Application of transport telematics in the cities

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ABSTRACT
Actual problems of transport information centres introduction have been described in this paper. The growth of vehicles number in the Czech Republic in recent years is evident. Road construction is time-consuming and very costly. An advanced telematics system solution should be applied. Information is now more important for drivers. The traffic congestions are an important problems for drivers. However the drivers can accommodate their own way and save time using traffic information. Time saving impacts on economy, accident frequency and last but not least on the environment. Current technical solutions can get authentic information, which other entities can provide to the users. The main problems are the functional interconnection of traffic information and distribution of existing traffic information to drivers.

KEYWORDS: application of transport telematics, transport information centres, traffic information

1. Introduction
Traffic information is a highly-valued instrument for traffic network capacity improvement. Final costs are incomparably smaller than costs of new roads and tunnels construction. Providing the traffic information cannot substitute missing roads, tunnels and bridges, but can relieve current roads. The effect of traffic relief using traffic information is very important on overloaded roads or roads with unexpected traffic problems.

2. Unified system of traffic information
Many entities of public administration and other entities of public and private sector can work with various types of traffic information. The government of Czech Republic passed resolution No. 590 of 18th May 2005 on the implementation of Unified System of Traffic Information.

The aim is a coordinated utilization of information for the benefit of public administration agencies, road users, the media, the carriers and other users including cross-border exchange of traffic information with neighbouring states or EU member states. The guarantors of provided information are mainly the public administration authorities (CR Police, Fire Brigade, road administration authorities, road administrators and other entities).

Disclosure of the guaranteed traffic information to other entities has significant benefits to resolve the following problems:
- traffic safety,
- influence on road users behaviour,
- improvement to road traffic continuity.

The unified system of traffic information enables:
- implementation or control of the process to eliminate limiting events on a current basis,
- informing all traffic system users of limiting events,
- process optimisation and introduction of support for informing.
• analysing recurrence causes of limiting events and taking measures to eliminate these events.

Data and information sources as well as data and information outputs are illustrated in fig. 1. Complex information is provided to the public through http://dopravniinfo.cz web pages.

The final aim of built Unified System of Traffic Information in the Czech Republic is publication or distribution of traffic information. This information about all types of events increases traffic safety on all roads in the Czech Republic.

3. Traffic information centres

The hierarchy of traffic information processing and providing is represented in the Czech Republic by the following items:
• National traffic information centre in Ostrava,
• Regional traffic information centres in Prague and Brno.

3.1. National Traffic Information Centre (NTIC)

The NTIC workplace works seven days a week, 24 hours a day, within the framework of the Unified System of Traffic Information for the CR, in close cooperation with the CR Police, Fire Brigade, health rescue services, road administrators, road administration authorities, operators of the town traffic information centres, tunnel control centres, operators of telematic applications and others. The NTIC collects processes and verifies the traffic information on accidents, closures, vehicle fires, faulty traffic lights, road negotiability or weather. The NTIC also controls the traffic through the telematic applications on the CR motorways.

The traffic information from the National Traffic Information Centre is:
• published on the equipment for information displaying (variable information boards) on the motorways and highways,
• transmitted together with Czech Radio by the RDS-TMC service for navigation instruments,
• published on the http://dopravniinfo.cz web pages, 
• provided based on a contract in the form of data through a distribution interface to further interested persons from the radio stations, TV stations, telecommunication operators, internet portals, operators of traffic information services and other consumers.

The traffic information from the NTIC is also displayed in the information systems of dispatchers of the health rescue services and other components of the crisis management to optimize the access routes at rescue events.

National Traffic Information Centre includes three major subsystems with related functions:
• dispatcher supervision,
• traffic control,
• traffic and control information.
• Further subsystems include:
  • system management,
  • analytic applications for traffic engineers.

3.1.1. Current range of provided information

The traffic information from the National Traffic Information Centre is published on the web pages of the Road and Motorway Directorate of the Czech Republic in the section of traffic information. This information is divided into categories (see below) and is related to concrete motorway or concrete region. It is usually the information about 1st Class roads and 2nd Class roads.

Road closures

Information about motorways and highways closures is provided to Centres of Administration and Maintenance of Motorways and Centres of Administration and Maintenance of Roads with Limited Access on the basis of actual road works. Information is registered within the framework of the Unified System of Traffic Information for the CR (central registry of closures).

Central Registry of Closures (CEU) includes data about events within the highway and motorway road network in the entire Czech Republic area. Users can easily gain information about roads with traffic limitations in the country, regions and districts.

Road negotiability

Dispatchers distribute the information about winter road negotiability to road administrators in the whole Czech Republic. This information is assigned actually at
every weather change or practicability conditions and periodically every day in the standard time between 3 and 5 hours, 7 and 8 hours, 14 and 15 hours and between 18 and 20 hours. The information contains a weather report, road surface status and recommendation for practicability of the roads in a given region or in a given stretch of motorway and highway. The service is working only in the winter time.

Actual weather state

The information about meteorological conditions contains actual weather state in the location of relevant road weather station on concrete motorway or some highways. The information contains the air temperature, road temperature, classification of road surface status and potential rainfalls.

