Chapter 29

The Components of Psychological Safety of Oil and Gas Shift Workers in the Arctic

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Abstract The chapter focuses on justification of the psychological safety model of oil and gas workers in the Arctic. The safety in industrial activity depends firstly not only on the employee, on his attitude toward observance of occupational safety and health regulations, but also on the personal attributes of the specialist, his subjective perceptions and effectiveness of his psychological self-regulation. The study was conducted at an oil and gas facility with a watch-based method of labor organization in the Arctic zone of the Russian Federation (duration of a rotation shift is 30 days). The study involved 70 persons at the ages from 24 to 60 years (average age 38.7 ± 1.3). The methods were as follows: study of documentation, monitoring of work process, questionnaires, psycho-physiological and psychological testing, and statistical methods of data analysis. The study verified the concept of psychological safety as a mental state of a subject who has control over a set of internal and external factors of the ergatic system providing updating of internal resources of the individual for efficient professional activity on the psycho-physiological and psychological levels. As a result, the model of psychological security of oil and gas workers in the Arctic was introduced and evidence based. It includes the following components: (1) The psycho-physiological level of functional status (reduced or optimal); (2) The psychological level of functional state (emergency or economical); (3) The image of the labor object (low undifferentiated hazard assessment or high differentiated hazard assessment); (4) The perception of the subject (high undifferentiated or moderately high differentiated self-assessment); (5) The perception of the subject-object and subject-subject relations (neutral, negative, or positive). In this research, the components of psychological safety of oil and gas workers of different professional groups (operators of oil and gas, boiler operators, drivers, engineers and technical workers, maintenance specialists) in the Arctic were empirically studied and characterized. The psychological level of functional state was expressed in economical adaptive strategy mainly on the basis of results gained from the study of operators of treatment facilities and boiler houses, engineering

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and technical staff and maintenance staff. On the contrary, the emergency strategy was defined in the course of the study of oil and gas operators. Low psychophysiological levels of functional states were noted among drivers and operators of treatment facilities and boiler houses. Higher rates of this component of psychological safety were found among engineering and technical personnel, oil and gas operators, as well as maintenance specialists. Among the components of psychological safety related to the mental structure of the regulation, there are no strong differences between workers belonging to one group or another, depending on job. In all occupational groups there is a predominance of a higher and more differentiated assessment of the impact of adverse factors and potential hazards during the rotation shift and moderately high self-assessments of competence. However, the composition of the subject-object and subject-subject relations shows a predominantly negative evaluation of socio-psychological environment mostly among drivers, in other groups of specialists the attitude was neutral or positive.

29.1 Introduction

According to the World Health Organization, accidental deaths rank third after cardiovascular diseases and cancer (Sudak 2011). Every year in the world there are 125 million industrial accidents resulting in 1.1 million deaths globally, out of which 25% under the action of harmful and hazardous substances, according to estimates of the International Association of Social Security and the International Labor Organization (Sudak 2011). In the European Union, there are about seven million cases of occupational injuries on a yearly basis (Sudak 2011). The recorded rate of industrial accidents in Russia is 3–12 times lower than in the EU, but the rate of fatal accidents is 3–9 times higher (Sudak 2011). Achieving a high level of industrial safety at all enterprises of extractive industry including oil and gas production is one of the priorities of the “Energy Strategy of Russia for the period until 2020” (Morozov et al. 2013).

The safety in industrial activity depends firstly on the employee. Not only by his attitude toward observance of occupational safety and health regulations, but at the same time on the personal attributes of a specialist, his subjective perception and the effectiveness of his psychological self-regulation. A personal factor in the accident rate is defined as a totality of all mental and physical characteristics of the person, which may be tied to the incident (Kotik & Emelyanov 1993). Therefore, both (1) organization and work environment and (2) characteristics of psychological safety as a potential way to avoid errors should be taken into account by research of employees’ safe behavior.

Analysis of previous investigations (Azizov and Khodjaeva 2010; Kora 2012; Korneeva et al. 2013; Kotik 1990; Kozlov 2007; Morozov et al. 2013; Sautkina 2015; Simonova 2011) have revealed a contradiction between scientific evidence of

human factors' influence on accidents and emergencies in the oil industry, and small number of studies reflecting psychological characteristics of rotational specialists who committed errors leading to accidents. Another contradiction appears between the need to improve professional activity efficiency of rotational workers, and the lack of systematic analysis of the effectiveness' criteria. One more challenge is an increase of accidents, injuries and occupational errors made by rotational workers, and the lost opportunities to improve the situation by means of psychological follow-up and support.

