

WHO BENEFITS FROM ITS?

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WHO BENEFITS FROM ITS?

Road Users and other Travellers

In the first instance, those who benefit from ITS are the road users and other travellers (often referred to as end-users). Car users, truck drivers and delivery vehicles can all gain from ITS, for example, through greater safety, more certainty in their journeys, shorter journey times, more direct routes and easier access to parking. Pedestrians and other vulnerable road users can experience greater safety and a balancing of traffic priorities in their favour. Public transit users can have shorter journey times and rely on better information. By reducing the vulnerability of the transport infrastructure to extreme events everyone benefits. Thus ITS can help in preventing incidents and delivering a faster recovery when things go wrong (severe weather and flooding, security alerts, serious accidents and incidents, etc.). By better integration of services, ITS can bring benefits in improved response and efficiency for law enforcement, emergency services and other agencies in their work to serve the needs of the travelling public. For example, accurate location details for emergency calls can reduce the time taken to respond to incidents, which in turn cuts down the length of disruption on the network.

Some advantages of ITS come at a perceived cost to the user. There can be a trade-off. For example, safety, security and journey time predictability may come from tracking the location of the vehicle or controlling the driver's speed. Some will perceive this as an invasion of privacy, or

unnecessary interference with the driver's control. Similar issues of perception come with in-car ITS. Driver aids can make driving safer for older people, but many people do not want to be regarded as elderly. A common view is that driving aids are great "for people who need them", but, by implication, that isn't "me". Many people are, however, willing to give up some privacy or anonymity if they gain value and convenience. Others are happy to sacrifice control in return for improved safety or journey times. The underlying issue for an individual, as it is for society, is "does the value I get out of ITS warrant the cost?" whether the cost is in money, time or control. This is discussed further in Section 4.4.7

For public transport users, and for people wishing to make multi-modal journeys, ITS are an unequivocal good. They improve information, journey time, frequency and reliability and make interchange easier. Bus users, given a choice between a brand new bus being added to their route to increase frequency or a real time information system to improve certainty are increasingly choosing the real time information system¹.

There is some education and persuasion to be done before all the positive outcomes of ITS are accepted as benefits by the users. In most of the developed and developing world, traffic growth will outstrip the benefits gained through the ITS within a few years, unless the ITS is implemented as part of a wider scheme for change. Such a scheme might include car restraint, pricing or public transport priority. Debate and dialogue are needed to establish the role of ITS in congested traffic – the systems are there to ensure fewer delays, smoother traffic flows, a safer environment, less noise, pollution and other traffic nuisance. Historically, traffic signal control systems were generally aimed at improving car journey times, but today most ITS are intended to produce other benefits. Where smoother traffic flows result in faster journeys, car drivers need to be part of the debate about the wider system in which ITS operate.

That said, where congestion creates demand for new road building, and public opinion is opposed to road building, then ITS can 'buy' a few years of traffic growth. Using ITS to smooth traffic flows and improve journey times without a wider ranging scheme to restrain growth can postpone the need for road building. This is a perfectly valid application, so long as politicians, drivers and residents understand that it is only a postponement, to soak up traffic growth in the short term.

When the circumstances are right, major ITS benefits such as route planning, navigation, and VMS signing are generally welcomed. An example of this is in the public response to the Multi-Modal Transport Studies conducted in 2000-2003 throughout England: many people wrote in asking for "controlled motorways", meaning the variable speed limits they had seen on the M25 motorway around London. Drivers perceived that the steady flow of traffic at 50 mph (80 km/hour) resulted in overall time savings in comparison with the stop-start of motorways on which people drive at speeds varying from 30 mph to 90 mph (50 – 145 km/hour)².

