

Management of the Social Package Structure at Industrial Enterprises on the Basis of Cluster Analysis

Mykhailo Vedernikov, Maria Zelena, Lesia Volianska-Savchuk,
Valentina Litinska, Juliy Boiko

Khmelnytskyi National University, 11, Instytuts'ka str., Khmelnytskyi, 29016, Ukraine

Abstract – This paper represents theoretical generalization and a new method for complex solution of important scientific and practical problem – the effective management of industrial enterprises through formation and improvement of the compensation package. The method for constructing a social package based on cluster analysis is proposed. On the basis of correlation models, the stochastic relationship between the level of individual approach to the formation of compensation package and the level of satisfaction of its fullness is analytically determined. The recommendations are given for improving management efficiency on the base of controlling personnel turnover; increasing personnel motivation level; increasing labor productivity; attracting highly qualified employees to the company; ensuring favorable social and psychological climate in the teamwork; creating positive image of the enterprise in the labor market. The strategic list of measures for construction and operation of individual components in the general mechanism of formation and implementation of the concept for controlling personnel motivation at industrial enterprises has been formed.

Keywords – management, compensation package, controlling, cluster analysis

DOI: 10.18421/TEM91-35

<https://dx.doi.org/10.18421/TEM91-35>

Corresponding author: Maria Zelena,
Khmelnytskyi National University, Department of Personnel Management and Labour Economics, 11, Instytuts'ka str., Khmelnytskyi, 29016, Ukraine.

Email: mariaverde4@ukr.net

Received: 03 January 2020.

Revised: 07 February 2020.

Accepted: 12 February 2020.

Published: 28 February 2020.

 © 2020 Maria Zelena et al; published by UIKTEN. This work is licensed under the Creative Commons Attribution-NonCommercial-NoDeriv 3.0 License.

The article is published with Open Access at www.temjournal.com

1. Introduction

Effective methods providing activation of human resources are now priority tasks for enterprises of all forms of ownership and branches.

Modern methods in economics demand owners to implement new types of economical motivation mechanisms. The modern practice in human resources at enterprises requires development and implementation of new personnel motivation techniques, in particular compensation package [1].

Literature survey testifies of multiple publications on human resources and motivation [2], [3].

The papers [4] research motivation effectiveness in relation to its actual effect on the public administration system. The principle of publicity takes important place in motivation function. Some issues on creation and conduct of the range of programs, and also the functioning of the management system at various levels that maximizes its effectiveness are described in paper [5].

Effective methods designed to manage social package structure [6], [7], [8], give reason to search interdependence between motives of the personnel and their stimulation at the enterprise.

The development of mechanisms is required to match the priorities of an enterprise and the priorities of the single employee, aimed at maximal reaching individual needs for both sides, by motivating employees and employers to reach maximal effectiveness in pursuit of a single goal [9].

Most of the methods assessing satisfaction of the personnel by its labor have drawbacks caused by selecting a concrete list of factors, which effect labor motivation and focus on external factors and social and psychological characteristics of the occupational environment. Thus, application of a method based on compensation package is reasonable. Compensation package represents a motivation technique that integrates methods for material and immaterial labor incentives, includes a system of methods to satisfy the needs of the personnel at the enterprise and directly influence production management.

In the paper, enhancing the effectiveness of social package management is offered by using cluster analysis. The advanced method for ranging elements of social package on the basis of correlation and regression analysis has been proposed.

2. Research of the Modern Personnel Motivation

In modern economic conditions and growing world economic crisis most of the industrial enterprises are unable to provide independent stable economic results. The problem of increasing competitiveness of Ukrainian industrial enterprises is growing furthermore.

The possible solution to this problem appears to be an optimal usage of actual natural and gained advantages for solving system problems in Ukrainian industrial complex and international cooperation.

Nowadays, the majority of managers at industrial enterprises prefers using classic methods for personnel motivation, however there are some who consider changes in external market and the use of innovation techniques.

Noteworthy is that the controlling relation between labor effectiveness and average salary rate is essential in modern conditions of forming market economics, since the other case will cause overusing salary fond, increasing the cost of production, decreasing the profits, and finally decreasing competitiveness of products and of the enterprise [10], [11].

