevant exposure information could be located which could be compared with the accident data to permit risk calculations to be made.

Overall, when driving task-related factors are a cause in an accident, it appears that road users are caught by surprise by the sudden change in events and are unable to deal with the situation in hand. In most of the situations analysed, it appears to be the driving task-related factor itself that is the main factor that leads to the deterioration in the situation. In other words, without these driving task-related factors, it is possible that the accident would not have occurred. This is the nature of driving task-related factors, as they have an immediate effect on the road user. In order to prevent many of the driving task-related factors from occurring in the first place, other factors further back in the chain of events (i.e. trip and social/cultural) would need to be dealt with. Therefore, by preventing factors at a trip or social/cultural level, it might be possible to also prevent the factors at a driving task level.

5 Outcome and Discussion

5.1 Outcome of Workpackage 3

The Objectives of Workpackage 3 were successfully met.

First it was possible to detect relevant factors which contribute to road traffic accidents with casualties: The relevant factors are defined by risk increase and frequency of occurrence. By using literature and the existing databases the relevant factors were found to be: "alcohol", "speed", and "inattention (and distraction)".

Second the frequency of all factors was analysed for the available databases. Alcohol contributed to a share of accidents of 4% to 19% in the national databases and to 0% up to 13.7% in the according in-depth databases. Speed contributed to accidents in up to 28% of the national databases and up to 41% in the in-depth databases. Inattention or distraction is found in up to 38% in the national databases and 40% of the in-depth databases.

Third the factors were analysed by a multidimensional point of view, including the environment, the vehicle and the human (including medical, societal, toxicological, psychological aspects), as well as on a background, trip, and a driving task level, giving answers to "when, where, how, under which circumstances, by which (combinations of) failures and to whom" accidents related to certain factors happen. In addition this lead to suggestions for prevention measures from all these dimensions.

For alcohol it is seen that focus groups are males, unemployed persons, and pedestrians, during a leisure trip, that focus places are either urban (for pedestrians) or rural but predominantely on minor or other roads, that the time for alcohol related accidents is more often after 16:00 in darkness and on weekends (where fatal alcohol related accidents happened more often during daylight conditions), and that leaving the road, bends, no specific manoeuvres and unadapted speed in low speed limit zones together with overall failures in sensomotoric and cognitive functioning give a defined picture about typical alcohol related accidents.

An alcohol related accident can be prevented on a background level by a cultural and sociological condemnation or ostracism or by more controls (e.g. at night on weekends before entering rural roads). Further these accidents can be prevented on a trip level by inhibiting the trip, e.g. by alcolock systems. In addition, first hints were derived that these accidents might be this kind of typical that on a driving task level still prevention might be possible (at least for some of these accidents) by Lane Keeping Assistence, Intelligent Speed Adaption Systems or others.

For speed typical combinations were found by multidimensional analysis as well. The focus groups are male and <45 years old, either motorcyclists or car drivers, the place is more often in bends in rural areas on non-major roads, the time is usually during darkness from midnight to 8:00 o'clock. For inappropriate speed it was found that especially rural high speed roads with degraded road surface and degraded weather conditions added to the accidents, and accidents with illegal speeding were seen especially on low speed roads. Further circumstances like vehicle <6 years old, frontal impacts and hitting immobile object, as well as rollover and run off the road accidents, either in overtaking manoeuvres or while going ahead were seen predominantely in speed associated accidents. Typical human functional failures for inappropriate speed were detection failures, whereas for illegal speed the persons failed in their decisions.

A speed related accident can be prevented by means to bring about cultural changes, by driver education to highlight dangers of both illegal speeding and inappropriate speeding, by stricter enforcement of speed limits, in particular patrols at ‘high risk’ locations for young (<45) males in cars and on motorcycles (i.e. low speed roads). Also driver assistance systems which inform the road user of the appropriate speed to travel for the terrain, Intelligent Speed Adaptation, Lane Keeping Assistance, Electronic Stability Control, Brake Assistance, ABS, Active Cruise Control, Collision Avoidance for road users encountering an errant speeder, and Night Vision might help to avoid speed related accidents. Further clear roadside signage to warn drivers of impending bend in road and advise on safe travel speed could be of help.

