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Recent trends in on-line passenger information systems

Abstract: Passenger Information systems are one of the most significant aspects of carrier's offer and affects on his attractiveness. Lately it is noticeable strong development of: on-line tickets platforms, information applications etc. There are also a lot of options of buying on-line tickets, dynamic sales system. Together with growth of society's mobility and development of mobile devices this kind of amenities are particularly important. The aim's of paper is make a review of actual trends in that themes. Additionally, authors will point out this elements which are affecting on sales system's functionality.

Key Words: Passenger information; Systems of train (bus) schedules; Public transport

Introduction

Passenger information is an essential element influencing the availability and quality of public transport [6]. In the era of universal access to the Internet and mobile devices an important role plays electronic form of communication of information about the activities of transport. Different sites offer more advanced tools that help people to plan a trip. More often apart from the possibility of checking timetables, routes and travel time, you can also use the extensive search connections, platforms purchase tickets online or tools to inform about the current location of the vehicle and possible delays. Internet usage in relations with the passenger becomes a standard and hauliers, who remained only the traditional form of information are exposed to marginalization, which in turn translates into a decrease in their competitiveness compared to other transport companies.

Particular sites differ from each other significantly at the level of progress and the severity of system content. The aim of this article is to review and evaluate selected elements of the systems web passenger information that affect the functionality and efficiency of the use of the service. In addition, current directions of development and current trends in this form of data transmission will be defined. This type of studies are relatively new area of interest in publications related to the subject of the information in public transport, which has so far focused mainly on its traditional forms. One of the first attempts to review the techniques and define the role of the Internet information in public transport was the study of Dumpty K. and B. Molecki [3]. Another developments were mostly related to analyzes the use of modern tools, devices and applications in passenger information [2] [4], [7]. Due to the high dynamics of change in this area, continuous updates of research are required, what the authors aim in this article.

Schedule

The main task of passenger information systems is to provide data on hours of departures or arrivals of individual public transport connections. This information may be available through the connections researcher or traditional schedule, in linear or substation form (Fig.1.)



1. Forms of of sharing information about public transport connections. (Source: own)

Connections researcher are the most advanced form of data presentation about the offer of public transport. It is an analytical tool that bases on specific criteria selected by passenger, choose the best connection according to preferences. This is the simplest and most flexible form of search connections through which you can save the time needed for analysis, often many, distinct schedules.

It is worth emphasizing that the researchers function in two versions, which the study defined as: their own and collective. The first type are researchers created by the administrator of the website, presenting the combination of one, specific shipping company. The second type are collective browsers, which usually have information about the connections of many transporters to which the passenger may also be diverted from other addresses.

The basic criteria that a search engine user must specify are: start and destination, as well as the exact date of departure. More often there are additional options, so that you can determine the preferences concerning to comfort, time for a change or the speed of travel. Most often advanced browsers appear on popular sites for comprehensive information on the different transporters (e.g. www.pkp.pl). Browsers on these pages allow selection of transporters or means of transport, the choice of rolling stock adapted to transport people with disabilities or other facilities (e.g. train with seat reservation; available sleeping cabs). An interesting idea is a system of modes proposed in the site www.jakdojade.pl, where the traveller determines whether he cares about comfort, short travel time, or want to select the optimum combination that satisfies both criteria.

The second type of information about the connections of public transport are the traditional timetables, which can be divided into line and substation. Linear schedules present us a whole line of communication (i.e. the line table) with individual stops, with certain hours of departure. A specific type of linear schedules are schedules of public transport, where, due to the large number of courses, timetables and stops we have given in two different parts of

the distribution. Line timetables largely relate to the former collective "Network Timetable Trains," which in the form of books published every year, presented the rail connections by specific route.

At transporters sites we can see two basic types of linear schedules. The first, developed by the carriers, only the line at which it transports and usually are listed only their own trains. The second, in turn, is published online by PKP Polish Railway Lines, where is a possibility to download a particular table for the relevant line. In the first type of linear distribution, there is a distinct lack of completeness of the information on lines which transports also carry other carriers. Only one company Koleje Dolnoslaskie publishes a general "Timetable of Dolnoslask", where apart from trains, the company provides information of regional trains (Regional Transport) and higher categories (PKP Intercity). It is very useful solution in context of a comprehensive passenger information on a specific line of communication.

