



OPERATIONAL RELIABILITY OF PASSENGER STATIONS

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ABSTRACT

The article raises the problem of the need to define the impact of organizational-technical failures (in operational work, presented in the form of delays incurred in handling of trains and during processing of trains) on the reliability of operations of passenger stations and coach yards. The author identified the necessity of analysis of operation of these stations, on the basis of a table proposed by the author and entitled «Delays of trains classified into elements of the technological cycle of formation and turnaround of passenger trains resulting from failures of various kinds in subsystems of a passenger station and a coach yard».

Operational failures can be divided into two types:
– Failures of technical equipment;
– Organizational and technological failures, not directly related to wear and tear, failure, deterioration of working parameters of technical facilities.

Most of the organizational and technological failures are group intermittent failures – failures of the same nature which are repeated periodically due to various causes of traffic flow delays.

Transport systems such as passenger stations or coach yards, have a strong structural and functional connectivity and are difficult to calculate. Over the past few decades experience has been accumulated in application of various methodological approaches and models of computation and optimization of transport systems.

A considerable number of publications are devoted to identification of root causes of traffic flow delays directly at the station.

Problem in this area is blurring of term «failure» and unofficial status of failures (in fact, they are delays in trains' handling). They are indicated graphically by personnel involved in the implementation of traffic schedule at centralized control posts, but there is no accounting in writing [4]. This is due to the very specific nature of operational work (total number of such events is sufficiently large), information about each phenomenon is contained in different sources of information (station logs, certificates of various forms), while different services and departments are responsible for them.

It is proposed to analyze the factors that affect handling, quality maintenance and servicing of passenger trains at stations with the help of Table 2. In this table failures that occur during handling and preparation of passenger trains for travel, are grouped as four elements of a process:

1. Failures while receiving a passenger train at the station.
2. Failures while a passenger train is at a receiving-departure yard (prior to repositioning to a coaling track).
3. Failures while servicing passenger trains at post of formation and turnaround.
4. Failures while repositioning a passenger train to a receiving-departure yard and its departure from the station.

Accordingly, the following examples are typical situations that may occur at various moments of a technological cycle of trains' handling during the shift at a passenger station and a coach yard:

- Failures in signaling arrangement and communication system, including other stations;
- Occupancy of all tracks of a receiving-departure yard by trains, hostility of departure / arrival routes;

ENGLISH SUMMARY

Background. Overview of domestic and foreign experience shows that the identification of root causes of traffic flow delays, which occur directly at the station, is connected to a sufficiently large volume of works. Improvement of rolling stock and technical base is an indispensable part of reliability problem of rail transport functioning. Sufficient volumes of carrying capacity and processing capacity, proportional development of railway routes, junctions, stations, depots have a great impact on the quality of the network operation.

Objectives. The task is to establish the dependence of operational reliability of passenger stations and coach yards on their technology and equipment.

Methods. The author focused on the study of passenger stations and research of delays of trains classified into elements of the technological cycle of formation and turnaround of passenger trains. Theoretical base of research comprises principles of queuing theory and theory of algorithms.

Results. One of the objectives of the general traffic flow theory is determination of their optimum option with regard to an element. If the flow exceeds its optimum, the element will operate in overload mode, with delays, failures, economic losses. But in case of railway station the situation may look different: because of imperfections in the station scheme, lack of good interaction between involved departments and divisions, as well as other factors, there may be a stable reproducibility of certain situations, which have nature of operational failures. To eliminate such an unpleasant phenomenon, it becomes necessary to examine issues related to the reliable performance of duties (within the branch system) and liabilities (regarding customers) by stations.

Reliability of transportation along with other features characterizing the level of transport efficiency (total travel time, safety of goods, cost of transportation), is an important objective measure of the quality of the transportation process.