Transport Professionals

The second main group who can benefit from ITS are transport professionals. Whether they are planners or transport network and system operators and managers, ITS can enable them to do a better job. An investment in ITS can help them to deliver safer and more reliable journeys, reducing the detrimental effect on the environment, giving priority to freight transport, commuter traffic, transit or pedestrians, whatever is the key market segment – even the key market segment at a given time of day. Alternatively, if the task is to manage a city road network, then ITS can help maintain a balance between the many conflicting priorities. These might include the competing needs of residents, commercial retailing, tourism and the environment, not forgetting the need to give safe and convenient access for people who do not have a car available.

¹ Gilliard E, 2000.

² Social Research Associates 2002

Uniquely, ITS can help deliver many of the transport objectives set by planners, managers and politicians. If the objective in a city is to enable free flow of car traffic, then ITS can manage the road space to maximise capacity. If the objective is the opposite, to restrain traffic, then ITS can give information to travellers about alternative modes and can help block access to key areas and collect the charges for access and the penalties for breaking the rules. Furthermore, many ITS services will gather and process large amounts of data and information, which can be used for future planning and system management. ITS can make the tasks undertaken by transport professionals both more effective in the short run and, over time, allow them to be better informed.

Local Residents and Enterprises

A third important group who experience ITS are the residents and enterprises located where ITS are deployed. Cars, trucks, buses and trains all have impacts on the people living, working, walking or playing and socialising near where the transport operates. ITS can deliver access control schemes, parking management, lorry routes and road user charges, all with substantial impacts. Streets may be quieter and safer, and in residential areas children may be able to play more safely. There may be reduced noise and emissions due to smoother traffic flows. But the benefits of ITS can still be a trade-off: benefits to some may come with unacceptable cost and inconvenience to others.

Local enterprises can benefit from ITS providing more reliable deliveries and more reliable journey times for goods being dispatched. Local shops can benefit from ITS helping provide a better environment for visitors and shoppers. In a wider context, the business community benefits from ITS providing cheaper, safer, better managed deliveries of goods.

WHAT ARE THE SPECIFIC BENEFITS?

Problems of Quantification

The benefits of ITS are varied and not always directly calculable. Real time information systems on public transport, for example, are often introduced at the same time as priority measures which make the service faster and more reliable, and often with new or refurbished vehicles. It can be difficult to separate the causes of the perception of improved service and the increase in patronage. In the opposite case, real time information on public transport may have no effect on patronage: if non-users are not made aware of the improvement, it will not influence their choices. There are, however, many examples where the benefits of ITS have been measured. The section below discusses some of the generic benefits.

The remainder of this section looks at specific aspects of benefits. It is useful to consider both the aggregate and disaggregate benefits - that is to consider the impact the ITS investment will have overall, but also consider where the benefits will fall. Some benefits are in specific goal areas, such as safety. Others will be for specific groups of people, such as the rising population of mobile elderly and disabled people.

Safety Benefits

Two common measures for safety improvement are percentage reduction in collisions and percentage reduction in rescue response time. The former is a direct indication of safety but difficult to obtain empirically from operational tests since real accidents are infrequent. Safety benefits of intelligent vehicles, cooperative vehicle-highway systems (CVHS), and active safety systems can be measured indirectly from test results on proving grounds away from public roads. There are, however, a few multi-year longitudinal studies that have provided reliable before-and-after data on the impact of ITS on accident rates. For example long term monitoring of accident rates on a section of controlled motorway in the Rheinland has shown a substantial reduction in

accidents³. In Washington DC, roll-over warnings on exit ramps reduced the number of lorries rolling over from 10 in the 5 years before the installation to 0 in the four years afterwards⁴, while speed enforcement cameras on sections of major route in Norway reduced injury accidents by 26%⁵.

Safety Impacts of CENTRICO

In Germany, the national evaluation guidelines concentrate on evaluating the safety impacts of ITS. The CENTRICO project has monitored a section of controlled motorway in the Rheinland over several years, and compared the accident record with an adjacent 'control section' of the motorway. Speed control measures and a ban on overtaking by lorries were introduced at different points in the monitoring period. 'Before and after' monitoring of accidents showed a reduction of 30 – 40% in the type of accident that could be influenced by speed control measures, but no clear reduction in accidents overall⁶ (see Case Study).

