

Original Research Article

Depletion of occupational performance effectiveness in electric power engineering industry: psychophysiological factors and risk evaluation

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ABSTRACT

Background: The modern society cause the increase of workload and impact of environment factors on performance efficiency of occupational duties and health safety of workers. Emergencies and expert mistakes often arise not so much from rules ignorance of object management, but due to insufficient development of worker's own psychophysiological qualities. The goal of our investigation is to develop the estimation technique for evaluation the risk of depletion in efficiency performance of occupational duties for operative service workers in electric power engineering industry.

Methods: In our investigation, we examined the materials of psychophysiological survey by the multivariate statistics, dispersion analysis and regression binary choice models. The study is based on workers' survey, encompassed exogenous psychophysiological indicators that included the observation of 466 operative service workers of in electric power engineering industry in Ukraine.

Results: We determined seven psychophysiological indicators that are significant important risk cause of critical depletion in worker's occupational efficiency. We estimated the multivariate regression logit model that evaluate the impact of each factor taking into account the age of worker.

Conclusions: For workers with high values of average reaction time, regardless of the age group, we predict a high risk of occupational effective performance loss. The analysis showed that for workers with average values of other factors, the increase of adaptability and variability lead to decrease in risk of occupational professional efficiency depletion. Based on developed approach, we estimated that, in electric power engineering industry in Ukraine, the risk of effectiveness loss is less than 0.5 for 84% of workers.

Keywords: Age differences, Occupational health, Psychophysiology, Risk evaluation

INTRODUCTION

The modern society cause the increase of workload and impact of environment factors on performance efficiency of occupational duties and health safety of workers. These tendencies require the improvement of occupational psychophysiological selection that is

developing in several directions. One of them, traditional, involves the specifying the list of professionally important qualities and ways to evaluate their level. Other direction is related to the applying methods for analyzing the complex of psychophysiological occupational qualities through the usage of various mathematical and statistical techniques and approaches.

Within the first direction framework, there is revealed the complex of psychophysiological qualities that are significant for the occupational activity of workers. The ranking of these psychophysiological qualities by size allows making the occupational professional selection more purposeful.^{1,2} The investigations established that traditional methods, used in professional selection, can be supplemented by genetic approaches that can increase its effectiveness and reasonably predict unwanted deviations in the behavior of workers in extreme conditions.³

New technology for determining of professional successful accomplishment are offered.⁴ This technology involves the presence of a video survey for employees in order to evaluate the performance of their work. The openness of the survey proved the existence of a moderate connection between the received measurements utility and the attitude of employees towards the proposed selection technology.

Insufficient development of worker's own psychophysiological qualities cause an inefficiency in cooperation between man and machine and can lead to loss of work safety and occupational health depletion.⁵ By means of the expert assessments, it has been established that for the successful professional activity of motor vehicles drivers it is necessary to carry out training of sensorimotor reactions and other professionally important qualities that reflect the properties of higher nervous activity. However, workers with intentions and sympathy to their work are more likely to provide healthy and safe life.⁶

Implementation of another direction in the development of occupational psychophysiological selection involves the usage of modern mathematical techniques for the collection of informative indicators set and aggregation of information in order to obtain clear answers about the degree of ability of workers to professional activities. The analysis of the typical structures of the occupational selection strategies includes the approaches to their formal description based on the multidimensional modification of the generalized structural method.⁷ The modeling of main strategies in occupational selection allows to evaluate the various aspects of the professional selection integrity and to identify the optimal strategy for each specific goal. The proposed models describe the various typical structures of all sorts of occupation selection strategies. They give the possibilities to deduce the necessary relationships and to evaluate certain aspects of the integrity of a strategy in occupational selection as well as to compare the different professional selection strategies by set of indicators to identify the optimal for specific goal under given restrictions.