Also, noteworthy is the use of the so-called mixed type of motivations in the process of labor incentives. The exchange of labor results for the complex of all rewards given by the enterprise takes the central place in relations between the worker and the enterprise.

In order to assess the satisfaction with labor conditions the, respondents were reviewed by the list of the statements given in Table 1.

The information about forming compensation package is obtained by using the method of sociological survey, as a method for studying social processes.

The verified number of the reviewed is 100 experts working at machine-engineering enterprises in Khmelnytskyi region. The experts were selected as highly qualified, experienced and skilled workers.

The selection of the experts was irreversible. The input parameters are: probability – 95 %, sampling error – 6 %, and 90 % of the reviewed are experts in the researched subject. Calculation is performed by the formula, which specifies a sample with respect to the number of personnel at the industrial enterprise:

$$n_i = n N_i / N, \quad (1)$$

where n – total sample; N_i – typical group amount; N – general amount.

Table 1. The results of the respondents' review by statements of satisfaction with the labor conditions

Statement	Completely satisfied, %	Satisfied, %	Partly satisfied, %	Not satisfied, %	Highly not satisfied, %
1. You are satisfied with the enterprise	18.2	63.6	9.09	–	–
2. You are satisfied with the physical conditions (heat, cold, noise etc.)	9.09	27.3	54.5	–	–
3. You are satisfied with your job	9.09	63.6	18.2	–	–
4. You are satisfied with the warehouse location	9.09	36.4	36.4	–	–
5. You are satisfied with the staff transportation	9.09	18.2	18.2	27.3	–
6. You are satisfied with working day duration	27.3	45.5	9.09	–	–
7. You are satisfied with the salary in relation to the labor	–	9.09	63.6	9.09	–
8. You are satisfied with the salary with respect to the same job at other enterprise	–	18.2	45.5	36.4	–
9. You are satisfied with the occupational conditions at the workplace	27.3	36.4	27.3	–	–
10. You are satisfied with the promotion opportunities	27.3	27.3	27.3	9.09	–
11. You are satisfied with the application of your skills and experience	18.2	45.5	45.5	–	–
12. You are satisfied with the technical equipment of the warehouse	9.09	45.5	45.5	9.09	–

The results of the statistical analysis made for the respondents on their assessment of individual approach to forming compensation package is given in Table 2.

Table 2. Statistical data of the respondents' assessment of individual approach to forming compensation package

Statistical indicator	Value
Mean	72.4
Standard error	2.4
Median	80
Mode	80
Standard deviation	17.7
Sample dispersion	314.7
Excess	-0.58
Asymmetry	-0.56
Interval	70
Minimum	30
Maximum	100

Using data in Table 2., the variation coefficient is calculated by the formula:

$$V_{\sigma} = \sigma / \bar{x} \cdot 100\%, \quad (2)$$

where σ – standard deviation [12];
 \bar{x} – arithmetic mean.

The variation coefficient equals 30.3 %. Since the variation coefficient is less than 33%, the sample of employees selected for the study is homogeneous. The asymmetry coefficient is negative and exceeds (by absolute value) 0.5 ($|A| > 0.5$), which indicates of high asymmetry in the distribution of employees' assessments of individual approach to forming compensation package at the enterprise. Therewith, negative excess value ($E_k < 0$) indicates, in accordance to data in [5], that distribution is more flat-topped in comparison with the normal. Irrespective to high average statistical parameters (mean value, median and modal value) of reviews on individual approach to forming compensation package, almost the third of the respondents indicated 60 % or even less. Such fact indicates insufficient attention paid by employers, managers and human resources officers to forming compensation packages.

In order to justify the individual approaches to forming compensation package among the target audience (employees), the chosen factors are verified by effect to the level of compensation package. The indicator stated by "individual approaches to forming compensation package" is considered as productive and given the symbol y . Factor indicators: x_1 – level of satisfaction with compensation package; x_2 – level of satisfaction with occupational conditions; x_3 – provision of promotion opportunities; x_4 – attitude of the company management to employees.

Stochastic relationship between productive (y) and factor indicators (x_1, x_2, x_3, x_4) is revealed by using mutual conjugation tables. Mutual conjugation table for indicators of "individual approaches to forming compensation package" and "level of satisfaction with compensation package" is given in Table 3.

