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1. Introduction and summary

Accident and exposure data and statistical analysis methods are a prerequisite for an effective road safety policy. The knowledge on risks and the effectiveness of road safety measures can only be obtained by research with these methods and data sources. Road safety research, the stock of knowledge on road safety and the knowledge on effectiveness of measures are nowadays an international affair. The knowledge in the field of road safety is based on the accumulation of national research results over more than thirty years. However, the knowledge is still far from complete and on many issues there is no international agreement. For further progress the comparability of national results is a main problem. One big problem is that the variables which describe the national accident data generally are differently defined for each country. An other problem is the accident registration itself. Many accidents, if not most accidents including relative serious ones, are not reported and or not registered. The selectivity in the registered accidents is partially unknown and for so far as it is researched it shows marked differences per country (IRTAD, 1994). Not withstanding the progress made, thereby, a meaningful exchange of national results and knowledge progress in the field of road safety are seriously hampered. The use of modern information technology in the registration and processing of accident data and international research cooperation are needed for an improved situation.

The current use of road safety information systems and the few systems for international use are discussed. Recommendations are formulated for a more efficient, less costly and improved accident registration on the local, national and international levels. It is argued that cooperation in the use of state of the art tools from modern information and communication technology for accident registration can open new possibilities for unobtrusive international registration harmonization and cooperative international road safety research. Some possible misunderstandings on the level of international organizations are clarified. The needs and possibilities for international accident databases and information systems with different levels of data aggregation and information services are reviewed. It is concluded that an improvement towards a meaningful use of multinational accident and transport data and progress in road safety knowledge are very well feasible by further international cooperation and application of modern information and communication technology.

2. Needs for a variety of databases and information systems

There is a variety of user needs for accident databases and road safety information systems which can not be covered by a single accident database or the same type of information system, not on the national level nor on the international level. Not withstanding the fact that every official whose concern is with road safety needs in some way output from a

database with information on accidents that have occurred, their user needs do vary greatly. Local authorities have other data and information needs than the national government and international officials may search for again other types of data and information. Generally the main needs of authorities diverges with the size of their territory. However, also other factors than territorial size cause differences in user needs. The national Bureau of Statistics will specify other functions for an accident database than the researchers in road safety at universities and both differ from the functions for road safety information systems needed by officials from the Ministry of Transport.

These differences in needs ask for differences in content which can be characterized by different coverage, selections or aggregations of registered accidents, by different levels of detail in the coding of variables and by different aggregations of accident variables. Moreover, there is a need for enrichment of the data by information form other sources such as exposure information, insurance and medical information and above all research information from data analyses and evaluations as well as information on road safety policies. The enrichment mainly comes from research on accident data and national or international policy bodies. For example research on risk comparison of types of road users or regions and nations or preceding years as well as differences of national road safety related laws or policies. In the end no one is satisfied by a print of selected data base elements. Optimal registration efficiency and information services ask for differences in accident data bases and user oriented enrichments by road safety information systems.

Nonetheless all the information must be based on selections or aggregates of the totality of the very same registered accidents (or in theory on the same registration of all the relevant accidents that have occurred, which regrettably is different from the registered ones). This asks for integrity guaranties of the data selections, aggregations and accumulations as well as for transparency of the relations between the different data and information systems. In order to stress the importance of what has been summarized above for a further progress in these matters, a deeper exploration is pursued in the sequel.

2.1. **Size of territory: accumulation of data and divergent needs**

Local and municipal concerns
Generally the local police will document and make records of accidents in their territory for so far as these accidents need their assistance or ask otherwise for their registration. Apart from this implicit selection in the source registration of accidents, these police records are the original source for the national and or provincial accident register. These local records of accidents generally are specified by registration rules from the national accident register authority. In some way (not seldom by awkward postal means) these specified data are input for the national accident base. The territorial accident data, either obtained by selections on area related codes from the provincial or national register or directly obtained by the accumulation of records from the local police offices in the territory, are the basis for the road safety information at the local or municipal level.

