Archives of
Transport System
Telematics

Volume 8

Issue 2

May 2015

Telematics is it useful and safety? African perspectives

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ABSTRACT

Transport is among the key sectors that play crucial roles in the effort to achieve sustainable economic growth and poverty reduction thereby bringing about sustainable development in Africa. By 2010, traffic accidents in Africa will kill almost the same number of people annually as now die from HIV/AIDS in East and Southern Africa combined. And, for every 20 Africans who die in 2010, one will be killed in a traffic accident. Intelligent Transport Systems play an important role in shaping the future ways of mobility and the transport sector. It is expected that through the use of ITS applications (Telematics), transport will become more efficient, safer and greener. The huge potentials and benefits, however, can only be reaped if ITS solutions are put in place and be well managed. By investing now in reducing the number of traffic accidents, Africa can save millions of lives over the coming decades and reap significant economic and social benefits.

Keywords: telematics, traffic management, traffic congestion, public transport, ITS

1. Introduction

Telematics is the blending of computers and wireless telecommunications technologies, ostensibly with the goal of efficiently conveying information over vast networks to improve a host of business functions or government-related public services.

The term has evolved to refer to automobile systems that combine global positioning satellite (GPS) tracking and other wireless communications for automatic roadside assistance and remote diagnostics.

Applications of telematics in road transport taking about 40% of the whole telematics market. The telematics industry is not limited to automotive applications. Other applications are being studied or developed for monitoring water and air pollution, for medical informatics and health care, and for distance learning.

Around the world automakers are equipping new prototype vehicles with wireless-based services controlled by voice commands. This kind of telematics could enable motorists to perform a variety of wireless functions such as accessing the Internet, receiving or sending e-mail, downloading digital audio and video files, or obtaining "smart" transportation information, automatic crash notification, roadside assistance, stolen vehicle tracking, door unlock and general concierge services.

There is no doubt the technology being used by some of the providers is excellent and future developments will make it even better. In nearest future cars will be able to book themselves in for maintenance when they meet set mileage limits, while any accident will be accompanied by information on the vehicle's location and on the nature of the incident. The car might even be able to contact the nearest repairer directly.

Contrary to the benefits, while an attack on a PC or mobile device can result in financial damage, a compromised telematics system can endanger the life of the driver, passengers, and anyone who happens to be on the road at the time.

There are some considerable risks in using some telematics devices:

- Lack of data integrity protection
- Lack of authenticity of data
- Repudiation possible (rejection of records by driver or fleet as invalid)
- High level of complexity
- Availability of enforcement infrastructure
- Availability of wireless network
- Key and certificate Infrastructure
- Transaction costs.

2. Benefits and objectives of telematics

Telematics offer some range of benefits these are:

- Optimise traffic flow on base of existing transport or traffic infrastructure by helping consumers to avoid traffic jams and so by saving time, fuel consumption and reducing pollution.
- Improve traffic management and increase the average travelling speeds by providing the right information to road user about the most convenient route.
- Reduce negative environmental impact trough optimised planning, so that CO2 emission and cost can be reduced.
- Promote economic growth, the huge potential of this market sector is obvious, 3or 4 luxury-class cars, and more mid-class ones are now manufactures with navigation systems. In Germany about 10% of all new cars is equipped with navigation systems. With about 140 million cars in Western Europe and more than 40 million produced worldwide each year.
- Keep travellers and motorists informed and improve accessibility by integrating digital maps for sending traffic data, GPS for positioning or GSM for two way communication.
- Improve mobility while increasing transport safety in reducing the rate of accidents.
- Maximising comfort, reducing traffic congestion through the use of Vehicle-to-Vehicle and Vehicle-to-Infrastructure (V2X) communications, the number of vehicles has increased dramatically, which has also resulted in an increase in traffic congestion and accidents.
- Increase efficiency of freight and fleet operations through maximizing mobile workforces, decrease accidents and increase driver safety, boost productivity, track costs, and reduce speeding, including monitoring driver behaviour through telematics data.

