Psychological Barriers in Professional Activities of Engineers

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Abstract. This paper is devoted to considering a system of psychological barriers which can result from professional activities of a modern engineer. It is based on the content analysis of tasks typical for engineer’s professional activity. It is discovered that implementation of engineer’s professional activities causes barriers reflecting difficulties of professional skills: emotional, motivational, cognitive, operational, and others.

The experimental study of psychological barriers among engineers of different experience groups was carried out on the basis of the method of expert evaluations. The most significant difficulties identified in all groups of experts are value and motivating, reflective, of creative constriction, subject-subject relationship, communication. It is shown that the identified system of psychological barriers allows to apply corrective actions for engineers to develop their barrier resistance to improve their professional activity in general.

1. Introduction

A modern engineer in his professional activities should realise a set of competencies (universal cultural, general professional and professional), related to various difficulties associated with situations arising when solving engineering problems, including psychological barriers.

In this regard, the profession of an engineer requires from specialists psychologic reserves in the field of self-control and self-regulation. Psychological difficulties when implementing professional duties lead to the fact that a significant part of persons experience tension, discomfort, anxiety, stress, which consequently reduces working efficiency, increases conflict, aggravates health.

The goal of this paper is to describe the results of experiment in studying psychological barriers in modern engineers’ activities, impeding the effective solution of professional problems.

2. Relevance, scholarly importance of the subject and literature review

The relevance of studying the problem of psychological barriers in the professional activity of the individual is due to the processes of modernization taking place in the economy of the country, and the Russian society as a whole. In the conditions of introducing new technologies, development of production, requirements to professional qualities of a modern engineer are changing and effective implementation of his activities demands active interaction with the world around, continuous self-improvement, getting new knowledge for overcoming the barriers standing on the way to achieve his
goals. In this regard, psychology as a field of study looks for conditions and means of overcoming obstacles, i.e. barriers to certain activities or actions, in particular for engineers, and it is of practical importance.

At present there is a large number of studies on various aspects of professional activities. The problem of success in professional activity is central and is presented in the studies of V A Averin [1], A B Bodrov [2], A A Derkach [3], E A Klimov [4], L M Mitina [5] Yu P Povarenkov [6], O N Rodina [7], E E Cymanuk [8] and others.

In foreign psychological researches the problem of psychological barriers is studied in the context of personality development offered by them. From the point of view of our study of particular interest are: psychoanalytic theory of Z Freud and his followers (K Jung, E Fromm, E Erikson, A Adler), humanistic conception of the personality by K Rogers, cognitive direction in the theory of personality by G Kelly, personality theories by E Berne and K Levin, as well as the works of other authors, close to the problem of our study.

Nowadays in Russian psychology and pedagogy there are enough works devoted to the study of success in military (V I Khamkov [9]), teaching (I V Arendachuk [10]), management (A G Ivashkin [11]), and other professional activities. Engineer’s professional activity is no exception. Its features were studied by V A Molyakov (design engineer’s activity) [12], A T Rostunov (vocational training and aptitude) [13], V P Zakharov (engineer’s technical intelligence) [14], A S Bysiuk (psychological factors of success professional activities of metrology engineers) [15].

However, studies of professional difficulties relate mainly to the activities of teachers: professional deformations (A K Markova [16]), difficulties of teaching (N V Kuzmina [17]), psychological barriers of pedagogical and innovative pedagogical activities (V A Slastennin, I A Zimnyaya [19], S.S. Nazmetdinova [20], L S Podymov [21]). The Basic research of psychological barriers was carried out by N A Podymov, who developed a typology of psychological barriers in the professional activities of teachers [22], [23].

At the same time, the problem of engineer's barrier-resistance is still not developed, there are no focused system studies of barrier-resistance features in engineer's professional activities, their peculiarities at different stages of professional and personality development, and there are no training programs to form various options for regulating their barrier-resistance.