ITS which reduce vehicle speeds also have the potential to reduce the consequences of accidents. Examples include speed enforcement (see Case Studies on Automated Traffic Enforcement in France, Speed-over-distance enforcement in the Netherlands and Intelligent Speed Adaptation); the Case Study on ISA in Sweden shows the potential for a 20% reduction in injury accidents with a 3-4% reduction in average speeds in urban areas, and the results for Dynamic Speed Adaptation in Flanders show [results available end June]⁷.

The measure of percent reduction in rescue response time is not a direct indication of safety but is amenable to direct measurement in an operational test. Clearly, reduction in rescue response time would reduce the number of fatalities and the extent of injuries after an accident. Again, the ultimate impact of response time on fatality, for example, is confounded by other factors such as the severity of the accident.

Help System

In Tokyo tests of the HELP system which sends location data from the vehicle to a control centre in the event of an accident (e.g. if the airbag is activated), found that information from the in-vehicle system was received in the control centre within 59 seconds on average, compared with 101 seconds from a mobile phone⁸.

Safety benefits from ITS go wider than measurable accidents. Hazard warning systems on motorways, for example, have been shown to improve drivers' perceptions of safety, thus improving the quality of journeys⁹. The perception of personal safety is also important. The confidence that travel is safe does not come only from reducing accidents or collisions and their consequences. Many countries now have policy priorities relating to perceptions of personal safety, whether that is nervousness about traffic, crime, isolation or a wider perception of community safety. Many people are frightened of traffic, even if they have never been involved in an accident or collision. This fear has societal costs. ITS can be used to manage the interfaces between pedestrians and traffic, making zones safer and more pleasant. Access control and

³ Guido Schuster. Evaluation of a Motorway Control System – CENTRICO. Proceedings of IBEC workshop, Madrid, 2003 – see <http://www.ibec-its.org/> and Session 1.5, Proceedings of Euro-Regional Conference, Dusseldorf June 2003 – see www.centrico.ten-t.com/

⁴ "IRD uses WIM Info in Suite of Truck Safety Advisory Systems. *Inside ITS* 15 December 1997 p8-9 and www.benefitcost.its.dot.gov

⁵ Elvik R. "Effects on Accidents of Automatic Speed Enforcement in Norway" Transportation Research Record no 1595, 1997 and www.benefitcost.its.dot.gov

⁶ Schuster, IBEC 2003 proceedings, www.ibec-its.org

⁷ www.verkeerscentrum.be

⁸ See ITS Developed by Japanese Police, Japan Traffic Management Technology Association Institute of Urban Traffic Research.

⁹ TABASCO & Scottish Executive. UK M90 COMPANION Hazard Warning System. TEMPO Secretariat and STREETWISE, 2003 <http://www.tempo-sec.org/>

area management schemes have been successful in improving the quality of city centres, for example the City of London 'Ring of Steel' reduced the number of accidents involving pedestrian significantly.

Access Control in London

The Corporation of London implemented access control using extensive traffic management measures to reduce the number of access points combined with digital image recognition technology at the remaining eight entry points. The scheme was known as the 'Ring of Steel' because it was implemented following two terrorist bomb attacks in the area. The number of vehicles entering the controlled zone was reduced by 25%, circulating traffic fell by 30%, emissions were reduced by 15% and there were 39% fewer pedestrian accidents¹⁰.

Efficiency Benefits

Improving efficiency is a major goal of all ITS programmes around the world. ITS can deliver efficiencies in journey time and certainty. The actual efficiency benefit to the traveller, however, depends on the context. For example, until congestion significantly affects travel time, the advantage to drivers provided by in-vehicle or roadside traffic information is small: diversion information is not needed when the road ahead is clear. At the other extreme, in a completely congested network, the value of switching routes may be low. Travel time savings will depend on levels of congestion and available opportunities for diversion. There may be potential disbenefits from use of unsuitable roads, especially by heavy goods vehicles. Direction and route-finding information will generally have value regardless of congestion. Pedestrians can also benefit in terms of reduction in wasted time waiting to cross streets through smart signal controls.

