SYSTEM SUPPORT FOR FULFILLMENT OF ESTABLISHED REQUIREMENTS BY STAFF

Vorontsov, Vladimir I., *Krasnoyarsk State Transport University, Krasnoyarsk, Russia.*

ABSTRACT

From different points of view coming to complex dependencies that relate to fulfillment of technological and security requirements for transport, the author evaluates subjective factors, technical means of control in operational work of staff as well as the possibility of systemic support for professional activities of transport specialists through the use of modern knowledge, information and management technologies, training and educational programs.

Keywords: transport, operational management, control means, safety, risk zone, violation, staff, dispatching service, responsibilities, action algorithms.

Background. *In the transport sector, where issues of traffic safety are so acute, it is especially well understood that it is much more profitable and easier to prevent a crisis than to eliminate its consequences. At the same time in order to prevent a possible transport accident it is necessary first, as rightly assumed, to comply with rules and regulations for performance of technological processes.*

Depending on process requirements, existing regulatory framework, applied methods (principles) of management and experience of staff of the organization criteria are introduced for labor evaluation and incentives, support and control of employees' activity, designed to improve the quality of performance of official duties, to minimize the likelihood of risks and «human factor» costs in the production.

Objective. *The objective of the author is to consider a system support for fulfillment of established requirements by railway personnel.*

Methods. *The author uses general scientific and engineering methods, evaluation approach, comparative analysis.*

Results.

1.

Among the main causes of errors in the work of staff of railway transport (Pic. 1) should be mentioned [1]:

– Lack of knowledge and / or skills;

– Lack of tool support;

– Fatigue, overexertion, painful conditions;

– Negligence, malice.

Tools that provide control over the observance of the technological process, are predominantly [2]:

– Technical means with elements of intelligent control, monitoring compliance with safety rules and blocking erroneous actions of personnel (such devices must have interfaces that involve integration with software systems);

– Software and hardware to ensure control and disciplinary control in respect of process requirements (software modules help to obtain data, to process them and provide to a user in a convenient way for solution and corrective action);

– Organizational means: monitoring of compliance through direct control, surveillance (monitoring) of implementation process, as well as through inspection and audit of a posteriori information on directions of activity.

Given the composition of the tool base, it is possible to select a number of ways to control technological processes.

A. Software and hardware control *(Pic. 2).*

The most effective form of control of process implementation is carried out without human intervention – by intelligent software and hardware tools. Continuous monitoring during the process of operation. Basically – non-stop.

B. Supervisory control.

This type involves the use of all instrumentation for continuous monitoring of execution of the process by supervisory unit and other persons involved in control functions. Advantageously, the nature of control is non-stop

C. Audit control.

Here at the forefront is audit of safety state of traffic on the railways.

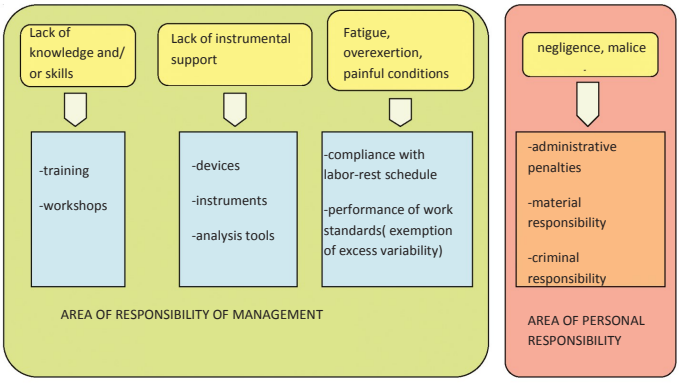
Frequency of control:

1. Periodic –in accordance with the plan of carrying out audits and inspections.

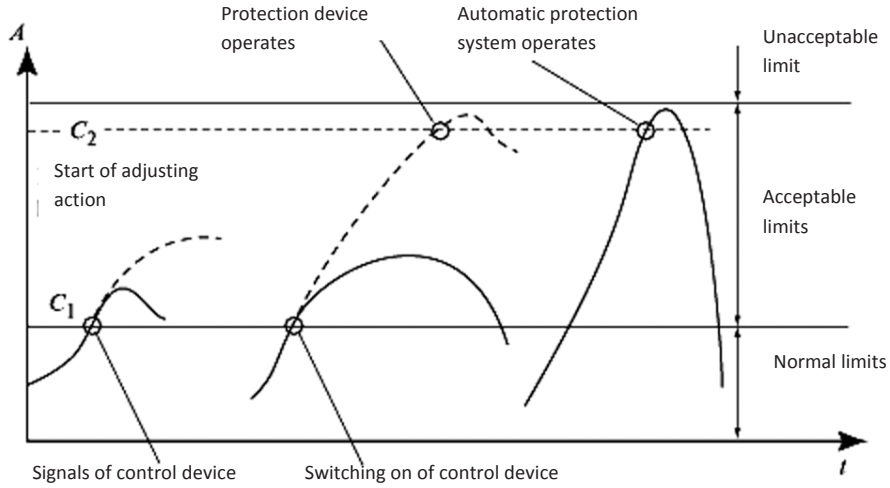
2. Unscheduled–additional control over the process if necessary.

These types of controls are used for many years and proven to be effective, but they do not allow to eliminate staff errors. Their disadvantages:

a) Incomplete coverage of software and technical control of the entire production process. Share of personnel impact to ensure safety is significantly high.



Pic. 1. The main causes of staff errors.



Pic. 2. Scheme of protective devices [3]:
A – variable characteristics of the process; t – time.

In particular, it is likely a deliberate exclusion of monitoring devices from work (Train driver's switching off of a vigilance button, redeployment of rolling stock without the need at prohibiting traffic light, etc.).

b) Train dispatcher controls only a small part of the unit entrusted to him, and then only on the reports of workers, also controlled by him (work supervisor reports to a power dispatcher a work permit, at the same time the dispatcher cannot monitor the condition of the team, how short to ground is made, etc.).

There are profession s to which these two types of control are not applicable. For example, a train compiler. In 2012, at Yudino a train compiler laid under a train nine brake shoes, but reported to a controlling person about laying of twenty brake shoes. As a result, the train began moving and cut up a railway switch, collided with an oncoming train. This category of workers combines all in «one person», the train dispatcher cannot control it, and the software and hardware control for shunting masters has not yet been developed, only audit control is applied.

c) Audit control is not able to cover all of the work of staff. It is used rarely, mostly in fact of already made by someone else that does not give an objective picture.

2.

Conducted research revealed all breaches of safety on the railway network in 2012 through the fault of employees (Pic. 3).

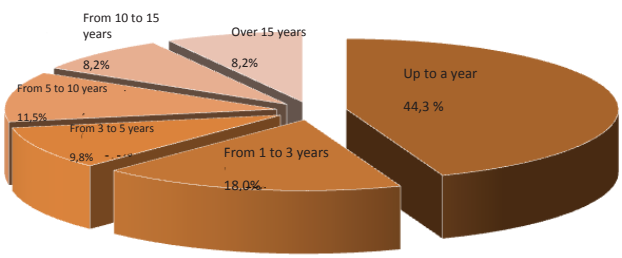
As can be seen from the data on the railway transport poorly prepared and inexperienced person violates rules more and more. Almost half of the breaches (44%) were committed by employees with experience up to a year. And before he gains necessary experience, how many errors he commits?

The process of becoming an expert is long again. It was found that it requires at least 10 years, under favorable conditions to become an expert in any field of professional activity [4]. At the same time a large role in its formation is played by constant exercise.

One of the principal conclusions reached by the designers of man-machine systems, is that the amount of information that can be well learnt and processed by the operator should not be specified in the information model arbitrary, but is determined by or for certain conditions, or on the basis of available quantitative estimates, or by conducting special experiments.

A feature of the activities of the operators is the fact that he usually for a long period of time operates trouble-free, performing a well-learned action, or even idle in anticipation of an emergency situation, which may not occur for the rest of his life in the workplace. Such regimes are dangerous because they can cause a loss of system management skills, reduce operating alertness. For example, to prevent the loss of necessary skills by pilots during landing it was considered appropriate to use not automatic, but semi-automatic control on final approach track. As a result the readiness of a pilot to operate manually in case of sudden failure of automation was constantly maintained by maintaining close contact with the object of control.