The psychological factors causing these contradictory findings among these different studies may be adjusted by detailed study of specialists in various professional areas working on a rotational principle of work organization in the Far North.

The objective of this study was to develop a model for psychological safety of oil and gas workers with a rotational principle of work organization in the conditions of group isolation in the Arctic environment.

29.2 Theoretical Justification of the Psychological Safety Model

In this study, the psychological safety implies the mental state of a subject who controls a set of internal and external factors of his/her ergatic system. It provides activation of internal resources of an individual for efficient professional activity on psycho-physiological and psychological levels. Put that way, the meaning of "security" in psychological terms serves as a criterion for psychological safety.

Considering the closeness of both terms to each other, it is necessary to determine how a mental state is understood in psychology.

Mental states are one of the components of the psychological phenomena that include mental processes and mental characteristics (Leontiev 1993).

The activity approach (according to A.N. Leontyev (Leontiev 1993), and S.L. Rubinstein (Rubinstein,2000)) considers mental states as functional, i.e. "The state of a man at work". Functional states are regarded as effective aspects of activity.

Altogether, the subject's internal features are determined by the concept of performance efficiency. A.B. Leonova (Rubinstein 2000) and V.I. Medvedev (Leonova 1984; Rubinstein 2000) consider the efficiency of economic activity at three levels:

1. physiological, which takes into account a state of health, specific features of metabolic processes, as well as neurodynamic properties of the subject;
2. psychological, which considers the functional content of work load, the profession requirements to functional systems which ensure the fulfillment of work tasks (work and rest, work posture, work load);
3. behavioral, which is characterized by the experience, skills, operating style, adaptive strategies of behavior.

M. Greenwood, J. Woods, N.L. Shlykova et al. (Shlykova 2004) suggest the dependence of psychological safety and safe behavior on the professional environmental conditions. Therefore, this study takes into consideration the understanding of mental labor regulators, which could act as components of psychological safety.

E.A. Klimov (2004) defined performance capability as a “functional system” of subject-object relations, and a person (the subject of labor) as the initiator of activity (Klimov 2004).

E.A. Klimov (2004) also identified psychological regulators of labor and psychological criteria that reveal professional development of a worker and his competence’s level.

The psychological regulators of labor can be divided into three groups: “image of the object”, “image of the subject” and “image of the subject-subject and subject-object relations”.

All labor regulators refer to the “image of the subject” group, which is formed during professional activities by gaining experience.

“The image of the object” helps to evaluate the worker’s perceptions of labor process as a whole and its structural components (subject, objectives, tools, working environment, duties, etc.).

“The image of the subject” is an actual “self-image” (self-identity) revealing the self-consciousness level of a worker, i.e. self-perception, awareness of one’s features, interests, values and meanings in accordance with the professional reality where he/she is acting; awareness of his/her role in the professional community and in the society.

“Image of subject-object and subject-subject relations” is an indicator used to explore and assess the level of professional self-consciousness, which formation is regulated by needs, emotions and feelings, attitude toward different perspectives of the objective reality, personality orientation and world outlook.

Given that psychological safety is understood as mental state which is considered to be a functional state according to activity approach, functional state both on psycho-physiological and psychological level can act as components of psychological safety by constructing a psychological safety model. In addition, the psychological safety model can include psychological labor regulators: “image of the object,” “image of the subject” and “image of the subject-subject and subject-object relations” are seen through the regulation psychological structure (Table 29.1).

Table 29.1 Psychological safety model

Psychological safety	
Functional status (Leonova 1984; Rubinstein 2000)	Mental regulation of activities (E.A. Klimov 2004)
1. Psycho-physiological level	1. The image of the labor object
2. Psychological level	2. The image of the labor subject
	3. The image of the subject-object and subject-subject relations

29.3 Materials and Methods

The study was conducted at the oil and gas facility with a 30-day rotational shifts organization in the Nenets Autonomous District of the Russian Federation. The study involved 70 persons in the ages from 24 to 60 (average age 38.7 ± 1.3 years). The length of work experience by rotation method in shifts varied from 0.5 year to 31 years (average experience 9.53 ± 1.2 years).

The methods used in the study were as follows: study of documentation, monitoring of work process, questionnaires, psycho-physiological and psychological testing, and statistical methods for data analysis. The questionnaire was designed to obtain information on the life record data of employees and the specific features of their work. The questionnaire included the following sections:

- general information on the education and work experience;
- subjective assessment of the adverse climatic and geographical, industrial and social factors that affect the workers during rotational shift;
- specific organization of free time during rotational shift;
- subjective assessment of the individual's professional effectiveness and level of professionalism;
- subjective assessment of different dangerous situations that may arise during the rotational shift;
- subjective assessment of workplace hazards and factors that contribute to their formation.