Factor models (Lenzenweger, 2015) and materials of external expert assessment (Shwetz and Kalnysh, 2007) are also very useful tools for studying the most valuable psychological and behavioral characteristics of a worker.^{8,9} The split into key components in personnel

selection procedure is also occurred by using a modular approach (Lievens and Sackett, 2017).¹⁰ Using factor analysis, scientists identify a number of characteristics that influence the ability to provide the professional activities. There are (1) cognitive abilities; (2) communication skills; (3) computer skills; (4) more specific, related to problem performance, abilities; (5) interpersonal communication skills; (6) related abilities; (7) physical abilities; (8) ability to provide security; (9) independence; (10) ability associated with adapting to the structure of a particular activity by Persch et al.¹¹

In the electric power engineering industry, one of the key factors that causes significant tension in the body of operational personnel representatives is the information-loading factor.¹² The research emphasize that the additional factors of pressure are the remoteness of the operator from the controlled object; different load on the senses of the operator (mainly on the visual analyzer); excessively high pace of work or monotony; the fact that in the power management TPP system the operator, as a rule, operates under conditions of time shortage. The faults at the TPP due to the fault of the personnel mainly relate to the operational switching, during which there were short circuits or the exclusion of them under voltage; violation of the operations sequence according to the form of switching or execution of switching without a form; incorrect actions with overlays of relay protection and automatics. The main causes of the operator's errors are the violations of the rules for switching in electrical installations, the lack of necessary accuracy in the conduction of operational schemes, earthing, operational management, lack of appropriate control of switching, both from the administrative and technical personnel services, as well as from the side of operational personnel. Most mistakes made the operational staff at the beginning or at the end of the term and due to insufficient seniority in the post (up to 1-2 years). In general, the study of accidents and injuries in energy power industry showed that their cause is a "human factor" in 18.8% of cases. Some research emphasize the difference between man and woman performance. In particular, the quantitative investigation of railway station controllers assert that the frequency of mistakes by female operators is 2.16 times greater than by men.¹³

The analysis of modern publications showed the importance of works devoted to issues of psychophysiological professional selection that focused on identifying a list of informative indicators and aggregation them into one integral indicator, revealing that the person belongs to one or another category of suitability. However, for timely and flexible management of the human resources workload we need to know more. Thus, we need to have not a jump-like estimation of the person's professional abilities, but estimation that can be smoothly changed and allows us planning the providing such a job for a worker that is more tolerant and safe according to his psychophysiological state.

The goal of our investigation is to develop the estimation technique for evaluation the risk of depletion in efficiency performance of occupational duties for operative service workers in electric power engineering industry.

METHODS

The characterization of occupational risks in reducing professional ability involves the establishment of natural psychophysiological causes of their formation during the long period of professional activity. The risk assessment procedure is a multi-stage process that provide the evaluation of the probability concerning the loss an appropriate level of efficiency because of the adverse impact of occupation activity. From practical point of view, an assessment of the risk is necessary to create adjustment decision to manage these risks. The risk management serve to develop the practical implementation aimed to eliminate or reduce the risks. On the other hand, the existence of quantitative information about the level of risk can give the opportunity to manage the adequate placement of personnel, taking into account the complexity of their work and the risk of critical depletion their performance under extreme conditions. In our investigation, we examined the materials of psychophysiological survey by the multivariate statistics, dispersion analysis and regression binary choice models. We obtained quantitative results using the EViews 8.0 software.

The investigation was based on workers' survey, encompassed 100 exogenous psychophysiological indicators. The sample included the observation of operative service workers in electric power engineering industry in Ukraine. The survey technique comprised several methodologies that consisted pendulum, adaptability, memory, square, triangle, square-circle, triangle-circle, attention switching, clock, closed space and other tools, as well as personal information.

Choice of the most important physiological indicators: factor analysis

Many of initial observed indicators were closely correlated and described the similar information. To construct a relevant analysis and adequate evaluate the risk of loss in occupational effectiveness, it was necessary to select smaller number of factors that nevertheless fully reflect important properties of data set. In this purpose we used the factor analysis at the first stage of our research.