Local and municipal officials and local policy makers are mainly interested in the places of local accident concentrations and the dominant types of accidents in their own territory of authority. They want local road maps with graphical indications of accident concentrations and simple accident tables as output of an information system. Fatal accidents and

accidents with serious injuries in small areas generally occur relative seldom and the more seldom the less populated the territory is. The local accident information, therefore, mainly must be based on damage only accidents. In a few countries the local authorities have their own PC-information system that can produce tables and sometimes even geographic pictures with accident frequencies from the locally stored accident data obtained from the coded police registration of accidents in the territory. Generally this is not the case. On the local level there also are no additional system facilities for further analysis or possibilities for comparison with other areas or national trends, nor there are expert or knowledge systems that provide useful information for the interpretation of accident frequencies or assist in relevant road safety measures for local problems.

In some countries the national accident database authority provides road safety data and information services on request by the local authorities with respect to the selected data of their territory. However, these services generally are not based on state of the art information technology and seldom cover userfriendly the actual user needs of local authorities. This is a real problem for countries that have decentralized many facets of the responsibility for road safety to the local levels.

Regional and provincial concerns
Generally the accidents registered according to the national specifications are send to the national or provincial authority, who put the coded data in a central database. On the regional or provincial level the coded accident data, either subtracted from the national database or directly stored by the provincial authorities themselves, are the source of their relevant road safety information. The accumulated frequencies of accidents on the regional or provincial level allow a richer analysis of the data than can be possible on the local level. But in many countries the regional or provincial offices are not better equipped with accident analysis and information facilities than the offices on the local level.

There are, however, great differences between the accident information facilities and services of regional or provincial authorities in different countries which seem not to depend on the economic situation in a country. In the Netherlands the provinces (and local or regional authorities as well) can obtain a multitude of data services for their territory from the national database centre. The SWOV together with the dutch ministry of transport also has provided for them an additional road safety information system that allows for interprovincial or national comparisons with kinds of monitoring, trend and prognostic facilities. It also provides road safety knowledge and policy information with respect to a diversity of topics for the interpretation of the data for their own territory. The information can be manipulated and copied for the preparation of the road safety policy documents of the provincial authorities. In contrast, and even on the national level, in Luxembourg all accident data information is still paper and pencil based and the transmission is by postal means. But, for example the Cracow region of Poland has a quite well advanced accident database system with many kinds of information services.

Anyhow the information needs at the regional or provincial level are different from the local or municipal level. For example they will be interested in traffic flows and accidents of freight vehicles on the main interurban roads and they may want to know how the risks compares with other provinces or how the safety of the freight transport can be enhanced by an improved infrastructure. Again decentralization of road safety responsibilities asks

for a multitude of safety and transport information services. The absence of system facilities for these purposes on the regional level is a serious bottle neck for the effectiveness of a decentralized road safety policy. It even can be detrimental to road safety, since also not seldom the analysis capacity and expert knowledge is not sufficient on the regional or provincial level.

National or state and federal concerns
On the national, state or federal level generally the information from the accumulated accident data is stored in a central database. It provides the central bureau of statistics with the data for the aggregated statistics on road safety which usually are published on an annual basis. Within a nation there may exist some regional differences in reporting practices that can influence the quality and meaningfullness of the, uniformly coded, central accident database of reported accidents, however, the main national problems are the non-reported accidents and/or the missing data elements in the reported accidents. The selectivity from the underreporting and missing data generally influences the national statics on road safety in such a way that many aspects of the true road safety problems remain hidden. Only for road fatalities the national database seems to reflect the nearly true level of lack in road safety. Less serious injury and damages accident and especially single accidents and accidents with vulnerable road users, even rather serious ones, seem everywhere to be greatly underreported in the national statistics (IRTAD, 1994). It misguides national road safety priorities. For research on the national level an additional problem is that the coverage and specifications of variables for the reporting of accidents do not contain enough information for causal analyses. In some countries this is compensated by very costly in-depth studies on selective samples of road accidents.

The needs of the national or state authorities concerned with road safety, such as the Ministries of Transport, Health, Law and Inner Affairs to name a few, are divers and different from decentral levels. A focus of interest for a Ministry of Transport may be trends in the number of fatalities and serious injuries or road risks for categories of road users over several years as well as the comparison of their national safety level with other nations. For disaggregated risk information one needs specified accident data as well as exposure data for the relevant specifications (such as mileage of different types of motor vehicles and road types as well as length and frequencies of trips for age categories of road users). For many national research questions the data from several sources must be linked and analyzed which in most North-West and middle European countries as well as in North America and Australia and partially in Japan is organized by a national road safety institute. In many countries, even in the countries with rather high levels of motorization, such central research facilities are absent. Consequently in these less equipped and organized countries a national road safety policy can not be based on the necessary facts. Despite the possible political expression of road safety concerns, the national road safety policies of these countries must be immature and never can be very effective. Some effectiveness then still can be obtained from the implementation of validated road safety practices in adjacent countries with more advanced research facilities and information systems. In some respects Belgium may be regarded as a country with such a strategy and likely several South European countries can be characterized by such road safety policies.