Table 3. Mutual conjugation table for indicators of "individual approaches to forming compensation package" and "level of satisfaction with compensation package"

Level of satisfaction with compensation package, x_1	Evaluation of individual approaches to forming compensation package, y				Total f_{j0}
	30–40	50–60	70–80	90–100	
30–40	3	4	0	0	7
50–60	1	6	12	4	23
70–80	1	1	12	8	22
90–100	0	0	0	3	3
Total f_{i0}	5	11	24	15	55

In order to confirm or refute the assumption of stochastic relationship between productive and factor indicators, the Pierson's criterion χ^2 is found by the formula:

$$\chi^2 = n \left[\sum_i \sum_j \frac{f_{ij}^2}{f_{i0} f_{j0}} - 1 \right], \quad (3)$$

where f_{ij} – frequency of column j and conditional distribution indicator i ; f_{i0} – summarized frequencies by the indicator x ; f_{j0} – summarized frequencies by the indicator y [13].

The Pierson's criterion χ^2 is found by [13] for indicators y and x_1 : $\chi^2 = 33.22$. The limit value χ^2 for $\alpha=0.05$ and degrees of freedom $df = (4-1) \cdot (4-1) = 9$ equals 16.9. Actual indicator exceeds limit value, what testifies of essential relationship with 0.95 probability between individual approaches to forming compensation package and the level of satisfaction with compensation package provided by conducted reviews.

The strength of the relationship is assessed by mutual conjugation coefficient [13] and calculated by Chuprov's formula:

$$C = \sqrt{\frac{\chi^2}{n \sqrt{(m_x - 1)(m_y - 1)}}}, \quad (4)$$

where n – total amount; m_x – number of groups by indicator x ; m_y – number of groups by indicator y .

Mutual conjugation coefficient (C_1) equals 0.45. The value of the coefficient indicates of moderate relationship between individual approaches to forming compensation package and the level of satisfaction with compensation package.

Analogically, tables are made for mutual conjugation of productive (y) and other factor indicators (x_2, x_3, x_4), Pierson's criterion χ^2 and mutual conjugation coefficients are calculated. The analysis revealed direct dependence between productive and factor indicators.

Calculated Pierson's criterion χ^2 exceeds limit value by all factor indicators, therefore the

relationship between productive (y) and factor indicators (x_2, x_3, x_4) is considered to be essential.

Mutual conjugation coefficients are equal to: $C_2 = 0.45$; $C_3 = 0.49$; $C_4 = 0.53$. The values of conjugation coefficients indicate of moderate relationship between x_2, x_3 , and x_4 .

In order to assess the level of effect that chosen external factors produce to productive indicator in each group, the mean values of productive indicator are calculated by factor indicator (Table 4.).

The growing averages along the groups indicate of correlation between factor and productive indicators. Data in Table 2.6 testifies of such correlation between all factor indicators and productive one.

To measure density of correlation between indicators mentioned above, the correlation ratio is calculated by the formula:

$$\eta^2 = \frac{\delta^2}{\sigma^2} \cdot 100\%, \quad (5)$$

where δ^2 – intergroup, factor dispersion; σ^2 – total dispersion [12], [14].

The calculation results of correlation density between the productive and factor indicators are given in Table 5.

The correlation is verified by assessing actual value η^2 against the limit one. The limit value of correlation is $\eta^2_{1-a}(3; 51) = 0.143$.

Table 4. Dependence of level of individual approaches to forming compensation package on factor indicators

Factor indicators values	The mean values of assessments on individual approaches to forming compensation package level			
	Factor indicators			
	Level of satisfaction with compensation package	Level of satisfaction with occupational conditions	Provision of promotion opportunities	Labor contribution in teamwork
30–40	44	42	38	38
50–60	51.8	54.6	50.9	53.6
70–80	65	73.8	66.2	75.8
90–100	72.7	86	81.33	92

Table 5. The calculation results of correlation density between the productive and factor indicators

Indicator	Factor indicators			
	Level of satisfaction with compensation package	Level of satisfaction with occupational conditions	Provision of promotion opportunities	Labor contribution in teamwork
Intergroup, factor dispersion δ^2	47.69	47.69	47.69	47.69
Total dispersion σ^2	204.3	122.3	130.3	176.3
Correlation η^2	23.3	39.0	36.6	27.0

Empirical correlations given in Table 5. exceed limits, therefore, the relationship between the compensation package level and all factor indicators is considered significant with 0.95 probability. The mechanism of composing productive indicator (y) variation depending on the indicators (x_1, x_2, x_3, x_4) will be researched on the base of economic and mathematical modeling. The conclusion can be made about regression relationship between productive indicator (individual approach to forming the compensation package) and factor indicators. Noteworthy is obtaining multiple regressions because of having a number of descriptive variables in regressor models.

