CHAPTER 8

PSYCHOLOGICAL SUPPORT OF WORK SAFETY AND LABOR PROTECTION

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8.1. WORK SAFETY AND LABOR PROTECTION SERVICES: LEGAL BASIS AND ORGANIZATIONAL STRUCTURE

The state labor safety system, established in the Soviet Union over 70 years, developed strict control over all enterprises in the country, from industrial giants to boiler houses, gas stations, universities, hospitals, museums, schools, etc. This system was based on national labor safety laws and spread from the so-called state committees and industrial ministries to enterprises and their branches. The general principles of the work safety system were contained in the "Foundations of the Labor Laws of the USSR and the Soviet Republics" and were approved by the Supreme Soviet, the country's parliament, in 1970 (Dvornikov, Livshits & Rumyantseva, 1971).

Responsibility for the execution of this basic law was placed with the State Labor Committee at the Soviet Government and the All-Union Trade Union Central Council. The principles of the law were specified in national and branch labor safety standards, general and branch labor safety rules, and sanitary and hygienic norms, which regulated work safety. The elaboration of these standards and rules was carried out by two research institutes: the All-Union Central Research Institute for Work Safety (under the All-Union Trade Union Central Council) and the Institute for Labor Protection and Occupational Diseases at the Academy of Medical Sciences.

Enterprises were obliged to introduce all necessary labor protection measures. In order to fulfill this task, each enterprise had a labor protection or work safety department. Their staff members were mostly engineers or technicians. They were responsible for elaborating and observing the technical requirements, as well as for instructing and training workers in work safety.

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The concept of work safety was one of the declared principles of the communist paradigm. Official Soviet ideology emphasized the care lavished on the people of the Soviet Union as opposed to the exploitation of workers in the capitalist countries. Therefore, officials did a lot to control work safety issues. Top managers of plants, factories and power stations were personally responsible for observing work safety rules and ensuring the safety of their enterprises. After any serious accident, particularly if there was a death involved, the manager, shop superintendents and sometimes even the local party leader could be fired or penalized. A punishment followed even if inspectors detected shortcomings in the observation of labor protection rules. That is why managers of all levels feared these inspectors like death itself.

It would seem that this strict state organizational system could have ensured effective and safe functioning for all enterprises. But numerous accidents and disasters demonstrated its vulnerability. At the end of the 1980s, industry became more complex and the weakness of centralized management became obvious. The Chernobyl tragedy exposed this problem to the whole world.

The disintegration of the Soviet Union in 1991 was followed by radical economic and political changes in Russia, which led to the collapse of the state labor protection system. The Soviet trade unions lost their influence and government financial support for work safety programs was radically reduced. Enterprises found themselves face to face with work safety tasks, but they could not handle them without legal, financial and organizational support. Work conditions and labor protection during that time in Russia started to deteriorate and were not taken seriously by the officials who had previously been in charge of this matter. As a result, the number of industrial accidents and occupational diseases increased (Krylov, 1999).

To improve this situation the Government of the Russian Federation took certain steps. In 1994 President Yeltsin signed the Decree on State Supervision and Control of the Observance of Labor and Labor Protection Legislation of the Russian Federation, which set up the State Labor Inspection Agency as the chief institution in this field. This decree gave impetus to the elaboration of normative legal acts containing general labor protection requirements. But these measures were not effective enough. One of the weak spots was their failure to consider the new economic and labor relations: nothing obliged managers and owners of private enterprises to follow labor protection requirements.

In 1997, in view of the new economic realities the RF Government approved the Federal Program for the Improvement of Labor Conditions and Protection. This document confirmed that work safety remains extremely important for the Russian authorities. It formed the new legal base and determined the organizational structure of labor protection regulation. The top of this organizational structure was occupied by the Ministry of Labor and Social Development, the All-Russia Center for Labor Protection and Work Efficiency and the Joint Labor Protection Committee. They were instructed to implement the Program. In the lower level interdepartmental and

branch documents, standards and sanitary rules and norms were to be developed. This work was under the authority of ministries and local governments. Enterprises, institutions and organizations at their level were to draft and approve concrete rules and instructions for particular types of work. Workers and trade unions obtained the right to participate in the drafting and coordination of normative legal acts on labor protection. The Federal Program determined the mechanisms of state control over labor protection. These mechanisms include obligatory regular registration of all enterprises and official examination of technical equipment and work conditions. The government also undertakes to implement educational programs in work safety and training in labor protection management.

An essential task of the Federal Program is to ensure the safe functioning of enterprises having a high probability of industrial or ecological accidents. The legal base for solving this task is the Federal Law "On Industrial Safety of Highly Hazardous Industrial Facilities" adopted by the Russian Parliament in 1997. It defined the legal, economic and social basis for the safe running of hazardous industrial facilities and the powers of their top managers in localizing and eradicating the consequences of accidents.

The Law contains a list of different categories of hazardous facilities and defines such concepts as industrial safety (the protection of the vital needs of personnel and society from accidents); accident (the destruction of structures or uncontrolled explosion of exhaust or poisonous substances); incident (the failure or damage of technical installations, a deviation from the normal technological process, or violation of labor protection legal laws and technical requirements). The Law determines the safety requirements set on technical equipment and conditions of work, as well as the general approach to personnel management in highly hazardous plants. It also defines the procedure of accident investigation. This procedure includes both the analysis of technical conditions and personnel behavior which could have caused the accident.

The organization of the safety service in the gas and oil industry is a good example of effective application of the new approach to work safety. The Department of Inspectors in the gas and oil industry has elaborated a guide for the process of safety management and risk analysis at highly hazardous industrial plants (Rukovodstvo po analizu riska na opasnykh promyshlennykh predpriyatiyakh, 1996). In the guide one can find definitions of a hazard (a source of potential damage or a situation which generates a possibility of damage), risk (the combination of the probability and consequences of a certain dangerous event), quantitative indices or types of risk, individual risk (the probability of loss of life or less serious injury to workers as a result of the impact of hazardous factors), collective risk (the expected number of mortally wounded persons in possible accidents), potential territorial risk (the spatial distribution of the probability of a certain negative effect), social risk (the probability of damage to the social and natural environment). The guide describes the main procedures, goals and methods

of the risk analysis, and contains recommendations for planning and organizing risk analysis, hazard identification and minimizing risks.

In the Soviet Union the state system of work safety was formal and forced upon lower-level organizations. It was perceived by workers and managers not as caring for people and their health, but as an additional strict requirement, and caused constant resistance. At present in Russia the situation has radically changed. People feel unprotected in the new economic situation and try to provide for their safety. The government is trying to find a way to regulate work safety in these new conditions. The conceptual approach to work safety has also changed: it implies not only the technical functioning of enterprises, but also a complex model of a worker - his/her motives, attitudes, goals, skills, knowledge and states. This approach is reflected in laws, where such tasks as personnel selection, professional training and control over HFS are defined.

8.2. THE ROLE OF PSYCHOLOGISTS IN WORK SAFETY SYSTEM

Up to the 1980s psychologists did not actively work in labor protection departments. But on the whole their impact on solving the tasks of work safety was significant. It was mainly connected with such issues of human reliability as personnel selection, the training of psychologically important qualities, the elaboration of ergonomic requirements and control over the HFS.