According to the concept of the factor analysis, we describe the multidimensional vector X_i , that includes the observations of the n indicators for each worker i , by using the matrix equation:

$$X_i - \mu = LG_i + u_i, \quad \dots(1)$$

Where, μ is a $(n \times 1)$ vector that describes the means of variables; L is a $(n \times m)$ matrix of coefficients; G_i is a $(m \times 1)$ vector of unobserved variables, termed common factors, u_i is a $(n \times 1)$ vector of errors or unique factors, or some special subjective factors that randomly affect the measurement results.

The analysis of the loading matrix coefficients for the first most important main components in the structure of the surveyed indicators formation (Table 1) allows us to distinguish the psychophysiological factors that have the greatest contribution into the creation of the main unobservable components. Hence, they have been used in constructing a regression model.

As result, we found that the largest loadings have the following 14 variables. The indicators X_{31} , X_{86} , X_{89} characterize the adaptability and time of task performance that were defined by the adaptability methodology. The variables X_4 , X_7 , X_9 , X_{40} describe the total error, the number of positive values, the number of hits into zero and the variability that were determined on the basis of the pendulum technique. The variables X_{18} , X_{55} , X_{57} characterize the average reaction time, variation and error of the figure skipping that were determined on the basis of the square-circle technique. The variable X_{83} characterize the time of correct solution that were determined by attention switching methodology. The variable X_{54} describes the remaining errors according to the triangle-circle technique and variables X_{46} , X_{47} were determined on the basis of triangle and square techniques, respectively. Variable, belonging to the application form, don't have important contribution to the formation of the main components. Thus, taking into account the Spearman correlation coefficients among the 14 most influential factors by the factor analysis, we have chosen 12 following indicators for the further regression analysis:

- $f_1 = X_4$ - Total error (Pendulum methodology);
- $f_2 = X_7$ - Number of positive values (Pendulum methodology);
- $f_3 = X_9$ - Number of hits into zero (Pendulum methodology);
- $f_4 = X_{18}$ - Average reaction time (Square-Circle technique);
- $f_5 = X_{31}$ - Adaptability (Adaptability methodology);
- $f_6 = X_{40}$ - Variability (Pendulum methodology);
- $f_7 = X_{47}$ - Variability (Square technique);
- $f_8 = X_{54}$ - Mistakes (Triangle-Circle technique);
- $f_9 = X_{55}$ - Variability (Square-Circle technique);
- $f_{10} = X_{57}$ - Error of skipping the figure (Square-Circle technique);
- $f_{11} = X_{83}$ - Time for the correct solutions (Attention Switching);
- $f_{12} = X_{89}$ - Task performance time (Adaptability methodology).

Table 1: Loading coefficients of each variable in the formation of the first six main components.

