SMART ANSWERS DESERVE SMART QUESTIONS
ITS in the service of pedestrians and cyclists

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Paper presented to Intelligent Transport Systems Australia 1999 International Conference, Adelaide Convention Centre, 19 May 1999.

The views expressed in this paper are solely those of the author.

SUMMARY

ITS brings many potential benefits to road users and road managers. Road users include pedestrians and cyclists as well as drivers. Most major cities in Australia have already recognised the desirability of increasing walking and cycling and incorporated measures into their transport strategies. How will growing ITS affect this sector ? This paper reviews the impact of mainstream ITS applications on pedestrians and cyclists, and then examines specific applications of ITS with direct benefit to the green sector. It is clear that significant progress must be driven by public policy rather than market forces, but that the opportunities for such progress via ITS do exist.

INTRODUCTION

Consideration of "Intelligent Transport Systems" calls for a particular interpretation of the term "intelligence". A system of urban transportation which involves most individual travellers being encased in personal motorised containers many orders of magnitude heavier than the travellers themselves, for journeys which could be made with much higher container utilisation (public transport), or with the economical assistance of a bicycle, or in many cases just on foot, has questionable claim to such an epithet even if it is what most people seem to want

Accepting that "Intelligent" in this case means deriving practical benefit from applied electronic or communications technology, this paper reviews the extent to which ITS applications could affect - for better or worse - the "green sector" of travel (walkers and cyclists).

At the strategic level, all major urban areas are keen to increase the role of the green sector in their transport mix. In some cases, specific targets have been introduced to increase walking, cycling, public transport use and higher occupancy of cars, instead of the increase in single-occupant car use which can otherwise be expected. **Table 1** shows a rare example of targets adopted at a local government area level rather than citywide (for the City of Moreland, in Melbourne).

However the major applications of ITS tend to focus more on facilitating container movement (ie motor vehicles) than on content movement (people and goods). Hence the major beneficiaries - and the major markets - are vehicle providers or operators of one sort or

another. This paper scans the development sphere for systems which may benefit green travel, and also considers the general impact of ITS developments on this sector. (It will not consider the benefits of ITS for public transport users, except in so far as the off-bus or off-train component of their journey is concerned).

Table 1 Transport mode split targets (%) over various distances for Moreland

"Actual" is for 1994 ; "Target" is for 2010
Totals may not all add to 100% due to omission of "other" category and to rounding
Source : Moreland Integrated Transport Strategy, abbreviated (1)

Mode	Actual/Target	0.4 km - 1 km	1 km - 5 km	>5 km
Walk	Actual	46	13	0
	Target	60	17	0
Cycle	Actual	4	4	1
	Target	10	9	3
Car	Actual	46	76	79
	Target	30	62	65
Public Transport	Actual	0	7	19
	Target	0	14	32
Proportion of all trips (1994)		10%	40%	49%

This review is titled "Smart Answers Deserve Smart Questions". The suggestion is that it would be truly smart to promote ways of encouraging walking and cycling and reducing VKT, but few technologists have any interest in this and indeed some of the systems under development will have quite the opposite effect. The aim of this paper is not to denigrate the potential of ITS and its achievements, but to point out advantages in increasing their scope.

THE MARCH OF PROGRESS

Greater application of ITS represents real progress ? This is probably taken as axiomatic by most if not all people active in the industry. Certainly virtually all the applications under development are of potential benefit to someone, typically vehicle controllers, transport operators or public managers, sometimes vehicle passengers. **Table 2** shows this, for some of the major opportunity areas for ITS. While there are some benefits to passengers/travellers in general, the majority of the benefits occur in either road system management or vehicle operation. In many cases, of course, the vehicle operator and the passenger are one and the same.

Table 2 Significant Potential Benefits of Current ITS Opportunities

Application	To road managers	To vehicle operators
Advanced Traffic Control	high	medium
Route Guidance and Driver Information	medium	high
Incident Management	high	medium
Electronic Toll Collection	high	low
Automatic Vehicle Control	high	high

Freeway Management Systems	high	high

For the non-motorised sector of transport - a common description, which implicitly belittles its importance, "green travel" may be a better term - the news is not unambiguously favourable. This is a whole class of transport which is excluded from these benefits. The "non-motorised sector" accounts for 15-20 percent of all person trips made in cities - mostly on foot. Bicycle use varies from under 1 percent of trips (Sydney) to around 6 percent (Perth).