Stational schedules in turn represent all connections departing with the stop or station. They are domain of rail portals and bus transporters in large cities. Regardless of the type of carrier, the important issue of distributions station is illegible information contained therein. This is contrary to the basic functions that should serve timetables, namely accessibility, readability and ease of remember [5]. The primary disadvantage is the excess lettering and digital for this type of schedule (Fig.2.). In many cases, at the time of departure, we have several different signs, the importance of which should be found in the extensive legend. Moreover, it happens that the signs are mutually exclusive which introduces confusion among passenger. In addition, these distributions are usually published on its entire duration, but often during this time are expected multi-day repair work or other difficulties and changes, during which the means of transport departs at other times. As a result, the timetable we have a few new connections about similar times, and only after a very careful analysis it can be deciphered the dates and times of the particular course (Fig.3.). This affects the disturbance of receipt of information by the passenger in context of the overall running of trains on the line. Repeatedly specify a train due to variations scheduled, they give a false idea of a more extensive range of communication, which is contrary to the actual range of the carrier.

I - nie kursuje 26 XII	1 - nie kursuje 25-27 XII, 1-2 I, 1 i 8 dzień Wielkanocy
J - nie kursuje 1 XI	2 - nie kursuje 2 I
K - nie kursuje 20 XII, 1 i 1 i dzień Wielkanocy	3 - nie kursuje 15 VIII, 1 XI, 25-30 XII 2015, 1-2 I, 26-28 III, 1-2 V, 27-28 V 2016
L - nie kursuje 31 XII	4 - kursuje od 1 IX do 30 VI, nie kursuje 24-31 XII 2015, 1-2 I, 30 IV, 1-2 V, 28 V 2016
M - kursuje 10 XI 2016r, 2 i 6 I, 2 V, 27 V, 31 X 2016,	5 - kursuje 11 XI 2015, 6 I 2016r.
N - nie kursuje 24 i 31 XII	6 - kursuje od 4 VII do 30 VIII
O - nie kursuje 24 i 31 XII oraz w Wielką Sobotę	7 - kursuje od 1 X do 31 V
P - kursuje w piątek, sobotę, niedzielę i święta w okr. 1 IX do 15 VII	8 - kursuje od 29 VI do 30 VIII
Q - kursuje od 1 X do 15 VI	9 - kursuje od 26 VI do 30 VIII
R - nie kursuje w okresie ferii zimowych oraz szkolnych przerw świątecznych	10 - nie kursuje 15 VIII, 1 i 11 XI 2015, 1 i 6 I, 1, 3 i 15 V, Boże Ciało 2016
S - kursuje w czasie trwania roku akademickiego (1 X - 30 VV)	11 - nie kursuje 2 i 27 V 2016
T - nie kursuje w Wielką Sobotę	12 - kursuje od 1 VII do 30 VIII 2015
U - nie kursuje 2 V, 27 V 2016	13 - nie kursuje 15 VIII, 1 XI, 26 XII 2015, Wielką Sobotę, II dzień Wielkanocy, 1 V 2016
W - nie kursuje w dzień Bożego Ciała	14 - nie kursuje 15 VIII, 1 XI, 25-27 XII 2015, 1-3 I, 26-28 III, 1-2 V, 27-29 V 2016
Z - nie kursuje w piątek po dniu Bożego Ciała	15 - skomunikowany w Odolanowie z kursem do Ostrowa
AA - kursuje od 15 XII do 31 III	16 - nie kursuje 15 VIII, 11 XI 2015, 6 I, 1 i 26 V 2016
AB - nie kursuje od 1 VII do 31 VIII	17 - kursuje od 2 V do 30 IX
AC - kursuje od porzedzialku do piatku oraz w niedziele	18 - kursuje dodatkowo 1 I, II dzień Świąt Wielkanocy i 11 XI
AD - kursuje w soboty, niedziele i święta	19 - kurs z przesiadką w Niebylcu
AE - kursuje od porzedzialku do piatku oprócz świąt	20 - kursuje od 26 VI do 28 VIII
AF - kursuje od porzedzialku do soboty oprócz świąt	21 - kursuje w soboty, niedziele od 1 IV do 14 XII
AG - kursuje w okresie wakacji i ferii oraz szkolnych przerw świątecznych	22 - kursuje w II dzień świąt Wielkanocy i 3 V, nie kursuje w I dzień Wielkanocy 1 V i 1 XI
AH - kursuje od 15 IV do 30 IX	23 - nie kursuje 23, 30 XII