3. Impact of telematics on Africa's development

It is generally agreed that telematics is an important factor in the development process and that people in developing countries need to get access to telecommunication networks in order to benefit from the opportunities such technology offers. Many organisations and funding agencies have initiated information networking projects in Africa.

Most telematics implementations still operate on the periphery of local organisations. They have not penetrated existing communication and information infrastructures and processes. It is also equally clear that most organisations have not developed the capacity to implement, manage and sustain telematics applications. The reasons for this low impact and deficient capability are varied and relate to issues ranging from infrastructure to technology to individual user concerns. Many international and local development-oriented organisations have become increasingly concerned about the seemingly low level of access to developmental information that is prevalent in many African countries. The feeling among them is that lack of or inadequate access to quality information is a serious hindrance to the economic and social development potential of these countries.

While the resources for using telematics are very poor in most of Africa, over the last few years some countries have been able to put in place advanced communication networks operated by skilled and resourceful managers. Relatively low cost national and international electronic information services for the public are already a success in such apparently unlikely places as Mozambique and Ethiopia. With new developments in low cost communications systems and the trend toward modernization and liberalization taking place in parts of Africa, there are growing possibilities for reducing the North-South information gap if all these initiatives can be properly harnessed.

3.1. African development consortium

The Telematics for African Development Consortium was established in August 1995 with a vision of using information and communications technologies to improve Africa's access to and use of information for community development and education.

The consortium aimed to contribute to find sustainable solutions to several problems. These are:

- Content on the Internet and related education systems is often not relevant to users in the developing world since it is primarily focused on developed world issues;
- This lack of relevant content means that demand, and hence usage, in the developing world is low;
- Coupled with this lack of demand, the lack of infrastructure is causing the developing world to fall ever further behind in the Information Age; and
- Appropriate delivery and learning environments, tailored to the needs and realities of developing communities, are also lacking.

3.2. Telecommunication infrastructure

Despite the rapid technological advances and decreasing costs in telecommunication facilities, they have not kept pace with even faster developments in computing. Cheaply available hardware and software are now extremely reliable and capable of handling large amounts of bandwidth for multi-media applications. Demands for facilities to exploit these 'high-end' applications remain largely unsatisfied for most users, including those in developed countries. While more prevalent in developing countries, the telecommunication network generally the weak link in the telematics chain for even 'low-end' tasks such as store and forward messaging. This is almost always because of the fragility of the 'last mile' from the telephone exchange to the subscriber equipment, but service interruption on international leased lines is also not uncommon. The next generation of the PTO networks is expected to result in a 150-600 Mbit/s fibre optic based Broadband Integrated Services Digital Network (B-ISDN) for every telephone subscriber. However the time-scale foreseen for the roll-out has increased and not many believe it will be realized in the near future. The 'last mile' of optic fibre is expensive, real demand has still to materialize and

there are competing telephone, cable TV and satellite 'pipes' to dilute demand in most of the developed countries.

4. Telematics in Africa

The African environment is characterized by very large variations in telematics use. In some countries such as Zaire, activity is virtually non-existent, in others like Tunisia and South Africa; there are tens of thousands of users taking advantage of the advanced networks that have been installed in metropolitan areas which rival those in developed countries. As is to be expected, the majority of countries lie somewhere in between these two extremes. However, less apparently, the degree of telematics activity does not necessarily reflect the state of the telecommunication infrastructure.

4.1. The African's Telecommunication Environment

The overall waiting list for telephone connections in Africa has grown from 1.7 million to 3.6 million and the average wait in sub-Saharan Africa has lengthened to almost nine years. The installed network capacity in Africa is low and demand from customers is high. As a result, the total number of telephones is a burden on central exchanges and transmission equipment, causing network efficiency to suffer. Many areas experience very poor call completion rates, especially during office hours.