Psychophysiological indicators	Loading matrix coefficients					
	G1	G2	G3	G4	G5	G6
X10	-0.152341	0.167208	0.055957	0.014769	0.023179	0.029213
X11	-0.107229	0.186387	0.051086	-0.017060	-0.069420	-0.051734
X12	-0.291987	0.008352	0.134649	0.071849	0.042801	0.082284
X14	-0.069291	0.116844	0.121505	0.098308	0.084785	-0.144073
X16	-0.082548	0.206124	0.289060	0.000178	0.149410	0.123528
X17	-0.158322	0.224834	0.209749	0.337655	0.030145	-0.140096
X18	0.001316	-0.104578	0.656102	0.146835	0.435658	0.110580
X2	0.060024	-0.041947	-0.155895	-0.032424	0.014191	0.013265
X22	0.181732	0.056184	-0.047889	0.093419	-0.047740	0.023972
X23	-0.173445	0.078293	0.188149	-0.002384	-0.041217	0.051134
X24	-0.176266	0.090480	0.293381	0.062503	0.016997	0.002105
X31	-0.825027	0.172121	0.169849	-0.174265	-0.003725	-0.069376
X32	0.605438	-0.071717	-0.120310	0.128633	0.045984	0.009290
X4	1.02E-15	0.640974	-0.272916	-1.22E-15	0.717404	2.80E-16
X40	0.029330	0.873208	0.249959	0.029071	0.107500	-0.011779
X46	-0.340681	0.049177	-0.130694	0.313165	-0.021344	0.779832
X47	-0.352203	0.049989	-0.172226	0.321404	-0.001850	0.739332
X50	0.006388	0.061356	0.065337	0.224449	0.043660	0.069498
X54	-0.158604	0.082651	0.113281	0.908234	0.003645	-0.229746
X55	-0.027391	0.084485	0.104147	0.847368	0.073430	-0.163189
X57	4.44E-16	-0.262782	0.768008	1.37E-15	0.584046	2.29E-16
X7	-1.36E-16	0.493188	0.632265	2.50E-16	-0.597500	-1.26E-16
X8	0.015251	-0.382949	-0.299625	-0.053137	0.237028	-0.024837
X83	0.777810	-0.120111	-0.171137	0.168965	-0.011302	0.090640
X86	0.313491	-0.164379	-0.179062	0.062430	-0.055985	0.029647
X88	0.852544	-0.207630	-0.154430	0.151801	-0.119979	0.125774
X89	0.864702	-0.215231	-0.144906	0.174734	-0.043200	0.182641
X9	-0.019038	0.795221	0.513997	0.013839	-0.257531	0.001149
X90	-0.079239	-0.122002	0.291922	-0.056163	0.135539	-0.088509
X91	0.023548	-0.128112	0.260701	-0.194062	0.149896	-0.086082
X92	-0.091170	-0.092572	0.065468	0.030866	0.090201	-0.128125

Risk evaluation by construction of multivariate regressive model

In order to evaluate the level of risk for each worker and to form a scale of risk, we construct a multivariate regression model of binary choice. The model give us the possibility to determine the statistical significance and estimate the impact of each previously chosen main physiological indicators on the level of success in the professional activity of workers, health reliability personnel and readiness for dangerous circumstance.

We suppose that the risk (probability) of R_i is a linear function that depends on the set of explanatory variables $f_{1i}, f_{2i}, \dots, f_{ki}$ and random factor v_i , as follows

$$R_i = \text{Prob} \{Y_i = 1\} = \alpha_0 + \alpha_1 f_{1i} + \alpha_2 f_{2i} + \dots + \alpha_k f_{ki} + v_i, \quad i = 1, \dots, N. \dots(2)$$

The latter random term v take into account the measurement error or certain subjective stochastic factors that by chance affect survey results.

Model (2) is a linear multivariable regression model whose parameters are estimated using the least squares (LS) method. Estimations from this regression determine the expected probability that $Y_i = 1$ for every observation i . The coefficients estimates of the linear probability model are interpreted as a change in the probability for a risk of professional qualities depletion, if the corresponding explanatory variable (psychophysiological factor) varies by unit and the remaining explanatory variables are fixed.

However, the linear probability model of form (2) does not allow us to evaluate adequately the probability of a depletion risk in professional activity efficiency in our case. It is occur because of two reasons. First of all, the

estimated by LS values of R_i can not belong to the interval (0, 1), and therefore we are not be able to adequately interpret evaluated risk. Second, the statistical and mathematical analysis of the model (2) indicates the distribution discreteness of the random variable v_i . This fact shows that error is not close to normal distribution. In addition, the random term in model is heteroscedastic that don't support the obtaining effective estimates of the influence parameters, α_j . The disadvantages of the linear probability model (2) can be eliminated using the multivariable regression binary choice model

$$R_i = Prob\{Y_i=1\} = \Psi(F'_i \alpha + v_i), \dots (3)$$

Where, $\Psi(\cdot)$ is a function with domain in interval [0;1]; F is a matrix of observed exogenous factors; α is a vector of unknown model parameters that should be estimated. In case of usage for function $\Psi(\cdot)$ the logistic probability function

$$\Psi(x_i) = \exp(x_i) / (1 + \exp(x_i)), \dots (4)$$

The binary choice model (3)-(4) take the form of multivariable logit model. Logistic distribution function (4) transform the values $F'_i \alpha$ in order to obtain appropriate values of probability in interval between 0 and 1.