3. Problem statement and research methods
The goal of the empirical research is based on the statement that the implementation of professional tasks by modern engineers will be effective if psychological barriers are identified which hinder their professional activities considered as a type of transformative activities for creating material products. The task is to identify the main psychological barriers in the professional activity of the modern engineer and set up a program for developing skills of constructive overcoming of psychological barriers that increase the barrier resistance of engineers in various situations of professional activities.

We carried out experimental work to study how psychological barriers are shown in the professional activities of engineers of different experience groups and to define the causes of their origin. Mechanical engineers from various enterprises of Bryansk region were chosen as the main experimental base of the research.

Psychological barriers of engineers were studied in different age groups on the basis of the following age periods: youth, adulthood and maturity of specialists’ personality. Experimental groups were as follows: 1st group – 20-30- years-old (work experience up to 10 years); 2nd group - 30-45-years-old (work experience from 10 to 25 years); 3rd group – 45-55 (60)-years-old (work experience from 25 years and more). 86 engineers aged 22 to 60 took part in the study in total. There were used both theoretical and empirical methods: observation, experiment, questionnaire, testing, modeling, expert evaluation.
4. Theoretical analysis
The concepts "barrier" and "overcoming barriers" are associated with the development of all psychic structures. At the same time, it is possible to admit that the main function of barriers is to mobilize an individual's internal resources for overcoming the resistance of the environment to the process of satisfying his needs. Psychological barrier is considered as a factor that activates or destroys the activity. The process of overcoming psychological barriers is accompanied by deep inner work to overcome stereotypes of the activity, that requires adequate mental actions, willing attitudes, which increases the activity and intensity of the activity [24].

The barrier in an activity (communication) is a state of "failure" experienced by a person while implementing forecast (planned) event due to the rejection of the partner in an activity, communication, his actions; misunderstanding of the partner, changes in the communicative situation, his own mental state, etc. Difficulties are revealed in the form of interruption of an activity, communication itself, the impossibility of their continuation [25].

The psychological aspect of the professional activity includes the following range of problems: interaction of technology and man, communication of workers in the process of work, the study of psychological qualities that must have a representative of a profession and other psychological phenomena arising in human professional activities.

The success in solving the problems of modern professional activities in the sphere of overcoming psychological barriers depends on the ability of a person to master the patterns of barrier-resistant behavior [26].

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In our view, barriers in implementing engineer's professional actions and activities are emotional and motivating, cognitive, operational and reflective difficulties of a person in realizing professional skills.

Psychological barriers in engineer's professional activity under study can be defined as caused by badly-formed (imperfect) specific skills to carry out this activity in practice, as well as by insufficient ability of a person to define an objective (the image of a desired product), and inability to have a good sense of the term (reflection of adequate level of a skill and a perfect product of a transforming process, when the person himself brings “extra” condition in the orientation (P Ya Galperin) i.e. sets himself inadequate standards blocking the implementation of actions due to overstatement of quality standards) [27].

The origination of psychological barriers in the engineer’s professional activity is provided by certain situations, to which we refer:
- a situation of uncertainty (a sudden change in the activity means and conditions that requires professional improvisation);
- a situation of complicated conditions of engineer’s activity (requirements for being ready for integrated engineering activities);
- a situation of discomfort (dissatisfaction with his own activity, discrepancy of needs to opportunities, inconsistency of person’s success to expectations of his colleagues and managers);
- a situation of cross-pressure arising in the absence of mutual understanding; inability to find constructive ways to resolve a conflict in horizontal and vertical systems of subject-subject interactions of engineer’s professional activity;
- a situation of social and economic upheaval (salary delay, qualification downgrading, contract system of employment, profession downgrading, separation from work);
- situations of changing (improvement - deprivation) social position, status of an engineer, creating a certain positive or negative microclimate in the team (certification, competitions, project development, comparison of engineers with each other by various criteria);
- situations of entering a new professional environment (changing engineer’s social role, arising when moving to another team, to another position, in the case of being retrained);
- a situation of crisis in professional engineering activity in general (change in the system of society values, low social assessment of the engineering activity results or increase of social prestige without appropriate financial support).

