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## **The Effect of the Human Personality of a Locomotive Driver on the Professional Integrity Level**

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### **Abstract**

The article describes the significance of considering all components that affect the professional integrity level of a locomotive crewmember. The following individual characteristics are distinguished: physique, psycho-physiological, neurophysiological and, the most important ones – personal qualities. The article deals with the experimental research the aim of which was obtaining the objective information on how personal characteristics of workers affected the professional integrity level. A group of locomotive crewmembers of the depot was involved in the research. It has been found that the professional integrity of a locomotive crewmember depends on the factors A, L and Q3. The factors A and L had the sign (-) while the factor Q3 had the sign (+).

**KEY WORDS:** *personal characteristics; professional integrity of operators; locomotive crewmembers.*

### **1. Introduction**

The safety issue in such a viable and complex system as rail transport considerably depends on the human factor, which accounts for 75-80% of all errors [1-3]. Therefore, the effect of the human personality on the professional integrity level for locomotive drivers requires thorough investigation.

The statistical data and numerous scientific studies emphasize that the most important factor influencing the safe transportation process is the professional integrity of the person whose activity can be the cause of most accidents [4-6]. First of all, it refers to human operators, particularly, locomotive crewmembers and dispatchers as the most important professional groups, which directly ensure the safe transportation process. It should be noted that higher reliability of technical equipment is closely connected with and directly depends on higher reliability of a human operator [7].

The issue of higher professional integrity of a person has been the focal point since the first days of railway transport. And therefore the human performance reliability was the first criterion for locomotive crewmembers. Already in remote antiquity the Greek philosopher Plato pointed out that people differed each other greatly and, therefore, the results of their activity in terms of certain work would be different, and this depends on their natural qualities. At present there are several classification approaches. The oldest one is the theory proposed by the ancient Greek philosopher Hippocrates about four temperament models: melancholic, phlegmatic, sanguine and choleric. Each model has its own response pattern that allows forecasting the person's behavior in different circumstances. Later on this approach was proved to be very simple and some other classifications were put forward. Today the most popular approach is the so-called person-centered approach according to which each person possesses a certain complex of personality characteristics, which constitute his or her essence.

The objective of this research is to trace the interconnection between various personality traits of a human operator and his/her professional integrity level.

## **2. Determination of the Effect of the Personality Characteristics of a Locomotive Driver on His/Her Professional Integrity**

### **2.1. Personality Characteristics as the Factor of Professional Integrity of a Human Operator**

The assessment of the professional integrity level of a locomotive driver should include all components that are connected with it and influence it. Therefore, the following individual characteristics of a person play a crucial role: physical, psychophysiological, neurophysiological and others, among which the personality characteristics are of primary importance [8].

The issue of how the personality characteristics influence the professional reliability has been discussed since the beginning of the 20th century. The German psychologist Karl Marbe called them the potentially hazardous

characteristics [9]. He believed that some people had an innate ability to be involved in an accident, thus they had lower professional reliability and it could be explained by a set of certain combination of characteristics (physiological, psychophysiological, etc.). However, the data on the effect of the personality characteristics on the professional reliability for a human operator are mostly general, therefore it is extremely important to determine the correlations between the personality characteristics and the professional reliability especially for human operators of railways.

This can be explained by a close interrelation between the personality characteristics of a person and the psychosomatic processes. Thus, numerous scientific studies describe strong correlation dependencies between some personality characteristics and the blood group. Particularly, it was noted that introversion is a common presentation sign for those with the blood group AB (IV), while neuroticism, i.e. increase in mood swings, has a connection with the blood group B (III). The peculiarities of the immune system impact the extroversion and other individual-psychological characteristics of a person, among which are neuroticism, sociability, empathy and risk tolerance. Thus, the dependency of the individual and physiological characteristics of a person (extroversion, neuroticism, sociability, impulsivity, risk tolerance) that impact the individual activity level on the blood group, the same way as the hereditary background, such as the electroencephalogram, indicates the genetic mechanism that impacts the individual activity level and, thus, is involved in regulation of the functionality and performance in the workplace. Therefore, the personality characteristics that are constant and fundamental for an individual, can mostly determine the individual behavioural reactions and physical states that impact the professional reliability of operators [10].

And the objective information about their impact on the professional integrity level of human operators is a crucial factor that must be taken into account during assessment procedures. This approach is of practical value, the assessment of personality characteristics has long been substantially developed in psychology. And now there are numerous techniques extensively studied and tested and results of experiments that can be used to improve the safety of transportation process [11, 12].