2. A fragment of departure schedules signs of the bus station in Wroclaw (source: www.polbus.pl, access: 15.12.2015 r.)

1:00	III 6	IC - IC 83200 ORION	Opole Główne 1:48, Kędzierzyn-Koźle 2:32, Gliwice 3:07, Zabrze 3:18, Katowice 3:35, Mysłowice 4:12, Jaworzno Szczakowa 4:26, Trzebinia 5:01, Krzeszowice 5:24, Kraków Główny 6:06, Kraków Płaszów 6:47, Bochnia 7:13, Brzesko Okocim 7:24, Tarnów 7:48, Dębica 8:20, Sędziszów Małopolski 8:41, Rzeszów Główny 9:00, Łańcut 9:12, Przeworsk 9:26, Jarosław 9:38, Przemyśl Zasanie 10:08 Przemyśl Główny 10:13 14 XII 2015-12 III 2016 / 25 XII 2015, 1 I 2016; ni - na wybranych odcinkach.
1:00	III 6	IC - IC 83200 ORION	Opole Główne 1:48, Kędzierzyn-Koźle 2:32, Gliwice 3:07, Zabrze 3:18, Katowice 3:35, Mysłowice 4:12, Jaworzno Szczakowa 4:26, Trzebinia 4:55, Krzeszowice 5:17, Kraków Główny 5:53, Kraków Płaszów 6:10, Bochnia 6:36, Brzesko Okocim 6:45, Tarnów 7:03, Dębica 7:28, Sędziszów Małopolski 7:44, Rzeszów Główny 8:02, Łańcut 8:16, Przeworsk 8:30, Jarosław 8:42, Przemyśl Zasanie 9:12 Przemyśl Główny 9:17 13 III 2016; ni - na wybranych odcinkach.
1:00	III 5	IC - IC 83200 ORION	Opole Główne 1:48, Kędzierzyn-Koźle 2:32, Gliwice 3:05, Zabrze 3:16, Katowice 3:33, Mysłowice 4:12, Jaworzno Szczakowa 4:26, Trzebinia 4:51, Krzeszowice 5:15, Kraków Główny 5:50, Kraków Płaszów 6:11, Bochnia 6:37, Brzesko Okocim 6:48, Tarnów 7:08, Dębica 7:36, Sędziszów Małopolski 7:58, Rzeszów Główny 8:43, Łańcut 8:55, Przeworsk 9:10, Jarosław 9:23, Przemyśl Zasanie 10:01 Przemyśl Główny 10:06 14 III-30 IV 2016 / 27 III 2016; 5-26 V 2016; 31 V-25 VI 2016; 6 IX-10 XII 2016; ni - na wybranych odcinkach.
1:00	III 5	IC - IC 83200 ORION	Opole Główne 1:48, Kędzierzyn-Koźle 2:32, Gliwice 3:05, Zabrze 3:16, Katowice 3:33, Mysłowice 4:12, Jaworzno Szczakowa 4:26, Trzebinia 4:51, Krzeszowice 5:15, Kraków Główny 5:50, Kraków Płaszów 6:11, Bochnia 6:37, Brzesko Okocim 6:48, Tarnów 7:08, Dębica 7:36, Sędziszów Małopolski 7:58, Rzeszów Główny 8:43, Łańcut 8:55, Przeworsk 9:10, Jarosław 9:23, Przemyśl Zasanie 10:01 Przemyśl Główny 10:06 1-4 V 2016; 27-30 V 2016; 26 VI 2016; 27 VI-5 IX 2016;

3. Fragment of the stationnal schedule for the station Wrocław Główny. (Source: www.portalpasazera.pl, access: 15.12.2015 r.)

