Information in Transport Processes

K. B. Wydro
University College of Technology and Business in Warsaw, Poland

ABSTRACT: A paper concerns the problems of information ordering in intelligent transport systems accordingly their role and meaning for various transport processes. There is given an attempt to rules of classification of information, their standardisation questions, reduction of redundancy and false specimens. All these questions are of great importance from the information accessibility, usefulness and reliability point of view. Also are discussed problems of the information selection, it's protection, and it's evaluation as a factors influencing possible improvement of the transport decisions making. Finally, some outline of standardisation rules are presented.

1 INTRODUCTION

Dynamic development of the modern information technologies applied to all the activities in transport, generally called as intelligent transport systems (ITS) becomes possible thanks for growing accessibility to ICT solutions. But really just the broadened accessibility to information becomes crucial for great progress in the discussed area. Information, being beside energy and technical means an indispensable factor for realization of the all transport tasks, may have a decisive meaning for high effectiveness achievement. It is easy to observe, that in the last tens of years, thanks to new technological possibilities appeared not noticed former access to huge amount of ready or possible to obtain information. At the same time, in provided information emerge also considerable content or volume redundant, and even false or erroneous specimens, what obviously reduce effectiveness of the transport activities based on such information and certainly – even all the information processing tasks.

Generally observed growth of information meaning, resulted from progress of ability and possibility of it's intensified usage allowing all human activities improvement, caused even development of the research over this peculiar good, headed toward further improvement of it's usage. Among others there are conducted research on information evaluation, reduction of the redundancy and incidentality, extraction of the valuable parts, mainly these indispensable. It combines with the necessity of developing proper rules for broadly understood information management, what particularly concerns transport branch. Just there exists a need to work out standards (in meaning of mediocre type, pattern, model) and norms, which could be applied in particular areas of information applications in transport. It should improve the effectiveness of operations of various transport systems, level of the cohesion of transport activities and – may be first of all – it's security.

With reference to existing state of ITS resulted by spontaneous and incidental development (Wydro 2006), it should mean ordering of information management and processing according to it's content, what should give possibility to remove it's redundant part and processing of this part, but mainly considerable gains coming from more effective systems operations, (as at actual state

systems are weakly co-ordinated or not co-ordinated at all as a result of compatibility lack). Actually even information exchange between systems and equipment made by various producers and providers – often necessary – leads to additional costs and lower reliability of ITS as a whole. It became also a big obstacle for introduction to systems the new functionalities; it's extension or improvement. In particular, emerging in last time tendencies for creation of multi-modal transport structures, rising the security level, providing better transport conditions with information services to millions of individual recipients with very diversified needs profiles, requires efficient systems co-operation an – in some extend – it's mutual replacements or functional substitutions (Harems & Obcowski 2008, NTCIP 2009). That's just what a need of information operations ordering and rational management on the basis of exchanged information systematising and content selection, becomes an urgent and important task.

In many cases such procedures already are executed, nevertheless in numerous ITS applications areas lack of the proper information management and regulations can be observed. It is a result of various reasons, among which lack of necessary or desirable cohesion of the ITS as a whole is one of most important. Elimination of this and other shortcomings requires firstly to identify and systematize information users types (as well human as machines ones) and their needs, then making classification of the types of information, their features, considering even their dimensions and utilitarian meanings. Even defining of the features of technical means necessary or useful for information processing, exchange and presentation is needed. IT is to point that in the last mentioned area, one of main elements influencing system's cohesion and compatibility becomes protocols for inner- and inter-systems communications and interfaces to systems users and surroundings. Such a need can be superbly illustrated by the shortcomings resulted by traffic management systems incompatibility or variety of electronic fee collections along the international routes, from one side, and idea of internationally unified safety supporting eCall system – in other.

