ITS APPLICATIONS FOR SAFETY: OPPORTUNITIES AND ISSUES

We already have more than 20 years of intensive research behind us in the field of ITS. In Europe there have been a number of large and ambitious projects, including Prometheus, Drive, and ATT. Similar programmes have been undertaken in the US, Japan and elsewhere.

The results presented at various conferences – the ITS World Congresses being perhaps the most significant – offer an impressive array of ideas, proposals, technologies and demonstrations. In connection with these applications, significant benefits are claimed with regard to safety, efficiency and comfort. In many cases, these claims have been supported by test results.

Let us take just one example. Studies and demonstrations carried out in recent years with vehicle prototypes using Intelligent Speed Adaptation (ISA) have shown that this type of application has considerable potential benefits in reducing road deaths. The positive results have motivated further research which is yet more ambitious. Current initiatives are focusing on the so-called "cooperative systems" which – it is said - will lead one day to a situation in which the road infrastructure, vehicle and driver are part of a single system with a common 'awareness', able to take joint responsibility for managing the road and the driving task in a fully integrated way.

If we look at the 'demand' side, we find that here too the social and political pressures for improved safety and traffic efficiency are steadily growing. The European strategy to reduce the number of road fatalities by 50% by the year 2010 is just one illustration of the community acceptance of a commitment to safety.

One could be justified in imagining that this combination of ITS opportunities (the offer) and need for safety (the demand) would have created a fertile terrain for the applications of ITS for safety. The actual situation is however rather different. Real-life implementations are rare, or only limited in scale, and as a consequence the impact on safety has – until now – been only marginal. It is evident that the gap between ITS research and market deployment is wide. What is more worrying is that it seems to be in danger of becoming wider –research moves onwards towards ever more futuristic fields, while the practical benefits to society in terms of the reduction of accidents and number of road deaths still have to be demonstrated.

Why has this occurred? I believe there are a number of reasons, some of them technical and others of a non technical nature (relating for example to public acceptance and also issues of liability). Since these latter aspects will be dealt with by other speakers, I intend to focus on the former.

To understand better how this has happened, it is useful firstly to outline the varied panorama of ITS applications. If we begin with vehicle-based applications, we enter into the fascinating world of ADAS. Here it emerges clearly that, especially for the technology specialists, the challenge of developing an automated or semi-automated vehicle has always had a strong attraction.

In fact it soon becomes clear that one of the major weaknesses of ITS research efforts until now, especially in the ADAS area, is the fact that much of the research is generated by a '*technology push*'. The choice of research topics is based too often on areas which offer a tempting technology challenge rather than a careful assessment of the real needs and desires of the stakeholders or a rigorous cost-benefit analysis of the potential impact. The world of ADAS sometimes proves too fascinating for the technicians!

The systems can be classified in various ways: for example according to the degree of automation involved, or the role played by the systems (providing driving support, respect of road regulations, increasing safety, etc), or according to the degree of 'co-operation' between vehicles and the road infrastructure. In the first category, it is possible to define three broad groups:

- applications which offer fully automatic functions (a vehicle which drives itself!);
- systems which are 'semi-automatic', intervening on functions such as braking and acceleration, to support the driver's actions;
- applications which simply provide information or recommendations to the driver, leaving him or her free to act on them or not.

In the first category are applications such as platooning (the so-called 'electronic tow-bar' which has been demonstrated for convoys of heavy trucks), where a driver is in theory required only for the leading vehicle! While the technological feasibility of the 'follow me' function has been proven, it is far from being ready for actual implementation. On a less ambitious scale, automated vehicles have been used for example in the Netherlands but only on specific and usually non public roads (such as car parks or warehouses) or in situations where the vehicles are limited to fixed routes. For safety reasons, they are also subject to strict speed constraints.

Rather more successful deployment has been achieved with semi-automated functions including those using radar systems to provide longitudinal support (Adaptive Cruise Control) and automated emergency calls. Such systems tend to begin life as high cost features of top-end vehicles. One of the few cases of an application which has now 'taken off' commercially (and which, perhaps significantly, is not strictly a safety-related function) is that of onboard navigation systems.

