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A REVIEW OF TRIP PLANNING SYSTEMS

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CONTENTS

ABSTRACT

TIZANI, WMK (1992). A review of trip planning systems. *Working Paper **373**, Institute for Transport Studies*, University of Leeds, Leeds.

This report reviews current information provision in all modes of transport and assesses the needs for and benefits of trip planning systems. The feasibility of trip planning systems is discussed given the current state of technology and information availability and supply. The review was stimulated by technological developments in telecommunications and information technology which are providing the possibility of a greatly enhanced quality of information to aid trip planning decisions.

Amongst the conclusions reached were the following:

Current information provision is considered deficient in many respects. Travellers are often unaware of alternative routes or services and many are unable to acquire adequate information from one source especially for multi-modal journeys. In addition, there is a lack of providing real time information where it is required (bus stops and train stations) and of effective interaction of static and real time information. Most of the projects, which integrate static and dynamic data, are single mode systems. Therefore there is a need for an integrated trip planning system which can inform and guide on all aspects of transport.

Trip planning systems can provide assistance in trip planning (before and during the journey) using one or a number of modes of travel, taking into account travellers preferences and constraints, and effectively integrating static and dynamic data.

Trip planning systems could adversely affect traffic demand as people who become aware of new opportunities might be encouraged to make more journeys. It could also affect travellers choice as a result of over-saturation of information, over-reaction to predictive information, and concentration on the same 'best' routes.

However, it can be argued, based on existing evidence, that such a system can benefit travellers, and transport operators as well as the public sector responsible for executing transport policies. Travellers can benefit by obtaining adequate information to help them in making optimal decisions and reducing uncertainty and stress associated with travel. Public transport operators can benefit by making their services known to customers, leading to increased patronage. Public transport authorities can use the supply of information to execute their transport policies and exercise more control over traffic management.

KEY-WORDS: Information systems; trip planning systems; multi-modal.

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A REVIEW OF TRIP PLANNING SYSTEMS

1.INTRODUCTION

The growth in demand in travel has been substantial in the last three decades. A National Travel Survey (NTS 1985/6) shows a 61% growth in total person-km of travel over 20 years between 1965 and 1985. This is attributed to people making longer journeys (60% of growth) and people making more journeys (35% of growth) and a 5% of growth is due to increased population. Many factors such as increases in incomes and car ownerships (estimated to rise by 100% in the next 30 years, Brookman 1992) and the changes in land use will have induced more and longer journeys. It is also argued that transport policy has stimulated such trends by the pull-factors of reduced journey costs, and the push-factors of reductions in the availability of bus services and in the acceptability of walking and cycling (Hopkinson & May 1990).

Congestion is evident in most urban areas, on motorways, and on peak time travels on trains. However, the current trend of expanding the road networks and shrinking public transport services is thought to aggravate the problem. Experience on the orbital motorway of London, M25, has shown that creating new opportunities has created new demand.

The economic, social, and environmental costs of building new roads and the persistent growth in demand for travel have emphasised the need to make the best possible use of existing infrastructures. One of the ways of easing traffic problems is by maximising the proportion of trips made by public transport and by using the road network more efficiently. Other factors can influence the demand on travel, such as by encouraging people to work and travel nearer to home by changing the pattern of land use provision, avoiding high concentrations of activity and facilities; also by increasing the cost of travel, especially private travel, and encouraging walking and cycling.

Some of the factors which can encourage travellers to rely more on public transport are: increased reliability, comfort, access, frequency, and reduced uncertainty by the provision of adequate information and in particular real time information. Equally, the provision of information about alternative routes and roads conditions is a major factor for the efficient use of the available road network.

The effectiveness of influencing travel decisions will to a large extent depend on the adequacy of the information available to travellers. Based on this information, travellers can decide where to travel, when to travel, what mode or modes of transport to use, and also where to locate. However, current information provision is considered deficient in many respects. Travellers could be unaware of alternative routes or services and many are unable to acquire adequate and sufficient information about complex journeys especially those involving more than one mode of transport. In addition the lack of real-time information about waiting time, incidents, congestions, delays, engineering works and weather conditions contributes to the inefficient use of the roads network and discourages the use of public transport.