Traffic accidents

The information about traffic accidents, traffic barriers, vehicles fires and other traffic restrictions is entered by a constituent operating centre of the CR Police in the regions and districts. The CR Police perform accident’s location using GPS devices directly during the on-site investigation. Accident place coordinates are then entered into the Uniform Traffic Accident Location system. The software locates the place on the map and provides further data for exact accident location.

Closed-circuit television (CCTV) camera

So far the closed-circuit television (CCTV) cameras catch periodically update static pictures from the camera system only on the motorways (D1 and D8). The system cameras are static as well as mobile and transfer pictures from sections of long-term closures.

Information boards

Information boards are installed on motorways (D1 and D8) and highway (R35) and display the state of traffic situation on the next section of the road. This is information about traffic accidents, traffic barriers, vehicle fires, maintenance works, meteorological conditions. The travel time information is displayed on the motorway D8, too.

4. Possibility of traffic information evaluation importance and influence of information on the reliability of transport in terms of reducing potential risks

The traffic information centre is an information system integrating and processing the current traffic information from different sources. After that the traffic information centre provides traffic information by media to the general public. The traffic information supports person’s decision pre-trip and on-trip. Those decisions allow moving from place A to place B as fast, as comfortably, and as cheaply as possible. On the other side the traffic information improves the infrastructure utilization.

The usefulness of the information provided through the NTIC information system may be demonstrated using the diagram of risk. The situation without utilization of information provided before the trip and during the trip is evaluated there. This is a situation where neither the driver nor the operator has any information about the route capacity with regard to meeting the delivery time.

Table 1. Results of undesirable situation

<table>
<thead>
<tr>
<th>Results of undesirable situation (C)</th>
<th>C1</th>
<th>increase in transportation costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>C2</td>
<td></td>
<td>the transport time overrun, delay in delivery time</td>
</tr>
<tr>
<td>C3</td>
<td></td>
<td>the transport time overrun and carriage by a replacement vehicle</td>
</tr>
<tr>
<td>C4</td>
<td></td>
<td>failure of carriage</td>
</tr>
</tbody>
</table>

Table 2. Information request mode

<table>
<thead>
<tr>
<th>Information request mode (F)</th>
<th>F1</th>
<th>A single information request</th>
</tr>
</thead>
<tbody>
<tr>
<td>F2</td>
<td></td>
<td>Information requested continuously</td>
</tr>
</tbody>
</table>

Table 3. Avoiding an undesirable situation

<table>
<thead>
<tr>
<th>Avoiding an undesirable situation (P)</th>
<th>P1</th>
<th>possible under certain conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>P2</td>
<td></td>
<td>almost impossible</td>
</tr>
</tbody>
</table>

Table 4. Undesirable situation frequency

<table>
<thead>
<tr>
<th>Undesirable situation frequency (W)</th>
<th>W1</th>
<th>very low</th>
</tr>
</thead>
<tbody>
<tr>
<td>W2</td>
<td></td>
<td>low</td>
</tr>
<tr>
<td>W3</td>
<td></td>
<td>relatively high</td>
</tr>
</tbody>
</table>

Fig. 2. Diagram of risk
4.1. Diagram of risk

The diagram of risk is a qualitative method for determination of the level of risk. The level of risk determines the necessity of taking measures to improve the reliability of transport. This measure is the use of information provided through NTIC.

The diagram of risk contains a number of parameters, which together characterize the basic features of undesirable situation [3]:

- results of undesirable situation (C),
- information request mode (F),
- avoiding an undesirable situation (P),
- undesirable situation frequency (W).

The following categories of risk parameters (see tables 1-4) are defined to determine the level of risk.

For option P1 (avoiding an undesirable situation is possible under certain conditions) all the following conditions must be satisfied:

- the possibility of alerting drivers of the presence of undesirable situation,
- the possibility of undesirable situation prevention,
- sufficient time to prevent an undesirable situation.

Diagram of risk for the above mentioned parameters is shown in fig. 2. Using of risk parameters C, F, P leads to one of the eight outputs. Each of these outputs is mapped into one of three scales (W1, W2 and W3). Each value of this scale determines the level of risk. Level of risk determines the necessity of taking measure to improve the reliability of transport.

The method is used in the following practical examples.

Example 1

Neither the driver nor the operator has any information about the closure of a section of transport route during the planning of transport (before the trip). Classification of individual risk parameters for this example is shown in Table 5 and diagram of risk in fig. 3. Fig. 3 shows that the situation reaches the level of risk 1 – it is necessary to take a measure to improve the reliability of transport.

Example 2

The driver or the operator has information about the closure of a section of transport route. This information is provided through the NTIC information system during the planning of transport (before the trip). Classification of individual risk parameters for example 2 is shown in Table 6.