2 INFORMATION IN TRANSPORT STRUCTURE

Intensifying and improving quality of the transport related information requires – from technical side – creation and installation of various more advanced devices and programs for information gathering,

distribution, processing and usage for inner systems needs and proper improving interoperability between particular systems. Interoperability – first of all – means inclusion by common communication rules the information provision for all of users and operators of all transport systems, enabling distribution of actual, useful and reliable information which can be collected from all possible sources and provided for usage by all interested users, possibly suitably to theirs expectations. It causes a need to pay special attention to information content flowing in telematic systems and between them, especially ensuring optimal solutions applied for execution of these flowing.

Is to be underlined, that optimisation problems are always mostly related to quality of information content, i.e. it's adequacy to time and place of origin, validity and importance, but not as much to technical features of processing and distribution of information.

From the ITS needs point of view, the systems inner information decides about the state and activity of given kind of transport, but important role plays even outside generated information, describing circumstances and conditions influencing actions of this kind of transport. Of course, for assuring a proper and effective realisation of the transport tasks, there is also need to reach sets of information describing relatively constant (quasi-static) states and circumstances as well as dynamics of occurring processes (Wydro 2009).

It is obvious, that the total amount of information appearing in the system depends on system's dimension, i.e. on numbers of it's elements and processes in it occurring, theirs distraction and geographic locations, on dynamics of these processes and changes in surrounding, but also on types and tasks of the information systems utilizing this information. Also it is reasonable to take for analysis as an area of reference a road transport, which due to its specificity characterized by complexity of roads network with diversity of classes and conditions, states but even managing entities, bearing intensive traffic with high randomness and dependence on environmental conditions, even an area with richest range and diversity of implemented telematic applications, ensures possibly comprehensive analyse of information management problem.

Also, it have to be remembered, that as a result still emerging new technological possibilities, beside new user needs stimulating constructors invention, variety of new telematic applications still is rising, and existing ones use to be essentially upgraded –

what together strongly increases demand for information amount and it's improved quality (Report 2009, Wydro 2003). Obviously it broadens also areas of above-mentioned analysis.

With information management questions are also related problems of information transmission (understandable as carrying in space and/or time). What's important, in more and more transport cases, the information have to be delivered to moving objects. Besides, for the sake of required level of the reliability and resistance to possible interferences, some protections means are to be applied, what naturally expands the volume of transmitted information. Such a circumstances brings some difficulties for creation of the information systems, but have to be considered at information categorisation (i.e. problem of confidentiality).

In fact, for various modes of transport can – or may – be applied specialised teleinformatic systems, but, as a rule it's basic structures remains similar, what have some reflection in ITS architectures. Also particular basic applications for information exchange and processing may be equal, what in turn arise legitimacy and need of technical standardisation activity in transport telematics domain. But these last said so far concerns the forms of information, not interfering their contents[17]. If yet the devices should be active with reference to information's content or essence, functioning of such a devices should even be embraced by some defined rules and principles. Also, from infologic point of view, in electronic communications area the kind of transmission technical means is not important, although choice among accessible kinds may have some meaning for reliability, transmission capabilities and costs. Important is however so that information was transmitted in agreed formats (patterns) ensuring mutual understandable communication of system's elements. Having in mind that in telematic solutions becomes needs of communication among:

– Vehicles and infrastructure's teleinformatic equipment,
– Various vehicles,
– Vehicles and informatic and service points or centres,
– Infrastructure's teleinformatic equipment and service points or centres,

– Drivers and related informatic surrounding,
– Informatically co-operating parts of particular vehicles,

may be expected, that will be continued works on integration not only means of information exchange, but even on the manners of these exchange in ITS as a whole and firstly – on information transmission content-oriented protocols and selection and distribution of information methods with striving to more and more necessary automatic languages translations, as well as building personally tailored and dedicated information packages (Gut & Wydro 2010).