Traditionally psychologists participate in the *selection* of applicants for specialized colleges and schools (military, flying and air traffic control schools), as well as candidates for work in highly demanding conditions such as in aeronautics, polar expeditions and other occupations where unique human qualities and high compatibility are needed. Detailed selection methods of psychological assessment and diagnostics have been elaborated (Bondarev, Diakonov & Zagriadsky, 1981). By the beginning of the 1980s these methods were standardized and from that time the opinion of psychologists was considered very seriously (Bodrov, 1985).

In flying schools four different types of personnel selection are used: medical, educational, social and psychological. Psychological selection comprises group and individual assessment by qualified specialists with the help of standard and verified tools and procedures (Korchemny, 1986). Psychophysiological indices, cognitive abilities, the peculiarities of emotional reactions and motivation to flight work are tested. The results of the testing are kept secret from the applicants and are passed on to a competent commission. Conclusions made by psychologists are often crucial for the future of applicants: those who get the highest grades in psychological tests are admitted *hors concours*, and those who fail in psychological tests are not admitted at all.

Another sphere of the application of psychological knowledge in the work safety domain is *professional training and education*. Psychologists are involved in the process of professional training at simulators, which are widely used in flying and air traffic control schools. Simulators enable psychologists to create models of real

activity and to provide practice in psychologically important qualities (Altukhov, 1977). They also make it possible to evaluate the level of professional skill (Isakov, 1981).

Russian flying schools use a special system of "psychological monitoring" of students. It includes a wide range of regular social, psychological and psychophysiological assessment and psychological counseling of students. Psychological monitoring starts with the analysis of the results of psychological selection of applicants. After this a more profound investigation of personality characteristics begins. These measures are designed to enhance academic results and the efficiency of future professional activity. Psychologists try to predict the potential capacities of each student and their behavior in regular and abnormal or crucial situations. This prognosis forms the basis of an individual training program. Psychologists also take part in the formation of crews, trying to provide optimal social compatibility and psychological climate, which increases the efficiency of training and the students' resistance to flight difficulties. Special psychological support is available to those students who cannot easily adapt to the requirements of military training and service. This support consists in social-psychological training, counseling, psychophysiological correction, group and individual psychotherapy, and training in self-regulation (Ponomarenko & Vorona, 1992).

The principle of psychological monitoring is used not only in education but also in control over various professional activities. It consists of regular *assessment and correction of the HFS* and has been carried out on space stations (Beregovoi, 1974), warships (Butov et al., 1984), nuclear power stations (Dyakov, 1993) and in "more civilian" occupations (see Chapter 6 and Section 8.3.1).

Psychological knowledge is widely used in *ergonomic design*. Ergonomists and engineering psychologists have done much to adjust complicated technical devices and installations to human parameters (Zinchenko & Munipov, 1979). Their main contribution in this field is connected with the elaboration of psychophysiological, psychological and social-psychological standards. In the beginning, these standards defined the demands set on technical devices and work places, which had to correspond to sensory, motor and energetic human parameters (psychophysiological standards), as well as to the characteristics of cognitive processes and the development of professional skills and work efficiency rhythms (psychological standards). Later ergonomic standards began to take into consideration variations of human behavior in different work conditions and HFS. They also identified optimal conditions for group work (social-psychological standards).

In the 1970s psychological research in ergonomics was devoted mostly to the optimization of information displays. These studies examined different features of visual information: physical parameters such as brightness, visual contrast, size, critical frequency of flicker, shape and color, spatial and temporal characteristics, and quantitative parameters (Velichkovsky & Kapitsa, 1980). On the basis of the data obtained, in-depth recommendations on the coding of information on displays and visual indicators were elaborated. Particular attention was paid to signals used in

emergency situations. The tradition of these experiments was continued in modern research connected with the development of user-friendly interfaces (see Section 8.4.3).

Gradually the tasks suggested to psychologists at enterprises became more complicated and extended to a broader range of industrial activities. Psychologists participated in accident analysis, evaluation of potential risk and prediction of human behavior in emergency situations. At the end of the 1970s this led to the establishment of the official structure of psychological services in Russia. Psychological services had to cover different human aspects and levels of the functioning of enterprises. Such a complicated and diverse task demanded special training for the professionals working in psychological services. At the beginning of the 1980s the Moscow State University Department of Psychology proposed a special program for psychologists working in industry, which included combined training in ergonomics, work and social psychology.

In 1995 the RF Government decided to set up the Commission and the Research Center for Occupational Counseling and Psychological Support. This center supervises research in applied psychology and drafts official documents which regulate the work of psychologists at enterprises and define their rights, obligations and tasks. In a very short period psychological services were organized at ministries, banks, large companies, schools, enterprises, etc. Psychological services at enterprises have to solve a wide range of tasks, which can be divided into three modes. The first mode is analytical. It includes job analysis, investigation of factors influencing the effectiveness of human activity, causal analysis of the violation of work safety regulations, discipline and labor fluidity. The next mode is practical. It consists of personnel selection, psychological monitoring of professional activity (assessment and control of the HFS of workers) and professional training. The third mode includes recommendations for the optimization of work processes, personnel management and social climate in work groups.

Within the framework of labor protection and psychological support of people who are engaged in high-risk and hazardous work, it would be interesting to examine the organization of psychological services in the Air Force, the Ministry for Emergency Situations and the State Customs Committee.

The psychological service in the Air Force of Russia is one of the oldest and most diversified systems with branches at flying schools, air regiments, Air Force headquarters and test-flight institutes. This service has the most elaborate structure and regulations, and a large staff of psychologists. It extends to all main directions of psychological work such as professional consulting, selection, training, psychological support, personnel management and HFS management, analysis of errors and flight accidents, and ergonomic analysis of aircraft.

Psychologists face different tasks depending on the aspect of the pilots' work and training. At flying schools they are mainly engaged in the selection and educational training of would-be pilots. At this level psychologists take into consideration the human qualities that are important for proficiency in a pilot's work

and reaching the professional peak in this job. Work with experienced pilots in air regiments focuses the psychologists' attention on the issue of psychological reliability[1] and the qualities which underlie it. Recent research has defined these qualities and elaborated special instruments for their selection and cultivation (Firsov, 1996). It was shown that reliability includes several components, which can be divided into six groups on the basis of factor analysis.

The first factor is connected with flight experience (age, length of active service, total number of flight hours and types of aircraft mastered by a pilot). This factor is important at the stage of selection. The second factor – the factor of high professional level - includes the ability to work in non-standard situations and to mobilize internal resources. This factor cannot be formalized and cannot, therefore, be predicted at the early stages of training. The third factor is emotional stability. As opposed to the previous one, it can be diagnosed and used in psychological examination. The fourth factor is professional motivation: being a very important quality, it is of special interest for psychologists at the stage of expertise and individual counseling. The last two factors – the stability of cognitive functions and self-regulation skills - often become objects of psychological training. Besides individual psychological reliability, it is also possible to analyze and train group reliability. To deal with this task psychologists have to work with crews and pay attention to the process of interaction between them and air-traffic control services (Kluev et al., 1997). These measures make it possible to raise work efficiency and resistance to negative work conditions, stress and hazard in pilots.

In the field of test flights the issues of reliability of pilots and crews are closely connected with ergonomic analysis of new aircraft. At the Air Force headquarters psychologists are mainly engaged in the analysis of flight accidents and the elaboration and implementation of psychological recommendations that provide a high flight safety level. The structure of the psychological service in the Air Force is often used as an example for organization of psychological services in other fields of human activity.