However the situation is not uniformly bleak. Some countries such as Cape Verde, Gambia, Mauritius and the Seychelles, with small populations and a relatively high level of tourist income, and other more industrialized countries such as South Africa and Egypt, have developed extensive and sophisticated networks. Here telephone density is between 4 and 30 lines per 100 people and telecommunication provides more than 3 per cent of Gross Domestic Product (GDP) - twice the regional average (1.5 per cent). Several countries, including Burkina Faso, Congo, Djibouti, Ghana and South Africa, have succeeded in reducing their waiting lists over the last decade. Botswana, Cape Verde, Chad, Burkina Faso, Burundi, Egypt have achieved network growth rates of more than 15% a year between 1983 and 1992.

Digitalization on trunk routes is spreading rapidly, partly driven by the decreasing availability of spare parts for the old analogue technology. Digitalization is more common in the switching than in the transmission systems, but a number of countries including Botswana, Morocco, Senegal and South Africa are now implementing extensive fibre optic backbones on their major trunk routes. Metropolitan fibre networks have also been established in Benin, Burkina Faso, Côte d'Ivoire, South Africa and Togo.

4.2. The African Telematics Infrastructure

Until recently telematics users in most of Africa have had very little option but to make expensive international calls to access the only services available - in Europe and North America.

Public access packet switching services have recently been installed by many PTOs as their response to users' needs for data services. There are now 21 African countries which have a public packet switched data network (PSDN): Botswana, Burkina Faso, Cameroun, Tchad, Côte d'Ivoire, Djibouti, Egypt, Gabon, Gambia, Kenya, Mauritius, Mozambique, Namibia, Niger, Senegal, Seychelles, South Africa, Sudan, Togo, Tunisia and Zimbabwe. Tanzania and Ethiopia are known to be planning an X.25 service. The predominance of packet-switched networks in West Africa is partly due the presence of foreign oil firms in the area.

PSDNs are relatively cheap to use in Africa for intercity links but very expensive for international ones. As there have been very few local public access hosts, and almost none connected to the PSDN, most development oriented users in Africa have not been able to afford to use electronic communication tools. Those that have had sufficient funds have either used the PSDN sparingly or found it cheaper to direct dial without going through the PSDN. With the advent of high speed modems, data can be transferred so much faster over the traditional dial-up telephone network that the volume charges imposed by the PSDNs make them uneconomical by comparison. Kenya's PSDN (Kenpac) charges about US$ 19 per kilosegment (about 64 kbit) which is relatively low compared to some other countries (the Seychelles charges US$ 30/ksegment). The cost per minute for an IDD call from Kenya to Europe is about US$ 3.50, during which time the same amount of data could be transferred, if not more.

In most African countries a 9.6 kbit/s analogue line is the maximum speed of leased lines currently available. In some cases 4.8 kbit/s is the maximum speed guaranteed by the PTO. However it has been found that V.32bis (19.2 kbit/s) and V.34 (28.8 kbit/s) modems can be used on some of these lines to improve throughput considerably, in some cases up to the maximum 28.8 kbit/s possible. In other cases, while the local leads may be able to handle 28.8 kbit/s transfers, the multiplexer on the local exchange may allocate a more limited amount of bandwidth, effectively negating the advantages of a higher speed modem. Also, voice grade lines may have specialized voice compression software running on them to maximize voice channel capacity and this can also reduce data traffic speeds, especially where full-duplex protocols are in use.

5. Importance of telematics in Africa

Intelligent Transport Systems play an important role in shaping the future ways of mobility and the transport sector. It is expected that through the use of ITS applications, transport will become more efficient, safer and greener. The huge potentials and benefits, however, can only be reaped if ITS solutions are put in place and internationally harmonized to the extent**.**

Developed countries like the United States, Japan, and a number of countries in Europe, are Leading the way in Intelligent Transportation Systems (ITS). Initially, these countries applied ITS for simple traffic control (e.g. traffic light coordination) and later Electronic Toll Collection (ETC), but it has since evolved to include electronic ticketing and automated fare collection, in-vehicle navigation and route guidance, real-time public transportation information distribution, monitoring and active control of traffic

flow, and vehicles communications. The main drivers for ITS adoption are safety, efficiency, and environmental impact reduction. To a large extent, every region decided on a different approach, and proprietary technologies were used.