2.1 *Information sources*

In each of information-operated system can be distinguished two main areas of information origin. These are the observed objects and processes delivering basic information and sources of various supporting, already processed information. In transport system as such can be pointed the informational equipment of the transport infrastructure, transport means and entities (persons and institutions) participating in these processes. As examples of infrastructure's equipment delivering primary basic information may be mentioned vehicles detectors or other measuring devices (as photo-radars or weights), weather stations and other environmental sensors, observation systems (cameras), pedestrians detectors, security systems elements and alike. In turn, vehicle's information generating equipment embraces elements of such systems as warning, positioning, emergency (i.e. eCall), movement registration or even specialised measuring equipment (Floating Car Data). It is worth to underline that contemporary cars use to be equipped with various driver-supporting solutions, as ABS (Anti-lock Braking System), ACC (Adaptive Cruise Control), EBS (Electronic Brake Assist System), ESC, LDWS (Lane Departure Warning Systems), WLDW (Wireless Local Danger Warning) and others (2). These systems actually undergoes to operational integration and delivers information partially used at the time internally in the vehicle, partially transmitted for the outside use, both, in extend appropriate to needs, registered for future use. Next, information delivered by entities participating in transport processes are these generated by persons – individual, corporative or institutional – moving or causing movements of some transport objects.

As mentioned, centres for gathering and processing of raw temporary information, which later is supporting various users of information, form

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[17] Regulations related to the form of information concerning technical parameters have been known long ago as a "standards" and are properly advanced.

another important group of information sources. By the information processed here is understood operational information used in currently realised transport processes, as well as analytic or reporting ones as for example results of short-, middle- ors long-time analysis. These can be i.e. data from control centres, databases, or managing entities. A good example are sets of information passed to infrastructure's roadside equipment i.e. concerning or applied to traffic control elements as traffic lights or variable message signs, radio announcements and other actual communiqués. Similarly is with information for travellers.

Next, information creating strategies of traffic control in various areas (town, village, roads between inhabited areas) and current circumstances, methods of reaction to particular types of incidents, fleet management and alike, may be numbered among information coming from middle-time analysis. To this class can be included also information collected from observations and registrations of the vehicle's pictures with register plates recognition or points of truck weighing. Hoverer for example prognosis of the traffic flows spread stands for long-time analysis. Distinction between duration of the validity of forecasts important for determination of the sampling frequency of observed processes and observation of it's information content irregularity, seems to be important for information classification patterns.

2.2 Information recipients

Essentially, set of types of information recipients and users is the most meaningful classification criterion for transport information ordering purpose, as types of recipients determines what kind (in meaning of content) and of which quality information is to him needed and when and where have to be delivered. Among information users can be distinguished following main categories (Wydro 2009):

– Rescue services and systems,
– Information and communication systems,
– Administrative institutions,
– Drivers and travellers,
– Corporate operators,
– Research and educational institutions,
– Financial institutions,
– Legal institutions.

Theirs needs decides about basic content structures of used information and schedules as well as conditions of information delivering.

3 INFORMATION STANDARDISATION PREMISES

In the last years in ITS development frames emerged few projects comprising some elements of information content ordering and standardisation. As examples can be mentioned:

– Conception of the Minimal Set of Data (MSD) in eCall system,
– National Transportation Communications for ITS Protocol (NTCIP) project,
– Transport Protocol Expert Group (TPEG) project,
– Open Communication Interface for Road Traffic Control Systems (OCIT) project.

Minimal Set of Data (MSD) brings information necessary to inform rescue services about place, time, circumstances and nature of occurred incident or accident. This information is passed automatically or manually through emergency number 112 to nearest so called Public Safety Access Point (Gut, Wydro 2010) initiating rescue action.

The NTCIP (NTCIP 2009) is a name of American group of standards for communications in transport, specifying open, based on the project participants' agreement, suitable for this communications profiles and protocols as well as common data definitions. These standards allow fulfil all the conditions resulting from needs of communications in the areas of traffic control and transport managements centres.

However TPEG Forum (TPEG), is an European organisation of the group of experts in information technologies, aiming elaboration of the methods and techniques of the collection and delivering for various users – by the broadcasting means (radio, Internet) – information for traffic control and travellers. Here is assumed forming of hierarchically structured information, which recipient will get and will be able to use in various technical means of information processing and also – language independently – by humans. It has to be also information useful for multi-modal transport systems.