In order to reveal multicollinearity, the Farrara-Glober algorithm [15] is applied. The calculations revealed that regressor x_2 “level of satisfaction with occupational conditions” is much more dependent, unlike the other factors, and also correlates to regressor x_1 . By this consideration the regressor x_2 is to be excluded from the model.

The individual symbols that stand for factor indicators are shifted now: x_1 – level of satisfaction with compensation package; x_2 – provision of promotion opportunities; x_3 – labor contribution in teamwork.

Creating model starts from its specification – determining functional dependence type $y_i = f(x_i)$. In order to reveal the character of the relationship between productive y and factor indicators x_1, x_2, x_3 , the conclusion is made about their linear dependence.

Noteworthy is that empirical equation is expressed as:

$$Y = \beta_0 + \beta_1x_1 + \beta_2x_2 + \beta_3x_3 + \beta_4x_4 + \varepsilon. \quad (6)$$

To build the model the "Regression" tool of the "Data Analysis" in Microsoft Office Excel package is used. The model parameters are given in Table 6.

Table 6. The model parameters

Indicator	Coefficient	Standard error	t-statistics	P-value	Lower 95 %	Upper 95 %
Y-section	13.261	6.937	1.911	0.062	-0.666	27.188
Variable X_1	0.243	0.134	1.814	0.075	-0.026	0.512
Variable X_2	0.347	0.108	3.214	0.002	0.13	0.564
Variable X_3	0.296	0.117	2.534	0.014	0.062	0.531

Regression statistics data is given by: multiple R (correlation coefficient) – 0.791; R -square (determination coefficient) – 0.626; R -square normalized (corrected R_2) – 0.604; regular error – 11.16; observation (total amount) – 55.

Dispersion analysis of the model is given in Table 7.

Table 7. Dispersion analysis of the model

Indicator	df	SS	MS	F	Relevance F
Regressi	3	10640.22	3546.74	28.47	5.86931
Remaind	51	6352.51	124.56	–	–
Total	54	16992.73	–	–	–

According to analysis results, the regression model represents dependence of the individual approach to forming compensation package on the level of satisfaction of employees with compensation package, the provision of promotion opportunities and the labor contribution in teamwork and is expressed as: $Y = 13,261 + 0,243x_1 + 0,347x_2 + 0,296x_3$. To check the statistical significance of the model parameters, the following parameter is calculated $t'_{cr}(0.01; 51) = 1.67$, $t'_{cr} = t''_{cr} = -1.67$, and hence, the range of statistical criterion for which the statistical hypothesis $H_0: \beta_i = 0$ is true, equals to $[-1,67; 1,67]$.

In accordance to data in Table 5.: $t^*_{\beta_0} = -1.911$; $t^*_{\beta_1} = 1.814$; $t^*_{\beta_2} = 3.214$; $t^*_{\beta_3} = 2.534$. Since $t^*_{\beta_j}$ does not belong to diapason $[-1,67; 1,67]$ ($j = 0, 1, 2, 3$), then the null hypothesis H_0 is rejected which stated that parameters $\beta_0, \beta_1, \beta_2$ and β_3 are equal to zero. Thus, the statement about significant effect of factor indicators to productive one is asserted with 0.9 probability. The determination coefficient ($R_2=0.626$) determines factors present in the model. Its value explains the percentage (62.6%) of respondents' assessment variations on the level of compensation package.

The determination coefficient is to be assessed against the statistical significance of the Fisher criterion. Thus, in accordance to the outlined purpose, the value of observing Fisher criterion is defined by the following formula [16]:

$$F^* = \frac{R^2}{1-R^2} \cdot \frac{n-m-1}{m}, \quad (7)$$

The Fisher criterion that is observed in our case equals to 28.45. The value $F_{cr}(0,01; 3; 51)=4.13$ is critical for Fisher criterion [16]. In case of $F^* > F_{cr}$ the deviation is observed.

