DEVELOPMENT AND CONSTRUCTION OF AN ONLINE INFORMATION SYSTEM FOR RESERVATION IN PASSENGER RAIL TRANSPORT

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Abstract: The study presents the development of an online Information System for reservation of seats in passenger rail transport. Reservation systems in the European railway administrations have also been analyzed. The requirements for online information systems have been defined. The system contains administrative and user modules, and a timetable module. The system, which has been developed, can be used for making bookings on other modes of transport. It can also be used by private carriers in passenger transport. The system can be integrated into other reservation systems and may be used by private operators in passenger transport.

Keywords: RAIL TRANSPORT, INFORMATION SYSTEM, BOOKING, TRAIN, WAGON, PASSENGERS, RESERVATION, ONLINE, INTERNET

1. Introduction

Online information systems make the interaction between the carrier and the user of a transportation service in passenger transport possible. In general terms, they can be classified as systems for information about the timetable and the fares, and systems for reservation of seats. Online systems for reservation of seats are of great importance because through the interaction between the carrier and the user a particular purchase is made.

BDZ has an information system - “Electronic guide” about the train timetables and fares, which provides the clients of BDZ with the opportunity, via the Internet, to find out various possibilities of travelling by train, [5]. The implementation of an online system of selling electronic tickets would give BDZ a competitive advantage on the market of transportation services. BDZ has made an attempt in 2011 to introduce a hybrid system of reservation of tickets via the offices of “Rila” Ticket Agency but the process is rather clumsy and seems to make the reservation more difficult than easier, [1]. The aim of the study is to make an analysis of the system of reservation of seats in the European railway administrations, to define the requirements for that type of information systems and to develop an algorithm of an information system for reservation of seats in passenger rail transport.

2. Online portals of European Railway operators

In order to evaluate the state of the online information systems of the European railway administrations we have studied 26 European railway operators, Table 1.

- Austria. The site of ÖBB provides the following options for online purchase of tickets: electronic tickets, which are printed out; electronic tickets with electronic cards; electronic tickets for online purchase of tickets; electronic tickets, which are printed out; the tickets a certain number of tourist packages can be bought from the site.

- Bulgaria. The portal provides electronic tickets for printing out and such that are entered electronic cards. Apart from the tickets a certain number of tourist packages can be bought from the site.

- Germany. Deutsche Bahn provides electronic tickets for printing out, MMS tickets, tickets by mail delivery; SMS tickets whose price is either included in the bill of the mobile phone or is paid at special terminals at the railway stations. Apart from the various types of tickets, the site provides the service of buying cards with discounts and various package offers for holidays and cultural events.

- Belgium. The portal provides electronic tickets for printing out and such that are entered electronic cards. Apart from the tickets a certain number of tourist packages can be bought from the site.

- Greece. The portal of Greece provides reservations and payment of tickets online. Unfortunately, most of the site is in Greek, which makes it impossible to use by foreigners.

- Denmark. The Danish portal provides the option to use various kinds of transport when choosing an itinerary. An interesting option is that it shows the index of harmful emissions for each trip and compares them with those of travelling by automobile. Unfortunately, parts of the site are in Danish only, and although there is guidance how it is to be used in English, it is not easy to use. The electronic tickets, which have been bought, are printed out and are submitted for a check on the transportation vehicle.

Table 1. European railway operators

<table>
<thead>
<tr>
<th>Country</th>
<th>Railway operator</th>
<th>Site</th>
<th>Online booking</th>
<th>Online reservations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>ÖBB</td>
<td><a href="http://www.oebb.at/">http://www.oebb.at/</a></td>
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<td>no</td>
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<tr>
<td>Belgium</td>
<td>NMBS</td>
<td><a href="http://www.brakkelei.be/">http://www.brakkelei.be/</a></td>
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<td>no</td>
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<tr>
<td>Bulgaria</td>
<td>DB</td>
<td><a href="http://www.bahn.de/">http://www.bahn.de/</a></td>
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<td>no</td>
</tr>
<tr>
<td>Greece</td>
<td>GREECE</td>
<td><a href="http://www.greecetravel.gr/">http://www.greecetravel.gr/</a></td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
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</tr>
<tr>
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<td>Renfe</td>
<td><a href="http://www.renfe.com/">http://www.renfe.com/</a></td>
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<td>yes</td>
</tr>
<tr>
<td>Italy</td>
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<td>yes</td>
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<tr>
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<td>SNCF</td>
<td><a href="http://www.sncf.fr/">http://www.sncf.fr/</a></td>
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<td>no</td>
</tr>
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<tr>
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<td>yes</td>
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<td><a href="http://www.bahn.de/">http://www.bahn.de/</a></td>
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<td>no</td>
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<td>yes</td>
<td>no</td>
</tr>
<tr>
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<td>DB</td>
<td><a href="http://www.bahn.de/">http://www.bahn.de/</a></td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