RESULTS

Therefore, taking into account the previously conducted correlation and factor analysis that made possible to distinguish the main impact factors, we estimate the multivariate logit model

$$R_i = Prob \{Y_i = 1\} = \Psi (\alpha_0 + \alpha_1 X_{4i} + \alpha_2 X_{7i} + \alpha_3 X_{9i} + \alpha_4 X_{18i} + \alpha_5 X_{31i} + \alpha_6 X_{40i} + \alpha_7 X_{47i} + \alpha_8 X_{54i} + \alpha_9 X_{55i} + \alpha_{10} X_{57i} + \alpha_{11} X_{83i} + \alpha_{12} X_{89i} + \alpha_{13} AGE_GROUP_i + v_i), i = 1, \dots, 466. \dots (5)$$

The specification (5), in addition to the factors of the psychophysiological state of the worker, includes the variable AGE_GROUP that describes the age of the worker. The investigation provide analysis for 4 age categories of workers: group 1 collect workers under the age of 29, group 2 includes workers at the age between 30 and 39, group 3 includes workers at the age between 40 and 49, group 4 collects workers at the age 50 and older.

We analyzed the ability of the model to correctly evaluate the probability of professional skills drain and, accordingly, to predict the risk of a critical depletion in the professional activity efficiency and health. Performed on the basis of the Andrews test (Andrews goodness-of-fittests), comparison of actual and predicted values for different age groups (Table 2) confirmed the adequacy of evaluation technique for risk of critical reduction in professional competence and modeling correctness for all age groups.

The developed model (4)-(5) made possible to group and quantify the confidence intervals for risks. The analysis of the Hosmer-Lemeshow goodness-of-fittests test (Table 3) confirmed the adequacy of split (HL Statistic = 9.2638; p-value $\{\chi^2 [8]\} = 0.3205$) and the correctness of the risk evaluation for all intervals.

Table 2: The adequacy test results for evaluation technique of professional health depletion risk considering different age groups.

Goodness-of-Fit Evaluation for Binary Specification					
Andrews Test (Grouping based upon age_group)					
Age group	1 Age < 30	2 29 < Age < 40	3 39 < Age < 50	4 Age > 49	Total
Y = 0 Actual	73	94	82	87	336
Y = 0 Expected	77.5645	87.6323	84.6323	85.8343	336
Y = 1 Actual	43	23	34	30	130
Y = 1 Expected	38.4355	29.3677	31.0311	31.1657	130
Total	116	117	116	117	466
Andrews Statistic	7.4678				
p-value Chi-Sq. ⁴	0.1131				

DISCUSSION

The evaluation results showed the statistically significant effects of seven psychophysiological factors. They correspond with the total error, (X_4); the number of positive values (X_7) and variability (X_{40}), defined by the pendulum methodology; the average reaction time (X_{18})

according to square-circle technique; variability (X_{47}) according to the square technique; adaptability (X_{31}) and time of the task performance (X_{89}) according to the adaptability methodology. At the same time such factors as the number of hits into zero according to pendulum methodology, X_9 ; the mistakes (triangle - circle), X_{54} ; variability (square-circle), X_{55} ; error of skipping figures

(square-circle), X_{57} ; the time of correct solutions (switching attention), X_{83} , do not have the statistically significant effect on the depletion of the professional activity effectiveness. This result is reflecting and support

previous scientific conclusions (Persch et al, 2015)¹¹ about existence of certain number of psychological factors that have significant determinative impact on occupation duties performance.