Today, more and more often attempts a comprehensive approach to systems, passenger information website. An example is the portal www.e-podroznik.pl, which has information about most bus and train connections. On the the other hand at www.jakdojade.pl we can find information about timetables of public transport, suburban, regional and sometimes in selected Polish cities. In rail transport, an important element was the creation of a system SITKol (System Information Service of Railway Transport) [1]. Today it is a system having the fullness information about all connections of rail transport in Poland and Europe, and the target range is to be extended to other modes of transport [8] The implementation of this project would be an important step towards the unification of the different sites of public transport and the creation of a single, transparent passenger system. This would avoid a number of problems with the reception of the information mentioned above.

In case of mobile services is worth paying attention to application "myBus online", which was awarded at the International Fair of Public Transport Transexpo in 2013. There are presented the timetables of public transport for 34 Polish cities, and in general they are not smaller towns, which do not include other information systems (such as www.jakdojade.pl). Importantly, the application shows the real state of the communication system and not with theoretical timetable. The information is constantly updated and identical to those displayed on electronic boards within the stops.

Purchase of tickets

Another element of utility associated with the operation of public transport are platforms with purchasing tickets online. These days they are very important element in building transport offer of a particular transporter and influencing its attractiveness. Ticket purchase can be done either on the carriers site (Fig.4) as well as on sites of collective transport (e.g. www.e-podroznik.pl) (Fig.5).

Wyniki wyszukiwania

Kliknij na ⓘ i zapoznaj się z informacją o wybranej linii

Wybierz	Szczecinek	Data wyjazdu	Czas podróży	Linia	Cena
WYBIERZ	SZCZECINEK	05:45 - 16.12.2015 Biało Podlaska ul. Zeromskiego Przyjazd 06:40 - 16.12.2015 Siedlce Dworzec Autobusowy	00hrs 55min	P27 Przysiężona	1 liczba pasażerów 5,00zł
WYBIERZ	SZCZECINEK	09:00 - 16.12.2015 Biało Podlaska ul. Zeromskiego Przyjazd 09:55 - 16.12.2015 Siedlce Dworzec Autobusowy	00hrs 55min	P27 Przysiężona	1 liczba pasażerów 5,00zł
WYBIERZ	SZCZECINEK	12:00 - 16.12.2015 Biało Podlaska ul. Zeromskiego Przyjazd 12:55 - 16.12.2015 Siedlce Dworzec Autobusowy	00hrs 55min	P27 Przysiężona	1 liczba pasażerów 5,00zł

Wyjazd z *
Wyjazd do?
Przyjazd do?
Data wyjazdu *
Data powrotu
Kod promocyjny Użyj
Szukaj

4. Platform with on-line tickets at Polskibus.com (source: www.polskibus.com, access: 16.12.2015 r.)

Wrocław Główny - Warszawa Zachodnia

09:33 - 15:45
6h 12min

WROCLAW, Tymcz.D.A., Jeann...
10:00 - 15:30
5h 30min

5. An example of a collective search engine on www.e-podroznik.pl (source: www.e-podroznik.pl, access: 16.12.2015 r.)

In the area of rail transport, most carriers use the system to buy tickets online (except, i.a., SKM and the Warsaw Commuter Rail). In terms of rail connections, there is also the possibility of diversion from the search engine PKP (www.pkp.pl) to your specific carrier. In this case we can check the scheduled, along with the simultaneous purchase of the ticket. In case of bus transport, the situation is different. One of the most popular search engines schedules combined with the possibility of purchasing tickets on-line service is e-traveler (Fig.5). It allows you to buy tickets on selected courses, more importantly, some of the courses are have specific additional price promotions, discounts. Use your own platforms of purchase is particularly evident in the major carriers (including PolskiBus, Neobus, Albatros, Szwagropol) on regional transport market and national. Apart from web platforms possibilities have the option of booking a ticket by phone, but currently the system is used only by some bus operators.

