DEVELOPMENT OF RAILWAY TICKET SALES TECHNOLOGIES

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ABSTRACT

For almost two centuries there has been a certain transformation of the system of passenger service on Russian railways, which includes such purely commercial aspect as marketing, relations with the client, selling tickets, cash proceeds, and construction of all related technological processes. The authors trace evolution, gradual qualitative growth of the «ticket industry», which has become in the electronic network era a fundamentally different technology, half virtual, if we mean contact with a customer, a consumer of transportation services.

Keywords: railway, history, ticket, technology of sale, ticket evolution and its production, electronic age.

Background. *During a trip a passenger ticket is assigned to a role of an accompanying document. And thanks to this, it becomes a kind of a visiting card of a passenger and a railway which takes him on its own responsibility. And if so, then appearance of a ticket, quality of execution of a document must correspond to its purpose.*

Objective. *The objective of the authors is to consider development of ticket sales technologies on Russian railway transport.*

Methods. *The authors use general scientific methods, historical reviewing, comparative analysis.*

Results.

1.

Originally a ticket was reusable, because it was made of tin, mostly octagonal. A passenger bought a ticket in a «cashier's office», handed it over to a conductor upon arrival at the destination place, after which a ticket was again used for sale. At the first railway line in the country, which connected St. Petersburg with Tsarskoe Selo, there were tin plate-shaped tokens in the form of a quadrangle.

In 1836 T. Edmondson developed and organized in Manchester (England) production of ticket printing presses. They issued cardboard ticket cards, which were used as a travel document. The price on the cards was filled with a composter, which was later invented by Ya. Yu. Baranovsky.

Cardboard tickets on domestic railways were in circulation at the end of 19th – first half of 20th century. The ticket was a rectangle of cardboard with a three-millimeter hole in the center, through which it was threaded onto the cord. On top of the ticket special holes were made by a puncher. Their series consisted of seven or eight digits, denoting a number of a train, day, month and year. In the 1930s, ticket salesman P. Aladin suggested composting tickets directly on trains.

The first cash ticket printing machine (TPM) of Volkhov type (656 printed clichés and a working cycle of 1,5 sec.) appeared in the USSR in the 1960s. In 1966, there were about 145000 similar ticket printing machines and automatic machines at the stations. Only in the suburban cash desks more than 135 thousand units of such equipment operated, which allowed almost completely to automate the sale of tickets to passengers.

Semiautomatic ticket printing machine type KZh (key railway), which had a working cycle of 1,1–1,4 sec, was intended for printing and issuing tickets for commuter trains by a cashier, mechanization of accounting for tickets sold and money earned, etc. Automatic ticket dispensers without cashiers included AB 2 (single-zone), which allowed to sell tickets «there» and «back» to one of the first six tariff zones with the possibility of paying four coins; AB-6M performed the functions of printing and issuing full and children's commuter tickets within the first 13 tariff zones.

In 1976, over 890 million tickets (79 %) were sold to suburban passengers with the help of ticket machines, and 100 million tickets (more than 90 %) were sold with automatic machines, due to rational organization of the cashier's workplace and effective location of automatic machines at the station and station buildings.

In the 1980s, paper tickets came to replace the cardboard ones. At the railway stations, a stock of ready-made tickets was prepared, with the names of the stations, with which traffic existed, pre-printed on them in advance. Since the late 1990s, railways switched to combined or universal forms, which indicated the passenger's passport data [1].

Automation and mechanization of ticket and cash operations freed cashiers from the need for manual filling and composting of tickets, eased working conditions, created ample opportunities for improving and accelerating the compilation of passenger transportation reports, and saved considerable time for passengers. However, in itself the presence of mechanisms, saturation of stations and cash desks to the end did not solve the issues of increasing labor productivity of cashiers, saving passenger's time, improving the use of technology.

Further development of ticket technologies in railway transport was ensured when a hardware-software complex [ASU] for reservation of seats and ticket-cash operations ASU «Express» appeared.

2.

The main task of ASU «Express-1» was automation of management of ticket and cash operations on the scale of the railway junction of Moscow, serving daily up to 250 thousand passengers by direct and local traffic. Since 1972, the system of collective use has served the preliminary ticket offices of Kievsky railway station, and from 1974 to 1985 it carried out the function of selling tickets in real time to Moscow railway junction only from Moscow with a reservation period of 10 days to the train departure with the help of 580 automated ticket offices. Thus, there was no need to calculate the fare and fill out travel document forms, memorize information about places transferred by a dispatcher, and compile a report on the tickets sold. The work of a ticket teller in new conditions was reduced to the work of a operator behind a panel.

