

**APRIORISTIC FACTORS RANKING CONSIDERED IN THE DEVELOPMENT OF SPECIAL CLOTHING FOR WORKERS OF OIL INDUSTRY**

**АПРИОРНОЕ РАНЖИРОВАНИЕ ФАКТОРОВ, УЧИТЫВАЕМЫХ ПРИ РАЗРАБОТКЕ СПЕЦИАЛЬНОЙ ОДЕЖДЫ ДЛЯ РАБОЧИХ НЕФТЯНОЙ ОТРАСЛИ**

**МҰНАЙ САЛАСЫНДАҒЫ ЖҰМЫСШЫЛАРҒА АРНАЛҒАН АРНАЙЫ КИІМДІ ДАЙЫНДАУ КЕЗІНДЕ ЕСКЕРІЛЕТІН ФАКТОРЛАРДЫ АПРИОРЛЫҚ САРАЛАУ**

G.A. GANIYEVA, B.R. RYSKULOVA  
Г.А. ГАНИЕВА, Б.Р. РЫСКУЛОВА

(Almaty Technological University)  
(Алматынський технологический университет)  
(Алматы технологиялық университеті)  
E-mail: gaziza\_ganieva@mail.ru

*The article is devoted to the aprioristic ranking of factors considered in the development of special clothing for workers in the oil industry. Carrying out a questionnaire on the basis of aprioristic ranking there were revealed a consistency between the opinions of experts that allows to make a conclusion on rationality of developing new special clothing for workers in the oil industry. The degree of consensus of experts and the results confirmed the concordance coefficient and Pearson's chi-squared test. As a result, the data revealed that the most needed special clothing for workers in the oil industry is the jacket and trousers of straight silhouette and of red color made from anti-static fabric. It has been established that the special clothing must have good air permeability, oil and abrading resistance.*

*Статья посвящена априорному ранжированию факторов, учитываемых при разработке специальной одежды для рабочих нефтяной отрасли. Проведение анкетного опроса на основе априорного ранжирования позволило выявить согласованность между мнениями экспертов, что позволяет сделать вывод о рациональности разрабатываемой новой специальной одежды для рабочих нефтяной отрасли. Степень согласованности мнений экспертов и полученные результаты подтверждены коэффициентами конкордации и критерием согласия Пирсона. В результате обработки данных выявлено, что наиболее необходимой специальной одеждой для рабочих нефтяной отрасли является куртка и брюки прямого силуэта красного цвета из антистатической ткани. Установлено, что специальная одежда должна обладать хорошей воздухопроницаемостью, стойкостью к нефти и прочностью на истирание.*

*Мақала мұнай саласындағы жұмысшылар үшін арнайы киімдерді жетілдіру кезінде ескерілетін факторларды априорлық саралауға арналған. Априорлық саралау негізінде сауалнама жүргізу, сарапшылардың көзқарасы арасындағы келісімділікті айқындауға мүмкіндік берді, бұл мұнай саласындағы жұмысшылар үшін жетілдірілген жаңа арнайы киімдердің тиімділігі туралы қорытынды жасауға мүмкіндік береді. Сарапшылар көзқарасының келісімділік деңгейі және алынған нәтижелер конкордация коэффициентімен және Пирсонның келісім өлшемдерімен расталды. Алынған мәліметтерді өңдеу нәтижесінде антистатикалық матадан жасалған қызыл түсті, түзу мүсінді шалбарлар мен күрте мұнай саласындағы жұмысшылар үшін ең қажетті арнайы киім болып табылатыны айқындалды. Арнайы киім жақсы ауа өткізгіштікке ие болу керектігі, мұнайға тұрақты және жуған кезде мықты болуы тағайындалды.*

**Key words:** special clothing, oil industry, oil, aprioristic ranking.

**Ключевые слова:** спецодежда, нефтяная отрасль, нефть, априорное ранжирование.

**Негізгі сөздер:** арнайы киім, мұнай саласы, мұнай, априорлық саралау.

**Introduction**

Statistical data processing is characterized by many influencing interrelated factors acting in different directions, which causes some difficulties in their statistical treatment. In some cases there is a lack of original information, due to the inability to use signs, for whatever reasons in quantitative form. The solution to this problem is possible by using the knowledge and experience of industry professionals by applying the questionnaire. With a broad survey of leading industry professionals there could be identified the most informative features with different ways of organizing of the questionnaire. This approach reduces the amount of an experimental prospective work, allows to accept or reject some preliminary hypotheses, in addition to determine the influence of various factors on the optimization parameter [1,2,3].

**Objects and methods of Research**

For the development of special clothing for workers of the oil industry, along with the study of working conditions and workers' basic labor movements [4,5] a questionnaire survey was conducted. Application of this method of identifying important information signs caused by the fact that all the signs describing special clothes are qualitative in nature, and cannot be quantified to express the simulated index [1].