For inattention (and distraction) different combinations were found, so there is not one focus group, place, time or other circumstances (see chapter 4). This might be due to an overgeneralisation of different types of attention: inattention, competition of attention, and distraction. However, detection failures always seem to be crucial.

An inattention associated accident might be preventend by educating better awareness of dangers of poor driving habits related to different types of attention, in particular monotonous and dangerous situations, by improved vehicle design so that controls and displays are 'self explanatory' to reduce likelihood of competition for attention, by automated systems in vehicle to reduce competition for attention, by Collision Warning, Collision Avoidance, and Intelligent Speed Adaptation. Improved road design (i.e. 'self explaining') to reduce competition for attention could be of further help.

The fourth objective of Workpackage 3 to understand the factors better was impressively performed by the Human functional failure approach and by the societal view explaining why some existing ways to regard accident causation (like understood by the review and definitions of classifications and coding habits for interpreting the database results adequately) are limited for giving apt answers towards prevention measures.

The TRACE Projects objectives were met in the following aspects:

Factors have been studied together in order to provide a comprehensive and understandable definition of accident causation at the end of the project. Causation itself is a philosophical issue that can be understood in different ways depending on the questions raised and answers expected. For prevention reasons the best question concerning accident causation would be not to ask "who or what caused the accident?" but to ask "what missing safety system caused the accident?". This should be realised in future databases.

In WP3 out of the aims the "identification, characterisation and quantification of risk factors, groups at risk, risk related societal issues" has been performed partly very successful, sometimes only successful to an extent as to give first hints for how to go on (societal issues).

The question: When, where, how, why and to whom do accidents happen? was successfully answered for defined types of accidents that were caused by defined contributing factors.

In this WP3 the aim to "improve the multidisciplinary methodologies that are considered necessary to achieve this knowledge and especially methodologies for analysing the influence of human factors as well as the statistical methodologies used in risk and evaluation analysis" was successfully met. New in-depth and new statistical methods have been applied to existing databases giving insight to new knowledge.

In WP3 only the identification of possibly effective safety functions was performed.

The analysis for 3.2 showed that a lot of sociological and cultural factors (e.g. relation to the rule or social rule behaviour, social acceptability of Drunk Driving) can be found, that influence the following acts, behaviours, vehicles involved in the accident etc. But, of course it is not possible to explain every accident in sociological terms. And this is not wanted from a prevention point of view which in nowadays societies tries of course to protect the individuals but also tries to give responsibility back to the individual. It is however, necessary to know the underlying reasons for some factors found on a trip or even driving task level.

For accidents caused by a certain factor (of any level) it is not always necessary to go back in time for preventing this factor, but, the consequences of this factor (the characteristics of these factor-related accidents) are such a kind of typical, that prevention also on a level closer to the accident seems possible. This could be confirmed by using the statistic analyses in Work Package 3. From the Work Package 5 method applied further information on accidents of a certain contributing factors is derived. The Human functional failures, and the scenarios found, characterize the typical circumstances of typical accidents as well, but, not only by a "facts" directed objective statistic approach, but by already implying the objective needs that would have helped a driver/traffic participant to not getting involved in an accident. With this approach suggestions for the development of active safety systems are possible by explaining which needs those should cover/and which functions they should provide or take over. And in this Work Package 3 also the suggestions for the selection of Vehicle Safety Systems as provided by Work Package 6 and Work Package 4 were possible to be applied on the analysed cases to give additional prevention suggestions.

5.2 Contributing factors in traffic accidents on a European level

The presented frequencies of factors in D3.1 will have to stay on a descriptive level, as the results are derived from different countries, databases, sample criteria, classification criteria for variables, and are therefore not able to provide ONE frequency for Europe, also this is not rational due to assumed differences for the countries in the EUBy a relative coding representation the question "what is the most frequently coded/found factor is represented in the according accident database?" can be answered but not the question of implied risk for the accidents occurrence.

Work Package 3 was also expected also to give estimations and suggestions on a EU27 level for the relevance of the findings. As with a factors' point of view in-depth data are required in the first and by assuming that for a EU27 level at the utmost descriptive data would be available, the expectations were low to reach this goal. However, in task 3.2 a successful comparison is presented for discussion of the found sociological impact, and in tasks 3.3 and 3.4 a comparison of results seemed to be feasible to a certain degree. The results from the second data request 3B were used to discuss the in-depth results of 3.3 and 3.4, the simple cross tabulation gave a hint towards the question if the results of the analysis of the Work Package 3 Partners (pattern and scenarios) are likely to be found in other TRACE Partners data material as well. The same comparison (task results compared to bivariate results from TRACE Partners countries) is not possible for other European countries without the same bivariate analyses.

