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# Production of Space-rocket Technique: Psychological Factor

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**Abstract.** The article is devoted to the issues of studying the mental and physical condition of the shop workers who assemble carrier rockets and ways of processing their internal conflicts. It is shown that the complexity of the ongoing labor processes, the intensity of production activities and the responsibility for its end result lead to a high level of neurotic workers. The tendency to a long experience of a stressful situation helps them to increase the level of various forms of aggression and create a negative assessment of their official capabilities and successes. It is established that the duration of experiencing a stressful situation depends on coping strategies in the behavioral and emotional spheres.

## 1. Introduction

The history of the cosmonautics development is inextricably linked with the city of Samara.

A special contribution to the production of rocket and space equipment was made by the Progress plant which incorporated the Central Specialized Design Bureau (CSDB) in 1996 and is now called the Joint Stock Company "Rocket Space Center Progress" (Progress RSC JSC).

During its existence, the employees of the Progress RSC JSC developed, produced and operated spacecrafts of both scientific and applied value, many of which are unique and have no other analogues, currently it specializes in the production of middle-class launch vehicles that are used to launch manned and transport spaceships. Launch of carrier rockets is carried out both from the Baikonur cosmodrome and from the new Russian spaceport Vostochny (the first in the Russian Federation that has the status of a civilian cosmodrome), so there is no doubt that the quality of products of Progress JSC is a task of the state importance since the implementation of international and commercial space programs depends on it.

The quality of products is largely determined by the use of innovative developments and the scientific potential of the space industry. However, in our opinion, with all the development and automation of production it is impossible to underestimate the importance of the human factor, namely, their resistance to stress and ability to withstand the great neuropsychic overload associated with stressful nature of the work. On the one hand, the use of information technologies significantly increases the work efficiency, and on the other hand, it increases the amount of information that the employees when assembling carrier rockets should process per day since the quality of the final



product depends on the quality of the performed operations (at Progress RSC JSC flow production is used). This all leads to the emergence of psychological stress.

## 2. Objectives and tasks of analysis

The problem of psychological stress leads to the fact that a person does not cope with the task, does not have time to make the right decisions at the required pace, with a high degree of responsibility for their actions. The purpose of our study is to determine the mental state of employees and ways of processing their internal conflicts. The paper considers a psychodiagnostic complex of techniques that showed the enormous influence of emotions on the well-being, activity and mood of a person, which emphasizes the need to master the ways of regulation of the emotional sphere.

## 3. Research fundamentals

While getting a job, vocational training is highly assessed but insufficient attention is paid to their psychological training. The work intensity of the Progress RSC employees (often an irregular working day, uneven load) leads to the increase their psychological stress level resulting from a mismatch between the load and available resources, accompanied by negative emotions (fear, anger, frustration etc.). Psychological stress has a dual nature and is divided into information stress and emotional stress. Information stress occurs in situations of information overload, when a person can't cope with the task, does not have time to make the right decisions at the required pace with a high level of responsibility for his/her actions. Emotional stress appears in situations of threat, danger, resentment etc.

Professional stress is a diverse phenomenon, manifested in mental and physical reactions to stressful situations in the work activity of a person [1]. We conducted a study in which employees of the workshops took part, where assembly of carrier rockets (22 people in all) took place. We prepared a psychodiagnostic complex of methods, which include the following methods:

1. HAM methodology, this technique allows to determine the state of health, activity, mood at the moment. While carrying out this procedure, it was told in the instruction that the participants should note their most characteristic condition during the last 6 months.

2. Test of determining the duration of stressful situations.

3. L I Wasserman's method for diagnosing the neuroticism level (studying the features of the nervous system and its propensity for a neurosis).

4. N Pezeshkian's differential analytic questionnaire, from which we took only the block relating to ways of processing an internal conflict. For the convenience of results evaluating we introduced a "conflict conversion factor" (CCF), which allows us to determine the way in which the internal conflict is being processed. The value of the CCF shows whether the person is trying to resolve the emerging conflict ( $CCF = 5$ ) or trying to compensate it by "running away" from it in one of the four activities (bodybuilding (exercise or illness), work, communication, fantasy ) wherein the CCF values vary from 2 to 4 and from 6 to 8.