Since late 1980's, most of the above countries developed national architectures to ensure a stable implementation environment.

Developing regions in general and Sub-Saharan Africa (SSA) in particular, have lagged behind in the implementation of ITS solutions, with the exception of some cities in South-Africa. These exceptions include:

- Freeway Management System (FMS) projects in Gauteng, Cape Town, and Durban.
- Bus Rapid Transit programmes are rolled out in the major Metro poles, including Johannesburg, Cape Town, Tshwane, Durban, Rustenburg, Nelson Mandela Metropolitan Municipality ,Buffalo city Municipality etc.

The focus of these exceptional systems is largely the provision of high quality public transport services, and has a large technology component to enable the improved focus on user's satisfaction. These include fleet management systems, passenger information systems, surveillance on board and at stations to ensure passenger safety, electronic fare collection (cashless travel), etc.

Apart from these exceptions, the SSA region seriously lack guidance with regards to national ITS architecture. These countries are most vulnerable to ad-hoc deployments, technology/product dumping etc. The solutions realised by ITS address the needs of the developing world as if tailor-made. To name a few, ITS implementations have the following benefits: improvement in traffic congestion (which directly improves productivity), improvement in efficiency and effectiveness of public transportation, help with transportation infrastructure management, prevention of accidents, improvement in emergency services, and reduction of emissions and global warming.

The bleak reality is, however, that the developing world so desperately needs ITS, precisely because investment into infrastructure has been crippled by monetary constraints, mismanagement, and historical disadvantage the same reasons it was wrong footed by the digital divide, and the same barriers that might prevent successful ITS deployment. An area with substantial potential for ITS implementation in the developing world is the informal public transport system in SSA. The advent of the taxi industry was in the late 1970s early 1980s. Little attention was given to the transport needs of the poor-hence the rise of the taxi industry, which was initially unregulated. Focus on ways to start regulating, based on demand per route as well as vehicle fitness, was started late 1980s. Many routes are regulated (permits provided), but driver behaviour remains big challenge.

The African region has less than 2% of the world's registered vehicles, but almost 20% of the global traffic deaths. According to the Trans-Africa study, the majority of taxi owners in SSA manage to cover their operation costs, but cannot afford to adequately maintain and upgrade their fleets, comprising on safety and quality. Both Senegal and South Africa have introduced fleet renewal programs, with varying levels of success.

5.1. Traffic congestion

Traffic congestion is a serious problem in all parts of the world. The problem is growing fastest in developing countries where urbanization and the use of motorized vehicles are increasing most rapidly. Congestion causes delays and uncertainty, wastes fuel, results in greater air pollution, and produces a larger number of crashes. ITS can help to mitigate congestion by helping people plan travel better, by suggesting alternate routes and travel times, by keeping travellers well informed, by levelling traffic loads on roadways, and by helping to respond to and clear incidents more rapidly.

Road congestion is a problem in all cities. Its causes are poor management of traffic flow, in-adequate parking, and weak enforcement. Having evolved over the years without adequate planning, the cities are unable to cope with growing motorization. Less than half of all roads are paved, reducing accessibility for buses in densely populated neighbourhoods and outlying areas. Paved roads are just one-third of the average for cities in the developing world. The road network in all cities is substandard. Capacity is limited, service lanes are absents, pavement is deteriorating, and street lighting is minimal. Bad conditions reduce vehicle speeds, sapping the productivity of the bus fleet and increasing the cost of vehicle maintenance.

They also promote the use of minibuses, taxis, and motorcycles, which have greater manoeuvrability than large buses but are not as efficient as a means of urban mass transit. Most roads were laid when cities had a single center, and before the rapid growth in personalized forms of motorized transport. The primary road network radiates from the city center to surrounding areas; orbital or circumferential links are missing. The majority of the roads have one lane in each direction; where the roads are wider, one lane is often taken up by pedestrians and parked vehicles. Intersections are spaced closely together and are ill-designed for turning.