Recent developments in informatics and automobile vehicle identification have helped to enhance the quality of the information provided. Many systems have exploited the new technologies and some have included dynamic data. Most of these systems, however, have concentrated on one mode of transport, i.e. underground, trains, buses or private cars. As

yet there is no one comprehensive integrated system which could advise in general trip planning in all modes of transport.

This same technologies can provide the potential for an integrated trip planning system which can inform and guide on all aspects of travel. Trip Planning Systems, **TPS**s, can improve the quality and the quantity of the information provided. TPSs can help travellers in making optimal travel decisions before and during their journeys using effectively integrated static and dynamic data and an appropriate decision support.

This report reviews current information provision in all modes of transport and assesses the needs for and benefits of trip planning systems. The feasibility of trip planning systems is discussed given the current state of technology and information availability and supply.

2.CURRENT WORKS IN INFORMATION PROVISION SYSTEMS

2.1INTRODUCTION

Information in public transport is mostly provided by display boards and leaflets in termini and by travel information desks providing answers to enquiries conducted in person or by telephone. For private vehicles driver information is usually provided by maps, supplemented by some provision of real-time information collated by local authorities and other organisations and broadcasted by radio stations.

The relatively recent advances in the fields of telecommunication and information technology have provided opportunities for enhancing the quality and the means of information provision to travellers. The field of Telematics (**TELE**communication and infor**MATICS**: information technology) has emerged. With telematics it is possible to manipulate, store and transfer data between remote computers via digital telecommunication lines. Consequently, many systems which use telematics have been developed for the provision of information to travellers and many others are under various stages of development.

In public transport it has been possible to store large amount of data about timetables and fares in electronic databases which can be easily interrogated and more complex enquiries can be relatively easily answered. A number of information systems have been developed which supply travellers with real-time information. A number of these systems are reviewed in the following section. This section also reviews a number of information systems which have been developed to advise private vehicles on route selection and on in-route guidance using dynamic data.

2.2INFORMATION PROVISION IN PUBLIC TRANSPORT

All public operators provide static information about their scheduled timetables and fares, some of these are computerised. Operators also provide information desks to assist travellers in trip-planning and some provide real-time information. In the following, static information systems, information systems which use videotex technology and real-time information systems which use microwave technology are reviewed.

2.2.1Static information systems

Many, if not all, public transport operators supply, or are currently developing computerised information systems providing information on at least timetables and fares. Examples of these systems are:

-CENTRO's computerised bus information system for static information on bus services (Technical Innovation 1992).
-ITIS, an integrated transportation information system which can give information on schedules and fares and plan trips (TDC 1991).
-TOUCHMEVISION, a system which gives information on routes, schedule, and fares in addition to general travel information. This system was operational in Columbus, Ohio, USA since 1986 (Suen and Geehan 1987).

2.2.2Real-time information systems

There have been many projects which are aimed at providing travellers with real-time information via monitors or matrix displays in termini and at bus stops. Most of the current real-time information systems use microwave vehicle location technology through beacons that are installed along the services routes. As the vehicle passes a beacon, its identification, position and speed is transmitted to a central computer. An algorithm, supported by historical data, can then estimate the arrival time of the vehicle at the next bus stops. This information can then be relayed to the these stops via telecommunication lines and displayed onto matrix or video displays.

Examples of these systems include the following:

-real-time information system installed on the Northern Line of London Underground (Forsyth & Silcock 1985);
-a bus real-time information system demonstrated system at Heworth Metro/Bus station (Cowell et al 1988);
-Passenger Information at Bus-Stops (PIBS) which is a real-time passenger information system to be demonstrated in summer 1992 on 50 bus stop of London Route 18 (News:TE+C 1991);
-The Flexible Operation Command & Control System (FOCCS) which provide real-time passenger information and allows control of vehicle operations. The system is aimed at integrating public transport in all modes (Technical Innovation 1991). Work is under way on assessing standards for future computer-aided operation systems for buses for tasks such as scheduling, real time control, passenger information, fare collection, maintenance, strategic planning, and management information (DRIVE 91:CASSIOPE; Saint Laurent B. de 1991).

2.2.3Videotex in France

A number of successful information systems are in use in France. French public transport operators provided static and dynamic data on a common telecommunication network (Lassave & Meyere 1990).