A new feature is the possibility of showing the ticket on your mobile device. This form of ticket is currently widespread in most railway and bus transporters. In addition, some carriers do not even require presentation of the ticket, and the only element necessary to complete travel is reservation number (i.a., PolskiBus, AlbatrosBus). In case of mobile devices with Internet access, both selected transporters (including PKP Intercity, PolskiBus, Regional Transport) as well as the general's public transport (e-traveler) offer free mobile applications for download that allow an overview of the connections with option to purchase a ticket.

One of the modern applications, designed specifically for charges for public transport or car parks is "moBILET." After creating an account user must select the correct city, communication line and a ticket, and then use the funds in the account to validate ticket.

Importantly, the application works in offline mode, and Internet connection is done only by validation of the ticket, for which you have a strictly limited time in order to prevent fraud and dishonesty on the part of the passengers. It should also be noted that the communication charges are increasingly a part of other applications of wider application as "SkyCash" or "mPay," reflecting the high demand for such services.

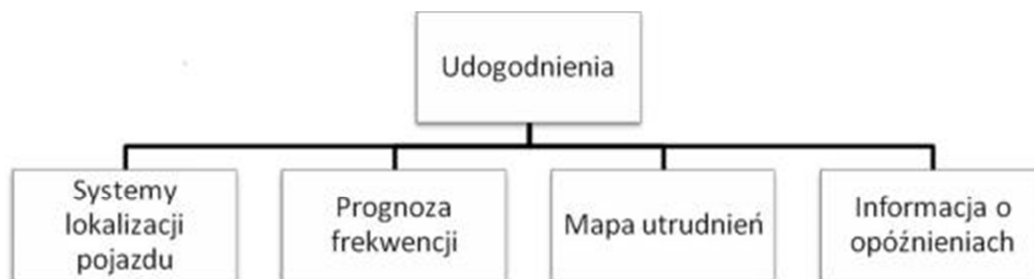
The system of purchasing tickets is a very important help for passenger, who can purchase a ticket virtually any time. Unfortunately, in the context of purchasing platforms currently exist a number of unworthiness. The most important should be the inability to purchase a ticket with change and on different carriers. The latter element requires improvement and the introduction in the framework of rail transport single comprehensive platform that allows the purchase of buying a ticket hub and route of different carriers. Currently, only a few carriers have introduced the possibility of buying a ticket with change (including the Regional Transport), but only in the framework of their operations. For other elements affecting the functionality of the system to purchase tickets should be included:

- the need to log into the system - depending on the specific carrier, you can purchase a ticket as the so-called. "Guest" without creating an account on the site, or registered user. The registration requirement can theoretically affect the negative, or at least inferior, assessment of a given system by the passenger,,
- the opportunity to learn the initial, approximate price in the first stage of the purchase,
- clarity and simplicity of interface- excess of the presented information (including train number, a group of carriages, terms of running) may affect the negative service reception by the passenger,
- the ease of possible returns and modification of the purchased ticket,
- lack of some promotions and discounts in commercial purchase platforms.

Also, if purchased tickets should mention the need for standardization of each system within the framework of the offered types of tickets. Transporters may offer purchase of only single tickets, but the complexity of passenger service should be based also on the purchase option of monthly and group tickets.

Modern solutions of passenger information

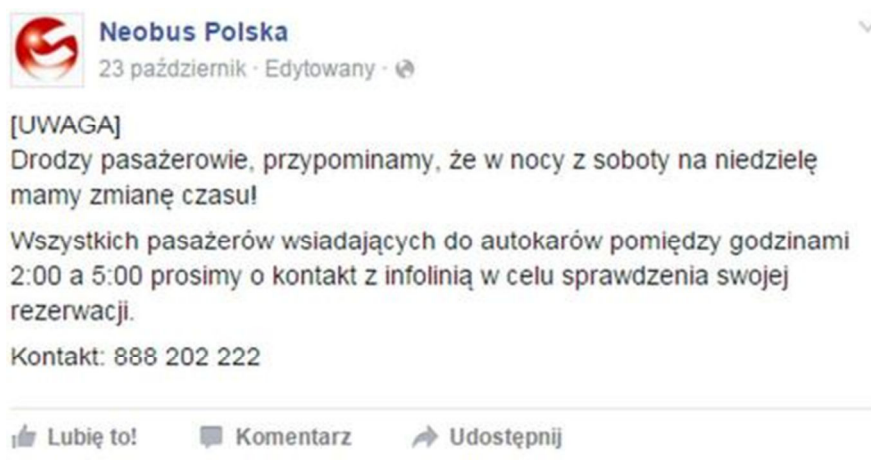
Apart from traditional elements associated with passenger information such as search of connections or the ticket purchase, with increasing mobility of society, there are new solutions to improve passenger service (Figure 6). It should be noted that the development of such systems mainly concerns the phase journey itself, not a period before the trip as in the case of other elements.