Beyond these general failings, little attention has been paid to other matters that facilitate the operation of public transport systems. Dedicated bus lanes are rare, or absent altogether. Bus stops, bus shelters, and other facilities for passengers are scarce and in poor condition. Bus terminals are little more than overcrowded parking lots, with no facilities for passengers.

5.2. Traffic Management

Traffic Management is concerned with the application of a range of traffic engineering and administrative techniques. As Gardner et al (1989) pointed out. Traffic Management measures can be applied to some selected streets/roads, part of a city or the whole urban area. The most important feature of traffic management is its emphasis on making optimum use of the existing infrastructure. Traffic management measures are therefore relatively cheap and capable of early implementation. Clearly, Traffic Management is a process of adapting the existing urban road infrastructure without the need to inject massive investment in order to meet transport objectives such as:

- Accessibility
- Efficiency Safety

- Equity
- Economy and
- Environment

Most cities in developing countries try to adopt the traffic strategies of developed countries hence the designs are different and the strategy is not sustainable. There is need however to learn from the developed countries and develop strategies that suit the environment and designs. Thus traffic management in developing countries needs to be sustainable for the benefits of the locals. According to Baluja, (2004), traffic management and urban land use are inseparable as enough space need to be set aside for wider roads, parking, pedestrians and cyclists.

Traffic management cannot be separated from parking. Most cities are faced with the parking problems because of the huge increase in car ownership. The problems emanate from failure to allocate more parking spaces or the misuse of the parking facilities by motorists. Parking bays can be provided by business owners for customers and employees. Usually these parking bays will be labelled to avoid scrambling for the parking space. The structure of the city is ever changing and this will determine the need for the parking space.

Private parking where some parking space is owned by individuals or companies is used in some countries, but this has been attributed to destroying the living space of cities since there will be huge demand of such space and some parking bays will be underutilized.

5.3. Driver distraction and driver inattention

Distraction in traffic is another risk and is becoming an increasing concern among policy-makers. Most research and attention in this area relates to driver distraction, largely because of drivers' increasing use of mobile phones and other technologies. When drivers are distracted, their attention is temporarily divided between what is often referred to as the "primary task" of driving and "secondary tasks" not related to driving.

Driver distraction can be one of four types:

- Visual (e.g. looking away from the road for a non-driving-related task);
- Cognitive (e.g. reflecting on a subject of conversation as a result of talking on the phone – rather than analysing the road situation);
- Physical (e.g. when the driver holds or operates a device rather than steering with both hands, or dialling on a mobile phone or leaning over to tune a radio that may lead to rotating the steering wheel);
- Auditory (e.g. responding to a ringing mobile phone, or if a device is turned up so loud that it masks other sounds, such as ambulance sirens).

By 2050 the International Futures (IFs) forecasting model anticipates that global traffic deaths will surpass 3 million people per year. This forecast shows that Africa will be particularly hard hit and will account for over 1 million of these deaths, or 35 per cent of the global total. To put this in perspective, by 2050, traffic accidents in Africa will kill almost the same number of people annually as now die from HIV/AIDS in East and Southern Africa combined. And, for every 20 Africans who die in 2050, one will be killed in a traffic accident.

6. Conclusion

Through its use of information technology, ITS offers advantages that is not available in convent transportation systems. Basically, ITS provides two kind of benefits. One kind is the resolution of traffic problems, including traffic congestion, air pollution, and traffic accidents. The other kind is improved services for users and increased efficiency of the transportation system and its operators.

Acknowledgments

I'm deeply grateful to my supervisor, Professor Janusz Szpytko for his guidance, patience and support. I consider myself very fortunate for being able to work with a very considerate and encouraging professor like him. I have been extremely lucky to have a supervisor who cared so much about my work, and who responded to my questions and queries so promptly. I also want to show my sincere gratitude to international organization UNESCO/Poland-AGH UST, for the constant support of Research Project at the Faculty of Mechanical Engineering and Robotics.

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