Public desire to promote green travel has been noted already. But how might ITS impact on this desire ? The increased sophistication of transport systems may come at the expense of the mobility of the pedestrian or the cyclist in urban areas. Advanced in-vehicle navigation systems may increase rat-running through local areas, where this is possible ; further, drivers' attention may be diverted from the road by the navigational instructions ; automated vehicle guidance systems may require segregated rights of way, and sever settlements in the 21st century the way railways have done in the past ; other forms of smart infrastructure might need to keep the not-so-smart human beings well out of the way ; the degree of smart-ness required of vehicles may increase the gap between the haves and have-nots, and also reduce the transport choice available to either or both groups.

Table 3 suggests the impacts on the green sector of the applications listed in **Table 2**. As well as the specific impacts listed, in nearly all cases the applications are also generally likely to encourage car use at the expense of the green sector and public transport.

Table 3 Potential Impacts on Green Travel of Current ITS Opportunities

Application	Effect	Possible Impact
Advanced Traffic Control	Faster/higher traffic flow	Harder for pedestrians to cross road More hazardous cycling conditions
Route Guidance and Driver Information	More rat-running More diversion of driver attention	Greater pedestrian/vehicle and cycle/vehicle conflict on local roads Higher accident propensity[1]
Incident Management	Quicker system recoveries	(none identifiable)
Electronic Toll Collection	Payment legitimises self-centred behaviour	Worse attitude displayed by drivers towards cyclists[2]
Automatic Vehicle Control	Dedicated rights of way for controlled vehicles	Greater severance of pedestrian environment
Freeway Management Systems	Faster/higher traffic flow	(none identifiable)

[1] Redelmeir and Tibshirani (2) suggest that the risk of collision when using a cellular phone is four times higher than when such a phone is not being used (and hands-free devices appear to make no difference, suggesting a deficit of attention rather than dexterity) : a similar effect may be expected from real-time navigation devices.

[2] "Get your f***ing bike of the road, I've paid good money for my car to be here" is not an unusual sentiment from aggressive car drivers, in the author's experience.

THE STATUS OF THE GREEN SECTOR

The use of motor vehicles is deeply embedded in the physical and organisational fabric of our cities, with many services such as traffic management, policing, courts, fuel supply, crash and breakdown repairs, training, licencing, car marts, scrapyards and so on all contributing to this single-mode system of "technology in use".

By contrast, the green sector involves little or no vehicle operation or management and usually only an embryo institutional structure, if any, to protect and progress the interests of this sector. The costs of green transport are low and therefore it does not represent a significant market for commercial Research and Development. Nevertheless most large Australian cities are trying to increase its relative importance via their transport strategies, either explicitly via targets or implicitly. It is unlikely that the desired outcomes will occur if left solely to market forces.

A scan of a six month span of issues of an ITS trade journal (in this case *ITS International*) only uncovered one report of any system geared to pedestrians. This was actually a system to tag booked-in passengers in airport terminals, to reduce the probability of them delaying plane departures through failure to follow airline directions (by quicker location of "no-shows"). While this fits the general pattern of a commercial ITS system developed to benefit commercial transport operators, it is one which has many other potential uses. Supervision of pedestrians with intellectual impairments could be one, as suggested later. There may be many other ITS systems which, although developed for particular purposes, lend themselves to applications well outside those originally envisaged. Forging cross-sectoral linkages with solution providers is a challenge for the green sector, to which its customary absence of leadership leaves it ill-equipped to respond.