For the EU27 consequences of the results different methods, ideas and suggestions were taken into account, discussed and checked if relevant and valid conclusions were possible by these ideas on the one hand, and it was checked if the necessary information (background data, explanatory variables) for performing the different ideas was existing and accessible. Statistic experts from Work Package 7 provided ideas as well as giving their expertise on what is not valid or possible. For the factors point of view in Workpackage 3, for the methods applied and also taking account the results of the in-depth data request of Work Package 8 it is only possible to discuss and compare the results, but no figures for either single countries of the EU not represented in TRACE or overall figures for the EU27 by any kind of extrapolation can be performed.

However, especially for Alcohol and Speeding a lot of information on the European level is available (EC, 2006 and ECMT, 2006). From the UNECE data (UNECE, 2007) it is known, that the highest share of accidents caused by alcohol (more than 10%) are the following (from 25% down to 10%): Estonia, Luxembourg, Denmark, Lithuania, Finland, Latvia, Hungary, Slovenia, Slovakia, Poland, Czech Republic. The Czech Republic is the only country represented in the TRACE consortium. Work Package 3 showed, that the Czech national data reveal a share of 19% of accidents being caused by alcohol (all estimates refer to 2004).

Regarding the topic Drink Driving, the European databases reviewed in task 3.2 show that this social phenomenon is an important one regarding its relationship to accident causation, which is an argument for further in-depth investigation. Especially research on cultural differences among European countries regarding their “habits” of alcohol consumption culture and, even more important, their diverse degree of social acceptability of Drink Driving should be further investigated. On this background, the common European space is a very interesting field for comparative research on this matter, especially regarding the analysis of best practices on how to integrate an given “alcohol consumption culture” and work on the fact that Drink Driving should be socially unacceptable.

From the UNECE data for 2004 (UNECE, 2007) it is further known that the highest numbers (from 24000 down to 2000) of accidents caused by alcohol are found in the following countries: Germany, United Kingdom, Poland, Hungary, Austria, Czech Republic, and the Netherlands. Most of these countries are represented in TRACE (except Poland and Hungary). So the Work Package 3 results for the factor alcohol are applying to the highest absolute number of accidents caused by alcohol in the EU.

It is assumed that by focussing on Alcohol, Speed, Distraction and Inattention, Road Condition and Layout by any prevention measures as found by the task 3.3 and 3.4 results the highest share of accidents in the EU can be prevented.

5.3 Methods used in Work Package 3

In Work Package 3, a search was undertaken for typical characteristics of accidents that were caused by certain factors. The selection of factors that were analysed was based on the results of the literature and database screenings with the focus to choose relevant factors. Factors are relevant if they either increase the risk for an accident or if they are frequently contributing to accidents. Further, the factors had to be available in the used databases.

The use of existing databases relies on the findings documented within them. If the databases don't provide certain information or the aspects searched for are not stored in the databases, then it is necessary to go back to the case level to retrieve this information afterwards. However, if in the case files this information is not covered at all, further analysis will not be possible. For example, if in the case files no information on sociological backgrounds is covered or if certain vehicle characteristics or damages are not documented, it will be very difficult to receive these informations afterwards. In-depth databases serve different interests, some might have a focus on the traffic participant, some more on the vehicles. Some might focus on the causation of accidents, some on the causation of injuries. Therefore the in-depth analysis will cover different detailed areas to answer these questions.

The method used for the analysis of sociological factors in task 3.2 is based on interviews on a case level. A social identity card could be added to every analysed case in in-depth case analyses to collect more information on this topic in the first. It highlightens the most important aspects and influences from a sociological and cultural background. In bigger samples then it will be able to show which of these factors are relevant for which kinds and which share of accidents, and on the other way round, where to invest with which preventive countermeasures.