Pic. 3. Distribution of traffic safety violations in the transport sector, depending on the length of service in the office and involved employees for 2012.



Along with training of workers in simulation simulator special expert systems are developed that help operators to analyze the behavior of an object that is different from the regular. It was found that perception, learning, information processing are affected by dozens of factors, including person's temperament. Due to the fact that any organization consists of people with different types of temperament, management decision should be presented in the training (training) form understandable to all potential participants in its development and implementation.

Research, as well as experienced leaders at various levels have repeatedly stated that operational staff of transportation sector (station duty officers, shunting dispatchers, train compilers) when abnormal situations do not resort to regulations, but to his colleagues –heads of stations, motion inspectors etc. That is, if in the workplace regulations, decrees, orders are available, they still do not use them [5].

One way to make the process accessible to people with different types of personality consists in drawing up solution variants corresponding to different temperaments. Another method provides execution of solutions in the form of a structured message (oral or written). Looking for approaches to each worker, it is necessary to use tools familiar to them. To do this, there are programs of assistance in making decisions that are based on databases of expertise (e.g., to assist ф stopped train).

It is important, in our view, to create a computer database of expert knowledge for operating railway employees and in assistance programs for them to describe in detail employee's algorithm of actions in abnormal situations. We have attempted to create a virtual organization. The program in real-time will control the assistance process and promptly intervene in case of incorrect decisions.

Krasnoyarsk specialists have developed a computer program to support operational staff, which allows for one pressing of a button to obtain a detailed course of action in any non-standard situation (with negotiations regulations, calculating location of a rear end of a train on a haul in course of assistance process, etc.) [6]. Application of the program will reduce time spent on unnecessary, inappropriate actions of dispatchers, eliminate errors.

After activating the program, train dispatcher and station duty officer sees a list of non-standard situations, where he needs support. After selecting his option (in this case «Helping train stalled on the haul»), he puts in the menu that appears the name of a driver, train number, haul, kilometer of stop, cause of the fault. These data will help him determine the correct stop position of the auxiliary locomotive, without hesitation to say all the orders, etc.

After entering the data on the screen appears algorithm of actions in this situation, created on the basis of expert knowledge. In the upper right corner there is a window «List of required documents», which may be involved by the dispatcher in difficult, controversial cases for detailed study of the situation. By activating this list, the dispatcher sees all documents that can help him.

The deepest level of the program allows to record all actions of the operating personnel in time. Activation of the program and each subsequent window in it will be reduced in the final report (protocol), which is available at the touch of a button immediately after the removal of the train from the haul. After all, according to the existing provisions it is necessary to assess correctness of actions of a person responsible for traffic control in each non-standard situation (Pic. 4).

Отчет

по порядку действий ДНЦ, ДСП при оказании помощи поезду, остановившемуся на перегоне.

1. Дата __ , __ часов, __ мин. получен доклад от машиниста остановившегося на перегоне: "Машинист (фамилия) поезда N__ требую вспомогательный локомотив с головы (с хвоста) по причине неисправности тепловоза (электровоза, МВПС, ССПС) серии__ N__ из-за (указать причину неисправности). Остановку головы поезда на __км, __пикете перегона __ подтверждаю. Время__". (приложение 1, строка 9, распоряжения №512р от 16.03.2010г.).