The general importance and status of human-powered transport has been reviewed elsewhere, for instance by the present author (3). That paper included using the findings of futurologist Hardin Tibbs, who recently took a long term view of continuing rapid global change and the future of transport (4). He identified seven important strategic implications for transport in general. Three of these are also of particular significance in relation to ITS in the green sector :

- Disaster contingency planning should be well developed. Commentators have long warned of the dangers of "brittle power" - a system of energy use that requires centralised sources and a continuity of flow, and that lacks diverse options in the case of breakdowns. While most concerns would centre round energy sources, the current Millennium Bug issue clearly suggests that ITS may also bring other potential problems of brittleness in future.
- A sustainable economy would be likely to treat the supply of manufactured goods as a service business, stressing leasing rather than purchase. If applied to vehicles, this would blur the distinction between public and private transport. This may increase the potential for mixed-mode travel, and a potentially larger role for the bicycle and other low-energy vehicles in future. Honda's ICVS system (see **Table 4**) shows how transport choice can be increased by offering a range of public vehicles, including bicycles.

- Technological developments that are likely to be a key part of future transport systems should be encouraged. ITS generally is of course a major component of the response to this issue. The theme of this paper is "don't overlook those who walk or cycle".

SYSTEMS FOR PEDESTRIANS OR CYCLISTS

Table 4 lists existing and potential applications of ITS that do not merely impact on pedestrians and cyclists but could actually be of benefit. Systems for pedestrians with problems are considered separately later.

Table 4 Existing or potential ITS Applications for pedestrians and cyclists

objective	application	example
increase alternatives to car use	provide temporary low-energy vehicles in limited areas	"Citybikes" free of for hire. Relatively simple schemes have been implemented in places such as Amsterdam and Copenhagen. Adshel have introduced a scheme in Rennes, France, where security is enhanced by ITS technology. The location of the 200 bikes involved in the Adshel scheme is monitored by satellite thanks to chips embedded in the bike frames. Honda's Intelligent Community Vehicle System (ICVS), at the Twin Ring Motegi complex north of Tokyo, increases the choice of vehicles. A smart-card gives access to a touch screen terminal which offers a range of vehicles, from power-assisted bicycles to an electric two-seater cart with generous luggage area. On-board satellite navigation not only guides the driver but also keeps track of the vehicle's location.
increase safety	detection of pedestrians on roadway	smart pedestrian crossings (e g "Puffins") which extend the crossing time for pedestrians if sensors detect that they are still on the roadway
assist navigation	hand-held navigation devices	Hand-held GPS are commercially available for recreational use (hiking, fishing etc). The potential for extending these for urban use, e g by directing people via safe road crossings, exists. Likely demand is uncertain.
deliver information	electronic information kiosks	The University of Wollongong recently installed a trial kiosk in the city centre to deliver public transport information. A hand-held device giving public transport information (INFOBUS) has been configured for Brussels as part of the EC INFOPOLIS project.
increase security increase security (continued)	personal alarms personal locators	as in-car systems : activation of the alarm summons assistance booked-in airline passengers can be "tagged" so that they can be located within terminals, if they fail to follow directions

objective	application	example
encourage cycling	smart storage	High cyclist interchange at railway stations or other locations calls for provision of secure and efficient storage. ITS can assist in allocation and retrieval, via automated warehouse-type facilities (found in Japan) or bike carousels (found in the Netherlands). This is a solution to a problem which Australia does not yet have.
	overcome gravity	Power Assisted Bicycles are popular in Japan and Europe but largely unknown in Australia. Torque sensors are used to activate supplementary battery power, but only when needed, e g when starting off or climbing hills. In Trondheim, Norway, the world's first "bike lift" pushes cyclists 130 metres up a 1:5 hill via footplates attached to a continuous cable embedded in the road. While this may not come within the strict definition of an ITS system, the degree of intelligence is commendable !
	deter theft	The Citybike scheme in Rennes has been referred to above. Extension of the tracking technology to privately-owned bikes could find a market, especially cyclists with relatively expensive equipment and/or insurance companies.
	reduce bike/car conflict	See later text
other	transport modelling	while there are some advanced simulators for simulation of complex pedestrian movements - for instance within transport terminals - there are no convincing models which incorporate walking and, even more so, cycling within multi-modal modelling systems

The above table omits one of the most ubiquitous technological devices available to pedestrians. If you accept walking as a means of transport, then the mobile phone has to be considered as a piece of ITS equipment because of the number of transport-related functions it facilitates : mixed-mode journeys ("I need a lift Mum"), transit information queries, direction-finding, location of individuals and so on.