Other important accepted assumption is that in information systems structures are not foreseen necessity of building big auxiliary databases, especially in users receiving devices. Forum tends to develop modular set of tools in prospect standardised by ISO and CEN, taking into consideration possibility of contemporary or future use for various informatic applications.

In traffic management systems particularly important for data exchange organisation are communications protocols. This exchange, usually

essential for co-operation of devices and systems provided by various producers, often needs extra investments for building appropriate interfaces and software, what brings significant complications for co-ordination of the systems operations, but even for new functionalities and applications implementation in traffic management structures. In such a cases, as generally in various others information systems, applies a rule of application of "open" protocols. It means application of the protocols worked out and standardised so, that system could work with any device independently of it producer and possess feature of "scalability".

Such a solution presents OCIT protocol (Haremza & Obcowski 2008) being a German standard, but in last years applied in other European countries as an open interface for communication between traffic control systems. OCIT standards are defined for two applications groups. First one, called OCIT-Outstation, pertain communication between local equipment (i.e. traffic lights controllers, measuring stations, VMS) and managing centres. Second one, OCIT-Instation, concerns exchange of information between various applications and systems on the central level of control or management.

Of course an important role in ordering of information areas plays standardisation institutions, mainly international ones like CEN and ISO (ISO).

In both of them activities in ITS (telematic systems) areas are performed by special Technical Committees (TC), each of which is divided between Working Groups (WG), in both cases thematically almost similarly structured. On the basis of commonly accessible information concerning structures of the can be supposed, that in each of Group can be found some elements connected with transport information treatment rules.

4 STANDARDISATION RULES OUTLINE

IT is obvious that basic group of features characterising information used in each well working system are these which can be recognized as determining their utility. Usually assumes (Wydro 2008) that each information in the system have to be:

- Essentially and operationally adjusted to recipient's needs,
- Possibly exhaustive as it concern meaning, completeness and conciseness,
- Ascribed to the time and place,
- Articulated, and in case of transport – easy to language translation,

- Possibly most up-to-dated,
- Verifiable.

As it mentioned earlier, ordering in information management area have first of all to be captured in some classifications frames, what make possible better identification and more convenient operations with their elements. Below are presented fundamental premises for the formation of the frames for content standardisation and information ordering for their more efficient management and usage.

Generally can be accepted, that division of the information features into groups mostly distinctive from the infologic point of view is a proper approach (Wydro 2008). These are features:

- Phenomenological, i.e. universal in relation to any area of application or analysis,
- Social and economic, related to utility in economic or social activity,
- Operational, significant from the point of view of information managing operator or information user.

A an example of phenomenological classification may be quoted a division of information according the following criterions:

- Type of source: inner – external, primary – derivative, public – private
- Kind: quantitative – qualitative, formal – not formal,
- Time: former – actual – future,
- Frequency of occurring: continuous – periodical – incidental,
- Usage: planning – control – decision-making – concluding,
- Level of usage: strategic – tactical – operational,
- Detail level: detailed – summarized – general,
- Presentation form: written – oral – visual.

As economic and social features may be mentioned: a direct market value of information, utilitarian value for economy, accessibility, utility for social activities in various dimensions – cultural, military etc.

From our research matter point of view, the most important is the set of operational features, however others can be also discussed. Analysis of the research matter shows, that legitimated is proposal of classification in two dimensions:

- Areas of applications (utilising),
- Conditions of usage.

Acceptance of the area of applications as the basic classification criterion results from the

primacy of meaning and role of information in transport (similarly in any case as in each other branch). For ITS such areas are to be determined by the character of services provided by given system for which given information is necessary. Groups of systems with similar service tasks makes up separated areas of applications. It is to point, that on systems qualifications in some extend influences also technical solutions applied in particular cases, which are often unique from the construction point of view, but shows some universality as can be used in various systems for various goals (i.e. vision systems use to be applied for security levering, traffic control or vehicle recognition). As the systems usually are not mono-functional, ascription them to areas of applications are even not unambiguous. Similarly not unambiguous are qualifications of the areas of applications. These are also qualifications and ascriptions of arbitrary types, even changing with the time. Nevertheless currently these qualifications are quit stable, what seems to be i.e. reflected in the names of Working Groups in relevant Committees of standardisation institutions or research works and papers concerning ITS, as well as in used commonly terminology in professional communication.