Improved vehicle control systems (crash avoidance systems) will increase throughput by reducing required headway. They will also reduce the number of collisions, thus further increasing throughput. A three-fold increase in throughput is possible with platooned vehicle operation. Less complete implementation of automated highway systems can increase throughput by 30% with rear-end collision warning in uniform vehicles, and by 60% with collision avoidance in vehicles differing in braking capacity.

Pre-trip traveller information can have benefits in travel budgeting as well as in travel time savings¹¹. This links to one of the major selling points of ITS: confidence. There are great benefits from improving certainty about the journey, whether that is routing, interchange between modes, or overall journey time¹². A comparative analysis of the impact of real time travel information systems showed examples where better information enabled travellers to choose alternative routes and modes, switch to public transport, and save time¹³.

Productivity and Cost Reduction Benefits

There are significant supply-side benefits of ITS in highways management. Lane management has been one of the outstanding successes of ITS. This includes HOV lanes, reversible flow lanes, variable speed limits and enforcement systems. These systems maximise the use of the infrastructure available, saving or postponing the very large costs of expanding the networks. In Barcelona, the introduction of two lane management systems successfully increased the capacity of the road network, managing variations in demand at different times of day: a reversible flow lane and a shared lane for deliveries and traffic (see Case Study). In the UK, the enforced

¹⁰ <http://www.clearzones.org.uk/>

¹¹ Wunderlich et al

¹² Black I “

¹³ CONVERGE, 2000. Real time travel information; results of cross-project collaborative study.

Deliverable D3.3.1 part D. http://cordis.lu.telematics/tap_transport/research/projects/converge.html

Variable Speed Limit and reduction in lane switching on the M25 'controlled motorway' has successfully improved the capacity of the motorway without increasing the number of traffic lanes.

While cost reduction is of interest to all road users, the associated benefits are most tangible to the operators of vehicle fleets and highway infrastructures. ITS productivity benefits have been assessed from the perspectives of fleet managers, transit authorities, and toll agencies. ITS options include automatic vehicle location (AVL) and computer aided dispatch (CAD) using sophisticated logistics software and close communications between the dispatcher and the driver. Each individual intervention appears marginal, but the overall effect in journey time reliability and time savings can make the difference between hitting a Just-in-Time delivery slot and missing it. In the USA, advanced routeing and decision-making software and organisation for the routeing of time-sensitive deliveries increased deliveries per driver hour by 24%¹⁴.

Benefits : Cost Reduction

- The automatic payment system for the Trondheim Toll system reduced operating costs to less than 10% of revenues. (See Case Study)
- Kansas City used an AVL/CAD system to reduce the number of vehicles required for some bus routes by 10% without reducing the service to customers¹⁵.

In freight transport, there are two separate streams of benefits available from ITS. The first is internal, improving the flow of supply chains through information and communication technologies ranging from control systems to vehicle and load monitoring. ITS can facilitate back-loads, port and customs pre-clearance and communications with the customer about the progress of the shipment. ITS can also monitor drivers' hours, alertness and driving performance. Traffic management in urban areas can bring access cost reductions to hauliers, though some policies which ITS help deliver can impose logistical constraints on hauliers by reducing access times to a relatively short time period each day (see Barcelona Case Study).

Benefits : Frieght

In Cologne, a series of services to support freight supply chain management, including multi-modal information service, electronic data interchange and smartcard pre-clearance improved business efficiency for 60% of the SME haulage companies involved, through time savings and faster handling of consignments¹⁶.

A two-year study by American Trucking Associations found that Electronic Data Interchange improved administrative processes for commercial vehicles and reduced costs to carriers by 9-12%¹⁷.