It has been possible, using the two main types of analysis in tasks 3.3 and 3.4, to identify not only the most ‘typical’ characteristics of accidents where trip related or driving task-associated factors are involved (using the statistical logistic regression analysis), but also to identify the main reasons for what went wrong in the accidents where these factors and their associated characteristics, are present (using the TRACE Work Package 5 methodology for case analysis). As opposed to providing conflicting views about these accidents, the findings produced using both methods have been complementary, and where both methods have been used to investigate the same factor, an even more detailed view of the accident process was produced. For future accident analysis, the use of both methods to obtain a detailed picture of accident situations is recommended.

For the statistic method (comparable to a case – control study with an induced exposure idea) improvements have to be undertaken in the selection of explanatory variables and by taking all contributing factors applied to one accident into account. Databases that allow multiple coding of contributing factors could be used to analyse if certain factors are associated with each other and build up typical patterns. In addition it would be possible to analyse whether driving task associated factors are depending on distinct background or trip related factors. The analyses in Work Package 3 were limited to a kind of pilot study, to be on a more objective level. As these already showed some good results, in particular by using the Mutual Information Content method, this next step can be recommended for future analysis. This method will always be able to show up characteristics of certain types of accidents in comparison to other types of accidents.

If more sociological factors were documented in databases and a harmonized coding and classification system was used in Europe (like developed in the EU-Project SAFETYNET for fatal accident databases) then the statistic method used in tasks 3.3 and 3.4 might be able to take all explanatory variables and all contributing factors into account simultaneously, to derive even more detailed pattern and more specific prevention measures. Further, the results gained by one database might be more easily transferred or extrapolated by statistical methods.

The attempt of analysing accidents by a view point of contributing factors on a trip level reveals some general insights: on the one hand the trip level is too general for modern analysis, thus, sometimes only well-known results can be gained. Too general means that the factors on this level are the consequence of underlying background factors and in addition are themselves the reason for different subsequent factors that will be found on the driving task level. Accidents caused by factors from a trip level comprise a variety of different scenarios which are defined as combinations of certain road user, site, time, and place characteristics involved in situations, manoeuvres and in this combination leading to typical failures. General recommendations can thus be derived by analysing trip related factors, but, as they comprise a variety of implied aspects, no conclusions on the actual relevance of the factor itself, or the impact of the suggested preventive measures, can be drawn.

As can be seen from the results of the analysis, many of the driving task-associated factors are a direct result of factors at a trip level. The link found between factors at a driving level and other levels being investigated in Work Package 3 (trip, Social/cultural) shows that it could be of future interest to take each specific driving task factor (e.g. speed) and analyse its effects throughout all 3 levels investigated in this Work Package. However, in order to do this, more work would need to be undertaken to harmonise the type of data collected at the scene, as it would be difficult to undertake this using retrospective data.

The existing coding structures of the databases available to the TRACE Partners collect and document factors on many different levels. For those factors that show high representations in the databases, results can still be gained. For factors of lower representation in the databases, the analysis on the trip level cannot show evidence for any typical accident pattern connected to this factor (e.g. experience that is showing a low frequency in comparison to other factors, and the analysis was not able to give satisfying results), whereas the analyses on the driving task level (e.g. sudden health problems, sudden technical defects and dazzling sunshine) were able to show pattern despite the low representation of these factors in the databases. This means on the one hand, that the closer to the accident the factors are the more specific conclusions about the circumstances of the accidents can be drawn. On the other hand this means that when multiple implications and meanings are combined for forming one trip-related factor and a certain pattern is detected, a lot of impact can still be expected by preventive measures.

The method used in task 3.3 and 3.4 to compare the results found in different databases to other countries is the optimum feasible and valid way. By comparing bivariate associations to patterns found in the regression model on a descriptive level it was possible to find hints and tendencies that the results might be transferable. But, as shown in the analyses, some of the bivariate associations vanish if adjusting to other factors and because of existing interactions. Thus also the bivariate associations found in other countries might not be stable and the transfer will not prove to be true in reality. Only the same kind of analysis applied to other countries will show if the same pattern are found. But, as already mentioned, this will only be useful if harmonization of databases is reached.

6 Concluding remarks and Outlook

Regarding the objectives of Workpackage 3 and taking the given material and the necessary methods into account the conclusion has to be drawn, that the best possible, although limited, results under these conditions were achieved.