What concerns of the formal usage conditions, it easy to state that can be distinguished three categories of obtained or distributed information:

– Obligatory,
– Contacted,
– Free.

It combines with legal rights to information and it's availability, but also with formal conditions related to technical means for information collection, distribution and presentation (Gut, & Wydo 2010).

Undoubtedly it is a factor essential for information operation and requires to be considered in assumption of rules and standards of information operation processes. For completeness of standardisations needs, it is also necessary to give for information (communiqués) some ordered structural form.

4.1 Application areas

Among already numerous telematic systems may be distinguished (Report 2009) basic ones, designed for the provision of single service or fulfilling some particular function (when it work in broader system) and complex ones (integrated) for servicing more complex transport processes on i.e. separated geographical area, mode of transport or tasks group.

Systems of the basic type are numerous and supported on various technical solutions. A good illustration to variety of such a systems, classified on the basis of users needs and contemporary technological possibilities gives list of real service systems presented – among others – in (Wydro 2006), where additionally the systems were grouped with respect to applications areas, though it have to be pointed that the list is not closed as with the time emerges new solutions resulted by new technological possibilities, constructor's invention and users expectations.

Next, as the examples of complex systems can be pointed sets or sub-sets of the basic systems, completed for realization of the complementary functions for fulfilment of the tasks for which they was build. Such a systems are usually ascribed to some given functionality (servicing) areas (IST-FRAME 2004).

According to said above, in particular complex system with well-defined tasks may be distinguished specialised parts, being components of the system as a whole. It is to underline, that specialised systems can in many cases fulfil some additional functions, for example deliver information to other systems.

In proposed standardisation concept assumes that formal classification of the information should be related to concrete telematic systems, with strong consideration of their role in the system and co-operation in functionality area frames, but also with consideration of it's capability to co-operation with other systems, with simultaneous preservation of the development openness and scalability.

Obviously, real classification of the systems from the point of view of information standardisation needs much more deeper analysis.

4.2 Structural requirements

As it was mentioned earlier, there is a need to give to information communiqués defined structural form. It is particularly important when are exchanged information between technical devices and even – in some cases – in transmission of the communiqués which have to be of high completeness and precision, as for example it is in the eCall system. Structurally ordered information makes also all the operations concerned with information storage in databases, processing, surveying and analysing. Even transmission of information in agreed formats inside each of systems ensures unambiguous mutual articulation between its elements as well as is necessary for compatibility of different systems. It's the reason for tendency to

operations on the ordered sets of dialogs and communiqués and ordered sets and allowed ranges of data, thanks for what not only information users but even telematic system's constructors could communicate in mutually comprehensible and unambiguous manner. It is also obvious need to complete communiqués and other information mails with data pointing place and time of the incident described in this information, and – if it concerns some process - also defining a proper frequency of taking of samples describing a following states of this process (Wydro 2008).

Foregoing remarks allows to state, that in fact the description of the structural form of information means creation of the corresponding meta-information i.e. information about information, which supports, among others, convenience of the identification, absorption and usage of information (Wydro 2008). It suggests elaboration of the system of markers, each of which could be ascribed to particular category of information and which interpretation would be stored in some database. It could create a convenient in operations, shortened form of above-mentioned description.

4.3 *ACCESSIBILITY CONDITIONS*

The second classification dimension having valid operational meaning is the accessibility status. As mentioned earlier, may be distinguished information, which has to be provided obligatory and cost of which bears operators or administrators of the infrastructure, who bears also responsibility, concerned with regularity of these information and correct delivering. Such obligatory information is for example road signs content, among them – these modern like VMS – or broadcasted by radio or Internet official information. Such ones have to be properly formatted and pass a proper verification procedure, as usage of it may result in material or legal consequences of high significance.