To summarize, all factors are considered significantly effecting the productive indicator.

In the paper, the partial elasticity coefficients are defined which are the limits of Y changes (%) over 1 % change of one of the regressors X_i :

$$KE_i = \lim_{\Delta x \rightarrow 0} \frac{\frac{\Delta y}{y}}{\frac{\Delta x_i}{x_i}}. \quad (8)$$

Partial elasticity coefficients are respectively equal to 0.017; 0.025; 0.021. The calculated coefficients of elasticity indicate that as each indicator changes (employees' assessment of their satisfaction with the compensation package, provision of promotion opportunities, determination of the labor contribution in teamwork) by 1%, the level of the compensation package changes by less than 1%. The research has also testified that identified factors (satisfaction with the existing “compensation package”, and also the appropriate conditions for promotion, determination of the labor contribution in teamwork) have 62.6 % effect to employees' assessment of individual approach to forming compensation package.

Thus, on the base of performed analysis of the national experience in the field of personnel motivation, the conclusion can be made that the existing scientific-theoretical and methodological approaches do not provide appropriate motivation to employees; however, the real activity of enterprises completely supports creating new perspectives for the personnel motivation. For this reason, the development of a compensation package becomes one of the most important strategic tasks in human resources at the present stage of social development [17].

Innovative methods for personnel motivation play a major role in maximizing work potential. Therefore, the experience of using innovative approaches in foreign companies can be applied to home enterprises, with the purpose of social and economic development in the whole region. Specific features of the market economy and the mentality of population are to be considered. The research defined intangible benefits used in foreign countries: benefits of work schedule; financial incentives; “Gratitude rewards”; various incentives not relevant to the workflow; quality of working conditions, etc. (Table 8.).

Table 8. Map of compensation package elements on the basis of personnel motivation in various countries

Country	Type of reward					
	Bonuses	Payment in kind	Individual rewards	Stock options	Material non-financial rewards	Additional payments
Austria	▲	▲			▲	▲
Belgium	▲	▲			▲	
United Kingdom	▲	▲	▲	▲		
Israel	▲					▲
Spain	▲	▲	▲		▲	
Germany	▲		▲			
China	▲			▲		
Latvia	▲				▲	▲
Poland	▲	▲				▲
Portugal	▲	▲	▲			
USA	▲		▲	▲	▲	
Hungary	▲		▲			▲
Finland	▲		▲			
France	▲		▲		▲	
Sweden	▲	▲	▲			
Japan	▲			▲	▲	

Analysis of the foreign experience in personnel motivation indicated that determining a unified single approach to motivation, which would have a positive effect, is highly unlikely, especially for a long time. That is why individualized approach and periodic review of its structure is needed. The problem of personnel motivation has many issues, however scientists have not come yet to a single vision of motivation in industrial enterprises [18].

The conditions and dynamics of material incentives for employees are a major aspect of the motivational impact on the work potential and the enterprise. Not only estimation of expenses used for remuneration is important, but also distinguishing the criteria for sharing material flows between employees for better use of labor potential in the enterprise.

For analyzing factors associated with risks of dissatisfaction with the level of remuneration, the method for constructing and analyzing multifactor logistic regression models was applied. The model uses five factor indicators associated with the risk of negative determination of the wage level: the need for increasing administrative control over labor discipline, the need for its substantial growth, the importance of premium payments for the specific volume and quality of work, the importance to control incentive part of the salary by consideration

of only indicators adjusted by employee. The logistic model of regression formed on these variables is considered to be adequate ($p < 0,001$ by criterion i-square) and coordinates the relationship (AUC=0.86; 95 % CI: 0.75–0.93).

The optimal limit for making decision on calculation is determined by maximizing Youden Index. At the optimal limit, the sensitivity makes 83.3 % (95 % CI: 62.6 % – 95.3 %), specificity – 76.3 % (95 % CI: 59.8 % – 88.6 %). The coefficients of the constructed logistic model are given in Table 9.