The psychological service at the Ministry for Emergency Situations was officially established in 1995. Two federal laws, "On Rescue and Life-Saving Services and the Status of Rescuers" and "On the Protection of Residents and Territories in Emergency Situations Caused by Natural or Technological Factors" formed the legal base for the functioning of the Ministry for Emergency Situations and the All-Russian Center for Disaster and Emergency Medicine. This medical center has a laboratory of psychophysiological support, which has branches in many regions of Russia.

From the very beginning the psychological service of the Ministry for Emergency Situations has been working very intensively and productively. It has

[1] Psychological reliability is defined as a complex structure of individual psychological abilities that is actualized in order to support the efficient execution/regulation of work activity depending on the specific professional demands and requirements (Firsov, 1996).

assimilated methods and approaches used in the psychological support of fire-fighters. The psychological characteristics of the work of rescuers are very similar to the work of fire-fighters. Both activities involve intensive physical loads and a high level of psycho-emotional stress, which result in various abnormalities in mental health and social adaptation and determine the main directions in psychological work in this field. Psychophysiological selection for work in rescue crews is not crucial for the applicants; psychologists can only give some recommendations. Much more important is regular assessment of the rescuers, which helps provide an early diagnosis of psychological troubles. Of primary significance in this work is functional rehabilitation of those who have already participated in the handling of emergency situations. It includes self-regulation training of rescuers.

In 1997 a psychological service was organized within the framework of the RF State Customs Committee. The work of customs officials has become complicated and even dangerous: the borders of Russia and some former Soviet republics are still quite transparent and have become an easy route for illegal drug and arms traffic. Customs officials have to possess special skills and abilities, which are difficult to formalize, including intuition, attentiveness and skills of deep personality analysis. They often suffer from a shortage of time and pressure from clients. An exhaustive job analysis of this occupation does not exist. This task is still a focus of attention of psychologists. Fulfilling it would help provide effective professional training and selection.

The state work safety system in Russia has a long and rich history. Although it has been in development for over seventy years, the last decade has seen a crucial turning point. Recent socio-economic changes in the country have weakened the overall work safety system and necessitate new mechanisms of state regulation of labor protection. During this transition period, Russian society has developed a feeling of subjective instability and a pervasive lack of safety. In this situation, workers and lower-level managers are changing their attitudes towards the observance of labor protection regulations leading to a radical increase of work safety motivation among them.

In response to growing demand for safety, psychologists have elaborated support methods for use during work which tend to be effective among a variety of professions. Among a broad range of practical tools and instruments, two relatively new trends in preventative practice are of special interest. The first trend grows out of the Russian invented HFS management. The second trend makes it possible to create computerized means for user support within the framework of Activity Theory.

8.3. HFS MANAGEMENT IN THE WORK SAFETY SYSTEM

8.3.1. Organizational Principles of HFS Management

For many decades in Russia and in some former Soviet republics an important part of the policy of error prevention in work-site settings was HFS control. Maintenance of the optimal HFS is one of the directions of prevention policy at the individual level (see Section 6.3). As is shown in Table 6.4, there are two principal ways to directly influence HFS: external recovery procedures and internal recovery procedures. Self-regulation techniques are classified as internal recovery means; their specificity lies in two main characteristics: first, the subject's active conscious participation in managing his/her own state and, second, the development of so-called internal (mental) HFS regulation skills.

Internal regulation skills are widely presented in the psychological structure of all human beings, otherwise one would not be able to maintain one's existence in the world. A new point in self-regulation training with respect to HFS management in work is the elaboration of special skills which may be developed and then used by the subject himself to manage his/her HFS in an optimal way. Understanding the optimal way implies such characteristics as high probability of reaching the required HFS level with respect to the work tasks, the limited time for the usage of HFS management procedures, full conscious understanding by a subject of the necessity and the targets of HFS management, and full conscious control of the techniques of HFS regulation.

Thus, the main goals of self-regulation training usually were as follows: higher work efficiency, normalization of workers' HFS, prophylactic treatment of work-related diseases, and fewer work errors. With respect to error prevention strategies, self-regulation training seems promising because of the possibility of preventing and/or reducing the errors which occur when non-optimal HFS starts to emerge (Dikaya & Semikin, 1991). The history of practical implementation of self-regulation is to a certain extent in accordance with the stages of work and engineering psychology expansion in our country (see Chapter 6).

Originally, HFS control and correction means were implemented in aviation and aerospace at the beginning of the 1960s. Self-regulation training, including mostly programs based on autogenic training and progressive (neuro-muscular) relaxation, was used as part of a pilot's professional training and also as part of different rehabilitation programs (Grimak & Khachaturiants, 1981; Marishchuk et al., 1969; Reshetnikov, 1978). The reasons for the introduction of self-regulation training in this field were both work specificity-related and financial. In aviation and aerospace, people usually do their work under extreme conditions and face emergency situations, and this makes it necessary to reach and maintain high work reliability and efficiency, because the "price" of work errors is too high. Also, government financial support was traditionally stronger here.

Some time later, self-regulation methods were extended to certain types of operator occupations, where a broad range of means of stress and fatigue reduction

were traditionally used (Dikaya & Grimak, 1983; Grimak & Khachaturiants, 1981). Then the practical implementation of self-regulation spread to other fields where the ordinary working conditions are classified as extreme: the mining and fishing industries (Filatov, 1984; Golubov & Tabachnikov, 1980; Repin, 1973). In the early 1970s, self-regulation training programs were extended not only to occupations with extreme working conditions but also to other industries: metal-working, the manufacturing industry, microelectronics, etc. (Fedorov & Leonova, 1987; Margolin & Chukovich, 1983). From that time, self-regulation methods such as HFS management tools became quite common in many industrial companies.

The rapid practical implementation of self-regulation training could be explained by its double effect. First, it raises the level of HFS after each training session, so it is possible to eliminate the negative consequences of work tension. Second, self-regulation training helps a person to develop new internal habits that could be used where and when this seems to be necessary without any additional help from another person, either a psychologist or anyone else. So, after a complete course of self-regulation training a worker develops a relatively well-established habit of helping himself to cope with poor well-being, control emotional reactions at work, and prevent work fatigue.

Self-regulation training was conducted in work settings in different organizational forms. As was shown in Section 6.3.3, self-regulation skills are developed during special self-regulation training, so in all cases it was necessary to conduct training courses which consisted of several sessions. Self-regulation methods were implemented in two ways: at the stage of occupational training (for instance, in aviation), and directly in work conditions.

Organizational aspects of work in many enterprises made it possible to conduct self-regulation training courses not only before or after work shifts, but also in the course of work shifts during special breaks in the work process. This proved reasonable because of the specific feature of self-regulation training mentioned above: the positive effects on the HFS may be reached during each individual training session, so even primary training helps to reach the required HFS level.

From the middle of the 1970s HFS management programs in work settings were applied as a special organizational form - in so-called “relaxation premises” (RP). Relaxation premises are the places used for rest and self-regulation training during work shifts under the professional guidance of qualified psychologists, and specially equipped for the purpose of supporting the relaxation and self-regulation process. According to the publications, the first RP were opened in 1974 at a metallurgy plant in Odessa (Leonova & Kuznetsova, 1993). In the mid-1980s, the development of RP concentrated more and more on the idea that self-regulation training is an effective way of improving individual resistance to stress, to raise reliability, to maintain a high level of work efficiency, and to increase work satisfaction. In consequence, it was considered useful in protecting physical health and preventing mental disorders.