- Ireland. In Ireland, electronic tickets for printing out are available, and they are in some cases cheaper that the tickets sold at the ticket offices.

- Spain. The whole site of Renfe is in Spanish. The site provides the purchase of electronic tickets online.

- Italy. Electronic tickets can be purchased as well as package options related to some trips. The electronic tickets are to be printed out.

- Luxemburg. Electronic tickets for travelling to neighbouring countries are sold.

- Norway. Tickets are provided for purchasing via smartphones. If the delay for the transfer is longer than 30 minutes the client gets a compensation. The system provides seats at an extra cost. It is possible to make hotel reservations too. The tickets that are bought can be used via a smartphone application or can be obtained from terminals at the railway stations.

- Poland. Online reservation of tickets is available, via the http://www.polrail.com/ site, which is an intermediary company.

- Portugal. Online electronic tickets for printing out can be bought. An interesting option is the possibility to buy tickets from ATMs.

- Romania. The online purchase of tickets is available via the http://www.circumlatori.ro/ portal. For tickets purchased in that way the clients get a discount of 5% off the price of the ticket.
• **Slovakia.** It is possible to buy tickets online.
• **Slovenia.** Clients are provided with a timetable only, without the option of making an online order or reservation of tickets.
• **Serbia.** Electronic tickets can be bought from the http://w3.srbail.rs/eticketing/ site, but only for trains to certain destinations. The electronic tickets are to be printed out and serve as a legitimate travel document.
• **Finland.** The electronic tickets can be printed out or received as an SMS.
• **France.** Online tickets are sold via the http://www.voyages-sncf.com/ portal. Tickets can be printed out or delivered by mail.
• **Hungary.** Only an online timetable and a few tours for tourists are on offer.
• **Holland.** Electronic tickets for printing out are available.
• **Croatia.** No online purchase of tickets is available.
• **Montenegro.** The site of “Railway Transportation - Montenegro” contains basic information on the statutory regulations in the country and PDF files with the routes available. Online tickets are not available.
• **Czech Republic.** A few types of electronic tickets for printing out are available.
• **Switzerland.** There are electronic tickets for printing out and mobile tickets for Smartphones.
• **Sweden.** Online purchase of electronic tickets is available. The analysis of the online portals of the European railway operators shows that the information systems in Western Europe and the Scandinavian countries are highly developed. Out of all the railway administrations, which have been studied, 77% of the countries have online systems for reservation of seats, Fig.1.

### 3. Requirements for the online systems for reservation of seats

An analysis of the data from the portals of the railway operators shows that a modern system of reservation of seats must have all or at least some of the following characteristics, fig.2:

- **Multilingualism**
  - Part of the users of the systems for online purchase of tickets are foreigners for whom, in some cases, the system is the only possibility of accessing the transport market in the country. The support of information in several languages requires greater resources and reduces the flexibility in supporting up-to-date information. That is why the choice of the languages to be used, should be done on the basis of an evaluation of the potential market. Almost all portals provide a version in English as it is the standard language on the Internet.

- **Mobile version**
  - Over the last few years the use of mobile devices has been increasing. That trend is quite natural bearing in mind the convenience and mobility of that type of devices. That is why it is necessary for the system to support mobile platforms. This can happen in several ways:
    - A basic site with an adaptable design, which can support both mobile and desktop devices. The advantages of this method are that only one site is developed and supported, which considerably reduces the costs and the time for developing and supporting it. On the other hand, the hybrid model has also certain limitations, which although in most cases can be overcome, make its development a bit difficult.
    - A separate version for mobile devices. That variant allows the developers some freedom in the development process of the two separate sites but makes its maintenance more complex and costly.
    - Mobile applications. The positive thing about that approach is the speed, transfer of a smaller amount of data over the distribution network and the possibility to provide functionality which is not available through the WEB browser. The disadvantages are the fragmentary ecosystem of mobile platforms and to make such a strategy effective it is necessary to develop applications at least for iOS and Android platforms, which have to be supported after that.
    - External developers. Since software development is rarely a priority for the railway operators, the task of developing a mobile version of the system can be commissioned to a third party. The best way to do this is to provide a program interface, the so called API system, which can be used freely by the developers so that they develop their own software product on the basis of the system.