Table 1

The concept of «reliability» in scientific literature

Authors	Content of the concept
Gruntov, P. S. Operational reliability of stations 1986.	«This is a property of the system or of any industrial product to retain their functions and performance under certain operating conditions» [1].
Ostreykovskiy, V. A. Reliability Theory, 2003.	«This is a property of an object to save through time values of all parameters characterizing the ability to perform the required functions in a given mode and conditions of use, maintenance, storage and transportation within prescribed limits» [2].
Ryabinin, I. A. Reliability and safety of structurally complex systems, 2000.	«This is the system's ability to maintain properties required to perform a given task, under normal (everyday) conditions of its operation within required period of time» [3].

Table 2

Delays of trains classified into elements of the technological cycle of formation and turnaround of passenger trains resulting from failures of various kinds in subsystems of a passenger station and a coach yard

Classification of failures into elements of technological cycle of train handling		Source of information received
Prior to the arrival of a passenger train at the station	Failures while receiving a passenger train at the station	1. Log book, form DU-46; 2. Protocol of signaling equipment failures; 3. Material on investigation of failure in the signaling equipment of a station; 4. Analysis of the security; 5. System KASAT; 6. Daily schedule, which is kept at signal posts of a station; 7. Minutes of the meeting, materials on analysis the situation when station was not receiving trains; 8. Train sheet; 9. Schedule of trains, which is kept by section controller.
1 st element of the technological cycle (at receiving yard)	Failures while a passenger train is at a receiving-departure yard (prior to its repositioning to a coaling track)	1. Log book, form DU-46; 2. Protocol of signaling equipment failures; 3. Material on investigation of failure in the signaling equipment of a station; 4. Analysis of the security; 5. System KASAT; 6. Daily schedule, which is kept at signal posts of a station; 7. Log book, form DU-2; 8. Log-book, form VU-14; 9. Log book, form DU-46.
2 nd element of the technological cycle (time spent at coal handling plant)	Failures while servicing passenger trains at post of formation and turnaround	1. Daily schedule, which is kept at signal posts of a station; 2. Log book, form DU-46; 3. Protocol of signaling equipment failures; 4. Material on investigation of failure in the signaling equipment of a station; 4. Analysis of the security; 5. System KASAT; 6. Log-book, form VU-14.
3 rd element of the technological cycle (repositioning of a passenger trains to a yard and departure of a passenger train)	Failures while repositioning a passenger train to a receiving-departure yard and its departure from the station	1. Log book, form DU-46; 2. Protocol of signaling equipment failures; 3. Material on investigation of failure in the signaling equipment of a station; 4. Analysis of the security; 5. System KASAT; 6. Daily schedule, which is kept at signal posts of a station; 7. Train sheet; 8. System KASAT.

– Complicated train situation at subdivision due to speciality of station scheme and / or the need to handle trains, which are late;

– Failures in devices and equipment of cars, entailing the need for shunting operations to exclude a corresponding car from the train;

– Inability to receive a train at coal handling plant (occupancy of all tracks of a coal handling plant by trains);

– Failures in the work of shunting locomotive during repositioning a train for various operations (exclusion / addition of cars into a train, washing, charging batteries, repositioning of cars with identified defects to the inspection point) or due to lack / occupancy of locomotives;

– Occupancy of a shunting locomotive due to operations on coupling / uncoupling cars, need to move specialized cars from the station (cars- salons, laboratories: track-measuring, crack detection wagons, etc.);

Keywords: rail transport, passenger station, coach yard, field operation, reliability, failure, spreadsheet analysis.

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– Timeliness of coal handling works, carried out by particular services, resulting in a increase of a handling time of a passenger train (at a coach yard or a coal handling plant);

– Failures in work of a train locomotive;

– Discrepancies in the functioning of station technology center;

– Faults in functioning of a check station.

Certain statistical sampling, presumably, will identify factors, which influence reliability of operation of passenger stations and coach yards to the greatest extent.

Conclusions. The study identified the factors that significantly affect the operational reliability of passenger stations. It has been shown that despite the unconditional fulfillment of requirements on safety of movement of trains and departure of passenger trains on schedule there are still some «narrow» places which should be systematized and studied.

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