For a Ministry of Health the relevant road safety information for its policy will be oriented to the medical prevention of death and curative recovery of injuries after an accident,

whereby the linkage of medical databases with accident databases comes into play. For Ministries of Law and Inner Affairs the juridical aspects of traffic, traffic violations and the influence of their activities on the regional and national road safety are of interest. Road safety research on data from quite different domains than transport also are needed for the policy optimization of these ministries. Therefore, data linkage and research from different sources are essential for user needs on the central level.

These national needs only can be well serviced by a central, interdisciplinary scientific institute for road safety with modern information technology equipment and specialized academic staff. Above all the central governments must provide the organization for the dissemination of road safety knowledge to the decentral authorities and officials as well as to the public. Modern information and communication technology and close cooperation between the research organization and organizations for preventive road safety, such as the decentral authorities, educational and public information institutions, can be of great help.

International concerns

On the international level, and to some extent also on a federal level, the information needs again are different. Generally the locally registered accident data within a nation have a common data specification and more or less common reporting practice within the nation. However, the specification of the accident registration differs in many respects between countries. The accident variables that are recorded differ per nation, while also common variables are differently defined. Even a road fatality is differently defined by varying time periods for death after an accident (that is from death on the spot to death within a variety of days after the accident). Moreover, even for common variables the subspecification within the variables are most times not identical, not only by codes but also by content. On top of that the national reporting rules and practices differ greatly, whereby nearly all the accident frequencies become incomparable between nations. International publications of national frequencies for types of road accidents as those published by the UN-ECE, IRF or ECMT for total numbers injuries or total number of alcohol accidents will be misleading. There simply is no meaningful way to compare these frequencies. Even if these figures are transformed to seemingly comparable risks per mileage or amount of inhabitants, such risk figures do not acquire any meaningful content. Not only because the definitions for accidents (and mileage ?) differ per country, but mainly because how often a defined road injury is reported or how often alcohol is detected in a defined alcohol accident in a country differs markedly per country. Even if the definitions would be harmonized the comparability problem caused by the nationally different reporting practices would not be solved. Most likely the different reporting practices can never be harmonized. What is needed, therefore, is additional research on national differences in the underreporting of comparable accidents. There is no international research organization with such a mission. The only body that partially provides a few research findings of this kind is the OECD-RTR group on the basis of cooperative research of the national institutes in the OECD countries that actively participate in the OECD-IRTAD system.

The IRTAD system is limited to a few variables on aggregated national subtotals of fatal accidents and some exposure measures that can be combined in a meaningful way to comparable fatal risks. The national subtotals in that IRTAD system are made comparable by internationally agreed factors based on research findings for the relevant national differences. The CARE-project of the EU for a disaggregated European road accident database is

also a most welcomed initiative as also are the R&D-projects of the fourth EU-R&D programme on transport, where the strategic transport information project of the latter may lead to enhanced and harmonized road transport exposure measures.

For some time the CARE-project will be in development and its possibilities for a meaningful use for European road safety information is still an open question. The ETSC has advised to develop from the databases of the EU-countries in CARE an additional European database of fatal accidents (ETSC, 1994) by the aggregation of those different national variables of fatal accidents that can be combined to identical or almost identical aggregated variables. To be clear this does not aggregate accidents but combines codes and or variables of individual accidents. For example the road types are differently defined in the EU-nations, but there combination per country into motorfreeways, roads outside and inside built-up areas defines an aggregated variable with three road codes that have an almost identical meaning for the fatalities in all countries. Such an effort is necessary, however, it does not solve the different time-lag definitions of a fatality in the EU-countries. Nonetheless if the CARE-project is developed in that way it would provide a fatal accident database that can be of great value for research and the improvement of the European road safety. A problem remains that only cooperative European research can enrich a European road safety policy, because no road safety institute with such a mission exists. Without additional Europe oriented research the value of a European accident database will be limited to questionable accident frequencies from which no enriched European policy can emerge.