The development of systems which can provide static and especially dynamic information is assisted by two major technological innovations: Videotex (a network of terminals connected via telecommunication lines to service stations providing information) and Automatic Vehicle Monitoring, **AVM**.

AVM collect data on the running of services in real time and enable operators to react to disturbances. A central station equipped with a transmitting receiver provides a speech and data link with buses which are themselves equipped with a one- or two-ways transceiver.

A telecommunication network provided by France Telecom, called Teletel, connects Videotex terminals called Minitel to serving stations. The service stations are commissioned by public or private operators wishing to provide information to their customers via the Minitels.

Using these technologies, current information on the locations of moving buses can be obtained and the estimated arrival times can then be provided on the street at bus stops fitted with a suitable display or at a remote location equipped with a Minitel. In some situations vehicle location information may be provided to passengers inside buses.

A number of services supplying real time information about public transport are using the Minitel system. For example, the BUSINTEL service provides at-home information on actual bus waiting times and destinations. La Rochelle SAI-AUTOPLUS provides information on activities in the town and allows the user to choose the best way of getting to them by various means of public transport. It was found that feeding data on cultural, commercial and local government activities helped to make some of the systems more acceptable and more useful, and has increased the request for transport information. Although most users of the system La Rochelle initially requested information on leisure and cultural activities (only 16% on transport), it has since been reported that requests for transport information have increased tenfold (Lassave & Meyere 1990). This is attributed firstly to the public became more familiar with the system, and secondly to people being interested in the activities needed the transport information to attend them.

The success of the Teletel phenomenon has been attributed to the national support which provided the network and distributed free terminals (Minitels) to users. The information suppliers are public and private organisations. This is in contrast to other countries where local initiatives have not been met with national support. However, a specific feature of the French experience was the absence of standardization and technical environment on a national level. In addition, setting up the system was costly, and France Telecom is still to recoup the cost of its investment (Newman D 1990).

2.2.4Videotex in other countries

In the United Kingdom a system similar to Teletel, called PRESTEL, have been developed by British Telecom. The network is being used by operators such as British Rail. Currently public transport operators uses the system to store, transfer and process data stored about timetables and fares in large databases. It is also being used for some dynamic data such as train delays and engineering works. Although this information is conveyed to users in termini, no access is provided for public users to use the system.

In the Netherlands the Viditel system provides general information on transport and other facilities (Soekkha 90).

In Germany a similar system, called BTX, developed by the Federal Ministry of Transport provides information about holiday traffic and tourist routes.

2.2.5Future trends

Information provision systems today rely mainly on a manual approach and some computerised tools which are mostly used for single or few tasks. Future trends in information systems for public transport are towards integrated systems, which can advise on all tasks such as scheduling, fares, real time control, passenger information, maintenance, etc. An example of such a system under development is CASSIOPE, which will assess the standards for future computer-aided bus operating systems (de Saint Laurent 1991). Cassiope is aimed at identifying the elementary functions useful for bus operators and defining integrated systems where all data used by separate functions form a part of a general database. The system will be constructed from function-oriented modules, where any operator can built a customized system using the needed modules.

Other systems should emerge which can deal with all functions of public transport and could integrate all services such as buses and trains services.

2.3INFORMATION PROVISION IN PRIVATE TRANSPORT

Information for car users is traditionally provided by maps, road signs, and radio broadcasts about real time information. Recently, electronic route planning systems have been developed to select the best alternative routes, given origin destination data and limited constraints, e.g. preference for motorways, avoiding B roads, etc. Such systems use static data only and are used by automobile associations and some are available as commercial software, e.g. AUTOROUTE.

The current trend is toward the development of drivers' route guidance systems for urban congested areas and toward driver warning systems using digital broadcasting protocols such as radio data systems (RDS). These are described below.

2.3.1Driver route guidance systems.

Driver in-vehicle route guidance systems are aimed at improving traffic management and control through guiding vehicle to their destination using an optimum route. The optimum route is selected using historic, dynamic traffic flow data and predictive data. The system can provide information for trip planning purposes and for in-trip information for location and route guidance purposes. In addition, it could provide hazard warning, emergency or service calls.