Table 5. Classification of individual risk parameters for example 1

<table>
<thead>
<tr>
<th>Risk parameters</th>
<th>Cat.</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Results of undesirable situation (C)</td>
<td>C2</td>
<td>The transport time overrun, delay in delivery time (C2).</td>
</tr>
<tr>
<td>Information request mode (F)</td>
<td>F1</td>
<td>During the planning of transport (before the trip) the information is requested by a single [driver] (F1).</td>
</tr>
<tr>
<td>Avoiding an undesirable situation (P)</td>
<td>P2</td>
<td>Almost impossible (P2).</td>
</tr>
<tr>
<td>Undesirable situation frequency (W)</td>
<td>W2</td>
<td>Low (W2).</td>
</tr>
</tbody>
</table>

Table 6. Classification of individual risk parameters for example 2

<table>
<thead>
<tr>
<th>Risk parameters</th>
<th>Cat.</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Results of undesirable situation (C)</td>
<td>C1</td>
<td>Increase in transportation costs (C1).</td>
</tr>
<tr>
<td>Information request mode (F)</td>
<td>F1</td>
<td>During the planning of transport (before the trip) the information is requested by a single [driver] (F1).</td>
</tr>
<tr>
<td>Avoiding an undesirable situation (P)</td>
<td>P1</td>
<td>Possible under certain conditions (P1).</td>
</tr>
<tr>
<td>Undesirable situation frequency (W)</td>
<td>W2</td>
<td>Low (W2).</td>
</tr>
</tbody>
</table>
of individual risk parameters for this example is shown in Table 6 and diagram of risk in Fig. 4. Fig. 4 shows that the situation does not require any measure. The use of information about the closure of a transport route section results in improvement in the reliability of transport.

Example 3
The driver is on the way and the recipient is informed about the delivery time but neither the driver nor the operator has any information about the closure of a transport route section. Classification of individual risk parameters for this example is shown in Table 7 and diagram of risk in Fig. 5. Fig. 5 shows that the situation reaches the level of risk 2 – it is very necessary to take a measure to improve the reliability of transport.

Example 4
The driver is on the way and the recipient is informed about the delivery time and the driver or the operator has information about the closure of a transport route section. This information is provided through the NTIC information system during the transport (during the trip). Classification of individual risk parameters for this example is shown in Table 8 and diagram of risk in Fig. 6. Fig. 6 shows that the situation does not require any measure. The use of information about the closure of a transport route section results in significant improvement in the reliability of transport.

Example 5
The driver is on the way and the recipient is informed about the delivery time but neither the driver nor the operator has any information about black ice on the route. Classification of individual risk parameters for this example is shown in Table 9 and diagram of risk in Fig. 7. Fig. 7 shows that the situation reaches the highest level of risk 4 – it is essential to take a measure to improve the reliability of transport.

Example 6
The driver is on the way and the recipient is informed about the delivery time and the driver has information about black ice on the route. This information is provided through the NTIC information system during the transport (during the trip). Classification of individual risk

Table 7. Classification of individual risk parameters for example 3

<table>
<thead>
<tr>
<th>Risk parameters</th>
<th>Cat.</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Results of undesirable situation (C)</td>
<td>C2</td>
<td>The transport time overrun, delay in delivery time (C2).</td>
</tr>
<tr>
<td>Information request mode (F)</td>
<td>F2</td>
<td>During the transport (during the trip) the information is requested continuously (F2).</td>
</tr>
<tr>
<td>Avoiding an undesirable situation (P)</td>
<td>P2</td>
<td>Almost impossible (P2).</td>
</tr>
<tr>
<td>Undesirable situation frequency (W)</td>
<td>W2</td>
<td>Low (W2).</td>
</tr>
</tbody>
</table>

Table 8. Classification of individual risk parameters for example 4

<table>
<thead>
<tr>
<th>Risk parameters</th>
<th>Cat.</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Results of undesirable situation (C)</td>
<td>C1</td>
<td>Increase in transportation costs (C1).</td>
</tr>
<tr>
<td>Information request mode (F)</td>
<td>F1</td>
<td>During the planning of transport (before the trip) the information is requested by a single [driver] (F1).</td>
</tr>
<tr>
<td>Avoiding an undesirable situation (P)</td>
<td>P1</td>
<td>Possible under certain conditions (P1).</td>
</tr>
<tr>
<td>Undesirable situation frequency (W)</td>
<td>W2</td>
<td>Low (W2).</td>
</tr>
</tbody>
</table>
parameters for this example is shown in Table 10 and diagram of risk in fig. 8.

Fig. 8 shows that the situation reaches the level of risk 1. The use of information about black ice on the route results in significant improvement in the reliability of transport.

Examples 1-6 illustrate the possibility of importance of traffic information evaluation and influence of information on the reliability of transport in terms of potential risks reduction.

5. Conclusion

Congestions are rife in the cities but road building in many cases is unrealistic. That is why there are telematic applications and the traffic information centre where the information is gathered from different sources, processed, integrated and distributed to the public. Traffic information helps the drivers before and during the trip. It is beneficial for road administrators, too, because it supports simple and efficient entering of planned and emergency road closures into the unified system. Mutual coordination of roads closing is significantly simpler. The use of traffic information leads to the increase in traffic continuity, congestion reduction, increase in road traffic safety and reduction of attendance time for vehicles of joint rescue service.

Bibliography