CONSCIOUS TRANSPORT – INFLUENCE OF PASSENGERS BY TELEMATICS SYSTEMS

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Abstract: *Few studies have investigated human behaviour in transport systems and revealed useful correlations among certain factors, but these analyses have not focused on role of passenger information systems yet. As significant advancement in information technology can be observed, application of these tools is a promising opportunity to improve quality of transport through providing value-added information. This paper proposes a new method for influence of passengers, and gives guidelines, how to create and operate the needed, integrated telematics system. The targets are: to offer such services (creating transport chains), which meet individual expectations and take social requirements also into account and to control locomotions effectively. This system concept significantly contributes to success of the mobility management, keep in mind that passengers' behaviour is one of the most crucial elements.*

Keywords: mobility management, integrated telematics system, influence of passengers, optimal solutions.

1. Introduction

Decisions of passengers are influenced by numerous factors before and during locomotion. Efficiency of operations (planning, organization, control, etc.) in the transport system depends mainly on the cognition of people's preliminary and actual demands as well as human decision making [1,6]. These should also be influenced so that global and personal optimal solutions are achieved at the same time.

The two-way information flows between passengers and transport operators as well as intermodal traffic centres (in simpler cases stations, stops) may be realised via passenger information systems. These systems have important role in the following fields:

- discovery and influence of demands,
- control of passenger flows,
- fee-collection,
- improvement of comfort, safety and security.

As these related functions use same data and the passengers' terminals are also often common, the integration of the systems is essential. Consequently, such a complex system can only be planned by using a system-oriented approach, emphasizing importance of human-machine interface and information handling processes in people.

2. Processes in Mobility Management

Mobility management approaches the public transport from demand side. It influences mobility demands and decisions (behaviour) using new solutions (e.g. comparison of mobility modes by several aspects). It tries to balance mobility demands and offers with consideration of many factors. Cognition of decision aspects and influence of them between certain limits are proper tools for transport system operators. Information handling concerning the passengers is executed predominantly before the locomotion.

Management of transport process is a "narrower" concept. It influences traffic movements derived from mobility demands through individual decisions. The aim is: "conduction" of traffic flows in the "transport space" on an optimal way with regards to capacity limits of the infrastructure. Information handling concerning the passengers is executed predominantly during the locomotion in public areas, at intermodal traffic centres (stations, stops) and on-board of vehicles, etc.

Fig. 1. shows the correspondence among the terms. Passenger transport is a "whole" of passengers' and vehicles' movements. Locomotion of passengers (outside and inside of vehicles) is a consequence of their individual decisions. Movements of vehicles are in accordance with the demands that may be derived (predicted) from the decisions. Demands and capacities are adjusted to each other before departure, during the preliminary/operative planning and control. Validity period ("dynamic feature") of information used at these processes depends on the length of time until departure.

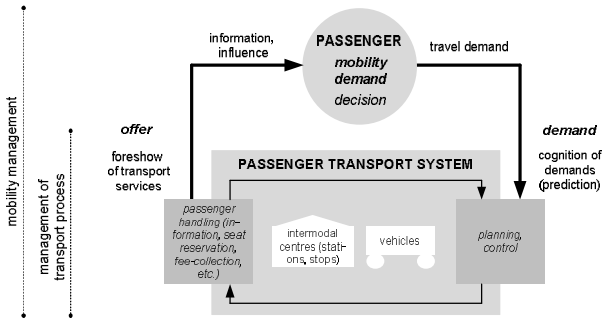

Fig. 1. *Process of Mobility Management*

The aim of passenger management functions in the planned and realized (exceptional) transport situations is: to make them familiar with transport services, that is information about the supply. These pieces of information significantly influence decision-making, which affects the way of satisfaction of mobility demands (temporal and spatial features, etc.). Two-way communication between information systems aiding planning and control as well as passenger information systems makes „regulation" of the transport system possible. In this way demand and supply can be converged to each other in several steps (in many cases with iteration).

3. Information Handling at Passengers

Although automatic procedures can be increasingly observed in transportation (at movements and in passenger management as well), purely technical solutions cannot replace human-machine systems. Namely the decision-making activities of human components are indispensable to control the stochastic transport processes. These components in passenger transport systems are the operatoring personnel (drivers, dispatchers, etc.) and the passengers. The logics of information handling beside machine and human components are similar to each other. The interface and information transmission between these two kinds of the elements are particularly important. The latter one depends on functionality and configuration of terminals.

Focusing only on passengers, the information handling processes are summarized on ***Fig. 2***. Logical subsequence of actions is indicated by numbers.