An electronic route guidance systems called AUTOGUIDE is under development in the UK commissioned by the TRRL (Jeffery et al 1987 and Beltcher & Catling 1987). The system consists of a central processor connected via telecommunication lines to beacons provided at the approaches of major intersections in the area served by the system. Vehicles are equipped with transceivers (transmitter/ receiver) which allow two-way

communication links between vehicles and roadside beacons using infrared technology.

The beacons hold information describing the road network in their surrounding area. A driver can input, using the transceiver, a code for the intended destination which is then transmitted to the processor via the beacon. Information on optimum route is then transmitted back to the beacon which is turn passed on to the vehicle's transceiver. The information is updated on route whenever the vehicle passes another beacon.

An important function of such systems is that dynamic data is collected from those vehicles equipped with transceiver. This data can include information such as traffic flow, time taken to transverse distances, etc. Therefore, real time data about incidents and predictive data about congestion can be continuously obtained. The guidance is then regularly updated based on this data.

A similar system is under development in Germany, called LISB. A bilateral working party has been established by the British and the German Governments to agree to a standard for the road vehicle communication link which would be the European standard for such systems.

Work in under way in DRIVE Project CAR-GEOS on evaluating models and strategies for dynamic route guidance (Bolelli et al 1991) and on the integration of dynamic route guidance and Traffic Control Systems to improve traffic management (Aicher et al 1991).

2.3.2The Radio Data System (RDS)

Broadcasting by radio provides one-way communication from the transmitter to the vehicle. The Radio Data Systems (RDS) facility defined by the European Broadcasting Union is currently under development. This system enables digital messages to be superimposed on normal VHF radio programme broadcasts which will be decoded by the next generation of car radios. Efforts are under way for full agreement on the data structures and protocols for RDS traffic broadcast and on the set of messages that will cover the traffic information broadcasts in all European countries (Jeffery 1990; Davies and Klein G 1991).

With the collaboration of the French television company TDF, a system called CARMINAT is under development by Renault and Philips. The system is adapted to receive traffic messages broadcast using the European Radio Data System. The system will provide a driver with a comprehensive in-vehicle information centre that could, for example, locate vehicles on maps, warns of weather and traffic problems in real time, guides over an efficient route to destination, warns about malfunctions in vehicles, show when services are due, and provides maps showing roads, garages and hotels (Jeffery 1990).

However, this system can only offer one way communication, i.e. no data is collected from the system user and the same information is broadcast to all the users. consequently, exercising traffic management and control is limited to directing the traffic away from congested or potential congested areas.

2.3.3Other operational systems

Some of the systems which are currently in operations are given below.

TOBIAS
ADAC (Germen Automobile club) employs an automatic system for route planning called TOBIAS. ADAC is also developing a Touring Information System (ATIS) in cooperation with other automobile associations from Britain (AA) and the Netherlands (ANWB) and under commission of the Alliance Internationale de
Tourisme (AIT).

WISE
WISE is a database gathering tourist information from a number of countries. The database is managed by the FIA (International Automobile Federation) and includes information on route itineraries, road works, dynamic information about traffic, and other traffic and tourist information.

AA Roadwatch
The AA Roadwatch is a service providing information on all aspects of motoring. Information is mainly provided by means of mail and telephones. It provides personalised itineraries, traffic forecasts and warning of extreme weather conditions, in addition to tourist and general information.

Hertz Europe
Hertz Europe operates a computerised system which can provide personal trip itineraries. The service can be accessed by users and is available at major UK and European offices and airports. It uses a touch screen interface system.

2.4INTEGRATED INFORMATION PROVISION SYSTEMS

A prototype public travel information system was developed by the TRRL during the late 1970's, which provided information about both bus and train services in Wiltshire (Pickett 1982). The system was computerised and integrated timetable and fares data for all public transport in the area. The system was tested by clerks in information desks and libraries in Wiltshire. The service provided by the system was publicised through local radio stations and newspapers and by distributing leaflets. Despite the publicity there was little response from the public in requesting information requiring the use of the system.

An integrated information system is under development by The Federal Ministry for Research and Technology in Germany. Research is under way to develop the overall technical and organisational concept of integrated traffic information services. This concept comprises general information, information about the road network, predictions, information about construction sites, goods traffic, and current traffic announcements.