Environmental Benefits

Planners are becoming increasingly concerned with climate change and 'greenhouse' gases. Transport is a major source of such emissions, and ITS can help reduce them, for example by smoothing traffic flows. Some of the Case Study examples show instances where smoother traffic flows have reduced emissions: see Melbourne City Link and Speed-over-distance

¹⁴ Doyle et al, 1998. Final Report: Commercial Fleet Management Project. George Mason University Transportation Policy Program. <http://www.benefitcost.its.dot.gov/>

¹⁵ Jones. ITS Technologies in Public Transit: Deployment and Benefits. Prepared for US DOT Joint Program Office, November 1995. <http://www.benefitcost.its.dot.gov/>

¹⁶ EUROSCOPE Project Deliverable D19. Evaluation Results and Comparative Assessment. http://cordis.lu.telematics/tap_transport/research/projects/euroscope.html

¹⁷ American Trucking Associations Foundation, Study Explores Benefit/Cost if ITS/CVO User Services. ITS America CVO Update, 1996. <http://www.benefitcost.its.dot.gov/>

Enforcement in The Netherlands. In most situations, local analysis and simulation are needed to estimate environmental benefits from a given project. It is difficult to measure air quality impacts on an entire region because of the large number of exogenous variables including weather, contributions from non-mobile sources, and the time-evolving nature of ozone pollution. Noise and vibration can be an issue, for example, when traffic control systems relocate traffic queues as part of a queue management strategy. Visual intrusion can be a problem where overhead gantry signs are required. In all these cases attention to the detail of location and design is required. In some cases, direct measurement of environmental impact can concentrate on a localised measure such as air quality surrounding a particularly snarled intersection or other points of interest. Such evaluation results are, however, highly dependent on the local terrain and road geometry, and are thus difficult to generalise.

Benefits : Environmental

■ The ENTRANCE project evaluated the environmental impacts of a series of ITS measures in Hampshire. By using data on the link between speed and emissions for different types of vehicle and estimating the effects of changes in speeds and flows of different types of vehicle on the road on emissions, the environmental impacts were estimated. A similar method was used to estimate changes in fuel consumption¹⁸.

Environmental zones can be managed and monitored through ITS. ITS can be used for signing the zone, especially if different regulations apply at different times. ITS can be used in air quality monitoring and in communicating air quality results to residents. A good example of this is in Queensland, Australia, where the South East Queensland Air Quality model uses GIS not only to map current air quality but to forecast the air quality implications of land use and transport planning decisions. The GIS maps are also used as a communications tool, informing people of air quality and promoting the need to improve air quality. In Turin, traffic management and public transport deployment in response to pollution forecasts are used to reduce the severity of incidences of poor air quality.

Benefits : Environmental

■ Leicester City Clear Zone uses air quality monitoring and forecasting, combined with Variable Message Signs, radio broadcasts and the internet to warn local people of days when pollution is likely to be higher than normal. People with respiratory conditions can choose to avoid the area, and the traffic control system can be adjusted to minimise the effects¹⁹.

Benefits to People with Mobility Difficulties

ITS can have significant benefits for people with mobility difficulties, for example, by improving access to public transport and making driving easier and safer.

In public transport, ITS offer many benefits for passengers with mobility difficulties. First, information can be provided in many formats – sound for travellers whose sight is impaired and text for travellers whose hearing is impaired. In Prague, blind people are equipped with a device giving them information about the approaching bus service, and enabling them to inform the driver of their intention to catch the bus²⁰.

An ITS application specifically designed to help visually impaired people has been developed in Japan. It is a navigation aid for pedestrians which uses dedicated infra red beacons for communications with a personal receiver. Voice instructions are transmitted by the beacons to help the user navigate on foot, and follow sometimes complex pedestrian routes. Instructions to the user can include road safety warnings, for example at busy street crossings.

¹⁸ Cloke, Hopkin et al (2000). Monitoring and Evaluation of the ENTRANCE project in Hampshire, Summary Report. TRL Report 415. Transport Research Laboratory, Crowthorne.