Table 3: The evaluation results for different risk groups of professional health and skills depletion.

Hosmer-Lemeshow Tests (Grouping based upon predicted risk (randomize ties))								
Group of Risk	Quantile of Risk		Y=0		Y = 1		Total	H-L Statistics
	Low	High	Actual	Expect	Actual	Expect	Obs	Value
1	0.0010	0.0612	44	45.0016	2	0.99839	46	1.02714
2	0.0682	0.1072	47	43.0490	0	3.95096	47	4.31357
3	0.1072	0.1460	39	40.2298	7	5.77016	46	0.29972
4	0.1460	0.1875	38	39.2639	9	7.73611	47	0.24717
5	0.1875	0.2529	36	37.0164	11	9.98356	47	0.13140
6	0.2530	0.3014	35	33.3485	11	12.6515	46	0.29736
7	0.3014	0.3487	34	31.8359	13	15.1641	47	0.45594
8	0.3487	0.4384	23	27.9311	23	18.0689	46	2.21626
9	0.4384	0.5680	23	23.0094	24	23.9906	47	7.5E-06
10	0.5684	0.9376	17	15.3142	30	31.6858	47	0.27525
Total			336	336.0000	130	130.000	466	9.26382
H-L Statistic		9.2638			p-value [Chi-Sq (8)]		0.3205	

For the developed multivariate logit model, unlike linear regression, the marginal effects of factors are not constant and depend on the values of all factors. Therefore, we evaluated the effect of change in the significant factors for given average stable levels of all other factors (Figure 1-2). The investigation also took into account different age categories.

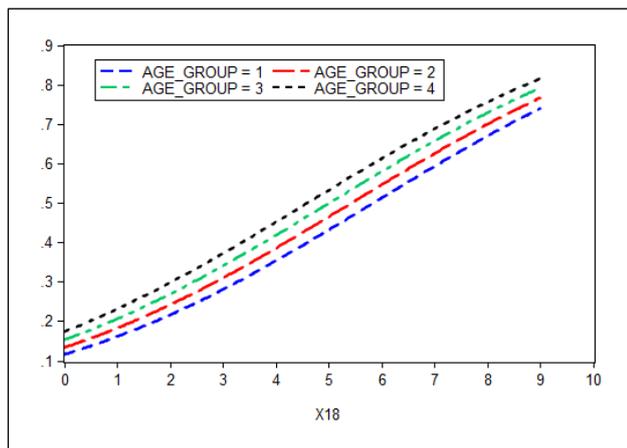


Figure 1: The evaluated risks for different values of average reaction time according to square-circle technique (X_{18}).

The simulation results showed that for workers with high values of average reaction time, X_{18} , defined by square-circle technique, ceteris paribus, we predict a high risk of professional efficiency depletion. On the contrary, the

low values of X_{18} cause the low probability value for negative expectation (Figure 1). At the same time, the results for different age groups are rather close that indicates that the age factor is not relevant for investigating of the impact of this psychophysiological indicator.

The analysis also revealed that the increase in the number of positive values, defined by the pendulum methodology, (X_7), and the variability, (X_{40}), lead to a reduction in the risk of a critical depletion in the professional successful activity. In addition, the curve of the marginal effects of factor X_7 is steeper than the curve of the marginal effects for factor X_{40} (Figure 2B). This result indicates that the impact of the factor that describe the number of positive values, defined by the pendulum methodology, is stronger than effect of the factor, X_{89} , which characterizes the variability. The simulation showed (Figure 2A) that for worker with average values of all factors but with a low value of positive values by the pendulum, regardless of the age group, we expect the significant degree of risk concerning the loss of professional qualities. However, for values of X_7 that exceed 500 such a risk is practically absent. At the same time, both factor X_7 and X_{40} give almost the similar results for different age groups of workers.