Table 9. Coefficients of five-factor logistic model for predicting the risk of negative assessment of remuneration level

Factor indicator	Model coefficient values, $b \pm m$	The significance level in coefficient differences from 0	VS (95 % CI)
The need for increasing administrative control over labor discipline	-1.1 ± 0.5	0.02*	0.32 0.12–0.85
The need for substantial salary growth	2.1 ± 0.8	0.01*	8.3 1.6–42.4
The importance of premium payments for the specific volume and quality of work	$1.7 + 0.9$	0.05*	5.5 1.0–29.5
The importance of using effective practices in work	-1.2 ± 0.7	0.06	–
The importance to control incentive part of the salary by consideration of only indicators adjusted by employee	-1.3 ± 0.7	0.05	–
Const	-3.0	–	–

The analysis revealed that, according to the respondents, the level of salary has no influence on increasing motivation. The main basis for its improvement, according to the personnel, is a clear fulfillment of their functional duties and administrative decisions about material and intangible incentives taking into account results of employees' activities and performance of work discipline.

The research results testify that increasing control of work discipline reduces the risk of respondents' negative assessment of the salary level ($p=0.02$), VS=0.32 (95 % CI: 0.12–0.85) by each degree.

Statistical analysis is performed for amount of options, which contain compensation packages at the surveyed enterprises.

Analysis results indicate that the average amount of options containing compensation package provided to personnel at industrial enterprises makes 4.38 and the median value is 4.

Table 10. Statistical indicators of amount of options, which contain compensation packages provided to personnel at industrial enterprises

Statistical indicator	Value
Mean	4,38
Standard error	0,184
Median	4
Mode	5
Standard deviation	2,026
Sample dispersion	4,104
Excess	0,07
Asymmetry	0,519
Interval	9
Minimum	1
Maximum	10
Sum	530
Total	121

The five-option compensation package is widely used. Using data in Table 10., the variation coefficient is determined by the formula (2).

The variation coefficient is equal: $(2.03/4.38) \cdot 100 = 46.3\%$.

Noteworthy is that variation coefficient exceeding the markup of 33% indicates the heterogeneity of social packages provided by industrial enterprises. The asymmetry coefficient contains a positive value (Table 10.) higher than 0.5 ($A > 0.5$), indicating the right-sided increased asymmetry of the distribution of industrial enterprises by the number of social package options. However, a positive excess ($E_k > 0$) testifies that the distribution is sharper than a norm.

According to the survey, the optimal compensation package, which is most preferred by the personnel, is different from actual packages. Therefore, the optimal number of compensation package options that will meet the personnel needs for the relevant benefits is six, which, on the average, gives two options more than the social packages offered to workers (Table 11.).

According to the research results, the conclusion can be made that on the average, the options, which are in demand by the personnel, make 58.28%. The variation coefficient exceeding 33% indicates the heterogeneity of the respondents. The asymmetry coefficient gained negative value (Table 12.) ($0.25 < A < 0.5$), indicating the left-sided moderate asymmetry in differentiating respondents, taking into account demand in compensation incentives, offered by employees, however such value as ($E_k < 0$) produces a flat-top shape unlike normal.

Noteworthy is that based on the rank correlation, the consistency is observed for surveyed workers of different age categories in setting compensation package.

Table 11. Statistical indicators of amount of options, which are in demand by respondents

Statistical indicator	Value
Mean	5.99
Standard error	0.212
Median	6
Mode	6
Standard deviation	2.806
Sample dispersion	7.873
Excess	-0.3
Asymmetry	0.484
Interval	12
Minimum	1
Maximum	13
Sum	1048
Total	175

Table 12. Statistical indicators of respondents' demand in compensation incentives offered by employees

Statistical indicator	Value
Mean	58.28
Standard error	4.209
Median	77.5
Mode	100
Standard deviation	44.147
Sample dispersion	1948.972
Excess	-1.687
Asymmetry	-0.385
Interval	100
Minimum	0
Maximum	100
Sum	6410.357
Total	110

Thus, the corresponding ranks were assigned. To determine the concordance coefficient the necessary calculations are provided.

The concordance coefficient is calculated by the formula:

$$W = \frac{12S}{m^2(n^3 - n)}, \quad (9)$$

where m – the number of indicators for the order scale; S – the sum of square deviations of particular variant rank set from the averaged ranks; n – number of variants.