The prerequisites for creation of ASU «Express-2» were a limited set of functions of «Express-1», a technological and information revolution in the countries of the West in the 1960s–1980s, the need to introduce computerization in the USSR. ASU «Express-2» (1982–2005) was developed on the basis of a ten-year experience of operating its analogue. The set of functions of «Express-2» has expanded due to reservation of seats and ticket sales from 45 days before arrival of a train to a destination station. If ASU «Express-1» was intended for integrated automation of ticket and cash operations at large railway junctions, a new ASU managed ticket sales and passenger transportation already on a regional scale (polygons) allocated to the railway network. The region served by ASU «Express-2» could include the territory of one or several roads.

The efficiency of ASU «Express-2» was determined by the indicators of reduction of time spent by a passenger for purchase of tickets; improving the use of seats in passenger trains and servicing passengers who travelled with transfers and purchased tickets for a return train. ASU was designed for round-the-clock work with a readiness factor of at least 0,99, which corresponded to 99 % of useful operating time.

Special technological departments, bureaus and groups have been set up to manage the technological processes of ticket sales through «Express-2» at Electronic computing centres (ECC), road departments and departments of the Ministry of Railways (MPS). Technological departments of ECC carried out monitoring of the process in ASU, correction of information arrays during transition to new days and when schedules were changed, opening and closing of ticket offices, ensured conformity of types and operating modes of the system, solution of various tasks and preparation on their basis of necessary recommendations for railways and the Ministry of Railways. Technological departments at road and ministry departments through remote terminal devices automatically received all the necessary information from ASU «Express-2» operating on the network (information on passenger transportation, work of ticket offices, ticket sales points, use of rolling stock, passenger needs, system recommendations and etc.) and prepared necessary orders.

Fifteen interconnected ASU «Express-2» automated all the processes of managing the sale of tickets, taking into account transit trains, including distribution of the part of sale of seats along the train formation station and route of the train; sale of seats through a bureau of orders by phone, execution of a direct seat card and group applications. The issuance of tickets was carried out on a free sale and using the number of previously made booking. A norm was allocated to each reservation number from a common database and that could be changed depending on the course of the current sale. All numbers were identical for any ASU on the road network. The reservation could be imposed on the car and separate places [2].

3.

ASU «Express-3» is a computer network for servicing passengers for automation of ticket sales and reservation of seats in trains, as well as for operational management of passenger traffic with a reservation period of 45 days to train departure.

Table 1

Content of information

№ .	Information	Content
1	Train indicators	Train scheme Circulation calendar Transportation volumes: • total • by types of cars • by benefits Profit income: • on tickets • on reserved seats • on cars • on trains Car-km Passenger-km Population: • in percentage • passengers • per car • change coefficient Train capacity Train profitability
2	Statistics	Number of passengers Volume of baggage, cargo and mail Income from transportation in all types of traffic Passenger-km Car-km Average range of travel etc.
3	Reporting	On cash desks On points of sales On roads On countries
4	Marketing	Market research Questionnaires Analysis of work Rapid response Profitability
5	Availability of seats	Prior to departure After departure
6	Income	Old tariff New tariff
7	Demand	Week Annual

The system has been operating since 2005 on the territory of the Russian Federation, the CIS, Latvia, Lithuania and Estonia and is a full member of the international community of reservation systems, interacting with European electronic systems within OSJD/UIC computer networks.

Creation of a passenger transportation management system is aimed at reducing costs, increasing revenues and providing new services to passengers. Another group of goals is related to the need to replace obsolete equipment and use modern digital communication channels.

The objects of ASU «Express-3» were passenger and financial facilities of railways along their main information and technological areas. Structurally all ASU of the system are united into a single computer network operating in real time mode and a single technological mode for passengers and specialists of railways.

Table 2

Comparison of ASU «Express-1», «Express-2» and «Express-3»

Indicator	ASU «Express-1»	ASU «Express-2»	ASU «Express-3» (Moscow)
Scope of application	For railway nodes	For regions of the railway network	For landfills on long-distance passenger trains
Period of reservation of seats, days	10	63	60
Number of reserved seats per day	up to 200 thous.	up to 450 thous.	up to 450 thous.
Number of serviced cash desks	580	up to 2000	up to 10000
Number of trains served:			
taking into account storage of seats	300	up to 600	up to 600
without taking into account storage of seats	no	up to 2600	up to 2600
Number of served routes of trailing cars and nonstop cars in one train	4	up to 16	up to 16
Numbering of long-distance passenger trains	three-digit (by node)	five-digit (all over the network)	five-digit
Numbering of stations and cars	four-digit (by node)	five-digit (international)	five-digit
Maximum number of stations serviced by the system along the route of one train	no	up to 256	up to 256
Number of different types of reservations for seats	3	up to 24	up to 24
Number of different operations (orders) made by cashiers	7	up to 100	up to 100
Average time of execution of a ticket, sec.	49,5	45	45
Number of possible travel options in one order	1	up to 6	up to 5
Type of computer	Route-1	ES EVM decomp. modif.	EC IBM-3270, 2780
Productivity (orders/sec)	4	15	up to 50

ASU «Express-3» is connected with the European railways due to interaction of Moscow center with «KURS-90» system; with the CIS and the Baltic – via a data transmission network (DTN) and an infonetwork 21.