Also on the European level policy makers need information services, partially comparable to what the IRTAD-system in a limited way can provide nowadays. It, therefore, is a regrettable misunderstanding that a CARE-system for disaggregated accidents is in conflict with an information system of aggregated subtotals of accidents and risks, as provided by IRTAD. Information services for international policy making ask for a disaggregated international accident database with meaningful variables as well as for systems with aggregated accident and road risks information. If IRTAD would not have been developed the EU must develop a similar enriched information services. It points to more cooperation between the EU-CARE projectgroup and the OECD-IRTAD group than there is nowadays. Still there is a long way to go. Even the IRTAD-system is more a background system with a limited, internationally comparable set of accident and exposure data for researchers than a system with enriched international road safety information for policy makers.

A quite different way for an improvement of international accident statistics in the EU may be the harmonization of the accident data definitions and reporting procedures. This seems a cumbersome way. But if a programme of the EU-R&D could be directed towards a new accident reporting system that by the use of modern information and communication technology is more efficient and less costly for the EU-nations, one may succeed in this direction. The European use of such a modern digital reporting system need not to change the national way of reporting accidents, which content can become a subset of the macro-EU reporting system. It can be a very attractive alternative for nations because of its enhanced efficiency and reduced costs. Such is quite well feasible since all national accident reporting procedures are very costly, rather in efficient and far below the standards of state of the art modern information and communication technology. In the sequel the topic is addressed again from that technological perspective.

2.2. **Divergent user needs and interfaced systems**

Not only different territorial authorities have different concerns and needs regarding road safety information. The database specialists responsible for the well functioning of a system for accident information have their more technical concerns and as users of systems they have quite different, but legitimate needs. A relational database system is needed for a any full grown accident system, because the variables that specify particular accidents are quite divers and partially overlapping. The variables that specify a car accident with an other car on a motorfreeway at night are for a large part different from the variables that describe a moped accident with a pedestrian on an intersection in day light. Such partially overlapping and partially unique data ask for a modern relational database system, but even scientific researchers are not well served by a relational database system and some query language. Such relational database systems for accident data are too specialized and complex for most road safety researchers.

For researchers it is more efficient to have a simpler accident record system for subsets of accidents with homogeneous variables, such as a multiple subset data system with data matrices for multiple car-car accidents, for single accident of freight vehicles, for single car accidents, etc.. They can do research by themselves on such simpler database of complete datamatrices by means of existing statistical analysis systems with a multitude of analysis programmes which are designed for the analyses of datamatrices. At SWOV in the Netherlands we have asked the database specialists to build such a derived system for research purposes which is updated annually. The data system of that research accident database is then so-called interfaced with the original relational database and the analysis system with statistical tools. It illustrates that one must not talk of a single accident database, but of a whole variety of related and interfaced systems. The interfacing of systems must grantee the integrity of the data and, therefore, the relations must be transparently established by database specialists. This transparent interfacing also holds for accident data systems at decentral levels and their accumulation to a national database.

Database specialist and researchers in the field of road safety are rather well supported by varieties of interfaced background data systems such as accident database systems, vehicle registration databases, medical registration databases, databases of motorvehicle insurers etc.. From these databases relevant subsets of data for research questions are constructed by linkages of the respectively needed relational databases. However, officials and policy makers and also interested layman, such as transport journalists and voluntary workers in preventive road safety organisations, have needs for accident and road safety information that can not be served by such background data systems. What they need is a forefront information system that in a userfreindly way can provide the answers to questions they have about certain types of accidents and relevant data interpretation problems as well as about the related road safety knowledge and policy information. Such information systems are forefront systems, that are interfaced by an in-between layer that links the background database systems of the reported accidents and the documentary systems of research and policy information on road safety. Such a distinction between background systems and forefront systems with intermediate linkages is nowadays often applied in business information systems (Donavan, 1993). The search, communication and transmission of data and documents is made possible by electronic networks and the so-called client-server architecture for information exchange. The mentioned dutch information system for the use on the

provincial level can be seen as such a forefront information system. However, in most countries there are no such forefront systems on accidents and road safety information developed. Consequently the non-professionals in accident background systems and road safety research are often badly served by the existing information systems for road safety.