5. A Bass and A Darki's methodology for diagnosing the indicators and forms of aggression (A K Osnitsky's adaptation).

6. K Maslach and S Jackson's questionnaire MBI ("Professional burnout") adapted by N E Vodopyanova contains statements about the feelings and experiences associated with working activity on which basis three sub-districts (emotional exhaustion, depersonalization and personal achievements) are singled out.

7. Definition questionnaire of behaviour coping strategies respectively in the behavioural, cognitive, emotional spheres.

The HAM methodology showed that the variance in indicators of health, activity and mood in the group was small, on the average, the level of well-being was just above the mean (5.1), the mood slightly below the mean (4.9), activity – 4.3. We tested the relationship between mood and well-being in a group. The correlation coefficient was equal to 0.855 that confirms direct dependence of health status and mood. The test results for the duration of the stressful situation showed that 60% of the examinees had been experiencing a stressful situation for a long time, the rest 40% had recovered after

stress quickly. The analysis of the results (Table 1) obtained by L I Wasserman's method made it possible to distinguish the neuroticism level.

**Table 1.** Diagnosis of the neuroticism level

Neuroticism level	Number of persons	Percentage
Low	7	32
High	15	68

The data in Table 1 show the neuroticism level among employees is quite high. It means that they have a pronounced emotional excitability which manifests itself in anxiety, tension, disquiet, confusion and irritability. This may also indicate difficulties in communication, social timidity, dependence and lack of initiative which are associated with dissatisfaction of desires are an alarming symptom for further professional activity.

Analysis of the CCF values allowed us to conclude that only 27% of respondents try to resolve the emerging conflict, for the others (73%) the desire to "escape" from the emerging internal contradictions (CCF from 5.75 to 6) is characterized. While a person is young and strong, the "flight" helps him to distract himself and cope with stress. However, the more often a person uses this way of internal conflict processing over a long period of time, the lower his effectiveness is as in each of these areas there are other stresses and conflicts which ultimately affect his health.

Analysis of the results of A Bass and A Darki's technique (A K Osnitsky's adaptation) made it possible to single out various indicators and forms of aggression.

**Table 2.** Results of the methodology for diagnosing indicators and forms of aggression

Indicators and forms of aggression	Low level	High level
Physical aggression	47%	53%
Verbal aggression	26%	74%
Indirect aggression	40%	60%
Negativism	46%	54%
Irritation	33%	67%
Suspicion	26%	74%
Resentment	40%	60%
Guilt	20%	80%

The results presented in Table 2 indicate that 74% of employees have a high level of verbal aggression. This means that employees allow sharp statements and insulting treatment in relation to other people. A high level of indirect aggression is noted in 60% of employees. The desire to see the bad in everything (high level of negativity) is noted in 54% of employees. 67% of employees are often very irritated. There is a high level of suspicion among 74% of employees. The employees have a high level of guilt – 80% (unfortunately, it is difficult to say whom they feel this feeling to: themselves, their family, their co-workers, convicts or other people). Thus, more than 50% of the staff that assembles carrier rockets has high rates of all forms of aggression.

The MBI questionnaire ("Professional Burnout") showed that 20% of respondents had psycho emotional exhaustion. This symptom is manifested in emotional and physical fatigue, indifference towards others (in some cases accompanied by depression or irritability). Deformation of relations with other people (depersonalization) is clearly expressed (30%). In some cases, this may mean increasing dependence on other people, in other cases it reflects the growth of negativity, the decrease in the number of contacts with others, irritability and intolerance in communication.

The highest values were obtained by the factor "Reduction of personal achievements" (32%). It can manifest either in a tendency to negative self-evaluation, their professional achievements and success, negativism about their official merits and opportunities, or in reducing their own dignity, limiting their abilities, obligations towards others which negatively affect the final result.