By the end of the 1980s the accumulated unique experience of practical implementation of psychoprophylactic means helped to transform RP into complex relaxation centers, which included a variety of premises to suit different purposes. Usually there were two main purposes: rest and improvement of recovery processes during work breaks supported by listening to music programs and/or watching relaxation slides and video films, and the development of habits of HFS management using self-regulation training. In addition such centers included fitness cabinets, rooms for reflexo-therapy, massage, etc. (Leonova & Kuznetsova, 1993; Margolin & Chukovich, 1983).

RP had different interior design concepts determined by their functional specificity. When the premises were used as resting places, the design was elaborated in order to stress the contrast between the working space and the resting space. This contrast is constituted by sound isolation, color schemes, and the range of accessories. For instance, it was quite popular to build fountains with colored lighting, to hang pictures and install colored dynamic panels on walls and ceilings, to put in plenty of plants and flowers, etc. For example, the RP at the Kishinev TV-assembly plant were designed as a picturesque grotto by the seaside. In those cases when the RP were used mainly as places to practice self-regulation skills, the design concept was different, because it was subordinated to the task of developing maximum concentration by the subjects on their own state without any distraction of attention. As was said above (see Section 6.3), self-regulation training requires full concentration of attention on the characteristics of one's state and on the dynamics of the state during training sessions. That is why colorful and unusual details in the RP could interfere with the training process, so the design was more restrained, there were not many striking accessories. The main achievements of psychological work on the basis of RP in work settings were showed at an exhibition of RP held in 1986 in the main Russian Exhibition Center in Moscow (Sayushev, 1986).

A variety of different self-regulation training methods and techniques were practiced in work settings: progressive relaxation, autogenic training, imagination training, and various programs based on different combinations of these methods (Leonova & Kuznetsova, 1987, 1993). According to practically all publications, the positive effect of self-regulation training on the HFS and work efficiency was observed. In spite of the proved efficiency of all self-regulation programs, the following main problem remains - "the problem of choice" of the most adequate self-regulation method: which self-regulation method should be chosen for implementation in particular work conditions, for a particular occupational group? In other words, how should a self-regulation program be arranged taking into account the specificity of each occupational group?

Between the mid-1980s and early 1990s, the Laboratory of Work Psychology at Moscow State University conducted a wide range of empirical studies in order to identify and to confirm the main principles of self-regulation implementation in work conditions. Section 8.3.2 presents the main results.

8.3.2. Efficiency of Self-Regulation Training in Different Occupations

The main purpose of these studies was to ascertain and evaluate the efficiency of different self-regulation techniques for HFS management and error prevention in different occupations. The dynamics of the manifestation of workers' states was taken as the main object of this research. This means that the sets of physiological and psychological functions were evaluated before, during and after the implementation of self-regulation programs.

In general, the research involved nine occupational groups: blue-collar workers, industrial managers, operators of high automated systems, air-traffic controllers, booking office operators, accounting workers, medical doctors, school teachers and students (Leonova & Kuznetsova, 1993). The dynamics of HFS in the process of self-regulation training was evaluated by a complex of diagnostic indicators for measuring the changes at physiological, cognitive and subjective levels of activity regulation. In each group, this complex was assembled according to the set task, and assessment of the most important psychophysiological functions for each type of job based on the results of job analysis. The combination of indicators was chosen on the basis of the HFS research methodology and in accordance with two main principles: a) the indicators should be adequate to the job content in particular occupations, and b) the experimental results obtained for different occupational groups should be comparable. The diagnostic complex included some general physiological indices and indicators (blood pressure, heart rate, vegetative Kerdo index), psychophysiological and cognitive performance tests (critical frequency of the flicker test (CFF), the modified Burdon checking test[2]) and tests of self-estimation of HFS (well-being scale, Spielberger's state-anxiety scale, acute fatigue scale).

During the study three self-regulation techniques were used. They formed the complex system of self-regulation training (Leonova & Kuznetsova, 1987, 1993): (a) *progressive relaxation training;* (b) *sensory-motor imagination and image reproduction* in a special combination; (c) *a modified version of autogenic training*. The general description of this system is presented in Table 8.1**.** The number and content of stages could differ depending on the occupational group, but their sequence was always the same.

In the special study we compared self-regulation techniques and their efficiency. First, the specific effects of using self-regulation techniques in each of the occupational groups were identified, and the main tendencies in the background level of HFS with respect to prolonged use of self-regulation techniques were evaluated. Second, a comparison of self-regulation efficiency in different occupational groups was made. In correspondence with that the influence of self-regulation training was evaluated on two levels:

[2] The modified version of the Burdon test was used as a correlative measure for the assessment of probability of attention errors during task performance.

- *Actual effects* of self-regulation training. These effects can be evaluated by comparing the data before and after each self-regulation session.
- *Prolonged effects* throughout training. These effects can be revealed by a comparison of background data gathered before the training sessions at different stages of the self-regulation program realization.

It was possible to make the following predictions: (1) application of different self-regulation techniques leads to HFS optimization immediately after each training session (actual effects) and cumulating of stable positive changes of HFS throughout the training course (prolonged effects); (2) the efficiency of self-regulation techniques may vary in dependence on the specificity of job loads in different occupations; (3) self-regulation methods based on the active utilization of mental skills (sensory-motor imagination training and autogenic training) have more clear positive effects on those manifestations of negative workers' states which are strongly affected by psychological factors.

Table 8.1. The program of self-regulation training

Self-regulation technique	*Content of stages*	*Additional procedures*	*Duration of session*
Progressive relaxation	Development of subjective feelings of a relaxation state, deep muscular relaxation	Verbal instructions, general and postural gymnastics, breathing exercises	20 min.
Sensory-motor imagination training	Transition to the voluntary relaxation of main muscular groups and body as a whole	The same	20 min.
Autogenic training	Self-ordering by verbal formulas and auto-suggestion	The same	15 min.

The obtained data show that in all occupational groups strong positive results can be achieved while using all self-regulation techniques. As an example, the main results of self-regulation training in the two occupational groups are presented in Figure 8.1 - the group of booking office operators and the group of accounting workers. In this figure the integrated relative scores of HFS were calculated[3] on the basis of the following indicators: accuracy and productivity of the Burdon test; CFF parameters; general indices of well-being, state-anxiety, and acute fatigue scales. The background scores before the progressive relaxation training were taken as a starting point and evaluated as the background "zero level", so the other integrated scores can be viewed as deviations from this position. Increased integrated scores

[3] The procedure of calculation was the same as described earlier (see Section 7.2.2).

manifest positive changes in HFS, decreased integrated scores - negative changes in HFS.