Personology is one of the extensively investigated approaches that is developing and studying the individual distinguishing features of a person, though the concept "personality" has no generally accepted definition and has different explanations given by various physiological schools [13]. Generally, the concept "personality" is defined as the systemic quality that characterizes a person; it is a relatively stable combination of intro-individual and psychical characteristics (complexes of symptoms) that constitute the individuality and the motives driving a person. In the most general terms, the personal characteristics are divided into characteristics of temperament and character and characteristics of the motivational sphere. And the personality is characterized by a combination of syndromes (syndrome-individual characteristics). If the reliability of a human operator depends on a change of these syndromes, it can be forecast by means of studying the combination of the individual traits. It was found that certain personality characteristics ensure success in studying and mastering some professional activity. Among these we should mention, first of all, emotional stability, ability to mobilize the self-energy, ability to control emotions, ability to forecast potential situational changes, and high motivation in achieving the objective. These characteristics can be manifested due to emotional stress, higher self-control or awareness. Particularly, it is a well-known fact, that pilots who frequently make operation errors, have some typical characteristics that probably can be taken as a pre-condition of so-called flight adventures. Therefore, the aviation human engineering is based on the study of the connection between the professional efficiency and reliability and the individual characteristics; this approach is rather promising and requires thorough investigation. It can also be implemented in railway transport; therefore, there is a need to find the connection between the professional integrity level and the personal characteristics for human operators in the rail industry.

The personalized approach to studying and molding reliable locomotive crewmembers includes the orientation to psychological and physiological resources and functional reserves of a worker. It is explained by the fact that the professional reliability of locomotive crewmembers is conditioned not only by their professional skills, but also peculiarities of motivation, cognitive, psychomotor, emotional-volitional, temperament and character personal spheres, as well as the productive environment.

## **2.2. Experimental Determination of the Effect of the Personality Characteristics on the Professional Integrity of Human Operators (by the Example of Locomotive Crewmembers)**

The objective of the research is to obtain the unbiased information about the influence of the personal characteristics of locomotive crewmembers on their professional integrity level. A group of locomotive crewmembers from the depot "Odesa Zastava" of Ukrainian Railways was involved in the research; it consisted of 40 persons of the age from 23 to 48.

The biggest obstacle during the research was the objective assessment of the professional integrity level of human operators. For many professions, and human operators of rail transport are among them, human errors are not very frequent due to an extremely high price. The assessment of the professional integrity level included various indirect techniques; the most popular among them were psychological, physiological, probabilistic, statistical, etc. [6].

The task was solved with the expert-based method as the most appropriate in the condition of no sufficient statistics. And the experts in the research were driving instructors who were familiar with those involved. The experts estimated the professional integrity level of a worker by the five-point scale:

- 1 – unreliable, periodically fails;
- 2 – not very reliability, definitely fails;
- 3 – fairly reliable, can fail;

4 – quite reliable, fails rarely;

5 – very reliable, never fails.

The dimension of agreement of the expert ratings was determined by Kendall's coefficient of concordance. The personality characteristics of those under study were determined with the Sixteen Personality Factor (16PF) Questionnaire developed by Raymond B. Cattell. The result included the expert assessments of the professional integrity level in the form of scaling ratings.

The connection between the factor values by Cattell's questionnaire and the expert assessments was found after the statistical processing of the data by means of the correlation and regression analysis. The results of the analysis are given in Table.

Table

The correlation coefficients of the factors in the Cattell test and the expert assessments

|   | MD    | A      | B      | C     | E      | F      | G      | H      | I     | L      | M      | N     | O      | Q1    | Q2    | Q3    | Q4     |
|---|-------|--------|--------|-------|--------|--------|--------|--------|-------|--------|--------|-------|--------|-------|-------|-------|--------|
| H | 0.283 | -0.611 | -0.320 | 0.168 | -0.299 | -0.279 | -0.105 | -0.483 | 0.057 | -0.339 | -0.149 | 0.367 | -0.075 | 0.203 | 0.180 | 0.363 | -0.329 |

The direction (direct or reverse) and strength of the correlation relationship are characterized by the linear correlation coefficient calculated by the sample of observations  $n$  by the formula:

$$r_{xy} = \frac{\sum_{i=1}^n x_i \cdot y_i - n \cdot \bar{x} \cdot \bar{y}}{\sqrt{\left(\sum_{i=1}^n x_i^2 - n \cdot \bar{x}^2\right) \cdot \left(\sum_{i=1}^n y_i^2 - n \cdot \bar{y}^2\right)}}, \quad (1)$$

where  $x_i, y_i$  – the values of variables for the  $i$ -th observation in the sample;  $\bar{x}, \bar{y}$  – the average values of the variables for the sample of observations  $n$ ;  $n$  – the number of observations in the sample.

The preliminary analysis of the effect of the Cattell test factors on the expert assessments was conducted with the correlation coefficients. The significant factors to be included in the model were selected at the level  $F = 1$ , which provided the level of coefficient signification  $p < 0.30$ , and the validity  $1 - p > 0.70$ .

Let us emphasize the correlation relationships in the set of data through their compaction (direction of the relationship as a secondary factor will be lost in this case). Determine the product module of the inter-correlation coefficients for each factor:

$$r'_{xy} = \prod_n |r_{xy}|. \quad (2)$$

The products of the correlation coefficients obtained were standardized. Similarly let us obtain the standardized products of the correlation coefficients for the test factors and the expert assessments.