Дата __ , __ часов, __ мин. ДНЦ, ДСП подтвердил правильность восприятия доклада машиниста: "Понятно, поезду N__ на - __км, __пк перегона__ требуется вспомогательный локомотив по причине неисправности тепловоза(электровоза, МВПС, ССПС) серии__ N__ из-за (указать причину неисправности). Время__"

2. Полученное уведомление о затребовании вспомогательного локомотива ДНЦ, ДСП записал в журнал диспетчерских распоряжений ф. ДУ-58 с последующей отметкой в журнале движения поездов (напротив номера поезда в графе примечание). (п.3 прил.7 ИДП). Примечание: В записанном уведомлении обязательно должно быть указанно: - время поступления требования об оказании помощи, - место остановки поезда (километр, пикет на котором находится голова остановившегося поезда), - причина затребования вспомогательного локомотива, - лицо, от которого получено уведомление (должность, фамилия). (п 2, 3 прил.7 ИДП, п.9 прил.10 ИДП)

3. Если уведомление машинистом поезда передано ДСП станции, ДСП в __часов, __ мин. передал его поездному диспетчеру.

4. Движение поезда не было возобновлено в течение 20 минут и не было возможности удержать поезд на месте на автоматических тормозах машинист поезда закрепил подвижной состава на тормозные башмаки, указав дежурному по ближайшей станции и поездному диспетчеру о закреплении поезда и количество уложенных тормозных башмаков (п.2.5 распор. №512р от 16.03.2010г.): Дата __ , __ часов, __ мин. "Машинист (фамилия) поезда N__, состав поезда закреплен __ тормозными башмаками со стороны станции__ и ____ тормозными башмаками со стороны станции__". (приложение 1, строка 13, распоряжения №512р от 16.03.2010г.). Примечание: Если поезд закрепляется на уклоне круче 0,012 тысячных, то диспетчер поездной получив информацию от машиниста поезда о закреплении, сверяет количество уложенных тормозных башмаков с данными унифицированной таблицы ГИД Урал ВНИИЖТ и делает отметку на графике исполненного движения. (прил.67 приказ №Крас-773 от 19.10.2012 г.).

5. Дата __ , __ часов, __ мин. Поездной диспетчер, получив информацию о закреплении подвижного состава на перегоне подтвердил правильность восприятия доклада машиниста: "Понятно, состав поезда N__ закреплен __ тормозными башмаками со

Pic. 4. The final report on the course of action of operational staff in an abnormal situation (Russian text is given just to show the formal character of a paper that should be filled in to assess staff actions in particular situation).

Conclusions. *Development of the program shown in the article will be a breakthrough, a new higher level of operational staff work in non-standard situations. It will ensure manageability and reliability of transportation, ensure the safety of passengers and cargo.*

Regulatory compliance system receives a reliable tool for learning and consolidation professional knowledge suitable for different human character types and levels of operational readiness.

REFERENCES

1. Bulletin of Joint Scientific Council of JSC Russian Railways [*Bjulleten' ob'edinennogo uchenogo soveta OAO «RZhD»*]. 2010, Iss. 3, 46 p.

2. Guidelines for implementation of functional strategies to ensure safety and reliability of transportation process at JSC Russian Railways [*Metodicheskie ukazanija po vnedreniju funkcional'noj strategii obespechenija garantirovannoj bezopasnosti i nadezhnosti perevozochnogo processa v OAO «RZhD»*]. Moscow, 2009, 18 p.

3. Faleev M. I. Reliability of technical systems and technological risks: educational guide [*Nadezhnost' tehnicheskih sistem i tehnogennyj risk: Ucheb. posobie*]. Moscow, Delovoj ekspress publ., 2002, 367 p.

4. Larichev O. I. Theory and methods of decision-making: Textbook [*Teorija i metody prinjatij reshenij: Uchebnik*]. Moscow, Universitetskaja kniga; Logos publ., 2008, 392 p.

5. Vorontsov, V. I. Teach to manage [*Uchit' rukovodit'*]. *Zheleznodorozhnyj transport*, 2010, Iss. 7, p. 40.

6. Vorontsov, V. I. Information and communication technologies in management: Monograph [*Informacionno-kommunikacionnye tehnologii v upravlenii: Monografija*]. Odessa, Kuprienko SV publ., 2015, 245 p. ●

Information about the author:
Vorontsov, Vladimir I. – deputy head of the analysis department of Krasnoyarsk Railway, associate professor of Krasnoyarsk State Transport University, Krasnoyarsk, Russia, vivdh@yandex.ru.

Article received 18.01.2016, accepted 22.02.2016.