START
START is a an integrated information system which is used for reservations at travel agencies and is currently in full service. The system has been developed by the German Railways (DB railways), Lufthansa, the TUI travel agency and operator, and other travel agencies. The system can be used for:
- obtaining schedules information, booking, and fares on DB railways, Lufthansa Airline, and neutral airlines using the Official Airline Guide.
- Booking and confirmation of package tours and other general tourist information and

services such as issuing insurance documents and bank transfers.

Teletel/Minitel
This is the Videotex service described earlier in 2.2.1. In addition to information in public transport, the system offers many other facilities including up-to-date road, traffic and weather conditions, traffic forecasts, information for heavy goods vehicles, and other transport related information. The aim of the traffic authorities in France is to use the system to advice travellers on optimum route, travel duration, and cost.

2.5EC DRIVE

A number of research projects in information systems are being developed under the EC DRIVE 1 and 2 initiative. Some of these projects are aimed specifically at the development of Road Transport Informatics systems (RTI) and others at developing RTI systems as part of general systems with different aims, eg relieving congestions. Some of these projects are listed below (DRIVE 91).

V1011:CARGOES
Integration of Dynamic Route Guidance and Traffic Control Systems.
The aim of this project is the development of an integration of traffic control systems (TCS) and dynamic route guidance (DRG) systems.

V1019:CASSIOPE
Computer-Aided System for Scheduling Information and Operation of Public Transport in Europe.
The objectives of this projects are: to specify the functional requirements of an integrated road transport environment (IRTE) and to achieve consensus on a common approach to standards and protocols for the higher communication levels within the IRTE.

V1024:
Driver Information Systems DIS.
The goal of this project is to specify the integration of existing systems into a comprehensive driver information system operating across Europe. The main objectives of the project are to determine and to evaluate users information requirements, to evaluate alternative technical methods for data handling, and to develop strategies and procedures of information generation and dissemination.

V1059:SPECTRUM
Strategies for Preventing Road Traffic Congestion.
The project is investigating different approaches to road traffic congestion. One of the approaches investigated is in the use of trip planning systems.

V1073:EUROTRIP
European Trip Planning System.
The main objective of this project is to design, install and evaluate a prototype trip planning system. EUROTRIP is producing a demonstration trip planning system installed as part of a field test. EUROTRIP will be based upon a detailed specification for a Europe wide system. Evaluation of the demonstration system will lead to recommendations regarding the installation of European system.

PROMISE
PROMISE is a DRIVE II project which aims to implement and evaluate a multi-modal traveller information system. The multi-modal system will provide information such as hazard warnings, public transport service information, parking availability and reservation, and tourist information and services. The PROMISE terminal will be a portable device capable of being used in the office, at home or while travelling on different sections of a multi-modal journey (News:TE+C 1991)

2.6OTHER INFORMATION SYSTEMS

Information systems in sectors other than passenger transport are also being developed. For example:

-Several systems have been developed to improve the flow of information between companies world-wide, mainly in the sector of freight transport in order to enhance the distribution of goods (Soekkha 1990).
-In Germany the Ministry of Interior offers information about all construction sites on motorways via Videotex/BTX.
-A trade information system, called INTAKT, is being develop funded by the German Ministry for Research and Technology. It uses Videotex/BTX to provide general traffic information, tariff rates for motor vehicles, route optimization and average travel time, and transport optimisation taking into account tariff and best course of delivery.

3.TRIP PLANNING SYSTEMS

Trip Planning Systems, TPSs, are integrated systems which can provide information and guidance to assist travellers with all aspects of travel. This can include assisting in pre-trip planning using all modes, such as private vehicles, buses, trains and airborne travel. It can incorporate a route guidance system for private cars, a Parking Guidance Systems, a Public-transport information system for buses and trains, and a general transport and tourist information. A TPS should coordinate the use of all modes and give guidance on multi-modal travel. It should advice users on making optimal journeys which satisfy their preferences and constraints, e.g. specific departure times or a specific arrival times.

In the following, the needs for such a system are assessed in addition to the likely benefits and disadvantages of such a system. The feasibility and functions of trip planning systems are then briefly described.