The overall regression equation for the expert mark "H" has the form:

$$H = 4.7520 - 0.2649 \cdot A - 0.0813 \cdot L + 0.1520 \cdot Q3, \quad (3)$$

where  $H$  – the professional integrity level of human operators;  $A, L, Q3$  – the Cattell test factors.

The determination coefficient for the model "H" at the factors  $A, L$  and  $Q3$  accounted for  $R^2 = 0.964$ . These factors were marked as: factor  $A$ : "unsociable – sociable"; factor  $L$ : "gullible – suspicious"; factor  $Q3$ : "low self-control – high self-control".

Thus, the scientific result obtained demonstrates the connection between the professional reliability of human operators (by the example of locomotive crewmembers) and personality characteristics determined by the Sixteen Personality Factor Questionnaire. Eq. (1) demonstrates that the professional integrity of human operators is connected with the factors  $A, L$  and  $Q3$ , in which the factors  $A$  and  $L$  has the sign (-), and the factor  $Q3$  has the sign (+).

According to the interpretation of the Cattell test factors we can state that the high professional integrity level of a locomotive crewmember greatly depends on such individual characteristics as certain unsociability, social awkwardness, and at the same time, tolerance and sociability, communicative skills and ability to be a good team worker. A high level of  $H$  is also related to a high level of self-control, which is characterized by high motivation, developed self-control, precision in performance of the social imperative.

### 3. Conclusions

The scientific result obtained demonstrates the connection between the professional reliability of human operators (by the example of locomotive crewmembers) and the personality characteristics determined by the Sixteen Personality Factor Questionnaire. As it is known, these characteristics are genetically predetermined and are virtually unchanged over time. And if these characteristics would be taken into account as early as at the beginning of a career it could considerably decrease risks in providing the transportation process and guarantee a better career choice.

It has been found that the professional integrity of human operators depends on the factors  $A$ ,  $L$  and  $Q3$ . The factors  $A$  and  $L$  have the sign (-) while the factor  $Q3$  has the sign (+). It means that those with a high intensity level of the factor  $Q3$  have more chances to become sufficiently reliable professionals and they must be top-listed by human resource departments. On the contrary, those with high intensity level of the factors  $A$  and  $L$  have all chances to become unreliable workers and should be oriented to master the professions that are closer to their inward nature.

### References

1. **Papadimitriou, E.; Schneider, C.; Tello, J.A.; Damen, W.; Vrouenraets, M.L.; Ten Broeke, A.** 2020. Transport safety and human factors in the era of automation: What can transport modes learn from each other?, *Accident Analysis & Prevention* 144: 105656.
2. **De Egea, B.G.; Holgado, P.C.; Suárez, C.G.** 2013. Humanscan®: a software solution towards the management of human reliability in the rail industry, 4th International Conference on Rail Human Factors, London, 718-724.
3. **Brusentsov, V.; Puzyr, V.; Vorozhbiian, M.; Ivashchenko, M.; Datsun, Y.** 2020. Higher efficiency of control over functional status of locomotive crew members, *IOP Conference Series: Materials Science and Engineering*, IOP Publishing 985(1): 012041.
4. **Dhillon, B. S.** 2013. *Human reliability: with human factors*. Elsevier, 260 p.
5. **Sujová, E.; Čierna, H.; Molenda, M.** 2016. Evaluation of human reliability in selected activities in the railway industry, *Management Systems in Production Engineering* 3(23): 191-197.
6. **Samsonkin, V.; Leshchenko, O.; Pertseva, K.; Burov, O.** 2012. Professionally Important Qualities of Train Drivers and Risk Prevention of Their Erroneous Work, *Human Aspects of Road and Rail Transportation*, CRC Press, 786-790.
7. **Dekker, S.** 2014. *Safety Differently: Human Factors for a New Era*, Second Edition. London: CRC Press, 312 p.
8. **Hockey, G.R.J.; Gaillard, A.W.K.; Burov, O.** 2003. Operator Functional State: The Assessment and Prediction of Human Performance Degradation in Complex Tasks, *IOS Press*, 379 p.
9. **Marbe, K.** 2019. *Praktische Psychologie der Unfälle und Betriebsschäden*. Walter de Gruyter GmbH & Co KG, 110 p.
10. **Sivash, O.** 2009. Person-centered assessment of professional suitability for pilots. *Actual problems of labour psychology, engineering psychology and human engineering* 1: 534-560 (in Russian).
11. **Gertman, D.; Blackman, H.** 1993. *Human Reliability and Safety Analysis Data Handbook*. John Wiley & Sons, 472 p.
12. **Schmitt, N.** 2012. *The Oxford Handbook of Personnel Assessment and Selection*. Oxford University Press, 992 p.
13. **Hjelle, L. A.; Ziegler, D. J.** 1992. *Personality theories: Basic assumptions, research, and applications*. McGraw-Hill Book Company, 603 p.

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