¹⁹ Leicester Air Quality and Traffic Monitoring. Clear Zones Case Study. <http://www.clearzones.org.uk/>

²⁰ www.eltis.org

ITS can also make travel easier by simplifying payment systems. Many people with mobility difficulties have some form of fares concession available; smartcard systems can make it easier to use different forms of public transport with one payment, with appropriate discounts applied automatically. If these systems can be extended to taxis, there are real benefits for wheelchair users and other people who have mobility difficulties. Where a person with limited mobility does not receive a concession (for example, someone with arthritis but who is otherwise fit), easy payment systems still have a benefit as it makes the journey smoother. Contactless smartcards, in particular, can help if people who find such movements tricky no longer have to search their bags and pockets for the ticket.

Benefits to Local Communities

One of the significant beneficiaries of ITS is 'the community'. Before illustrating these benefits, we should define what we mean by community. In any area, there are many communities or stakeholder groups. Identifying these communities is key to identifying who benefits from ITS. For example, better freight management has benefits for several communities:

- the retail community can receive goods more efficiently, has lower delivery costs and provides a more pleasant environment for its customers;
- the manufacturing community has lower costs and provides more reliable services to customers;
- the residential community has a better environment and improved road safety;
- the community of road-users (cars, public transport, cyclists and pedestrians) has fewer delays and lower levels of risk and fear.

For inter-urban roads, the communities or stakeholder groups which will benefit from ITS may be quite dispersed. Even people living a few miles from a major highway may suffer noise pollution.

Among the more obvious community benefits from ITS are the benefits to urban communities from traffic management and demand management. At its simplest, electronic parking signs which help guide drivers to an empty space can ease queues, thereby reducing emissions and other environmental impacts of circulating traffic; in Southampton, for example searching and queuing times for parking spaces were halved, reducing fuel consumption and emissions²¹. ITS which manage private traffic and ITS which manage public transport can both combine to make cities safer for pedestrians; the UTC system introduced in Paris included reducing the waiting time for pedestrians crossing at signals, and extending crossing time, adjusting signal times to suit cyclists have made the area safer for pedestrians and cyclists, and at the same time reduced the time which vehicles spend in traffic by 15%. This has wide community benefits, including giving freedom to some people (especially children) who might otherwise be unable to travel independently. In Trondheim, for example, the toll ring and traffic management measures reduced vehicle traffic in the city centre, and the change in mix of traffic on some routes reduced accidents by 60-70% (see Case Study).

Comprehensive schemes, such as that in Barcelona, use ITS to give distinct benefits to different parts of the community. During shopping hours, shoppers and tourists have safe and clean access throughout the urban centre, and the business sector benefits from the easy access which their customers enjoy. Before the shops open, the ITS are used to give access for freight and delivery vehicles (see Case Study). These community benefits arise from a whole-system application of ITS whose primary aim is to manage flows in a wider motorway and road network²²

²¹ Cloke, Hopkin et al (2000). Monitoring and evaluation of the ENTRANCE project in Hampshire, TRL Report 413. Transport Research Laboratory, Crowthorne.

²² www.dfki.de/fluids/docs/apr99/Barcelona_Traffic_Management_Application.html

and to manage and reduce the congestion impacts of incidents and emergencies²³. Each of these applications has community benefits in its own right, reducing traffic, delays, pollution and severance in Barcelona, but also contributes to the vibrant central area.

ITS can be used to implement community driven policies. In Turin, for example, every time a capacity gain is achieved through better control, that is used for public transport or pedestrians or roadside life. ITS provide a chance to use road space dynamically. In Chihuahau, Mexico, the poor have gained access to the labour market²⁴.

²³ www.trg.soton.ac.uk/prime/barcelona/descr5.htm

²⁴ Hernan G O. "ITS, Economic Development and Social Impact in Chihuahua (Mexico). Presented at 10th World Congress on ITS, Madrid, 2003.