Therefore, we obtain that age of worker is not a determinative factor that significantly influence occupation performance efficiency and does not increase risk of its depletion in electric power engineering industry. It is slightly stronger conclusion in comparison

to previous results that were obtained in psychophysiological assessment of operational reliability and working capacity supporting of military operators (Kalnysh, Shvets, 2011) and in investigation of labor productivity for military managers that suffer from hypertonia caused by professional activity (Saliev, Shvets, 2013).^{14,15}

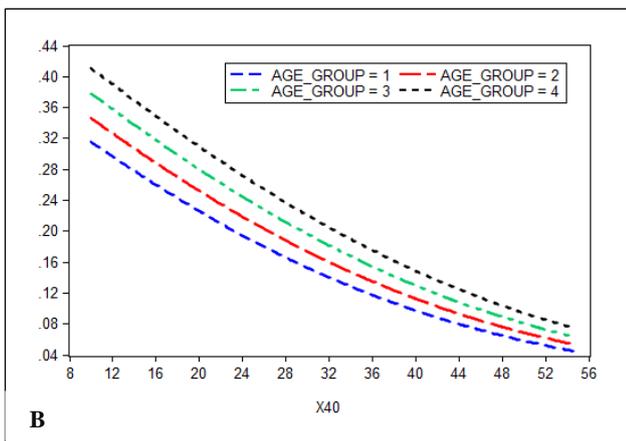
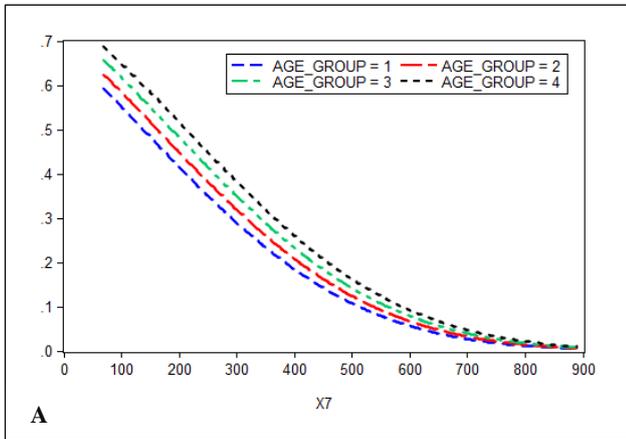


Figure 2: The evaluated risks for different values of (A) number of positive values (X7); (B) variability according to the pendulum methodology (X40).

Risk evaluation rule

The developed model imply that the probability of occupation qualities loss for a worker is calculated according to the formulas

$$R = 1/(1+\exp(-Z)), \dots(6)$$

$$Z = 6.3619 - 0.1471 * X_4 - 0.0081 * X_7 + 0.3283 * X_{18} - 0.1388 * X_{31} - 0.0655 * X_{40} - 0.1017 * X_{47} - 0.0704 * X_{89} + 0.1588 * AGE_GROUP. \dots(7)$$

Therefore, our research develop the approach for the evaluation of the risk with regard to critical depletion of occupation effectiveness and health working. Specifically, in order to determine the risk level for an individual worker, it should be done three steps:

1) On the basis of the psychophysiological examination of the worker to determine the value of seven psychophysiological indicators; namely, based on the method of the pendulum methodology, to determine the total error (X₄), the number of positive values (X₇) and variability (X₄₀); based on the adaptability methodology, determine the level of adaptability (X₃₁) and the time of task performance (X₈₉); by means of square-circle technique, determine average reaction time (X₁₈) and, based on square technique, to determine variability (X₄₇).

2) Substitute the values of the psychophysiological factors and the age of the worker in (7) and determine the value of the variable Z;

3) Based on formula (6), calculate the expected probability of R that characterizes the level of risk and the degree of the occupational efficiency depletion.

Getting the value of R, based on the formula

$$Ready = 1 - R,$$

It is also possible to evaluate the level of readiness of workers to work, in particular in difficult and extreme circumstances, and to decide on its involvement in the performance of occupational duties.