6. Modern web applications of passenger information systems used in the stage of the journey (source: own)

First of all, attention should be paid to the significant differences in this field between bus and rail transport . Bus transport is characterized by a deficiency of central coordination in the field of passenger information. Each carrier introduces elements inform passengers

about the difficulties, changes in real time on their own. For this purpose are used different ways of communication, i.e.: SMS system of newsletters, e-mail notifications or delivery delays and difficulties on the side of corporate portals communities (Fig.7 i 8).



7. Examples of messages posted on the social network site on NeoBus fanpage (source: www.facebook.com, access: 16.12.2015 r.)



8. Examples of messages posted on the social network site on Beskid fanpage (Source: www.facebook.com, access: 16.12.2015 r.)

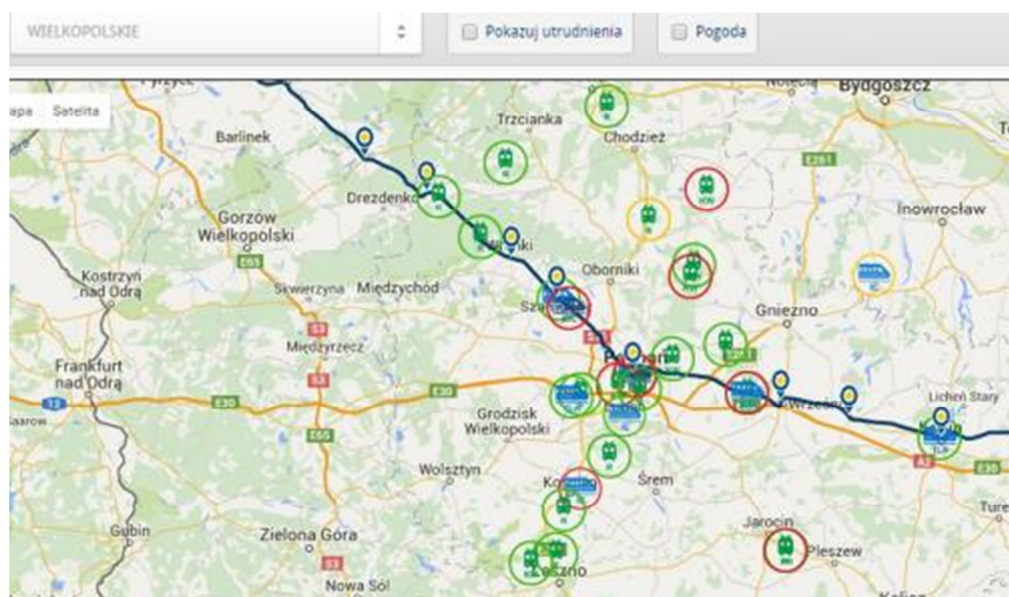
In case of an SMS newsletter is required prior registration (sending an SMS with "order information"). In case of e-mail information is sent (PolskiBus, Neobus) to the email address given when purchasing the ticket.

In addition, bus companies provide information about changes in the timetable, tours etc. on their websites, but most often they relate to long-term modification by the journey and not the information in real time. Often profiles on social networks also make it possible to ask questions by passengers and receive answers relatively quickly. Usually, these are the doubts of passengers related to aspects of the rules of transportation, ticket prices and timetables.