- **Diverse methods of payment**
  - Successful payment is one of the main tasks of the system so the support of a variety of credit and debit cards is important for its usage. In Bulgaria possible ways of payment are:
    - ePay (http://www.epay.bg/). It supports the majority of debit cards issued in the country and require that the user has a registration;
    - eBg (http://www.ebg.bg/). It supports payment by Bulgarian debit cards and virtual credit cards;
    - EasyPay (http://www.easypay.bg/). It is a combined online charging and offline payment. A popular variant of payment for users without cards;
    - Virtual POS. It is provided by several banks, payment by international credit cards is accepted and usually no registration of the user is required;
    - Bank transfer. It is provided by every bank;
    - Payment on delivery. This is a widely used method of payment in Bulgaria when tickets are delivered;
    - PayPal (http://www.paypal.com). It is an international operator of payments by card, which is convenient for use by international clients;
    - SMS payment. For very small sums. They require that contracts are signed with all operators and a common system is developed. They are convenient for the users as they require only a mobile phone without any limitations regarding its operating system.

Out of this list of possible methods of payment it is necessary to choose not only one operator but all cost effective options since the different users use different ways of payment and have different preferences for the services available.
4. Travel documents

Producing a travel document which can be validated is one of the main tasks of the system. The following variants of documents are used:

- Electronic ticket. That is one of easiest ways of issuing documents. It is printed out as a form generated by the system, which includes travel information, the price of the ticket and information for office use only, which confirms the validity of the document. Generally, barcodes marked on the ticket are used to check its validity by the ticket inspectors. QR codes or a simple identification number, which is entered manually, can also be used. In order to use that method, the ticket inspectors must be equipped with devices with barcode readers. That allows them to check whether the ticket is unique, whether it has been issued for that particular train and for that particular data of travelling. The information in the devices can be synchronized after the reservation period has ended and before the train starts.

- Mobile ticket. It is issued by means of a special application for a Smartphone, which is the recipient of the data of the ticket. In this variant a printout is avoided and the check is most often done through an QR-code.

- SMS ticket. With that type of ticket the client receives a unique code from the system, which is sent as an SMS. The code is checked manually by the ticket inspector;

- Electronic cards. Usually, that is a magnetic card, which identifies the client in a unique way. When purchasing the ticket, the system signifies that a card can be used to travel on a particular date to a particular destination and that information is checked by the ticket inspector.

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5. Capability to combine it with other services and modes of transport

The need for a transportation service rarely stands by itself but is quite often part of the client’s intentions to do something else as well. The provision of extra services such as hotel reservations, car rentals as well as connections to other modes of transport brings a great added value to the system. The overall service provided to the clients builds up trust and can also lead to a lower total price of the service and a higher turnover for the operator. That approach is widely used by air carriers and there is no reason why it shouldn’t be applicable for land transportation.

6. Access to full and up-to-date information

That requirement allows access to a full and accurate timetable as well as to all variants of getting tickets, which the passenger is entitled to.

7. Bonus programmes

Part of the operators give discounts off the price of the ticket, if it is purchased online. Another option, for example, are discounts offered when the client goes on frequent journeys.

The tasks the system sets itself are to realize the base functionality needed to serve the clients successfully. Of course, such a system can be refined and developed further almost without limits depending on the specific situation and the plans of the management.

4. Design and development of a system for online sale of electronic tickets

The study presents the development of a system for reservation, which consists of four functional modules, shown in Fig.3. The user and administration modules are WEB based in [6], written in the PHP programming language, with the use of the CodeIgniter library. The system makes use of the WEB server Apache2, but it also work with nginx, lighttpd or another server, which supports mod_php or php-cgi.