In foreign psychology the term coping is used to denote the specifics of these behaviour types. Stimulated or suppressed reactions that help restore the balance (coping) can be more or less appropriate, i.e. adaptive if they help achieve equilibrium and further reduce or eliminate harmful side effects.

Among the whole arsenal of behavioural individual responses, adaptive behaviour is highlighted on the basis of the concrete definition of the behavioural goal. Behavior can be called adaptive if its main goal is to establish productive interaction between the individual and the environment. In this context, the concept of "adaptive" does not mean that such behaviour necessarily ensures the optimal individual adaptation: the chosen strategy can be more or less successful. Nevertheless, adaptive behaviour is always launched in conditions of inconsistency of interacting systems and aims to achieve some coordination between them.

The problem of copying a person with difficult life situations arose in psychology in the second half of the 20th century. By copying R Lazarus [2] implies constantly changing cognitive and behavioural attempts to cope with specific external or internal requirements that are estimated as tension or exceed human resources in their overcoming. Following the approach of R Lazarus, N A Sirota and V M Yaltonsky consider the coping as an activity of the individual to maintain the balance between the environmental requirements and the resources that meet these requirements [3].

The coping ways mean constructive activity: to go through the situation, to survive the event, not to evade troubles. The subject of the coping psychology as a special field of study is the study of the mechanisms of emotional and rational behavioural regulation by a person aimed optimal interaction with life circumstances or their transformation in accordance with his intentions.

There is a sufficiently large number of different classifications of coping behaviour strategies.

At the stage of adaptation of a new employee to professional activity, E Yu Zarubko and N S Vakarina divide the coping strategies into constructive ones (seeking public support, positive interpretation and growth, active copying, planning, suppression of competing activities) and destructive (use of alcohol and drugs, Negation and mental detachment) [4].

We will consider coping strategies of behaviour in three planes (E Hale):

- behavioural (8 variants of behavioural strategies);
- cognitive (10 variants of cognitive strategies);
- emotional (8 variants of emotional strategies).

Adaptive variants of coping behaviour strategies include:

- in the behavioural sphere – cooperation, treatment, altruism (in all three cases, the behaviour of a person is aimed at constructive interaction with people, and sometimes a person has a desire to help people in overcoming their difficulties);
- in the cognitive sphere – problem analysis, setting the own value, self-control (these behaviour forms are aimed at analyzing the difficulties and possible ways to overcome them, increasing self-esteem and self-control, a deeper understanding of their own value as a person, belief in one's own resources by overcoming difficult situations);
- in the emotional sphere – optimism, protest, reflecting the emotional state of active outrage and protest in relation to difficulties and confidence in the possibility of getting out of any even the most difficult situation.

Relatively adaptive variants of coping behaviour strategies which constructiveness depends on the significance and severity of the overcoming situation include:

- in the behavioural sphere – compensation, abstraction, constructiveness – the behaviour forms characterized by the desire for temporary withdrawal from problems with the help of alcohol, drugs, immersion in a favorite business, travelling, fulfillment of their cherished desires;
- in the cognitive sphere – relativity, giving meaning, religiosity – the behaviour forms aimed at assessing difficulties in comparison with other problems, giving special meaning to their overcoming, believing in God and persevering in faith when facing complex problems;
- in the emotional sphere – emotional unloading, passive cooperation – the behaviour that aims to relieve tension associated with problems, emotional response, or to transfer responsibility for solving difficulties to others.



Non-adaptive variants of coping behaviour strategies include:

- in the behavioural sphere – active avoidance, retreat, which presuppose the behaviour that causes the avoidance of thoughts about troubles, passivity, solitude, isolation, the desire to get away from active contacts, refusal to solve the problem;
- in the cognitive sphere – humility, confusion, dissimulation, ignoring – the passive behaviour forms with the refusal to overcome difficulties due to unbelief in their own strengths and intellectual resources with deliberate underestimation of troubles;
- in the emotional sphere – suppression of emotions, obedience, self-blame, aggression – the behaviour characterized by a depressed state of hopelessness, submissiveness, anger and guilt on themselves and others.