Another category makes information exchanged between partners contracting services containing information as content of the service itself or as a factor influencing essence of the service. Exchange is fulfilled on the basis of the contract (agreement) between provider and recipient. As an example may be pointed delivering of roads condition pictures or parking accessibility, performed on the aid of infrastructure administration by some external professional entities. Here also the ranges and formats of information are established, and some legal aspects concerns nor the contents of delivery, but rather assurance of keeping on agreed frequency and continuity of delivery.

At last, there exists also a huge area of free information exchange and provision. As example can be mentioned positioning data (non-professional) delivered by the satellite systems or information broadcasted by CB-radio (even other radios or Internet). In such a cases there is in fact no any formal constrains, and if a recipient undertakes soma decisions or actions based on those information, does it on the own responsibility.

5 CONCLUSIONS

Elaboration of the rules (standards) allowing to order activities in area of obtaining, exchange and usage of the context valuable information should create an important circumstance facilitating functioning, but even construction of the ITS solutions. Such a conclusion comes from survey of contemporary implemented telematic systems as well as from direct discussions in involved professional environment – technicians, researchers as constructors. In many areas of information users such a ordering are in scope of interest of administrations in sense of development and modernizing activities in transport. Therefore elaboration and putting to practice broadly accepted methods of coherent manners of information exchange in transport branch as whole and in ITS particularly, is an urgent question. It should lead to formation of the rational system of operation on content-selected ordered information in transport area.

An important part of above defined task requiring to be researched broadly is a problem of transport meta-information creation and manners of information verification, especially these of high importance for the systems. Other important tasks are reduction of redundancy existing in information by the nature and also caused by information replication, and elimination of unimportant information. Possible solution in these last tasks needs of advanced research with methods of *semantic selection* (Wydro 2008).

Fulfilling of the pointed expectations may be done by adequate research and development entities working in proper interdisciplinary structures and co-operating with international ones. Achieved results in a broader depiction could also make a contribution to methodology of electronic communications systematising and rationalising in other branches of economy, what can be exploited at construction of various development plans in broadly understood electronic communication in information society.

REFERENCES

CEN Technical Committee 278, www.cen.eu/cenorm/sectors/ technicalcommitteesworkshops.

Gut H., Wydro K.B. 2010 eCall system as an equipment of the intelligent vehicle, Magazyn Autostrady, 1-2/2010 (in Polish).

Haremza P., Obcowski D. 2008. OCIT protocol as an international standard enabling integration of the solutions and sub-systems in road traffic control, First Polish Congress of ITS, Warszawa, (in Polish).

ISO Technical Committee 204, www.iso.org/iso/ standards development /technical _committees.

IST-FRAME. 2004. *Planning a modern transport system. A guide to Intelligent Transport System Architecture*, DG T&E, Brussels.

NTCIP 9001. 2009. *National Transportation Communications for ITS Proto*col, American Association of State Highway and Transportation Office, Washington DC.

Report. 2009 *Problems of transport telematics development*, NIT, Warszawa (in Polish).

TPEG, www.ebu.ch/en/technical/projects/b_tpeg.php

Wydro K.B. et al. 2003: *Analisis of the flows of information in ITS* , NIT, Warszawa (in Polish).

Wydro K.B. 2009. *Some problems of information exchange in transport telematic systems,* IX International Conference "Transport Systems Telematics", Katowice – Ustroń.

Wydro K.B. 2006. *Telematic techniques in transport* , Multi-annual program"Development of telecommunications and posts in information socjeit era, NIT, Warszawa (in Polish).

Wydro K.B. 2009. *Inteligent transport systems – an outline of problems*, Magazyn Autostrady, 3, 4, 5/2009 (in Polish)

Wydro K.B. 2008. *Information – features, basic technologies, usage*, Obserwacje - Wydawnictwo Naukowe, Warszawa (in Polish)