The modules of the system must be self-sufficient and must communicate following established protocols selected on the basis of their effectiveness. That would facilitate the expansion of the system when there is the need to support heavier consumer traffic.

Database Module

The site uses MySQL database for storing and processing the data. MySQL has been chosen because of the extensive use of that system of management of databases (DBMS) and because it is relatively easy to use by both professionals and novices. The system allows a transition to another DBMS, for example PostgreSQL, with relatively slight modifications.

The data is distributed in the following tables, Fig.4.

Fig.3. Functional modules of the system

- calendar_prices (List of scheduled trains).
  - id - identifier;
  - train_id - identifier of the transportation vehicle;
  - day_of_week – day of the week in PHP format (1 - Monday, 7 - Sunday);
  - status – status of the record;
  - created – date and time of entering the record

- ci_sessions (Table for storage of the user sessions)
  - session_id - identificator of the session;
  - ip_address - IP address of the user;
  - user_agent - User-Agent of the browser;
  - last_activity – last activity of the user;
• distance_prices (Fares per distance)
  • id - identifier;
  • train_type_id - identifier of the type of train;
  • ticket_type_id - identifier of the type of fare;
  • lfrom - lower limit of the distance range,
  • lto - upper limit of the distance range;
  • class1 – price for a class 1 ticket;
  • class2 - price for a class 2 ticket;

⇒ order_status (List of possible statuses of ordering)
  • id - identifier;
  • name – name of the status;

⇒ route_detail (Segment of calculated route)
  • id - identifier;
  • route_id - identifier of the route;
  • train_id - identifier of the train;
  • from_station_id - identifier of the railway station of departure;
  • to_station_id - identifier of the railway station of arrival;
  • distance - distance (in hundreds of metres);
  • departure_time – time of departure (in minutes after 0:00 hours);
  • arrival_time – time of arrival (in minutes after 0:00 hours);

⇒ station (List of stations)
  • id - identifier;
  • name – name of station;
  • latitude - latitude;
  • longitude - longitude;
  • sorder – order of sorting;
  • status – status of the record;
  • created - date and time of making the record;

⇒ ticket_type (list of fares)
  • id - identifier;
  • name - name of fare;
  • sorder – order of sorting;

⇒ orders (Clients’ orders and reservations)
  • id - identifier;
  • user_id - identifier of the user;
  • route_detail_id - identifier of the segment of the route;
  • train_id - identifier of the train;
  • ticket_type_id - identifier of the fare;
  • date – date of journey;
  • quantity – number of tickets ;
  • price – price per ticket;
  • from_station_id - identifier of railway station of departure;
  • to_station_id - identifier of railway station of arrival;
  • class – class of ticket;
  • wagon – number of the wagon (0 if it is without reservation );
  • place_num – number of the reserved seat (0 if it is without reservation );
  • status – status of the order;
  • created – date and time of ordering;
  • expires – date and time of the expiry of the reservation;

⇒ route (Calculated route between two stations)
  • id - identifier;
  • from_station_id - identifier of railway station of departure;
  • to_station_id - identifier of railway station of arrival;
  • distance - distance (in hundreds of metres);

⇒ train (Transportation vehicles)
  • id - identifier;
  • name – name of the transportation vehicle;
  • train_type_id – type of the transportation vehicle;
  • from_station_id - identifier of railway station of departure;
  • to_station_id - identifier of railway station of arrival;
  • status – status of the transportation vehicle;
  • departure_time – time of departure (in minutes after 0:00 hours);
  • arrival_time – time of arrival (in minutes after 0:00 hours);
  • created - date and time of making the record;

⇒ train_station (Points on the route of the train)
  • id - identifier;
  • train_id - identifier of the transportation vehicle;
  • station_id - identificator of the railway station;
  • travel_time – duration of the journey (in minutes);
  • departure_time – time of departure (in minutes after 0:00 hours);
  • arrival_time – time of arrival (in minutes after 0:00 hours);
  • sorder – chronological order;
  • created – date and time of making the record;

⇒ train_type (list of types of transportation vehicles)
  • id - identifier;
  • name – short name of the type;
  • long_name – description of the type of vehicle;
  • status - status;
  • created – date and time of making the record

⇒ train_wagon (Rolling stock of the transportation vehicle)
  • id - identifier;
  • date – date of the stock (0 if it is a base one);
  • train_id - identifier of the transportation vehicle;
  • wagon_type_id - identifier of the type of wagon;
  • sorder – serial number;