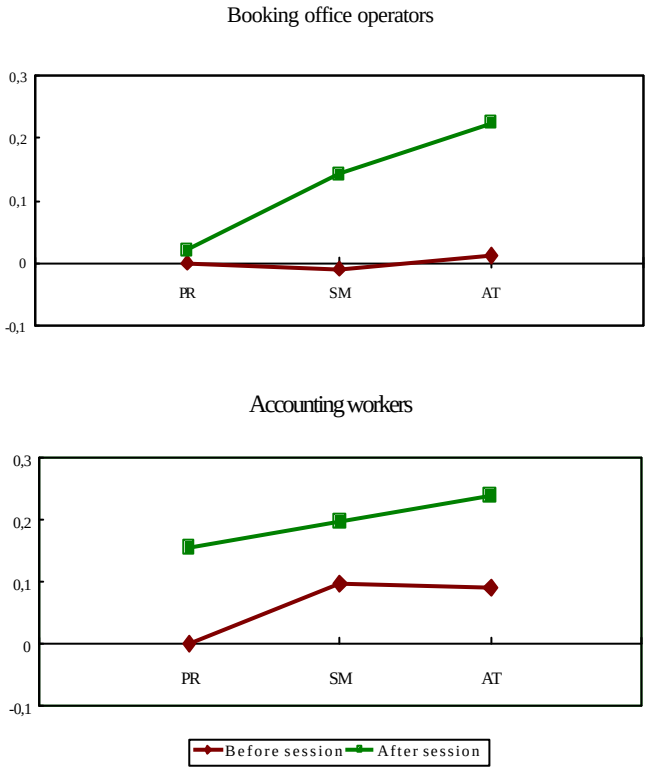

Figure 8.1. Actual and prolonged effects of self-regulation training (data are presented in total integrative relative scores calculated for whole sets of indicators; PR - progressive relaxation; SM - sensory-motor imagination training; AT - autogenic training).

The positive actual effects of the self-regulation sessions are clearly pronounced in all groups of indicators of a worker's state. The type of workers' states achieved after the self-regulation training sessions can be qualified as "activity mobilization". This is manifested in an improvement of physiological, cognitive and subjective HFS indicators.

At the same time there are some specific effects which depend upon differences between occupational groups. The changes in HFS indicators show that in each group the mental and psychophysiological functions more sensitive to the influence

of self-regulation training are those that are more involved in the process of job execution, i.e. the most important professional functions.

The specific positive effects were also observed in the indicators of the Burdon test in the groups of booking office operators and accounting workers (see Figure 8.2). After applying different self-regulation procedures both indicators of the test (accuracy and productivity) increase - in parallel with the reduction of the number of errors the workers begin to perform task faster. This result could be interpreted in terms of the minimization of so-called attention errors and activation of a more efficient strategy of visual information processing.

Concerning the prolonged effects of self-regulation training, the following results were obtained (see Table 8.2 and Figure 8.1). When subjects were trained systematically, positive results were reached with respect to all indicators of HFS. The physiological indicators of blood pressure and heart rate change towards general normalization: from negative background positions (either too high or too low) the scores reach the level of an optimal range; at the same time the background normal scores remain the same. The psychophysiological and cognitive performance indicators, as well as the indicators of self-estimation of HFS, are also transformed positively.

Positive prolonged effects were obtained in all occupational groups, but their grades were different. For instance, in the group of accounting workers the positive changes of the background HFS level before training sessions started to be quite explicit by the middle of self-regulation training period (see Figure 8.1). At the same time, in the group of booking office operators these changes were not so obvious. This result in this particular group reflects that the period of the training course implementation accidentally coincided with a high increase of workloads; nevertheless, by the end of the training course the background HFS level improved.

In general, the observed prolonged effects manifest the improvement of such components of a worker's state which suffer more from the job loads in the ordinary course of work activity. Such functional "weaknesses" are not the same in different occupations. As the result, the dominant effects of the training course are professionally specific (see Table 8.3). Data show that in the group of industrial managers, the most explicit positive changes manifest themselves in normalization of physiological functioning; in the group of air-traffic controllers - in the improvement of both attention indicators and increasing feelings of subjective comfort; in the group of booking office operators - in the decrease of emotional tension and increase of the speed of visual information processing; in the group of accounting workers - in the decrease of acute fatigue and increase of the quality of information processing.

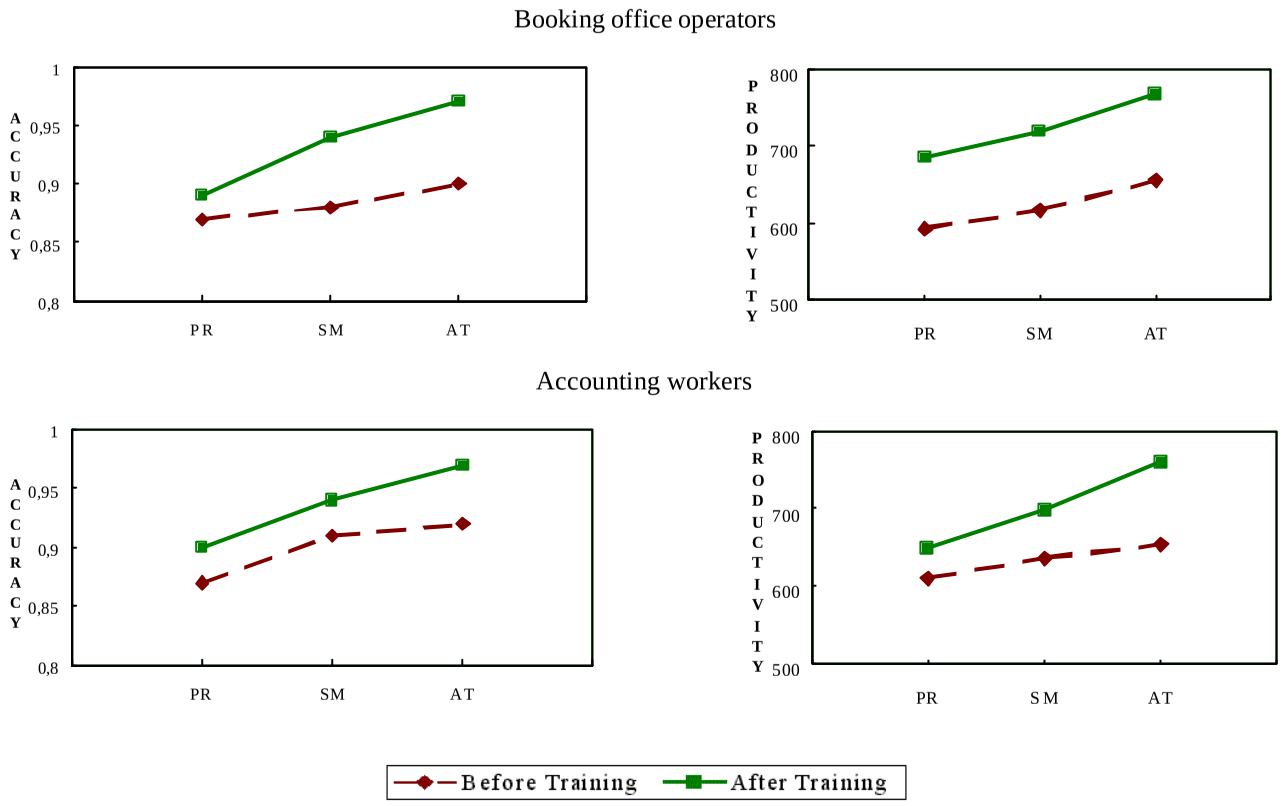

Figure 8.2. Effects of self-regulation training on the indicators of visual information processing – accuracy and productivity of the Burdon cheking test (PR - progressive relaxation; SM - sensory-motor imagination training; AT - autogenic training).

The comparison of actual and prolonged effects demonstrated the cumulative character of self-regulation exercises. While after the first sessions, mostly in all occupational groups, the indicators showed a slight tendency towards positive changes, at the end of the training course this effect became more clear and stable (for the most evident example, see the results of booking office operators, Figure 8.1). This result could be interpreted as a demonstration of the gradual transformation of overt execution of self-regulation exercises at the stage of progressive relaxation into special mental skills, or a self-regulation habit, at the stage of autogenic training.