For the processing of the results of the questionnaire we used the method of aprioristic

ranking. Usually aprioristic factors ranking is performed in the following order: on the basis of literature data a list of factors affecting the studied parameters is made, and then set the domain of each of the factors. Then offer it to those skilled in the branch, to arrange a series of factors in the degree of their influence. In addition, each expert can make additions to the list, if he, in his opinion, is not complete or express an opinion on changing the intervals of variation. The contribution of each factor is measured by the rank-place assigned to a specialist of this factor when ranking all factors with regard to their expected impact. Factors that attributed the leading role, given the first place, the rest are arranged in descending order of their effects on the studied parameters. If it is difficult to determine the dominant influence of some factor over another, then they are assigned the same rank, the arithmetic mean of the estimated amount of their ranks. The survey results of specialists are presented in the form of a rank matrix [6].

**Results and discussion**

The survey of experts was conducted with the help of questionnaires and personal interviews. The questionnaire was designed taking into account the appearance of uniforms and working conditions of workers of the oil industry, had a multistage nature and was included the factors listed in Table 1.

Table 1 – Factors, characterizing special clothing

| Fact<br>ors    | Cut               | Color  | Kit of special<br>clothing   | Fabrics                      | Hygienic<br>properties | Dangerous<br>harmful<br>industrial<br>factors | Wearing<br>factors |
|----------------|-------------------|--------|------------------------------|------------------------------|------------------------|---|--------------------|
|                | 1                 | 2      | 3                            | 4                            | 5                      | 6   | 7                  |
| x <sub>1</sub> | Straight          | Red    | Jacket and<br>trousers       | Fire retardant<br>fabrics    | Airpermeability        | Oil   | Tear               |
| x <sub>2</sub> | Semi-<br>fitting  | Vinous | Jacket and<br>short overalls | Antistatic<br>fabrics        | Hygroscopicity         | Dust  | Abrading           |
| x <sub>3</sub> | Close-<br>fitting | Blue   | Overalls and<br>jacket       | Thermo-<br>fireproof fabrics | Watertightness         | Static<br>electricity                         | Washing            |

A total of 80 completed questionnaires were obtained. Matrix of rank obtained from the questionnaires is shown in Table 2. As can be seen from the table in the preparation of a matrix

of rank assessed each factor by assigning him the rank number. In accordance with the matrix rank is defined by the sum of ranks, deviations of the sum ranks and their squares.

Table 2 – Matrix of ranks

| № | Factors   | Conditional numbers of experts |   |   |   |   |   |   |   |   |   | Sum of ranks | Bias of the sum ranks, $\Delta_i$ | Squares of deviations, $\Delta_i^2$ |
|---|---|--------------------------------|---|---|---|---|---|---|---|---|---|--------------|-----------------------------------|-------------------------------------|
|   |   | 1                              | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 |              |                                   |                                     |
| 1 | $x_1$   | 1                              | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 11           | -9                                | 81                                  |
|   | $x_2$   | 2                              | 3 | 2 | 2 | 3 | 1 | 3 | 2 | 2 | 2 | 22           | 2                                 | 4                                   |
|   | $x_3$   | 3                              | 2 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 27           | 7                                 | 49                                  |
|   | Total: $\sum_{j=1}^m a_{ij} = 60 \sum_{j=1}^m \frac{a_{ij}}{n} = 60/3=20$ |                                |   |   |   |   |   |   |   |   |   | S=134        |                                   |                                     |
| 2 | $x_1$   | 2                              | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 11           | -9                                | 81                                  |
|   | $x_2$   | 1                              | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 24           | 4                                 | 16                                  |
|   | $x_3$   | 3                              | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 25           | 5                                 | 25                                  |
|   | Total: $\sum_{j=1}^m a_{ij} = 60 \sum_{j=1}^m \frac{a_{ij}}{n} = 60/3=20$ |                                |   |   |   |   |   |   |   |   |   | S=122        |                                   |                                     |
| 3 | $x_1$   | 2                              | 2 | 3 | 2 | 1 | 3 | 2 | 3 | 3 | 2 | 23           | 3                                 | 9                                   |
|   | $x_2$   | 1                              | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 11           | -9                                | 81                                  |
|   | $x_3$   | 3                              | 3 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 26           | 6                                 | 36                                  |
|   | Total: $\sum_{j=1}^m a_{ij} = 60 \sum_{j=1}^m \frac{a_{ij}}{n} = 60/3=20$ |                                |   |   |   |   |   |   |   |   |   | S=126        |                                   |                                     |
| 4 | $x_1$   | 1                              | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 10           | -10                               | 100                                 |
|   | $x_2$   | 2                              | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 21           | 1                                 | 1                                   |
|   | $x_3$   | 3                              | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 29           | 9                                 | 81                                  |
|   | Total: $\sum_{j=1}^m a_{ij} = 60 \sum_{j=1}^m \frac{a_{ij}}{n} = 60/3=20$ |                                |   |   |   |   |   |   |   |   |   | S=182        |                                   |                                     |
| 5 | $x_1$   | 1                              | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 12           | -8                                | 64                                  |
|   | $x_2$   | 3                              | 3 | 2 | 1 | 3 | 3 | 3 | 3 | 2 | 3 | 26           | 6                                 | 36                                  |
|   | $x_3$   | 2                              | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 1 | 22           | 2                                 | 4                                   |
|   | Total: $\sum_{j=1}^m a_{ij} = 60 \sum_{j=1}^m \frac{a_{ij}}{n} = 60/3=20$ |                                |   |   |   |   |   |   |   |   |   | S=104        |                                   |                                     |
| 6 | $x_1$   | 1                              | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 10           | -10                               | 100                                 |
|   | $x_2$   | 2                              | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 22           | 2                                 | 4                                   |
|   | $x_3$   | 3                              | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 28           | 8                                 | 64                                  |
|   | Total: $\sum_{j=1}^m a_{ij} = 60 \sum_{j=1}^m \frac{a_{ij}}{n} = 60/3=20$ |                                |   |   |   |   |   |   |   |   |   | S=168        |                                   |                                     |
| 7 | $x_1$   | 2                              | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 23           | 3                                 | 9                                   |
|   | $x_2$   | 1                              | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 11           | -9                                | 81                                  |
|   | $x_3$   | 3                              | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 26           | 6                                 | 36                                  |
|   | Total: $\sum_{j=1}^m a_{ij} = 60 \sum_{j=1}^m \frac{a_{ij}}{n} = 60/3=20$ |                                |   |   |   |   |   |   |   |   |   | S=126        |                                   |                                     |