2.3. **Varieties in contents of accident databases**

It needs no further comment to note that the coverage of the accident databases is different on the respective territorial levels and that the coverage increases by the accumulation to a state or federal accident data base. The coverage of international databases can be very immense. A EU-CARE database that also would include damage only accidents will cover more than 20 million detailed accidents on annual basis. Generally it is assumed that a higher efficiency is obtained if the data details are reduced for selections of the accident data when the coverage of the data increases. This is what the national centre for statistics and analysis of the department of transportation in the United States has done on the federal level (Walsh, 1995). It must, however, be considered that we then gain efficiency at the costs of loosing information. The loss of information details starts already with the original registration process of the local police. The verbal document information of the local police for an accident is much more detailed than its coded data for the accident base. This loss of information detail can be very detrimental for research on causal factors of accidents. In the Netherlands these original documents of the police also have been studied (Noordzij, et al. 1993) for research purposes. For example for frontal accidents on rural roads it became evident from the researched original documents that a large proportion of these accidents occur by an oversteering reaction of drivers who first come just alongside the road edge on the soft shoulder and then come by a forced oversteering on the opposite traffic lane. Such frontal accidents and many single accidents could be prevented by a broad paved reserve strip adjacent to a noise producing roadside alignment. An accident cause and safety measure for frontal accidents that never could be revealed from the frontal accident data in the national database.

Due to the vastly reducing costs in information technology for memory, access and transmission of data as well as due to the progress made in object oriented information systems, it is no longer necessary for efficiency reasons to reduce the details of the electronic available data. This does not mean that we should not have database systems with less detailed accident information. This still is more efficient for the often use of aggregated information and in cases of repeated data manipulations as needed for the production of accident statistics and evaluations of safety measures. But it does not imply that we should not keep the original full detailed and structured information of the local police records somewhere stored in the local servers of the electronic network and within reach for special, unique but often very important road safety questions. A larger range of accident data systems only asks for a hierarchy of databases. On the lowest level in the network the detailed data of all accidents in a territory ought to be stored in local accident databases. Databases on higher levels ought to be constructed transparently from lower level accident databases either by aggregation of variables (the ETSC advice for a CARE system of fatal accidents) or by aggregation for accident types (the IRTAD-system) or by samples or selections of accidents (respectively GES and FARS of the USA) or by combinations of these strategies.

Raw accident data only acquire usefulness if they are related to enriched meaningful contents. If we do not know what the influence is of statistical random error in the data frequencies or what the relations between variables are or what the data imply for road safety measures, we can not responsibly use accident data for any purpose. Too often raw accident data are ad hoc subjectively interpreted and used irrationally in many debates on road safety. Road safety research has provided an overwhelming amount of important meaning for accident data. By modern information technology it is nowadays possible with the object oriented approach in information systems to attach tags to the variables of accident databases, which tags contain the necessary pointers to meaningful information for the warranted use of accident data. In this way the accident database systems can be enriched and such enriched relational databases again can be coupled with documentary information systems for road safety research or policy information about relevant subjects which are then indicated by corresponding tags. Such relations between data variables and documentary systems ask for the technological architecture of distributed background systems for accident databases and documentary systems on the one hand and on the other hand for the client/server architecture for the background and forefront information systems. However, up to now there is no country that has achieved such a qualitative enrichment for their road safety related information systems, while the opportunities offered by the electronic networks and client/server architectures for integrated data and document communication are hardly used for this purpose in nearly all countries. But such is very well possible to achieve by proven state of the art information technology. It is applied in many business information systems (Donavan, 1993) and other domains, for example librarian services (Dempsey, 1992).