The obtained results could be summarized as follows. The positive effect of self-regulation training on human well-being and mental functions is distinctly manifested in all occupational groups. It can be achieved by all self-regulation techniques used in the study. Concerning the problem of error prevention, the results showed the possibility of developing self-regulation skills as a good basis for the prevention of attention errors.

In the last part of the study we tried to compare *the efficiency of different self-regulation techniques*. For the comparison, four occupational groups were taken: industrial managers, air-traffic controllers, booking office operators, and accounting workers. These groups can be differentiated by the intensity of emotional and cognitive workloads. The main results show that the efficiency of the distinct self-regulation techniques is not equal. For instance, in the group of industrial managers the most positive dynamics was observed after using the progressive relaxation technique. In the air-traffic controllers group the most positive effect was reached after sensory-motor imagination and autogenic training. In the group of booking office operators and in the group of accounting workers, the most positive effect was achieved after autogenic training.

The following general tendencies in manifestations of the efficiency of different self-regulation techniques can be distinguished. First of all, the most significant positive effect is always observed for some, but not for all indicators of HFS dynamics, while the trend towards a general optimization is the same for all self-regulation techniques. Secondly, the most "psychologically-oriented" techniques, such as sensory-motor imagination and autogenic training, have a stronger effect on the emotional and cognitive components of task execution, while progressive relaxation procedures make it possible mostly to normalize the indicators of psychophysiological functioning and to minimize negative psychosomatic effects.

The results of the study provide an opportunity to elaborate general recommendations and basic principles for the implementation of self-regulation training according to professional specificity. Systematic self-regulation training leads to a wide range of immediate and cumulative positive effects: the HFS improves and the number of human errors decreases. It is recommended that self-regulation training courses be conducted during work shifts in order to prevent the negative consequences of workloads and avoid high-pressure job environments. The application of self-regulation techniques is also recommended as a means of short

Table 8.2. The prolonged effects of self-regulation training in different professional groups. Positive effects: +! (p < .01); + (p < .05); +? (p < .1). No effects: 0. The measure was not used:space is not filled

Occupational groups	*Blue collar workers*	*Industrial managers*	*Operators of highly automated systems*	*Air-traffic controllers*	*Booking office operators*	*Accounting workers*	*Medical doctors*	*School teachers*
Blood pressure	+!	+	+	0	0	+?	+	+?
Well-being score	+	0	+?	+!	0	+!	+	+
State anxiety score	+	0	+	0	+	0	+	+
Acute fatigue score	+1		+		0	+!	+?	+?
Critical Fusion Frequency					+?	0		
Accuracy in Checking Test				+!	0	+!		
Productivity in Checking Test				+!	+	+		
Trait anxiety score	+?	+?	+?				+	+
Chronic fatigue score	+	+?	+				+?	+

and intensive active rest and effective controlled recovery. Self-regulation methods are the most efficient in respect to those components of HFS that suffer more from intensive physical and mental loads in the ordinary course of work activity.

The level of optimization can be varied depending on the type of self-regulation technique. Their application should correspond to the dominant type of complication or deterioration in the activity regulation process in particular occupational groups. Besides occupational specificity, it is necessary to take into consideration individual characteristics of workers. The choice of an adequate self-regulation technique is also based on the causal analysis of typical errors. If errors are caused by physical and mental exhaustion during prolonged work without rest, self-regulation techniques, which normalize psychophysiological exertion and improve feelings of subjective comfort, will be more helpful. Progressive relaxation is an example of such a technique. If errors are caused by psychological difficulties at work, such psychologically enriched techniques as autogenic training or sensory-motor imagination will be preferable.

Table 8.3. The specificity of prolonged effects of self-regulation training in different occupational groups

Industrial managers	*Air-traffic controllers*	*Booking office operators*	*Accounting workers*
Normalization of physiological functions	Improvement of attention	Decrease of emotional tension	Decrease of acute fatigue
	Increase of subjective comfort	Increase of the speed of visual information processing	Decrease of attention errors

The observed programs and implementation results are examples of the well-developed psychoprophylactic approach in Russian work and health psychology. They aim at a systematic acquisition of new psychological skills for HFS management. Specially organized self-regulation training programs enrich the existent sets of spontaneously formed coping skills and increase the ability of individuals to maintain an optimal level of HFS during the work process. Because of the generalized nature of these coping skills, they are always at the disposal of a person, and the programs of self-regulation training fit well in any organization and in any work environment.

Today the share of computerized work activities is rapidly increasing. Computers have become the main instruments of work in almost all types of professions, and thus, to some extent, this instrument is also always on hand. Thinking along these lines, could it be possible to use a computer not only as a tool for work, but also as a tool of psychological support? One of the possible ways to realize this approach involves the installation of computerized relaxation and self-regulation programs at the work place. The content and duration of the programs can differ. During fixed or

individually preferred breaks, a worker can choose a program and run it in order to support his or her rest or to facilitate recovery processes.

8.4. PSYCHOLOGICAL SUPPORT OF COMPUTERIZED PROFESSIONAL ACTIVITY

Intensive development of computer technology in Russia started only at the beginning of the 1990s. Before this "computer boom" computers were available mostly in large research and information centers, laboratories and leading business institutions. For these privileged users a computer was not the *means*, but rather the main *object* of activity: all their efforts and attention were directed to the computer itself, its software and options. Most of the faults in the process of computer usage were explainable by the low level of user competence (Donskoi, 1998). The users themselves were made responsible for all difficulties, and nobody cared about the ergonomic aspects of the information system.

For a long time, the software market in Russia was lacking. At the end of the 1980s Russia became open to foreign products, and its market was flooded with Western software. Russian developers had to compete with international companies when their financial interests and copyrights were not protected. They mostly spent their time trying to promote their products and to protect them from unauthorized usage rather than on user support.

At the beginning of the 1990s the situation in the market began to change. Russian software companies which offered products for such branches of business as banking, trade and industry flourished. By this time the computerization level of some occupational groups increased so much that basic and advanced computer training became necessary. To answer this need, software companies started to organize some sort of support service for end users.

8.4.1. Different Paradigms of Support for Computer Users

Nowadays computer users can obtain different kinds of support, such as training courses, hot-line support services and usability engineering.

Training courses. New software training is provided by the established companies for all personnel. During the classes employees get detailed instructions and information, learn basic operations and get initial experience in software handling. Of course, students can ask questions, but they do not yet know all the coming difficulties and cannot foresee their future needs. This is one of the reasons why training courses are not effective enough. They could have helped developers to raise the usability of their product, but inadequate feedback prevents them from doing that.

Hot-line support groups. Today almost every software company has its own technical support center, which provides hot-line services for users. Programmers or advanced users who have already taken a special training course become operators

of the technical support group. A user can ask for help in case of emergency or when having difficulties in mastering the software and its options. Help is provided in real time, but it is not effective. Very often the technical support group lacks adequate skills in providing the necessary support if operators are unaware of possible professional problems and the level of user competence. The two sides speak different languages: the user thinks of the software in terms of the work at hand and his professional tasks, while the operator thinks in terms of abstract functionality, discrete operations and commands implemented in the software. The resulting misunderstanding negatively affects work efficiency and the well-being of both.

Apart from user support groups, there are analytical groups, which are responsible for the development of new versions of software and bug-fixing. Only in a few companies do these two groups work in close contact, because developers do not consider the opinion of users as valuable input. As a rule, users report only disadvantages and are not able to give any constructive ideas about the realization of software options. The development of new software versions is dragged out.