Pedestrians with problems

Older people have the highest pedestrian fatality rate of any age group, and various surveys show that about 30-35 percent of older pedestrians find traffic or crossing roads a significant difficulty when getting around on foot. Pedestrians with disabilities, of whatever age, clearly face additional problems. Ling Suen & Mitchell (5) reviewed ways in which ITS systems could assist these two types of road user. Their table is reproduced as **Table 5** below.

Table 5 Pedestrian problems and ITS equipment
Source : Ling Suen & Mitchell (5)

Impairment	Problems	ITS equipment
Mobility	Distance to walk	Hand-held route guidance system to advise routes with resting places
Mobility	Curbs, steps, ramps and hills	Hand-held route guidance system to advise routes avoiding particular barriers
Everybody	Crossing roads	Crossing signals that extend crossing time for slow pedestrians and/or warn drivers of pedestrians on crossing
Visual	Crossing roads	Audible systems at crossings Hand-held navigation system.
Everybody	Falling on uneven pavements	Pavement condition monitoring Hand-held fall detector Mayday system
Visual plus visitors	Getting lost	Hand held navigation system, vision enhancement systems, audio sign posts
Visual	Finding correct bus stop	Audio announcement when triggered
Visual	Walking into traffic	Hand-held navigation system
Visual	Accidents ; walking into plate glass, falling off platforms, steps	Hand-held navigation system
Dementia	Getting lost	Personal transmitters plus trackers
Everybody	Crime	Hand-held Mayday systems

priorities and equipment usually favour motorised travellers

There are many other electronic systems in action on our roads today that affect pedestrians or cyclists, but often more in a spirit of control (and deterrence) than encouragement. Examples include:

- "cross/don't cross" pedestrian signals that fail to allow sufficient time for the frail elderly to cross the road
- vehicle detector loops at traffic signals that fail to detect the presence of cyclists

There are also systems or practices which are conspicuous by their absence. In heavy rain, street drainage may be inadequate to prevent significant water pooling in some places. Traffic progressing within the usual speed limit still throws up cascades of water, to drench pedestrians on footpaths and/or waiting at bus stops. There are ITS messaging systems to slow drivers down in fog for their own safety - why can we not install electronic messaging to remind (or instruct) drivers to reduce speed in rain in areas of high pedestrian activity/poor drainage for the protection of the pedestrians ? This assumes of course that the cost of the messaging system is significantly less than the cost of fixing the drains.

bicycles as traffic

A bicycle is at least a vehicle, and hence penetrates the attention barrier of some traffic engineers. Some low-cost electronic devices have been adopted to increase the safety of

cyclists. For instance, cyclists felt unsafe when (legally) using a tunnel on Highway 971 in Washington State. Now, a button-press before entering the tunnel activates flashing lights in the tunnel long enough for the cyclist(s) to travel through and out. A sign before entering the tunnel advises "PEDS/BICYCLES IN TUNNEL WHEN FLASHING". This appears to be a useful initiative, although not much more sophisticated in principle than a door-bell. On the other hand, the extension of this device to regular surface roads (as on Highway 40 in Colorado) - "BICYCLES ON HIGHWAY" - is more questionable. Driver alertness for cyclists might eventually be solely triggered by such signs - including on unsigned roads.

However sauce for the goose could also be sauce for the gander, and requiring car drivers to stop and activate a flashing "CAR IN STREET" sign could be a useful supplement to the traffic calmer's arsenal in low-traffic-volume residential neighbourhoods or pedestrian malls. A high-tech alternative which detected the vehicle automatically would be counter-productive, in eliminating the behavioural message in requiring the driver to stop and activate the sign.

CONCLUSION

ITS applications to improve conditions for people who use our roads on foot or on a bicycle could be smart in both senses of the world - not only in harnessing the power of various technologies but also in improving the equity in distribution of the beneficial effects and the likelihood of raising the degree of sustainability in our future transport systems. The green sector is unlikely to attract significant commercial Research and Development effort in its own right but the protection and enhancement of this sector is important in public policy terms.

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