The obtained results of the mathematical processing of the matrix of ranks assess the degree of consensus of experts using the concordance coefficient W:

$$W = \frac{12 \times S}{m^2(n^3 - n)} \tag{1}$$

where S – sum of squared deviations;

M – the number of experts;

N – the number of estimated factors.

Concordance coefficient evaluates the degree of consensus of experts on ranking and varies from 0 to 1. In this case we can assume that between the opinions of experts has some agreement, because the coefficient of concordance is different from zero.

The significance of the concordance coefficient is checked by Pearson criterion which is calculated by the formula:

$$\chi_p^2 = m(n-1) \times W \tag{2}$$

Taking into account the 5% significance level and the number of degrees of freedom f = 9, table value criteria  $\chi_r^2 = 16.92$ . Since all of the calculated values of Pearson criterion  $\chi_p^2$  are more than table one  $\chi_p^2$ , we can assume that the opinions of experts are agree.

In this case the obtained coefficients and values  $\chi_p^2$  are presented in Table 3.

Table 3 – The values of the coefficient of concordance W and Pearson criterion  $\chi_p^2$

| № | Factors                               | Coefficient of concordance W | Estimated value of the Pearson criterion $\chi_p^2$ |
|---|---------------------------------------|------------------------------|---|
| 2 | Color                                 | 0,61                         | 12,2  |
| 3 | Kit of special clothing               | 0,63                         | 12,6  |
| 4 | Fabrics                               | 0,91                         | 18,2  |
| 5 | Hygienic properties                   | 0,52                         | 10,4  |
| 6 | Dangerousharmfulindustrialfactor<br>s | 0,82                         | 16,4  |
| 7 | Wearing factors                       | 0,63                         | 12,6  |

As a result, the data revealed that the most needed special clothing for workers in the oil industry is the jacket and trousers of straight silhouette and of red color made from anti-static fabric. It has been established that the special clothing must have good air permeability, oil and abrading resistance.

### **Conclusion**

Thus, questionnaire on the basis of aprioristic ranking there were revealed a consistency between the opinions of experts that allows to make a conclusion on rationality of developing of new special clothing for workers in the oil industry. The degree of consensus of experts and the results confirmed the concordance coefficient and Pearson's chi-squared test. Matrix of ranks obtained on the basis of a questionnaire, show the ratio of questions about the artistic and aesthetic, mechanical, sanitary and protective properties and determine the choice of textile materials for the manufacture of special clothing for oil workers.

### REFERENCES

1. Ryskulova B.R. Research methodology: A Tutorial.-Almaty: НЦНИИПК, 2011. - 111 p.[in Russian]
2. Khlussov V.P. Basics of Marketing. M.: «Prior». – 2000. – 180 p.[in Russian]
3. Savel'eva I.N. Fundamentals of the theory, methodology and practice of design engineering working clothing. – Ufa: PD RSciEdMC MoE. – 2005. – 272 p. [in Russian]
4. Ganiyeva G.A., Ryskulova B.R. Study of basic labor movements of the oil industry workers /Proceedings of International scientific and practice Conference «Innovative development of Food Light and Hospitality Industry». – Almaty: ATU, 2014, P. 271-273 [in Russian]
5. Ganiyeva G.A., Ryskulova B.R. Development of special clothing for workers in the oil industry through the study of working conditions /Proceedings of International scientific and practice Conference «Innovative development of Food Light and Hospitality Industry». – Almaty: ATU, 2014, P. 270-271 [in Russian]
6. Aprioristic ranking of factors / ed. by Shchekin. –, 2<sup>nd</sup> edition. – Khabarovsk: KhSUoT, 2004. – 18 p. [in Russian]