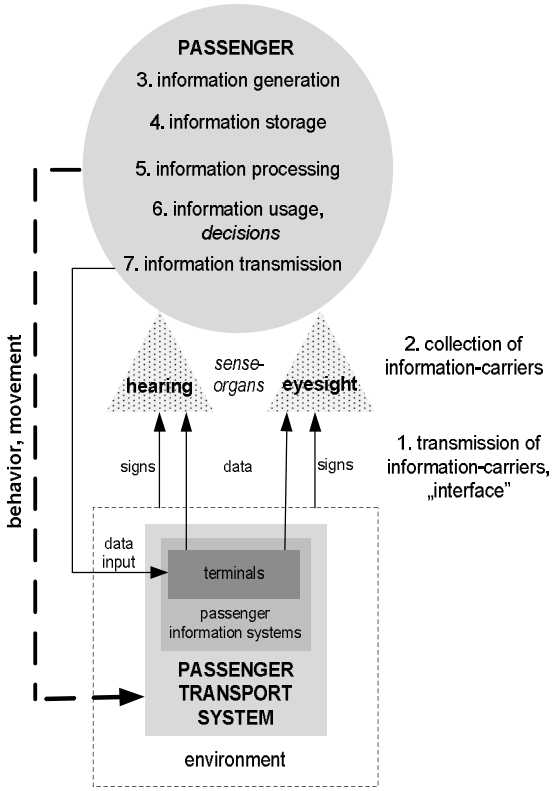

***Fig. 2**. Information Handling Procedures of Passengers*

Passengers collect "information-carriers" (signs, data, etc.) about the transport system and its environment through various channels. The passenger information systems belong also to these „sources". The "information-carriers" get to the passenger (as into an "information handling subsystem") via the senses. Considering the proportions, sight has the largest and hearing has a smaller importance (the role of other senses can be neglected in comparison with the forementioned ones). As all passenger groups need the indispensable information regarding the journey, therefore special information channels may complement (partly) the missing functions of the certain senses at handicapped people (e.g. tactile signs for visually impared persons).

Information is the reflex of the objective reality in the human consciousness. People obtain the information by interpretation of the incoming information-carriers. To this, acquired skills (e.g. reading), capabilities, as well as previous experience and knowledge are needed. Information storage and processing are results of encephalic (central nervous) activity. Passengers make decisions on the basis of "accepted" and interpreted information; meanwhile the individual nature (e.g. emotional state, tiredness, etc.) is also dominant. Within human body, nerves mediate the "control" signs among the certain organs. All of these actions are resulted in passenger behaviour and movements. Passenger-flows are formed from these moving persons. One part of movements is made as routine, while other part is the result of long preliminary deliberation (as conscious locomotion). The behaviour is also influenced by given information in emergency situations (e.g. accidents) as well as by feeling of safety and security (on board of vehicle and at passenger facilities).

As human capabilities for information handling (storage, processing) are limited and they work with relatively many failures, therefore these capabilities can be extended by machines. For this purpose the telematics terminals (mobile or immobile ones) are applicable. Latter ones have the following advantages: location independence and easy join to senses by advanced peripherial abilities. In case of interactive terminals, there is two-way data-flow between the human and machine components.

4. Influencing of Decision-Making of Passengers

The most important, quantifiable factors at decision-making regarding a travel chain are:

- distance of locomotion (taken by vehicle or on foot),
- departure and arrival time of locomotion (duration),
- measure of fees (features of tariff system).

Additional factors influencing transport behaviour (and related information handling) are:

1. personal features

- capabilities for movements, (willingness for walk),
- features of disability [7],
- individual vehicle ownership,
- language skills,
- income conditions,
- age, sex,
- mood (psychological state), fatigue (physical, mental),
- environmental awareness,

2. features of locomotion

- motive of locomotion (e.g. transport purpose or other purpose),
- carriage of luggage,
- wheather (road conditions),
- regularity,

3. features of passenger transport system

- features of transport network (routes of services) – spatial availability,
- temporal availability,
- features of interchanges (e.g. short walking distances, safety),
- features of vehicles (e.g. comfort, security),
- mode of fee collection, operational features of the fee collection system,
- "flexibility" features of public transport [3].

Some factors are „dominant", namely they basically limit options for selection. Others have "supplementary" effects, namely the traveller can accept several solutions.

Efficient mobility management is achievable by information handling suited to the individual demands. To this, personal features of passengers and features of locomotion (input information describing decision-making factors in groups 1 and 2) as well as features of transport system (stored information describing decision-making factors in group 3) should be known. Some information concerning these features may be modified often, or in certain cases they are available with low confidence level (e.g. forecasted wheather conditions).

Information communicated after processing, its details, validity duration, etc. may be influenced by objectives of the participants in transport (users, operators, society). The application for comparison of certain passenger transport modes on the website of Deutche Bahn is exemplary in this regard, which ranks the optional travel modes in case of a concrete journey, taking several aspects (also individual ones) into consideration [5]. So, it helps also the choice of vehicles. In case of advanced conditions, so called continuously "learning system" may also be created, which stores users profiles and later "produces" the desired information with its consideration.