In addition to the given situations, we consider it expedient to analyse situations that provide the insight into engineering activity as a type of transforming activity to generate material products:

- informative and analytical (the goal is to determine the strategy and tactics of engineering activities, possible and limiting conditions, and the means necessary for engineering solutions to problems; the choice of a product sample in accordance with the plan);
- experimental and analytical (the goal is to realize the skills to determine material properties and select materials depending on different conditions);
- design and constructive (the goal is to realize the skills of creating a product image and to fix it in a symbolic form);
- organizational and preparatory (the goal is to realize the skills of planning and arranging one’s activities; to realize the skills to arrange the workplace, depending on various conditions);
- operational and practical (the goal is to realize the skills of performing practical actions which lead to generating a product with specified qualities depending on various conditions);
- evaluating and correctional (the goal is to realize the skills to exercise control, evaluation and correction of activity process and results).

Effective implementation of engineer’s professional activity depends on the peculiarities of overcoming psychological barriers, which is carried out according to fundamentally different strategies: constructive and destructive. Constructive strategy is expressed in transforming semantic structures of the person; destructive strategy is found in psychological protection, in refusal of productive solution of critical situations, in calming emotional tension and preserving illusory integrity of personality structure. Depending on the degree of tension and how much a person is sure that he will cope or not cope with it, we can conclude that there are several ways to overcome a psychological barrier.

On the basis of mentioned above, we can propose the following classification of psychological barriers that a modern engineer may face in solving the problems of his professional activity:

- value and motivating barriers caused by an incomplete or distorted need for professional activity or its absence in a particular situation; by dissatisfaction with the existing situation, emotional discomfort, anxiety due to the lack or absence of information on the required values and the possibility of obtaining access to them in this situation, as they are the starting point of the activity, playing a key role in the activity structure;
- cognitive barriers due to insufficient maturity of professional skills required in the area of possible and restricting means and conditions of implementing these skills, as well as immature specific skills, which are necessary to find semantic match of conditions in dealing with professional tasks. They affect the mobilization of energy resources of the actor, which means updating experience, knowledge, skills, abilities, regulating the composition and structure of actions performed;
- individual barriers related to the influence of some individual and psychological peculiarities of the actor of engineering;
- barriers of subject-subject relationship type are contradictions arising in business relationship while solving professional problems associated with inadequate assessment of professional qualities of cooperating participants;
- barriers of creative constriction expressed in inability to think and solve professional problems on the basis of creative approach;
- communication barriers arising as a peculiarity of interpersonal communication characterized by immaturity, distortion of the need for business communication or its absence in a particular situation; lack of means (verbal and non-verbal) required for implementing this communication, as well as immaturity of certain communication skills;
- reflexive barriers, expressed in inability to make rational control and value
judgments concerning their own activities, the activities of other actors in solving engineering problems, as well as qualitative assessment of their activity.

Identification of the most significant psychological barriers according to their influence on the efficiency of engineering activities was carried out on the basis of the method of expert evaluations [28].

We formed expert groups in accordance with the above-mentioned experience groups.

Engineers were asked to express their opinion concerning the most significant psychological barriers in accordance with the questionnaire (Table 1). The data obtained are shown in Fig. 1.

### Table 1. Questionnaire Form.

| №   | Factor                                | Expert Opinion |
|-----|---------------------------------------|----------------|
| 1   | Cognitive difficulties                |                |
| 2   | Value and motivating difficulties     |                |
| 3   | Creative constriction                 |                |
| 4   | Difficulties of subject-subject       |                |
|     | relationship                          |                |
| 5   | Communicative difficulties            |                |
| 6   | Reflexive difficulties                |                |
| 7   | Individual difficulties               |                |
| 8   | No difficulties                       |                |

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\sum X_{\text{max}} - \sum X_j
\]

**Figure 1.** Results of expert evaluation of significance of psychological barriers in engineers’ professional activity.