⇒ train_wagon_pricelist (Configurations for combinations train/wagon/fare)
  • id - identifier;
  • is_calendar - scheduled (0-no, 1-yes);
  • train_type_id - identifier of the type of transportation vehicle;
  • wagon_type_id - identifier of the type of wagon;
  • ticket_type_id - identifier of the fare;

⇒ user (Registered users)
  • id - identifier;
  • email - e-mail address of the user;
  • password – password in an encrypted format;
  • name – name of the user;
  • phone – telephone of the user;
  • admin – administrator’s rights (0 -no, 100 - yes);
  • status - status of the profile;
  • created - date and time of making the record;

⇒ wagon_type (Types of wagons)
  • id - identifier;
  • name – name of the wagon;
  • long_name – description of the wagon;
  • reservation – possibility for reservation of a seat (0-no, 1-yes);
- seats – number of seats in the wagon;
- passenger - passenger (0-no, 1-yes);
- layout – seating arrangement in the wagon;
- status – status of the wagon;
- created - date and time of making the record;

The whole process of building and entering the data in MySQL is automated.

Razpisanie Module (Timetable)

Module Razpisanie accomplishes one of the main tasks of the system, which is to come up with routes between two stations or stops that are as close to the optimal route as possible. The requirement set out for this module is to perform the search as fast and as accurately as possible.

In that module the railway system is represented as a symmetrical directed graph, where each station is a vertex in the graph, and each route between two stations is represented as a directed arc with a weight the distance between the two stations on the route, Fig.5.

In order to perform the search two algorithms form the theory of the graphs: the algorithm of Floyd-Warshall and search in depth of a graph, [4]. In that particular case, the algorithm of Floyd-Warshall is used to determine the minimum distances between every two points in a graph, Fig.5. Those distances are used in the search of routes.

The search in depth of a graph is an algorithm for finding roads in a labyrinth. The algorithm is recursive and involves serial tracking of all the arcs of a certain vertex until the desired final vertex is reached. The advantage is that it has a relatively good speed of searching. The graph consists of columns, where each column represents a station. In each column the vertices are arranged in an ascending order in terms of time, and each vertex contains a list of the connections to other vertices in the graph. A chart of the sample data processed in the form of an extended graph is presented in Fig.7.

In Fig.7 the normal running of the trains is represented as solid arrows, and the transfer arcs are marked with dotted lines. The text in the boxes contains the name of the station, the number of the train, the time and symbol A, which stands for arrival and symbol D – for departure. The vertices of the extended graph are of two types - arrival and departure. The arcs are also of two different types – the running of the train and the transfers. When the extended graph is created columns are made and each of them contains vertices belonging to one and the same station. Two methods are used for filling in the graph – adding a new vertex or adding an arc, which connects two vertices. After the graph has been filled in with the vertices and the arcs of the running of the train, the transfer arcs are built in. A transfer arc is the arc which connects two vertices of one column in the extended graph, which meets the conditions of having a transfer of passengers from one train to another. After the vertices have been sorted out, there is a check on each vertex of the column which aims to find out whether it is possible to have a transfer from one vertex to each of the vertices, which follow it in the column. If there is the possibility of a transfer, a transfer arc is created from the current vertex to the transfer vertex.

Fig.8 shows the algorithm for search in a graph in depth.

Since, in the general case, the routes between two vertices of the graph are numerous, and only a small part of them are cost-effective, the search is limited by a few restrictive conditions:

- Minimal number of transfers between transportation vehicles. The introduction of that restriction is based on the presumption that transfers are not convenient for the passenger and most clients when offered two routes, in which the other parameters are the same, would choose the one with fewer transfers.
- Length of the route. The condition, which is imposed here is that the length of the route must be smaller or equal to the minimal length between two stations multiplied by a coefficient of distance. It can be assumed that routes with a length of 20% over the minimum are cost effective for the passenger, i.e. the coefficient is 1.2.

The overall functioning of Module Timetable is shown in Fig.9.
User Module

The user module of the system is targeted at the end users of the transportation service. The following technologies have been used to create it:

- **PHP** ([http://php.net/](http://php.net/)) - programming language;
- **Twitter Bootstrap** ([http://twitter.github.com/bootstrap/](http://twitter.github.com/bootstrap/)).