3.1THE NEEDS FOR TPSS

Information plays a central role in the planning of journeys by travellers. Available information will influence the travellers decision on where to travel, when to travel, what mode or modes of transport to use, and selecting the optimum route.

Public transport operators provide information by conventional means (posted timetable, timetables leaflets and telephone enquiries) and more recently (although on a limited scale) via electronic systems such as Videotex. Road users obtain their information from

maps and public broadcasts, and from telephone enquiries services for route selection operated by organisations such as the AA and the RAC.

This information provision is considered deficient in many respects. Many travellers make travel arrangements based on the available information and many are unaware of alternatives and special services. It was shown that publicizing travel services can increase its use (Tebb and Ellson 1981). The same applies to road users who are unaware of more optimal routes.

Many travellers are unable to acquire sufficient information about complex journeys especially those necessitating multi-modal trips and, as it is often the case, unable to acquire the information from a single source. Research has shown that if undertaken, multi-modal journeys can lead to shorter journey times, fewer interchanges and more trip-opportunities being available (Pickett 1982). In some cases it is quite difficult to find out where to interchange (Tebb 1977). However, it is difficult for an operator to hold and keep up to date all time tables information of other complementary and competitor operators.

One of the major defects of current information provision is that in most cases it does not take into account real time and predictive data. This is true for both the roads network and rails. It was shown that many benefits can be obtained for both travellers and operators if real time and predictive information is relayed to travellers (Forsyth & Silcock 1985).

Therefore, the need is for a transport information system which can integrate all sources of information, give information and guidance on all aspects of trip planning and make an effective use of real time and predictive data.

There is also a need for an integrated system which travellers would recognise as the source for all travel information. The system could also help the public sector influencing travel patterns, and could therefore use the system to exercise more control in traffic management and markets its transport policies.

3.2POTENTIAL EFFECTS OF TPSS

A trip planning system will potentially benefit all those involved in transport. Three main parties are identified: the travellers, travel operators, and the public sector.

3.2.1Benefits to travellers

Travellers are able to make better and informed decisions in the presence of adequate information and guidance. Given all alternatives, travellers are able to make an optimal decision, albeit a subjective one. In addition, an integrated information system which is independent of a particular operator can provide travellers with comparative alternatives between competing operators, modes and multi-modal trips.

Travellers can also benefit from reduced cost of travel gained through obtaining the most cost effective and less time consuming means of transport for a particular trip. It has been established that excess travel due to sub-optimal route selection amount to 6.4% of all travel by non-commercial vehicles in the United States (King 1986).

The additional information provided by TPSs extends to social benefits such as reduced uncertainty and stress, and the improved image of transport in general. This is particularly true when real time and predictive information are provided to car users and to public transport users. A recent survey by South Yorkshire PTE showed that around 20 percent of a bus journey is spend waiting (Technical innovation 1992).

For car users, avoiding congested areas or incidents will, in addition to reducing travel time and cost, lessen frustration.

Prior knowledge of estimated waiting time or delay time could help to reduce the disadvantages of public transport in the eyes of its users. Real time information will inevitably reduce uncertainty. In a study about a real time information system installed on a number of platforms in the London Underground, 95% of passenger interviewed found the system reassuring and 65% of them commented on reduction in uncertainty (Forsyth and Silcock 1985). Travellers will feel assured if they know how are they expected to wait and will try to fill unoccupied time or, in case of a long wait, they might decide to return nearer the time of boarding. In a study about a real time information system for buses in the Newcastle area has shown that 23% of passengers believed that the information led them to wait for a shorter time (Cowell et al 1988).

Another benefit of providing real time information is that passengers might decide to re-plan their journey based on this information. Re-planning might include change of mode, change of route or waiting for a less crowded vehicle or carriage arriving shortly. In the Newcastle study 35% of passengers made use of the provided information to plan their journeys.

In a survey in the area of Mirfield, West Yorkshire, UK (Tizani 1992), 91% thought that a trip planning system would be useful for their travel arrangements, 95% said they would consult it before planning their unfamiliar journeys, 33% of those working would consult it before planning their journeys to/from work, and 38% would consult it before planning their familiar journeys other than work.

Generally, a trip planning system is expected to give travellers more choice and provide them with updated information about new alternatives concerning routes and services.