All travel documents and information on the performed voyages of trains and cars, passenger service (Table 1) are received in the single analytical database on passenger transportation of JSC Russian Railways [3]. The base contains about 120 million travel documents and 3,5 voyages of cars. The shelf life of this information is 12 years. Based on the analytical database, the following transport management tasks are solved:

- *sale of tickets with place indication not only from the starting point, but also from intermediate points of the train route;*
- *choice of complex routes with transfers;*
- *search for travel documents, identification of a passenger's travel and information on transportation for renewal of personal travel documents in case of their loss;*
- *analysis of the dynamics of sales;*
- *analysis of departure and correspondence of passenger traffic;*
- *evaluation of the economic efficiency of trains [4].*

ASU «Express-3» includes subsystems in which their functional capabilities have been expanded. Among them:

1. Subsystem of planning and management of passenger traffic is based on a database that contains information on all transportation carried out by Russian railways. Autiomatic workplace station (ARM) uses a special access key to serve a subscriber of ASU «Express-3», which determines the content of output information during execution of the order. Regulation of passenger transportation is based on received data.

2. Subsystem of sale and accounting of travel documents in all types of traffic allows to register passengers in the process of selling tickets, when they pass through turnstiles. Thus, control of passengers during the departure is carried out, information on incomes received from transportations, and on transported passengers is formed. In long-distance traffic, a passenger's seat number is indicated on a ticket.

3. Subsystem of comprehensive reference and information services for passengers (ECASIS) allows to receive information certificates in all types of traffic by phone, in offices, through the Internet, etc.

4. Baggage control system (ASUBR) includes all baggage operations (loading, unloading, search, etc.) to regulate baggage transportation in order to obtain the maximum revenue from the transportation process.

5. Subsystem of passenger car fleet management system (ASUPV) automates the technological

processes for operation and repair of passenger cars. It relies on ARM for tracking traffic safety, planning repair of cars, preparing trains for journeys, etc.

6. Subsystem of financial and statistical accounting of passenger transportation (AFIS) provides reporting on passenger transportation daily, monthly, decades, etc. With its help, mutual payments are made for passenger transportation between the railways of Russia and other countries. AFIS conducts accounting and control of financial activities of ticket and baggage checkers, as well as receipts for railways of forms of strict registration of travel and transportation documents and their expenditure by each cashier.

7. Subsystem of passenger service provides passengers with services for a hotel booking, taxi, car rental, food, etc

8. Subsystem «Schedule» controls in real time passage of trains on the established schedule. In case of deviation from the schedule, the subsystem provides real information on an information display and platform indexes. In addition, it is used to prepare service timetables for movement of long-distance and suburban trains.

9. Subsystem of interaction with other ASU ensures work with systems operating on railways or relating to other modes of transport.

The technical means of ASU «Express-3» includes: two data processing centers in Moscow and St. Petersburg, specialized cash terminals, printers for replicating railway tickets, scanners of reading barcodes from travel documents, visual software systems intended for collective access, network infrastructure based on TCP network, specialized technical and software tools to ensure information security of servers based on VipNet technology [3].

Comparison of main indicators of the modifications of ASU «Express» is given in Table 2 [3–5]:

4.

Conclusion. *Thus, the choice of the material from which passenger tickets were made was influenced by the possibility of their repeated use (tin), production on ticket printing presses (cardboard), the need for printing station names for preparation of a strategic stock (paper forms), and in the era of network technologies a natural transition to electronic tickets was executed.*

The sophistication of technical devices for issuing passenger tickets was caused by the desire to mechanize (ticket printing press, composter) and to automate the technological process of ticket and cash operations (semi-automatic ticket printing machine, ticket machine, etc.).

Improvement of the passenger transportation management system through the hardware and software complex «Express» was carried out by digitizing the main technological processes in the passenger sector (the second half of the 1970s to the present). Automation of ticket and cash operations went in the direction of its expansion (the capital's railway junction, the allocated network polygon, the interstate reservation system for seats, ticket sales and passenger transportation management) and improving the quality of public services (from reducing time to purchase tickets to sale from intermediate train points, increasing time of booking and searching for tickets).

Forecast for further development of ASU «Express» using the capabilities of modern programming and design tools can be implemented using the methodology for assessing historical conditionality and feasibility of introducing new technology (system) in rail transport [6]. Of the stages to be evaluated, the most significant is estimated expected impact of the implemented model of the new system, based on comparison with the implementation history of an analog sample. Moreover, an analyst should assess the predicted increments taking into account improvement of traffic safety in railway transport, improvement of passenger and freight traffic, impact of innovation on the environment, reasonable balance of economic costs, long-term positive and negative consequences of implementation, overall position of management authorities, chronology of development and implementation of the project, changes in the psychology of users (service personnel and passengers) after introduction of innovations (based on media analysis).

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