To achieve the research objectives, the following methods were used:

1. Complex visual-motor response (CVMR) using a psycho-physiological testing device UPFT-1/30 "psychophysiology" (Ltd. Medicom MTD, Russia). This is an assessment of the operator's performance by parameters of dual-alternative complex visual-motor reactions.
2. Variable cardio measurement (VCM) using a psycho-physiological testing device UPFT-1/30 "psychophysiology". This is an assessment of the functional condition and adaptive capacity of the cardiovascular system according to the method of cardio measurement.
3. Measurement methods of cerebral hemispheres activation using hardware and software complex "Aktivatsiometr AC-6" (INGOs "Acceptor", Russia).
4. A questionnaire "The state of health. Activity. Mood" (Karelin 2007) developed by V.A. Doskino, A.N. Lavrent'ev, V.B. Sharay and M.P. Miroshnikov (Karelin 2007). The questionnaire is intended for assessment of the state of health, activity and mood.
5. Color preferences test (M. Lüscher adaptation Sobchik L.N.) (Sobchik 2001). The test is aimed at identifying emotional and characterological basis of personality and its current state thereof. In order to use the test data of M. Lusher, interpretational factors developed by G.A. Amineva were applied.
6. "Express-method" for investigation of working social-psychological environment by O.S. Mikhalyuk and A.Y. Shalyto (Dmitriev et al. 2010). This method

Table 29.2 Methods and techniques of diagnostics components of psychological safety of rotational workers

Components of psychological safety	Methods and techniques
Psycho-physiological levels of functional states	1. A complex visual-motor response, using a psycho-physiological testing device UPFT-1/30 “psychophysiology” (Ltd. Medicom MTD, Russia)
	2. Variable cardio measurement, using a psycho-physiological testing device UPFT-1/30 “psychophysiology” (Ltd. Medicom MTD, Russia)
	3. Measurement of activation, using hardware and software complex “Aktivatsiometr AC-6” (INGOs “Acceptor”, Russia)
Psychological level of functional states	1. Questionnaire “State of health. Activity. Mood” (Sobchik 2001)
	2. Color preferences test (Dmitriev et al. 2010)
Image of labor object	1. Study of documentation
	2. Observation of workflow
	3. Survey of environmental factors and dangerous situations arising during the rotational shift
Image of labor subject	Questionnaire about the self-assessment as a professional.
Image of subject-object and subject-subject relations	“Express-method” to study the socio-psychological environment in the workplace (Dmitriev et al. 2010)

facilitates identification of emotional, behavioral and cognitive components of relations in the work team during the rotational shift.

Correlation between the methods, the diagnostic techniques and the components of psychological safety of rotational workers is presented in Table 29.2.

The statistical methods used in results’ analysis were as follows: descriptive statistics; contingency tables with calculation of Pearson X² criterion; two-step cluster analysis. Statistical analysis was performed using the statistical package IBM SPSS Statistics (license agreement № Z125-3301-14 (Northern (Arctic) Federal University).

29.4 Results and Discussion

Based on the theoretical analysis, functional status and psychological labor regulators compound psychological safety of a person. To study the psychological safety components, a two-step cluster analysis was carried out for the variables related to the psycho-physiological and psychological parameters of functional states, the image of the object and the subject of labor, as well as for the image of the subject-object and subject-subject relations. The results show two clusters corresponding to professional groups having a statistically significant difference per totality of psychological security parameters (Table 29.3).

Table 29.3 Components of the psychological safety of oil and gas workers identified as a result of the empirical study

The psychological level of the functional status		
Emergency	Economical	
Psycho-physiological level of the functional status		
Reduced	Optimal	
The image of the labor object		
Low and undifferentiated risk assessment	High and differentiated risk assessment	
The image of the labor subject		
High and undifferentiated assessment	Moderately high and differentiated assessment	
The image of the subject-object and subject-subject relations		
Neutral	Negative	Positive

Based on the results, one can assume that the reliability of professional activities is related to the development of psychological safety. It can be traced by high levels of physiological parameters of a worker, a positive attitude to the working team on the emotional, cognitive and behavioral levels. Not less important are choice of adaptation strategies, presence of a moderately high self-appraisal of one's professional skills and the adequate assessment of adverse factors and potential hazards encountered by shift workers in the Far North.

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