3.2.2Benefits to operators

A trip planning system would make accessible information about all the services offered by public transport operators, thus encouraging more people to use services that they were not aware of or to use it more efficiently. It has been shown that even limited publicity about special services can lead to a significant increase in use of such services leading to financial benefits to operators (Tebb and Ellson 1981).

One of the main disadvantages of public transport is uncertainty. Users are not always certain how long are they going to wait and whether they are going to board a comfortable or a crowded carriage. The users perceived image about the service would improve by providing more information relevant to their trips and by constantly updating this information (Forsyth & Silcock 1985). This could increase the use of public transport by travellers who feel assured and more certain about the service. It was argued that it is the perception of the values of factors affecting choice of mode which underlies the users

behaviour and not the real values of those factors (Harris 1987). In the Newcastle survey about a real time information system, 11% of travellers claimed to use the buses more often as a result of the enhanced public information system (Cowell et al 1988).

It can be argued that, coupled with increased reliability, frequency and efficiency of public transport, trip planning systems could increase the people's acceptability of public transport and their tendency to use it.

3.2.3Benefits to transport authorities

A trip planning system would allow public transport authorities to have more control in traffic management. This can be achieved by using TPSs to recommend travel arrangements which make better use of the available infrastructure, e.g. guiding travellers to corridors on the networks which are not used efficiently and marketing modes of transports which are more capacity efficient such as busses and which use different right of way such as railways.

Public authorities can publicise schemes which are considered strategically important to transport planning, for example Park and Ride schemes.

A TPS would also bring the benefit of a centralised source of dynamic information about incidents, congestions, road works, and weather forecast and warning.

In addition to the above a TPS would help in achieving a number of public sectors goals such as (Hopkinson and May 1990):

a) influencing journey destination
b) reducing traffic congestion
c) improving safety, resulting from reduced travel distances
d) protecting the environment
e) marketing tourist and development areas
f) conveying regulatory information.

3.2.4Likely disadvantages of TPS

It is difficult to foresee the effects of a system which is not in use. It can be stated, however, that the main disadvantage of a trip planning system is its potential adverse effects on travel demand, for example increase in private vehicle use for more and longer journeys. This is a likely outcome as people who become aware of new opportunities would be encouraged to make more journeys (Hopkinson and May 1990).

Improved information, especially dynamic and predictive information, could lead to a number of adverse impacts such as: *over-saturation*, where travellers are distracted by a large amount of information and are unable to make optimal choices, *over-reaction*, where a large number of travellers reaction to dynamic or predictive information cause congestion to transport from one location to another, and *concentration*, where the provision of identical information on a large scale tends to reduce the variations among travellers and more choose the same 'best' alternative which could potentially produce congestions (Ben-Akiva et al 1991).

Other likely disadvantages are:

-the effects of one source of travel information on competing operators, and
-the effects of advertising activities and tourist information on travel demand on the areas concerned.

3.3FEASIBILITY OF TPSS

The feasibility of a TPS is influenced by two major factors the availability of the required information and the capability of the current technology to carry out the functions of TPS.

3.3.1Information availability and supply

The sources of information can be divided into three categories: administrative authorities and public institutions; clubs and associations; and commercial organisations.

The information availability and the willingness of its suppliers to provide this information, unhindered in volume and quality, is essential to the feasibility of a TPS. It is envisaged that administrative authorities and public institutions will supply such information. However, some doubts could be raised about the full cooperation of the other two sources. Clubs and associations are themselves providers of information and they charge for some of their services. More difficulties might arise from the commercial organisations who will consider the potential effects of such systems on their financial standing.

Because of the unknown response of users to such a system and its effect on the market, difficulties might arise some of which are listed below.

-Since a TPS will provide independent information in all aspects of transport from one source, some public transport operators will hesitate to supply information which might give its competitors an edge.

-Is a TPS going to be managed or supervised by a public sector institution such as the Department of Transport or by private organisations?

-Will the objectives of the public sectors, in exercising control over information provision in order to forward a strategic transport policies, contradict those of some of the information providers?

-Is the cost of initial investment and running cost going to be borne by users and, in this case, what are the likely effect on the demand for information?

3.3.2Technology

It is envisaged that the development of a TPS can be successfully realised using the following technologies: Telematics, large database management systems, geographic information systems, and object-oriented approach in programming.