3. The actual situation

The actual existing road safety information systems in nearly all countries can be described as rather technologically awkward and inefficient as well as rather expensive. The local police collect the accident data mostly by paper and pencil work and their verbal accident reports are seldom assisted by intelligent information systems. Also the reporting of coded accidents to the registering authority is in many countries not electronic sustained and without the use of networked information transmission. Moreover, a police officer generally has to do double work for the verbal accident report and for the completion of the coded accident register format. Not seldom the latter is regarded as non-motivating extra work that can wait. On the local level one has the most detailed information, but the local authority has no userfriendly tools to extract special overviews from that detailed information and has no easy access to relevant road safety information for the meaningful use of the detailed information. Since there usually is no support system provided they invent there own ways of using the data for local road safety purposes and then the wise guys of a research centre are sometimes even telling them that are doing the wrong things. In some seemingly less awkward countries the national register authority provides the local and regional authorities with tables of accident frequencies and or geographic maps of accident frequencies in their own area, but it concerns output that could have been provided directly by a local support system for their own data. In the Netherlands the local and regional authorities even have to pay for such central services, although it concerns the very same data they gratuitously have provided for the national register centre.

The locally reported data are on the provincial and or national level collected in some database system. It is not known in how many countries this storage asks for a renewed digital input of the same data at different places, but it surely are not a few since there are many countries where the local police sends the completed data formats to the register authority by post instead of electronic mail. Such repeated input procedures are not only a threat to the reliability of the data, but are also inefficient and expensive. At the national level the national accident database is used by research institutes and in many cases they construct again special databases for analysis purposes by queries from the national data base. It are the research institutes and the ministries of transport that enrich the data information with research knowledge or policy information. Also on that national level the data are selected and aggregated to information for the IRTAD-system that up to now is the best, but limited data source for research and comparison in policy making on the international level. The research and policy information on road safety in all countries consists in all kinds of information such as texts, tables and graphs, but that kind of information mostly is contained in papers and reports. Although nowadays the papers and reports are made by word processors for electronic documents, they are delivered as printed material and stored in mostly old fashioned libraries which by manual search and retrieval will lend the documents to road safety officials and others who need that information. However, there is some progress in this field. The international road safety and transport research community of the OECD-RTR has developed by the IRRD system a modern service for their librarian needs (by joint efforts of IRRD (OECD), TRIS (TRB-USA) and TRANSDOC (ECMT) also integrated to the main documentary system on road safety and transport information on CD-ROM). It helps to search the relevant documents and is easy accessible for researchers, but it can not electronic deliver the document contents.

It is sad to note, but not a distortion of reality, that the richer and the more relevant the information on road safety is, the less easy accessible the information is for non-scientific users. The international and national road safety research community is up to now relatively the best served by the existing accident and road safety information systems. It is evident how valuable in itself this is for road safety, but it is not enough for the improvement of the local and regional road safety. On that level the road safety information services we deliver are of a poor user quality, but just mainly there the implementation of road safety improvements has to take place. Especially for decentralized road safety policies it is a deplorable state of affairs that need to be changed.

4. State of the art technology and road safety information systems

4.1. Re-engineering the information landscape

The application of state of the art information and communication technology in the field of accident registration and road safety information would change the landscape in a way that is beneficial for all parties involved and above all it would be beneficial for road safety itself. It asks for a re-engineering of the actual landscape of road safety information that is pictured above. Therefore, it may be instructive to see the outlook of the re-engineered landscape and to consider its feasibility and benefits in more detail.

In the background we need what we already have in a stand alone way: medium power computers with relational databases of accident data and documentary road safety information systems. What we also need, and is already present in most motorized countries, is an electronic network for transmission of data and documents. The missing link at the moment in nearly all countries is the technological architecture for the exchange of information between the background database systems and forefront PC-systems. The potential forefront users need a modern PC that is connected to the network. Most users already have such a PC available, but not all are already connected by a network. A simple PTT-line and modem is not sufficient. More hardware than mentioned here is not needed and since most parts are already provided its completion asks for a relative small budget.

On the software side we need for the background systems the implementation of relational databases with query tools (such as Oracle or Sybase with SQL) for which many vendors have developed additional software. The national as well as the decentral accident background database systems should have linkage facilities for geographic road information and the derived background system at the research centre should be coupled with advanced statistical tools, like SAS or SPSS. For the forefront systems at the offices of the users we need standard communication software and standard user software for the PC (word processors and spread sheet programs with some simple statistical and graphical tools and d-base facilities, which all should support their compounding in documents and where needed also geographic information tools, such as Arc-info or Atlas, should be included). However, most important the software environment must support object oriented information exchange for searches and selections of information from the relevant background systems for personal applications. These types of software are for example provided by Windows 95 and Visual Basic or Delphi, where the latter two are a userfriendly visual tools for an easy construction of personal applications. These personal applications function independently from the background systems, but will contain easy searched and selected information blocks or elements (data, text items or blocks, graphs etc.) from a multitude of background systems.