CSS/JavaScript is a library supporting an adaptive structure.

The process of purchasing tickets is shown in Fig.10.

**Fig. 10: The process of selection and purchasing of an electronic ticket**

The module provides the user with the following options:

- Search for routes between each pair of stations/stops on the timetable for a particular date.
- Selection of an appropriate route from the list.
- Overview of the stations/stops, which transportation vehicle passes through, Fig.8.
- Overview of the transportation vehicles, which pass through a particular station/stop.
- Reservation of different types of tickets and selection of a seat to book on a transportation vehicle, where it is possible.
- Option of paying for the reserved tickets online.
- Option of registering in the portal, from which to monitor all the tickets the client has bought.

Figures 11 to 14 show some of the screens of the user module.

**Fig. 11. Search for a route**

**Fig. 12. Selection of route**
Administrative Module

The administrative module offers the option of manipulation of the following elements:

- Stations/stops. Each station or stop in the system is represented by a name and geographical coordinates. The coordinates are used when information about a station is displayed, and also the routes of the trains.
- Trains. Administration allows the introduction of new trains, as well as the editing of the information of already existing ones. Each train is described with a name and a type.
- Routes of the trains. The route of each train consists of a sequence, which includes the name of the station, time of arrival, time of departure and distance from the beginning of the route. The routes can be supplemented and altered.
- Rolling stock of the train. It allows a specification of the stock of the train. That information is used in the purchase of tickets.
- Transportation vehicles. Administration allows the supplementation and editing of the elements of the rolling stock. Each transportation vehicle is described with a code, name, number of seats and seating arrangement, which appears in the selection of reserved seats. The syntax for defining the scheme of the transportation vehicle is: "-" - corridor; "," - or "|" - wall; "1" or "2" - a specific class ticket;
- Fares. Allows the editing of the fare coefficients for transportation.

Apart from changes in the data, administration provides access to several basic statistical references:

- Minimal distance between two stations (it is derived from the matrix of module razpisanie);
- Busyness of the stations;
- Section speeds on routes for the trains;
- Monthly revenue per train;
- It is possible to add extra references when they are needed.

Figures 15 to 20 show part of the screens of the user module.
5. Conclusion

The study which has been carried out gives grounds for reaching the following main conclusions:

- An analysis has been made of the information systems of passengers in the European railway administrations.
- The main requirements for developing an online information system for reservation of seats have been classified.
- An information system for reservation of seats has been developed.

The system, which has been described above is subject to constant development and modifications. A possible additional use of the system could be its integration in the so-called kiosk systems. A configuration of such a system could be supplied with ATM functionality, as well as with a fiscal printer for direct printing out of tickets.

It is possible to integrate the system with similar systems for other types of transport. That will add more value to the service. The return such a system could produce can in times bigger than the investment for its development or purchase. The operating costs for the system are minimal and most of them have already been incurred for the portal, which is available at the moment.

Such a decentralized system would be able to communicate with the various systems of the providers of transport services through an unified program interface (API), which as a minimum should include commands for:

- Routes between two points for a specific time interval;
- Vacant positions on a route;
- Option for reservation of a position.

Fig. 21 shows a diagram of an integrated system for providing transportation services.

The benefits of such systems are:

- Convenience and predictability for the clients;
- Uniformity of the criteria;
- Improved conditions for competition;
- Easier “selling” of the transportation service;
- Possibilities for optimization and planning.

In terms of the introduction of an information system for reservation of seats by BDZ the following conclusions can be reached:

1. The development of an online system for reservation of tickets is necessary to improve the competitiveness of BDZ EAD;
2. The development of an online system for reservation of tickets by BDZ the start as soon as possible because in this respect the company is far behind the common European trends. The production of such a base system is possible to achieve over a short period of time at a price, which the company can afford;
3. The market of online services in Bulgaria has been growing and a growing number of the operations which have traditionally been done on the spot will have their electronic analogue;
4. Bringing the railway system of Bulgaria closer to the European railway systems should be done not only at the physical but also at the information level.
5. The strategy for providing electronic services must be long-term and accompanied with a periodic reconsideration of the priorities so that it can meet the requirements for a modern service.

6. Literature