Taking into account the large amount of data involved in such systems and the diverse sources of data, a standard for data structure and data exchanges is essential. Also, given that work is under way in the European Community on information systems, TPSs should be built on an agreed international standard of protocols for the exchanges of information (Klijnhout, in Soekkha 90).

3.4FUNCTIONS OF TPSS

A trip planning system should provide assistance in the following areas.

- Pre-trip planning for travellers.

-Trip planning in any mode of travel, including multi-modal journeys. The modes of travel include: roads, public transport, freight transport, air transport, and local and international transport.

- Route selection and route guidance in public and private transport. Recommending optimal routes taking into account real time and predictive data about travel conditions, for example: incidents, changing traffic situations, and anticipated journey duration. Optimal route must be based on a trip efficiency criteria which should be defined taking into account users bias and network efficiency.

- Time of travel. This includes satisfying constraints such as arrival time, route or mode preference, and selecting the optimal time to start the journey taking into account travel conditions. It also includes selecting the day of travel in order to take into account situations at destinations, e.g. events, booking accommodation, and weather.

- Selection of suitable destination. The recommendation of destination given the purpose of the journey.

- General travel information. This can include: location of service facilities, filling stations, hotels, interesting sites, etc.

3.5MEANS OF INFORMATION DISSEMINATION

The effectiveness of a TPS will depend on the means of distributing the information. Potentially, information should reach all transport users in locations including the home, the office, on the journey and in public places such as termini and services areas. TPS can distribute information using means such as: mails, telephones, public broadcasts, facsimile machines, computer links, radio data systems (RDS), terminals in public areas, and in-car guidance systems.

The effectiveness of a TPS will also depend on the cost of providing the information, the ease with which the information can be retrieved and its perceived reliability by users. Special care should be exercised when this information is provided by unconventional means. For example, terminal used in termini should appeal to all types of users and not only to those who are computer literate. A touch screen user interface would encourage more people to use the terminals than if when keyboards are used.

3.6TPS STRUCTURE

A TPS at its basic level can be composed of the following components.

INPUT: an input facilities for both static and dynamic data must be provided. This includes electronic data exchanges with information sources.

DATA: databases on the different transport systems. This can be composed of a number of databases which are mode-oriented. A data structure should be defined which allows the effective interaction between static, dynamic and graphical representation of data network.

ALGORITHM: computational algorithms are needed to carry out task-oriented functions such as generating routes and scheduled trips on the transport network.

KNOWLEDGE BASE: a knowledge base is needed to assist in decision support on the optimal choices between alternatives generated by the algorithms.

HUMAN-COMPUTER INTERFACE: suitable for system operators and ravellers.

OUTPUT: TPS should be capable of providing output to homes, offices, in-car, and in public places by all means such as those mentioned in 3.5 above.

4.CONCLUSIONS

Technological developments in telecommunications and information technology are providing the possibility of a greatly enhanced quality of information to aid trip planning decisions.

Current information provision is considered deficient in many respects. Travellers are often unaware of alternatives routes or services and many are unable to acquire adequate information from one source especially for multi-modal journeys. In addition, there is a lack of providing real time information where it is required (bus stops and train stations) and of effective interaction of static and real time information. Most of the projects, which integrate static and dynamic data, are single mode systems. Therefore there is a need for an integrated trip planning system which can inform and guide on all aspects of transport.

Trip planning systems can provide assistance in trip planning (before and during the journey) using one or a number of modes of travel, taking into account travellers preferences and constraints, and effectively integrating static and dynamic data.

TPSs could adversely affect traffic demand as people who become aware of new opportunities might be encouraged to make more journeys. It could also affect travellers choice as a result of over-saturation of information, over-reaction to predictive information, and concentration on the same 'best' routes.

However, it can be argued, based on existing evidence, that such a system can benefit travellers, and transport operators as well as the public sector responsible for executing transport policies. Travellers can benefit by obtaining adequate information to help them in making optimal decisions and reducing uncertainty and stress associated with travel. Public transport operators can benefit by making their services known to customers, leading to increased patronage. Public transport authorities can use the supply of information to execute their transport policies and exercise more control over traffic management.

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