The personal applications individually connect, order and combine the information blocks into new personal documents or individual local systems that satisfy the personal information needs. What still may be missing for such personal applications is the selective network connections and or protected object oriented access to the information of all relevant background systems for general users, where user identification for allowed access and selective access protection of private information elements must be installed in the communication architecture for these background systems. These missing links generally do not ask for much technological efforts, but for organizational efforts and client oriented attitudes of the background system organization. The needed software is available and for the most part already presently used in motorized countries and possible extra costs for its completion are relatively low.

On the local level, where the source is for the accident data, we need officers who are equipped with a small modern portable wireless pad computer, such as those nowadays used by census and interview bureaus. The special software for the needed functions of the electronic pad has to be developed partially. It would enable the local officers to input the information for the accident report and the accident register on the spot of the accident, where the location information itself can be generated from GPS and stored local geo-

graphic road information. At the police office the desk PC of the officer is connected with the pad from where the desk PC software generates the main parts for the verbal accident report of the officer. The desk PC software enables also the storage of the coded accident data in the local database of the authority from where the new accident data are selected for transmission to the provincial an or national accident database. If there are inconsistencies or missing elements the officer is asked to provide corrections or additional information and in this way completeness and quality of information is guaranteed. Here there are costs for the development of the special software, but the savings made in the production of police reports and in the accident registration are a multiple of the costs.

On the more central levels as well as the local level the variables for the data and the sections of documents need to be tagged by labels (the object orientation) which will make it possible for the forefront users of the information to connect the relevant data sets, data variables and research and policy information. All the (national or international) available relevant information then can retrieved in the forefront system on implicit PC-commands of any user of such a smart designed totality of road safety information by means of the network and the connected background systems within the underlying client/server architecture. These connected and tagged information structures are invisible for the forefront user, but are provided for the user by the object oriented information facilities.

The development of such an integrated structure of road safety systems may ask for some additional R&D, but it mainly is modern application of state of the information and communication technology. It should become a topic in the fifth R&D-programme of the EU for transport and telematics. Similar R&D programmes for other domains, like libraries, are already part of the existing fourth R&D-programme of the EU. May be we can envisage after such a EU-R&D initiative the new re-engineered landscape of road safety systems in Europe at the start of the next century.

This re-engineering would be also an opportunity for an implicit harmonization of accident data definitions in the EU, because the source data from the electronic pad of the local officer can be coded in different ways. One way of coding can be the existing coding for the national accident database and the other way the coding for a unified database for the EU-countries without any extra work for the local officer. It does not follow the cumbersome way of traditional harmonization, which often has been a dead alley. It provides more efficient, cost and labour reducing accident reporting procedures and information services on the local and national levels and by the way unobtrusively harmonizes the data definitions on the international level.

4.2. **Co-existence and integration of systems**

We conclude that the needs of non-professional users and the professional policy users as well as the requirements of data-specialists and researchers can be served simultaneously in the above described way. It asks for co-existence of background systems. The different user needs are related to the different contents of different systems, which all can be realised by a networked integration of background and forefront systems. However, a high quality of information for road safety would not only ask for connected road accident databases and documentary systems for research and policy information.

For risk comparisons we need information on exposure and, therefore, a nation should measure traffic exposure and develop a traffic exposure information system. At least it should contain exposure information for types of roads and types of vehicles, but also for types of road users (for example for age categories). Specified road measurements of mileage and a national census on trip frequencies and length can provide such information. If this is done in a regionally stratified way it would be of great help for decentral road safety policies.

Not only exposure, accident, research and policy information systems are needed. The national vehicle registration system should be part of the totality as well as the license registration system. Preferably also the data from medical registration systems should be selected for road accident patients and data systems of vehicle insurances may be asked to give selections of non-protected information on damages and injuries and their costs. Also this kind of derived systems should be part of the integrated information system. Such additional information would be of great importance for the priorities in road safety policies, because it can tell us more about costs and severity of accident outcomes. It presupposes that we have installed such data-linkage facilities that relevant information from these additional sources can be retrieved.