Software usability. In contrast to training and hot-line support, usability engineering makes it possible not only to abolish software faults, but sometimes to avoid them. This task is extremely important for computer systems in high-risk technological processes, such as nuclear power plants, air-defense and air-traffic control. Trading in financial markets is probably less dangerous, but the stakes involved sometimes make mistakes very hard to swallow. The users (software operators) of these systems have to work in real time and cannot take time off from their main activity to perform routine auxiliary operations (for example, manipulate the file system). It is necessary to create high usability information systems which could support the process of decision-making in real-time conditions (Bashlykov & Yeremeev, 1994).

Positive tendencies in the development of user-centered technologies have recently appeared. Market mechanisms play an important role in this process. After the domestic market had been flooded with software, competition among companies became more aggressive; they started to fight for customers. In turn, users became selective and fastidious (Donskoi, 1996). They try to avoid routine operations and minimize wasted time, and refuse to work with an inconvenient and uncomfortable software interface. Participation of Russian software companies in the international market has dramatically increased the ergonomic demands set on software products.

The development of information technology gave birth to such activities as Internet browsing and tele-working, which need psychological support (Velichkovsky, 1995). Internet and the virtual office paradigm have changed the psychological structure of professional activity in different occupations. In addition, the World Wide Web provides many new opportunities. Users can easily look through and evaluate software. They can just download several demo versions from different developers and decide which is the most suitable. Therefore, the users' opinion is becoming more important for software developers.

One crucial task for software usability is providing reliability and safety in large industrial settings. Operators must have easy access to all the necessary information. The form of information presentation must enable an operator to quickly analyze a problem situation, identify deviations from the norms and control the technological process.

Owing to these positive tendencies in psychological support, users feel more comfortable in the situation of rapid development of information technology. The technical paradigm of the users' adaptation to the requirements of information technology has been gradually but inevitably replaced by a more human paradigm - the adaptation of information technology to user requirements.

8.4.2. Error Prevention in Computerized Clerical Work

As a rule, usability engineering includes administration of questionnaires and interviewing end users, as wells as empirical psychological research of their computerized activities. It reveals the cognitive mechanisms underlying these activities and makes it possible to design an ergonomically adequate software interface. One example of such psychological investigation, which reveals the characteristics of computer-mediated activity in conditions of external interference, is an experimental study of interruptions in computer-mediated mental work. This study was conducted jointly by the Laboratory of Work Psychology, Moscow State University, Russia and the Work and Organization Research Center, Tilburg University, The Netherlands (Burmistrov & Leonova, 1996; Burmistrov & Leonova, 1997; Roe, Zijlstra, Leonova & Krediet, 1999).

Interruptions were chosen as the study topic for a number of reasons. First, since computerized intellectual work places high demands on the cognitive system, it is likely that this type of work is very sensitive to interruptions. Frequently interrupted work presents an important concern for work system designers. With the advancement of integrated computerized support, such technologies as broadband communication networks and multi-tasking environments, multiple task work has grown in importance as a design issue. Secondly, interruptions appear to be typical for the working conditions of many occupations in which computerized mental work predominates (e.g., office workers and secretaries). This makes it interesting to find out how people deal with them while carrying out their duties. Thirdly, interruptions may negatively affect a person's state and performance, thereby exerting an influence on workers' well-being and productivity. Finally, a practical consideration is that interruptions present an aspect of mental work with relatively high accessibility. Interruptions can be observed in practice, but they can also be evoked and studied under controlled conditions in a laboratory setting. This opens the possibility of doing laboratory research with great ecological validity, and testing the methods and findings used in the laboratory under real-life conditions. The ultimate study goal was to suggest usability engineering recommendations to the user

interface design of human-computer work systems aimed at preventing the negative consequences of interruptions.

In an experimental study 30 subjects performed a computer-assisted task (text editing) highly similar to real-life office tasks during two pairs of experimental sessions over two days. The experimental task was to make corrections in a computer file based on a hard-copy version of a text that contained handwritten corrections. During the experimental sessions the subjects' work activity was disturbed by a number of interruptions (phone calls). The interruptions were made according to a certain scheme, which had been designed in such a way that the effects of the presence (vs. absence) and complexity of interruptions could be ascertained. Interruptions affected three types of editing operations: (a) regular editing (making simple corrections); (b) typing in new text; (c) moving a block of text to a new location. Interruptions were made at predefined points, e.g. the operation "move a block of text" (which consists of several sequential actions: select block – cut block – find its new location in the paper-printed brochure – find the same in the computer file – paste block) was interrupted after cutting the block of text but before pasting it from the clipboard. During a telephone call the subject was asked to perform another task, referred to as an "interruptive task".

The independent variables were the presence/absence of interruption and the complexity of interruption (two interruption complexity levels were investigated: simple and complex interruptions). An example of a simple interruptive task was to find a telephone number in the telephone book. A complex interruptive task was to correct all the typing faults in a short article. Among others, a dependent variable was the editing latency (the time to complete a particular editing operation, such as typing in new text or moving a paragraph to a new location).

The experiment took place in a simulated office environment. The 40 m^2 laboratory was divided into two rooms by a wall. One room was equipped as an office workplace (with furniture, a personal computer and an intercom telephone), while the other was used as a control room. In the office location, a movable tripod video camera was placed to monitor the subject. The video signals from the camera and from the computer screen were routed to a video mixer in the adjacent control room. From this room the experimenter controlled the experiment and watched the mixed video signal (a view of the subject plus the contents of the subject's computer screen) via the video monitor. The mixed video signal was also recorded on a VCR. An intercom phone was used for communication between the control room and the office location.

Statistical analyses revealed the significant effects of both the presence/absence of interruptions and the interruption complexity on the editing latencies for cognitively complex editing operations (e.g. moving a paragraph to a new location), while the performance indices for cognitively simple editing actions (e.g. typing in a new paragraph) were not affected by interruptions. A probable explanation of this fact may be that the operation "typing in a new paragraph" is the simplest one in text editing. It neither involves the search and location of some point in the text (as in

regular editing) nor includes complex sequences of actions and additional mental load caused by the necessity to track the contents of the clipboard (as in moving a paragraph to a new location). The latter operation is an example of a "functional thread", i.e. a series of commands and actions; the effects of interruptions on this class of operations were more serious, e.g., subjects might have forgotten about and lost text transferred to the clipboard.

Results also suggest that an additional orientation activity, which appears after completing the "interruptive" task, is responsible for the increase in net operation time if an operation is interrupted. Additional compensatory activities (referred to as "strategic activities") caused by interruptions and directed at either immunization (removing the influence of the disturbance) or recovery (resuming the work activity at an appropriate point) were observed in the experiment. The analysis of the videotaped behavior of the subjects allowed the proposal of an empirical classification of interruption handling strategies.

Based on the analysis of interruption handling strategies, a number of recommendations for the user interface design for frequently interrupted work conditions were developed:

(1) The interface should give an opportunity to instantaneously "freeze" the current state of the system in order to prevent accidental damage to the information while working on interruptive tasks.

(2) The interface should perform complex operations (functional threads) as guided step-by-step operations. For example, "Select – Cut – Find new position – Paste", the sequential group of actions for moving a paragraph to a new location should be organized as a single command "Move paragraph" producing an appropriate support tool which guides the user in performing the necessary steps.

(3) Frequently interrupted work conditions require a more apparent indication of the presence of information in the clipboard (e.g., in a small floating window). Otherwise users may lose clipboard information when their attention is occupied by interruptive tasks.