There is a further group of applications, including latitudinal control (lane keeping support), hazard warning applications which use combinations of radar, infrared or laser sensing to identify obstacles, and finally Intelligent Speed Adaptation (ISA) which are constrained technically by two main problems. One is the difficulty of achieving sufficiently accurate *location* (relative and absolute) for safety purposes, and the other – often closely related – is the need for *support from the infrastructure*.

With respect to the degree of support to vehicles from the infrastructure, there has been a significant shift of emphasis over the last five years. Research efforts in the 1980s and 90s focussed mainly on autonomous applications, i.e. vehicle-based systems which did not foresee support either from the infrastructure or from other vehicles. A similar isolation applied also to infrastructure-based applications. This reflected to some extent the 'separation' of two worlds. But it also made it possible to avoid the technical problem of how to exchange data, and also the organisational and legal problem of how to share responsibilities.

In more recent years both the United States with the evolution from the earlier IVI (Intelligent Vehicle Initiative) to VII (Vehicle Infrastructure Integration) and Europe, with the 'Cooperative Systems' projects, are making very substantial investments in systems which integrate not only vehicle-based and road based sensing, but also create networks for data exchange between neighbouring vehicles (the so-called 'ad hoc vehicle networks' using short range communications).

The type of data which can be 'supplied' directly from the infrastructure includes both semi-static data (e.g. describing the road geometry) and dynamic data acquired from roadside detection systems (e.g. identifying obstacles or current road and traffic conditions). But this introduces the problem that the ability to provide such information varies greatly on different networks, and also involves the responsibility for calculating and updating the data.

Other technical problems being tackled in current research are issues connected with:
- the location of vehicles and potential hazards with sufficient accuracy for safety purposes;
- the definition of detailed digital maps to serve as a basis for dynamic databases able to store data which 'describe' the driving environment surrounding a vehicle;
- the reliable exchange of data between vehicles and between vehicles and the infrastructure (e.g. the potential of beaconing and issues associated with the use of given frequencies);
- rapid enough data processing to permit the generation of safety warnings in time to be useful;
- the development of a system which is reliable enough to generate confidence.

In order to achieve these technical goals, it has become clear that it is also necessary to establish much closer collaborative links between research institutions, private industry and the public administrations so that their needs and requirements are better understood.

A further issue which affects the public acceptance of ITS applications is connected with their 'awareness'. While the results of such research may well known within the ITS community, they are not always effectively communicated outside this specialised environment. This means that knowledge of the developments is often hazy and inaccurate. ADAS applications for example tend to be considered in a generalised way, without distinguishing their very different implications (in terms of impact on driver behaviour, decision levels, etc). It points to the need for more attention to the dissemination of information to both expert and non expert communities.

To sum up, the time has now come for a mature and critical assessment which goes into greater depth. This would need to be based on a detailed and specific 'case by case' analysis which provides a rigorous analysis of the technical status and constraints, deployment issues, questions of user acceptance, etc. For some well studied applications, this work has been started and achieved promising results.

A helpful basis for this task would be to propose a classification of ITS applications. These could for example be distinguished according to the degree of automation involved:
- those merely providing information or recommendations
- semi-automatic applications which actuate vehicle functions
- fully automatic and mandatory applications.

The basic requirements are therefore:

- For the public and private stakeholders to draw up a joint policy statement (on the willingness to use ITS for safety purposes and the relevant limitations);
- To establish a realistic set of priorities for action (beginning with applications such as ISA, 'alco-locks', for example, which do not have serious barriers to deployment, and could have a major safety impact once these are overcome);
- To define a "road map" for the implementation of above applications with indications of milestones, the sequence and way in which this will be achieved.

It is fundamental that research retains a primary role in the future, but it is also essential that a far closer dialogue is established between the world of research, industry and public administrations who would need to make investment before deployment is possible. In is therefore important:

- for researchers to keep decision-makers informed of the safety implications of their work;
- for decision makers to make clear demands to researchers to make a rigorous technical, economic and legal assessment of their projects.