5. International bodies concerned with road safety information

On the international level much has and can be further improved with respect to road safety information. The OECD-RTR with IRTAD (as well as IRRD) and the EU with CARE already have been extensively discussed. The OECD and the EU are the only two international bodies who are involved in electronic accident data information. These two systems differ markedly. The CARE-system will be developed for detailed disaggregated accident information, but the comparability of national data as far as we can judge now will be questionable. In contrast the IRTAD-system is not detailed and contains aggregated accident and exposure data, but the aggregated information of nations that is contained has a high level of comparability.

Three other sources of international accident data information have been mentioned by the way. All three sources consist of annually published documents with aggregated national data on road safety. The sources come from the UN-ECE (economic commission for Europe of the United Nations), the IRF (international road federation) and the ECMT (European committee of ministers of transport). The annual IRF-document contains also information non-European countries and additional transport information. The integrity of the information of the UN-ECE and the IRF publications is varying and its stability over the years is questionable. There are varyingly defined data and often missing data. In any case nations can not be compared in a reliable and meaningful way. The ECMT publishes annually the fatalities of the relevant nations, corrected for the 30-day death after the accident. It partially publishes what the IRTAD-system in more detail contains, although occasionally recency differences are observed. There are other international bodies concerned with road safety who are not so much oriented to accident data information, while also the UN-ECE, IRF and ECMT have more road safety activities than international information on road accidents. To mention other intercontinental bodies by a list we have:

OECD-RTR
In the road transport research division of the OECD are participating the main national road research institutes of the world. The OECD-RTR organizes the international cooperation of national road and road safety research bodies and has published since the late sixties many, most valuable, state of the art research overviews on topics in road construction, road transport and road safety. It also is the OECD-RTR that has established the IRRD (international road research documentation) system, that contains also most of the road safety research publications. The IRRD information can be obtained by CD-ROM (integrated with TRIS from the TRB in the USA and TRANSDOC from the ECMT) or is accessible from national road transport or road safety libraries by on-line services.

PIARC
Recently this permanent international association of road congresses also has a working party on road safety wherein researchers and officials from transport ministries participate. Every 4 year PIARC organizes a world conference on research and policy issues concerning roads, road transport and now also road safety.

PRI
The international union of the national public information institutions for the prevention of road accidents. It manly promotes by its activities public awareness for road safety.

WHO
A few activities of the world health organisation are also directed to road safety policies. Apart from the fostering of collaborating centres for safety research and training, the WHO itself is not active in road safety research or accident data systems.

World Bank
The world bank recently financed national road safety projects for newly motorizing countries and has organized international road safety conferences on the governmental level for regions of the world where vastly increasing motorized traffic is a recent phenomenon.

REAAA
The road engineers association of the austro-asian region, who promotes austro-asian cooperative research and has organized conferences on road safety in that region.

We mention also the TRB, although it is a national transport research board for the USA, because its conferences with many road safety research issues have an international status and participation (not only from North America).

In Europe we have the EU with DG-VII as its transport directorate that also is concerned with road safety policies and research in the EU. In the context of the EU road safety activities we also have additional bodies to mention:

ETSC
An independent European transport safety council with many valuable activities for the promotion of European road safety that is partially subsidized by the EU. It has published several highly valuable documents on recommended transport policy issues, based on reviewed research. The road safety issues are addressed by several working parties where-

in high level experts from EU-countries collaborate. The ETSC has a special working party on transport statistics. The activities of the ETSC are directed to the European Commission and its administration as well as to the European parliament.

ERSF
A European road safety federation of several international organisations with national member organizations concerned with road traffic, such as the tourist and automobile clubs, the organizations for road accident prevention information, the car industry etc.. The ERSF promotes road safety in Europe and also is partially subsidized by the EU. Its activities are more related to member and national interests for EU road safety policies and the ERSF also acts as prime contractor for EU-financed projects on road safety issues.

FERSI
The forum of European road safety research institutes in the nations. It acts as an informal institution for preparation and European research cooperation of road safety projects that are issued by the EU. FERSI also participates in the organization of annual road safety conferences on the European level and cooperates with the ETSC and ERSF.

To conclude: it is of utmost importance that all these organizations will be active in the promotion of improved road safety information for the benefit of all road users. Do not forget that world wide about a million road users are killed in traffic every four year.

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