This study has shown the benefits of using a unique human factors methodology such as the one used in this study, which was developed in TRACE Work Package 5. Harmonisation of data across European data sources, using for example this methodology for in-depth accident causation analysis, would help make a more Europe-wide view of the causes of accidents at a driving task level more achievable.

A further issue identified concerning sociological factors was that some of the research that could prove useful for road safety will take time, the data collection procedures will have to be adapted, and the accident investigators have to be trained to collect this “soft” data. In addition, in-depth accident research would profit by a more interdisciplinary approach and more flexibility regarding the evolution of its investigation tools. The “human factor” in accident causation is still the most important one, but to understand it to its full extent, more complex human and social sciences approaches have to be applied and more longitudinal studies on risk groups and on the origins of risk attitudes and behaviour should be encouraged.

The innovative concept of regarding accident causation from a factors point of view by separating background factors, trip-related factors and driving task related factors can still be considered for the future and Work Package 3 has been a rewarding 'pilot' of the concept.

It might be better to analyse accidents from a prevention view point; rather than ask why accidents happen, researchers should be asking what could have avoided the accident. Prevention efforts from legislation, infrastructure, vehicle and human behaviour could then be taken into account from the beginning. In accident causation research it is often the case that some of these aspects are not regarded, but the traffic participant is seen as the main contributor of an accident, mixed with questions of fault and the need to blame someone for the accident. This view will not prevent further accidents, as no natural - biological system is free of failures to occur or free from chances to become reality. Accidents happen because they can happen. Therefore everything should be done to decrease the chance for an accident to actually happen and provide safe traffic surroundings and conditions.

7 Acknowledgements

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No guarantee can be given on the correctness of the interpretations of the results. The conclusions drawn might not reflect the views of the organisations and partners, respectively.

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STATS 19: National Accident Data for Great Britain are collected by police forces and collated by the UK Department for Transport. The data are made available to the Vehicle Safety Research Centre, Ergonomics and Safety Research Institute, at Loughborough University by the UK Department for Transport. The Department for Transport and those who carried out the original collection of the data bear no responsibility for the further analysis or interpretation of it.

In the early 1990s, the LAB (Laboratoire d'Accidentologie de Biomécanique et de comportement humain PSA Peugeot Citroën – Renault) pooled resources with the state-funded INRETS (Institut National de REcherche sur les Transports et leur Sécurité) in a common active safety research program – VSR (Véhicule et Sécurité Routière). 4 teams of investigators were called out to injury accident scenes by the emergency services to collect real-time crash data (approximately 60 accidents per team per annum). In 1999, at the end of this joint program, the two partners chose different but complementary directions. The LAB began to evaluate the effectiveness of new safety systems, whereas the INRETS continued developing its driver failure model. The LAB has since adopted this model and included it in the ongoing in depth accident investigation program.

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List of Abbreviations

AAFS	Advanced Adaptive Front light System
ACC	Active Cruise Control
BA	Brake Assistance
BASt	Bundesanstalt für Strassenwesen (German National Higway Administration)
CA	Collision Avoidance
CIDAUT	Fundacion para la Investigacion y Desarollo en Automocion
CRS	Child Restraint System
CW	Collision Warning
DDD	Driver Drowsiness Detection
DIANA	in-Depth Investigation and ANalysis of Accidents (database)
EBS	Energy Barrier Speed
EDA	Etudes Détaillées d'Accidents (In-depth accident causation survey, database)
ESP	Electronic Stability Program
GIDAS	German In-Depth Accident Study
HGV	Heavy Goods Vehicle
INRETS	Institut National de Recherche sur les Transports et leur Sécurité
ISA	Intelligent Speed Adaption
LAB	Laboratoire - Groupement d'intérêt Economique de Recherches et Etudes PSA RENAULT
LCA	Lane Changing Assistance,
LKA	Lane Keeping Assistance
LMU	Ludwig-Maximilians Universitaet Muenchen (Munich University)
NV	Night Vision
OGPAS	Official German Police Accident Statistics
OTS	On the Spot (database)
SAVE-U	Vulnerable Road Users Protection
TPM	Tyre Pressure Monitoring and Warning Systems
TUG	Technical University Graz
VSRC	Vehicle Safety Research Centre, Loughborough University
ZEDATU	Zentrale Datenbank tödlicher Unfälle (database)