In case of rail transport possibilities of obtaining information during the journey are more developed. As part of the navigation systems and the associated location of trains on the

map, passengers can take advantage of the parties to specific transporters or central application within the PKP Polish Railway Lines. The disadvantage of location and navigation within a single carrier is no consideration of other railway vehicles. This is about the lack of functional completeness of the above. systems. Location in this case can have a dual nature: graphic (shown in the map) or text (e.g. the table).

Within the central system coordinated by PKP (fig.9), you can preview a specific area, and trains in the route, and each warehouse separately. The biggest disadvantage is the ability to choose only one province, and therefore there is no possibility of a comprehensive preview of the whole country. Passengers on the map is able to route besides also check the timetable, the number, the category of the train.



9. Vehicle location (PKP PLK) in the Wielkopolska Region. (continuous line marked the route of the train TLK; delayed trains are marked with red colour) (source: www.portalpasazera.pl, access: 16.12.2015 r.)

Apart from possibilities of checking transit times, in case of trains covered by the reservation of PKP Intercity, there is a possibility to get acquainted with the anticipated attendance on selected trains. The carrier based on the number of tickets sold publishes estimated turnout in three ranges: over 80%; between 50 and 80% and below 50%. Although this is only an estimate of occupancy of trains is undoubtedly a useful information for the potential passenger.

The information system about difficulties in train traffic is associated with the previously discussed system of vehicles location. When you select a map option "Show inconvenience" the system generates, signature mark on the map, only in the selected region. They may involve long term difficulties (e.g. the introduction of substitute transport on the section of the route) or incidents that affect the punctuality of trains (e.g. the failure of rolling stock or signaling equipment). The system also informs the passenger about expected length and scale length of impediments. This solution is undoubtedly useful for passenger, but note that this information is approximate and their accuracy is not perfect yet. There are inaccuracies, consisting in the fact that the train which has reported a delay, in fact, is going according to plan. Therefore, it is evident that the application of delays still requires a lot of work on the reliability of the presented information.

Apart from information provided in the graphic form - on the map, there is also a demonstration of the system delays for specific stations and trains. It is created by PKP Intercity system infopasażer (www.infopasażer.intercity.pl), in which you select a particular station and trains, which will pass through it, along with information about a possible delay are displayed. Additionally, you can preview a specific timetable composition and its delay. In the first phase of the system they have been given all the trains (even those which have not left the road), which positively affect the functionality of the system. Currently, information is published only about the trains that are on the road, or start running in a short period of time, which in turn can be considered to improve the readability of the system. Similar in case of maps difficulties, the reported information also should be considered approximate. They are largely dependent on the information aspects, among others, introducing into the system a specific train and can provide only approximate information for the passenger. Currently, the system does not include in the information Railway Malopolska and the Warsaw Commuter Rail, and that is why information in this case is not complex.

Summary

An overview of web systems passenger information allowed the identification of recent developments in this field. First, it clearly begins to dominate the tendency to use the search engine connections. They become, if not the only, then certainly the most exposed form of communication connection information on a web page. Admittedly this is the most convenient tool, but it is worth noting that the search engines limit the passengers the opportunity to offer a holistic view on a particular route. Therefore, it seems that the most optimal solution is a situation where on the website we have both the search engine and timetable in the traditional form (linear). In addition, the focus should be on improving the readability of these timetables, which instead of facilitating understanding the functioning of public transport on a specific route, often bring confusion.

Another trend in the web systems of passenger information is the ability to purchase a ticket online, which together with the development of platforms is very advantageous solution for the passenger. Such solutions transform the process of liquidating stage of the journey to buy tickets at the ticket office and the associated loss of time.

An important step towards the development of web systems of passenger information is to use more and more advanced applications. With these elements transporters offer fullness of knowledge about the actual location of interest to us of possible delays or anticipated attendance. This gives you more control of travelling and strengthens the relationship between the passenger and carrier.

In summary, in web systems of passenger information dominates the tendency to simplify the process of planning a trip, and to increase contact with the passenger, both before the trip and during its duration. Unfortunately there is still lack of a comprehensive information system that would allow for the treatment of public transport as a whole, regardless of transporter. Individual companies continue to compete with each other, but a single, coherent information system can contribute to the popularity of public transport in general, which would be a positive development in the context of the increasing congestion and pollution.

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