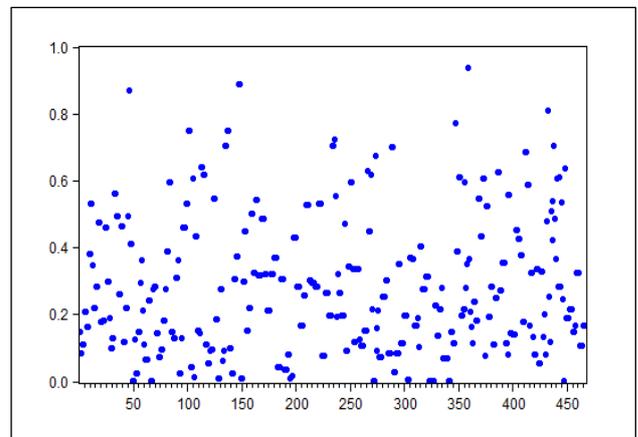


Figure 3: Estimated value of risk for 466 observed workers of operative service in electric power engineering industry in Ukraine.

Based on the developed methodology, we estimated the risk value for each person of the observed sample for 466 workers of operative service in electric power engineering industry in Ukraine (Figure 3).

We also calculated the percentage distribution of workers by allocating 5 risk groups (Figure 4). The results showed that for almost 44% of existing employees, the risk level of health and occupational effectiveness depletion is less than 0.2, which indicates their reliability and high readiness in case of dangerous.

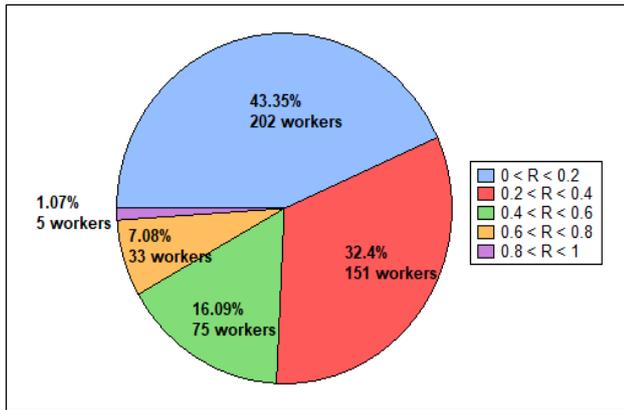


Figure 4: Distribution for observed workers of operative service in electric power engineering industry after split into 5 risk groups.

The investigation also shows that 84% of workers have a risk of effectiveness loss less than 0.5 so they can expect the success in their occupational activities. However, over 4% of workers can be exposed to the experience of critical reduction of their occupational qualities with risk factor above 70%. For 5 workers, the risk of health and effectiveness loss is greater than 80% that reveals their occupational unfitness and unreadiness to work in electric power engineering industry especially under difficult production circumstances.

CONCLUSION

The investigation revealed that the significant important factors, influenced the risk of occupational efficiency depletion, are the variability, the total error and the number of positive values according to pendulum methodology; the average reaction time according to square-circle technique; variability according to the square technique; adaptability and time of the task performance according to the adaptability methodology.

The investigation revealed that for workers with average values of all factors but with high values of the average reaction time by square-circle technique, regardless of the age group, we expect a high risk of professional qualities reduction. However, the increase in the number of positive values (by the pendulum methodology) and the time of task performance (adaptability methodology) lead to a reduction in the risk of a critical depletion in the professional successful activity. The results showed that the effects of first of these factors is stronger than effect of the second.

Based on developed approach, we estimated that for 84% of workers in electric power engineering industry in Ukraine the risk of effectiveness loss is less than 0.5 so they can expect the success in their occupational activities. However, over 4% of workers can be exposed to the experience of critical reduction in their occupational qualities with risk factor above 70% that is very

dangerous especially in difficult circumstances that can face energy production.

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