If at least in one sphere a person chooses a non-adaptive coping behaviour strategy, then this leads to an internal conflict which means incompatibility, a clash of conflicting personal relationships. Consequences that are inherent in conflict become sources of mental and physical disability only when they are central to the personality relations system and when the conflict cannot be reworked so that pathogenic tension disappears and a rational, productive way out of the situation is emerged.

The number of adaptive, non-adaptive and relatively adaptive coping behaviour strategies in emotional, cognitive and behavioural spheres is presented in Table 3. The ratio of adaptive, non-adaptive and relatively adaptive coping behaviour strategies in the emotional sphere is 16-20-8 coping strategies, in the cognitive sphere 24-20-10, in the behavioural field 22-8-24 coping strategies respectively.

**Table 3.** Number of coping behaviour strategies

Type of coping strategy	Sphere	Amount
Adaptive	emotional	16
Non-adaptive		20
Relativelyadaptive		8
Adaptive	cognitive	24
Non-adaptive		20
Relativelyadaptive		10
Adaptive	behavioural	22
Non-adaptive		8
Relativelyadaptive		24

In the emotional sphere the number of non-adaptive coping behaviour strategies (20) is more than the adaptive behaviour strategies (16) that is reflected in complains about well-being, and is explained by the emotional work intensity of the Progress JSC employees in the production of space technology. A large number of relatively adaptive coping behaviour strategies in the behavioural sphere (24) indicates the presence of compensations but not active actions which is confirmed by a low activity index (4, 3).

If there are adaptive and non-adaptive coping strategies in the emotional sphere, this indicates a pronounced instability of the emotional sphere (there is the pendulum principle i.e. extremely positive and extremely negative emotions). This can be compensated by adaptive coping strategies in the behavioural sphere (in this case a person takes active actions aimed at reducing the stress level due to "flight" in the field of fantasy).

#### 4. Aspects of rational material choice

The results of the research showed that the duration of the experience of a stressful situation depends on coping strategies in the behavioural and emotional spheres (i.e. on the emotions that a person experiences in a stressful situation and on the ways to overcome them). The duration of experiencing a stressful situation also depends on the way a person processes his internal conflict (the CCF value). The results of diagnostics showed once again the enormous influence of emotions on the well-being, activity and mood of a person, which emphasizes the need to master the ways of regulation of the emotional sphere.

In this regard, in order to improve the quality of products and the production efficiency of medium-sized launch vehicles special attention should be paid to the formation of emotional and stress resistance among Progress JSC employees. The stability of a person can be defined as a special, maximally effective organization of the functioning of a person as a system. Accordingly, stress resistance can be considered a special case of mental stability, which manifests itself under the action of stress factors [5]. Stress-resistance is the organization of the functioning of the personality as a system based on the psychological mechanisms of regulation, which allows him to act most effectively when exposed to stress factors.

According to B H Vardanyan [6], stress-resistance is provided due to either internal or external way of mental regulation. Internal methods include those methods of overcoming the emotional situation that help change attitudes towards it, give it a new meaning and cope with negative emotions. The methods of external overcoming are aimed at eliminating the external conditions of the emergence of an emotiogenic situation. This can be facilitated by training employees in self-regulation which mastery will allow an employee to cope with the negative stress consequences, prevent professional deformation that will have a beneficial effect on professional activity.

Summing up the above material, it can be said that the solution of the problem of the production and operation of space technology should be of a systemic nature, while paying attention not only to the technical and innovative improvement of production processes, but also to the psychological training of employees participating in this production since trainings of new staff are economically conditioned by the complexity of the technological processes.

## 5. Conclusion

The complexity of technological processes, the labour intensity and responsibility for its result lead to a high level of neurologization among the workers in the space industry that contribute to their increased aggressiveness of various forms and to the formation of a negative assessment of their job merits and opportunities because of a tendency to prolonged experience of stressful situations and lack of skills and abilities to effective conflict processing.

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