Timeliness (types) of decisions' effects is summarized on Table 1. Decisions influence – among others – spatiality (e.g. modification of destination, route-choice) and timeliness (e.g. postponement of journey) of locomotion, choice of vehicle, etc. These are complex processes and depend also on static and dynamic features of the individuals and the transport system. Decisions are made with smaller and smaller time-cycle, therefore travel demands can be recognized more precisely and the processes can be organised more efficiently

Table 1.: *Types of decisions regarding mobility*

name	description	influence mode of decisions
awareness building	motivation for use of sustainable transport modes in a significant rate; familiarization with advantages of „soft", environmentally friendly and public transport modes	education, organization of events
decisions with long time impacts	residence-choice, workplace-choice (distance work), ownership of personal vehicle, etc.	mobility advisors/coordinators, mobility plans at workplaces, motivation for car-pooling
decisions with medium time impacts	membership for car-sharing and bike-sharing, purchase of monthly pass for public transport, etc.	public information about transport services in collective way, based on static data
decisions with short time impacts	location-choice for a certain activity, route-choice, vehicle-choice, determination of time (time interval), luggage conveyance, etc.	personalized information (influence) regarding the certain locomotions, based on dynamic data
decisions with momentary impacts	door selection for boarding and alighting, use of escalators, elevators, etc.	public information on board of vehicle and at stations (stops) in collective way, based also on dynamic data

Efficiency of mobility management can be forth enhanced, if passengers give more points of view in order to personalized, value-added information:

- knowledge concerning the transport system (e.g. local resident or tourist),
- expected rate of "added intelligence" at processing by machines (e.g. publishing only raw data or taking over "thinking", partially),
- horizon of planning ahead (e.g. passenger plans his locomotions in advance or makes instantaneous decisions and behaves spontaneously),
- providing journey relations and (activity) chains repeated regularly (e.g. home-workplace-shopping activity chain),
- need for information depending on location and environmental conditions (e.g. security warning about slippery platform),
- just basic information or need for supplementary (premium) information (e.g. information about vehicle utilization).

In general, the certain points of view have a personal "weight" to reflect the priorities. Features regarding the persons can be stored as prior data, in the so called „user profiles".

The aim of information (influence) is: to inform passengers reliably about all of the necessary, important factors concerning their locomotions, as a consequence they form their demands and mode of service according to this. The passenger transport modes that are "tailored" to individual demands require more information handling processes than other modes. Decisions between several forms of individual and public transport are made after consideration of their advantages and disadvantages. The most important advantages of individual transport against public transport (in general) are:

- comfort (simple use without transfer),
- feeling of personal security,
- it can be used for almost all transport motivation.

These together enhance feeling of "independence" and individual nature. However, these personalized advantages can be achieved usually by higher fees. Generally, the more "flexible" (personalized) a transport service (and shorter the time for planning between demand and compliance) is, the higher the fees are. Namely, at flexible services the demand and the supply can only be approximated in a less efficient way. The individual feature can also be strengthend in public transport by services on board and on stations (e.g. „Kinderkino").

So, the favourable decision according to several aspects may be influeneced by all factors listed above. For taking these (weighted) factors into account and for achievement of personal and communal optimum solutions, telematics background should be applied that makes handling of enormous "information mass" possible.

5. Conclusions, Outlook

Target-oriented influence of decisions regarding locomotion can be achieved by more detailed description of passengers, as well as elements and operations of the transport system, that is to say by use of information. Consequently, increased quantity of information and searching for optimal solutions by taking several aspects into consideration also require development of processing. Especially in the case when efficient management of resources with regards also to environmental aspects is the aim.

Efficiency of operations is basically influenced by passengers' reactions to effects caused by the information system. Mathematical description of this is a cardinal issue. With view to spatial expansivity of the human-machine telematics systems, there are also multiple options. The solutions that are independent of transport operators and cover either a city (agglomeration) or a country are basically recommended. However, in the gradually unified European area there are cross-border solutions in operation even now; and their spreading is even more expected in the future.

References

[1] AJZEN, I.: A theory of planned behaviour. 1991

[2] BERKI, ZS.-FEJES, B.: Az utastájékoztatás integrált rendszere a BKSZ példáján (Integrated System for Passenger Information, example of Budapest Transport Association) . Városi Közlekedés. L.évf. 5. szám 273-279.o. Budapest, 2010. *

[3] CSISZÁR, CS.: Telematikai alapokon működő car sharing rendszer (Telematics based Car-sharing) . Városi Közlekedés. XLIX.évf. 4. szám 213-220.o. Budapest, 2009. *

[4] SOLTÉSZ, T.-KÓZEL, M.-CSISZÁR, CS.-CENTGRÁF, T.-BENYÓ, B.: Information System for Road Infrastructure Booking. Periodica Politechnica (Transportation Engineering). Vol. 39. (in print) Budapest, 2011. ISSN 1587-3811

[5] www.bahn.de

[6] www.eu-portal.net

[7] www.pedroute.hu *

* in Hungarian

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