(4) The metaphor "cooling down text" or "drying up ink" was also suggested. Authors recommended using color coding for indicating recently changed or inserted information on the screen, the colors "cooling down" during document-specific time from a hot color (most recently changed information) to a cold color (old or unchanged information). This improvement could reduce the time of orientation in the main task after completing an interruptive task.

8.4.3. Elaboration of a Human-Centered Interface for the Russian Trading System

An example of active participation of ergonomists and psychologists in industrial software systems development is the Technical Center of the Russian Trading System. The Russian Trading System (RTS), launched in July 1995, is Russia's

largest fully electronic system for over-the-counter (OTC) trade in securities. Today, the RTS consists of over 1000 workstations, throughout the country and abroad, connected to servers which link to the central processing complex in Moscow. The RTS Technical Center (RTS TC) was also founded in October 1995 as a technical support center to operate the RTS. Its main objective is to provide financial market operators with technological tools to perform trading, manage front office and back office activities, organize data transmission among the trading system, broker-dealer firms, clearing and settlement institutions, control authorities and the public. RTS TC is a service-oriented company. Its customers do not "buy" a product required to solve a problem, they rather "entrust" the solution of the problem to the company, complete with the task of updating the solution according to the modification of stock market regulations and new developments in the stock market infrastructure.

The Analytical Department (AD) functions as a specialists' support group within the RTS TC. The main goals of the AD are: (1) to perform efficient analysis and monitoring of the current situation on the Russian stock markets by accumulating and analyzing the opinions of professional market agents in order to create recommendations for the RTS management, and (2) to conduct usability engineering activities and user interface design for the software development departments of the RTS TC. AD research is usually initiated by requests from other RTS departments: committees and commissions, the software development division and trading system's managers. The AD uses both qualitative and quantitative research methods to guide RTS products and service development.

The AD's most prominent work is the development of the user interface for the stock trader workstation, *RTS Plaza* (Burmistrov, 1999). From the very beginning, the building of an on-line trading system became the focal point of the RTS TC activities. Initially, RTS traders used Portal™ software developed by NASDAQ, an obsolete character-based system with heavy keyboard operation. Later, RTS started the development of a stock trader workstation "from scratch" for the Microsoft Windows™ environment. In 1998, after two years of analysis, prototyping, usability evaluation, software engineering and coding, the new RTS Plaza workstation was launched.

The AD began with field studies of stock traders' tasks and the organizational structure of their work. To elicit the users' task structure and formulate system requirements, dozens of user interviews employing an ethnographic interview approach were conducted (Wood, 1997). Each interview was accompanied by detailed observations in actual dealing rooms. Using the data from videotaped interviews and observation, a comprehensive task analysis was executed.

The main difficulties in AD work were (a) that many users of a very high social status – in many cases, it was impossible to employ conventional requirements gathering and usability testing procedures, and (b) the very high level of secrecy in users' work – many of them treated the AD team members as collectors of insider information on their firms. These difficulties were overcome mainly through painstaking analysis of massive recordings of traders' negotiations via a chat

facility. A supplementary method of information gathering was the administration of questionnaires conducted via the Internet.

After formulating the general principles of the new system, the AD team developed paper prototypes of the new user interface and collected feedback from its prospective users. Then, the programming team developed the first executable prototype of the system, which was installed in about twenty broker-dealer firms. Feedback from beta-testers was collected and used for refining the user interface.

The OTC market has no trading centers. Instead, it consists of hundreds of brokerage firms located throughout the country and doing business via the computer network and telephone. Firms in the OTC market are generally referred to as "broker-dealers", because they can sell and buy securities either as brokers (agents) or as dealers (principals). OTC trading is performed by traders in dealing rooms of broker-dealer companies.

Of all the white-collar professions, modern stock trading is one of the most complex and stressful. Traders must absorb and analyze huge amounts of news and market information received simultaneously from different news agencies and different trading floors. They must extensively communicate with other traders in their own companies and counterpart firms. On this basis, they must make immediate decisions, at their own risk and taking full responsibility.

The analysis of users' activities showed that, in many aspects, they are similar to those of plant operators in control rooms in continuous process industries, air traffic controllers, and high-ranking officers in command of combat operations. The RTS Plaza design is based on electronic warfare techniques. In the "trading war", the adversaries are primarily the counterparts – other broker-dealer firms. This understanding determined the development of the trader workstation and the choice of user interface standards and guidelines. In the military environment, the systems are designed to receive, filter, and generate information based on large volumes of different inputs, and to provide decision support for crucial actions. RTS Plaza has similar functions – it filters stocks, receives price inputs and reports the outcome of trading sessions, alerts traders to market movements, maintains peer-to-peer communication between counterparts, and broadcasts financial and political news coming from the information agencies.

The AD developed their own set of user interface guidelines differing from the conventional guidelines for windowing applications in "office" work environments. In particular, many elements usual for desktop-oriented environments, such as overlapping windows and pop-up dialogues were banned in the guidelines, because they are extremely navigationally loaded and may hide important information. Instead, a fixed screen arrangement of information and control areas was recommended. The main reason behind this decision was that the speed of interaction with the system is a crucial factor in trading. A fixed arrangement of screen areas supports sensory-motor coordination, speeds up visual search, and minimizes the time wasted during window navigation activities, such as window selection, pressing the buttons or scrolling.

The RTS Plaza interface is not a "windowed", but a "frame-based", or "tiled" interface. In contrast to the windowed interface, the tiled interface is a display environment in which users do not lose their view of the process or alarm status, even while they access and view data in multiple screen areas from a number of sources. They have complete control over every tile in their system and interact with permanent windows that can never be hidden or overlaid.

Some of the distinguishing features of the RTS Plaza user interface are as follows:

- The RTS Plaza interface provides the optimal balance between the representation of a huge information feed and limited screen space.
- The primary interaction style in RTS Plaza is drag-and-drop operation via the mouse. About 90% of data input and manipulation can be performed with the mouse and, therefore, with one hand, thus releasing the other hand for other activities, e.g., holding a telephone handset.
- Special never-covered screen areas are used to inform traders about important news and events on the market and the necessity of performing urgent actions.
- The system provides text-based chat facility via the Communications tab. This facility is an important low-pace communication supplement to extensive conventional phone communication, which allows traders to maintain long-term contact with multiple counterparts throughout the trading session.

The RTS Plaza user interface received very positive feedback from actual traders. When Plaza replaced the previously used software, Portal™, one of the leading traders said that he felt as if he had "exchanged an old Lada for the latest model of Mercedes Benz".

The case of RTS is only one of many examples of active participation by psychologists and ergonomists in the design of software products that are mainly adapted to the actual needs and interests of real users. Today industry leaders, both in the West and East, have begun to fully grasp that in order to succeed in the market place, products and services must offer not only technological excellence, value, and aesthetic quality, but also, and most importantly, usability. Many experts believe that Russia is currently on the verge of a "usability boom." Although the concept of usability comes from the West, methodologies applied by Russian usability specialists appear to differ from those in the West in that they are more concentrated on the contextual analysis of jobs as a whole. Attempts to apply the principles of Activity Theory to human-computer interface design underpins the methodological framework of this work (Kaptelenin, 1996; Lepsky, 1999). A search in this direction is now at the initial stage. Nevertheless, this framework could eventually make the design of computerized products not only "friendly", but also truly supportive.