Analyzing the evaluation of the importance of psychological barriers in engineers’ professional activities, the following conclusions can be made:

- the collective opinion of the first group of experts suggests that the most significant psychological difficulties are value and motivating barriers. The second place is occupied by reflexive difficulties while the third position is held by barriers of creative constriction. The fourth place was given to difficulties of subject-subject relationship. And the factor indicating significant influence of communicative difficulties in engineering activities takes the fifth position. Further go individual difficulties and cognitive barriers respectively. At the same time, it should be noted that all 100% of experts spoke in a single voice that psychological barriers significantly affect the quality of
engineering activities;
- the collective opinion of the second group of experts says that the most significant psychological difficulties are also value and motivating barriers. The second position in this group of experts is also occupied by reflexive difficulties; communicative difficulties are in the third position. The fourth and fifth positions with almost the same results, the experts gave to the barriers of creative constriction and difficulties associated with subject-subject relationship. Cognitive difficulties take the sixth position, according to experts, and the seventh - individual difficulties. In the second group of experts, all 100% of engineers also expressed the opinion that psychological barriers significantly affect the quality of engineering activities.
- the collective opinion of the third group of experts is that the most significant psychological difficulties are also value and motivating barriers. The second place is occupied by reflexive difficulties, the third - individual barriers, and the fourth position these experts determine as barriers of creative constriction. Difficulties of subject-subject relationship in engineering activities take the fifth position, cognitive difficulties - the sixth place, and communicative difficulties – the seventh position, according to the opinion of the experts of the third group. The important influence of psychological barriers on the quality of engineering activities is also proved by the engineers of this group.

Thus, analyzing the data of expert evaluation on psychological barriers in engineering activities, we can range them according to their importance in the following order: value and motivating barriers, reflexive barriers, barriers of creative constriction, barriers of subject-subject relationship, communicative barriers.

The given system of psychological barriers allowed to carry out corrective actions with engineers to develop their barrier resistance to improve their professional activity in general [29]. We developed and tested the training program, which provides simulating professional situations, helping to analyse mistakes commonly found among engineers in overcoming barriers in their professional activities. It is aimed at solving the following tasks: expanding the scope of understanding their own mental states caused by barriers in the professional activity; harmonizing the inner world of specialists through the development of new knowledge and skills of barrier-free behavior in situations of professional engineering activities; updating and expanding the motives of professional self-improvement; strengthening personal and professional self-esteem of engineers, their awareness of their personal characteristics and creative abilities.

Implementation of the program of changes in engineers’ behavior, development of barrier resistance was carried out as research and practical seminar and training seminar. There were different types of trainings and traditional forms of work with engineers — lectures, round tables, discussions. The main purpose of the research and practical seminar is an insight into simple, available methods of stress relief, generalized methods of developing creative abilities, self-esteem boost, business communication. The purpose of the training seminar is to form skills to realize business communication and management actions.

At the final stage of the research, during discussion we studied how engineers overcome psychological barriers in the experimental group. Comparing the responses of the group participants, it was noted that according to the responses of the majority of engineers involved in the experiment after the program they continued to develop individually communicative, organizational, creative skills, intentions to show positive motivation of professional activity. In the situation of the barrier, experts adequately perceive difficult events, analyze them, control their own state, take responsibility for solving the problem.

Thus, engineers, who are exposed to systematic work on the development of skills of barrier-resistant behavior, have higher barrier resistance and more opportunities to diversify professional activities; therefore, the effectiveness of engineers’ professional activity depends on the systematic implementation of the proposed set of measures [30].
5. Conclusion
A system of engineers’ psychological barriers is developed, which is based on a comprehensive approach to the analysis of professional situations of modern engineering activities. Studying the problem of our research, we considered psychological barriers as an objective obstacle to effective professional activity, which can be identified and predicted.

Experimental work is carried out to diagnose psychological barriers in engineers’ activities on the basis of expert evaluation method.

It is shown that the given system of psychological barriers in engineering activities can serve as a ground for corrective measures to improve the barrier resistance of engineers, as well as for effective solution of engineering problems.

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