Using formula (9) the concordance coefficient is found for the surveyed employees of industrial enterprises for different age groups:

- under 26 years: $\frac{12 \cdot 25475.5}{45^2(13^3-13)} = 0.069$;
- from 26 to 30 years: $\frac{12 \cdot 61951.5}{60^2(13^3-13)} = 0.0946$;
- from 31 to 36 years: $\frac{12 \cdot 29373.5}{40^2(13^3-13)} = 0.1009$;
- over 36 years: $\frac{12 \cdot 16393}{27^2(13^3-13)} = 0.1236$

The surveys indicate changes in the concordance coefficient that is increasing with each age group, and their values remain quite low and explain the low level of consistency among respondents on the compensation package components, which are in demand by employees. As a result, the individualization is recommended for the components to design social package, since the needs of personnel, even of the same age category, may differ.

In order to verify the significance of the calculated coefficients, criterion χ^2 is calculated by the formula:

$$\chi^2 = Wm(n - 1). \tag{10}$$

Criterion χ^2 for respondents of different age categories equals to:

- under 26 years: $0,069 \cdot 45 \cdot (13 - 1) = 37,33$;
- from 26 to 30 years: $0,946 \cdot 60 \cdot (13 - 1) = 68,08$;
- from 31 to 36 years: $0,1009 \cdot 40 \cdot (13 - 1) = 48,42$;
- over 36 years: $0,1236 \cdot 27 \cdot (13 - 1) = 40,03$.

Actual values χ^2 exceed the critical value of the criterion $\chi^2_{1-0.05}(12) = 21.0^3$. This gives grounds to assert with 0.95 probability that values of the concordance coefficients are non-random and the sets of compensation payments that are in demand by respondents differ significantly.

3. Forming Social Package by Cluster Analysis

Modern effective motivation should be individual. Therefore, the management faces a number of issues when introducing a social package at the industrial enterprise. One of the key-points is defining elements of the package, which will be the driving force for employees' work activation.

The research was conducted in industrial enterprises. The research resulted in quite accurate analytical assessment of the actual personnel motivation and employees' view of social package components in Ukrainian industrial enterprises.

To determine elements of the social package, which were in more demand by the employees, the respondents were offered 40 elements of the social package. Respondents were asked to assess importance for each element in the package by giving scores from 1 to 100 (Figure 1).

The amount of social services defined by the respondents in the social package ranged from 10 to

18, and their specific weight was marked in the range of 10-90%.

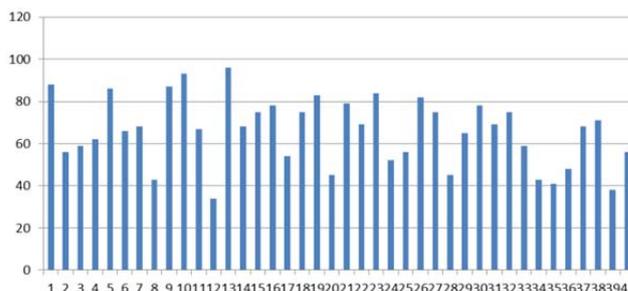


Figure 1. Survey results about the importance of social services

The figure demonstrates that not all social services, according to the respondents, scored equally high. Thus, the most significant can be selected. Let's take the limit of 75 points and select those social services that have scored 75 points and above. The cluster analysis was used for distributing components in the social package by criterion 15. Table 13. represents the input information for modeling a social package.

Table 13. The input information for modeling a social package

C 1	90	89	93	82	87	82
C 2	93	86	90	85	83	80
C 3	82	85	90	95	85	87
C 4	95	97	89	95	90	90
C 5	95	95	92	93	95	95
C 6	80	70	88	67	78	70
C 7	78	80	75	80	80	85
C 8	75	85	80	85	75	70
C 9	85	89	83	85	78	80
C 10	80	85	75	80	82	78
C 11	85	88	80	85	85	75
C 12	70	75	80	75	73	75
C 13	80	90	70	75	70	80
C 14	75	83	80	75	85	78
C 15	75	80	80	75	75	75

In the first stage, before calculating the distance matrix, the output Table 14. is to be normalized according the formula (11):

$$z_{ij} = \frac{x_{ij} - \bar{x}_j}{\sigma_j}. \tag{11}$$

The intermediate calculations are given in Table 15.

To construct a distance matrix (the second stage), the Euclidean distance is used:

$$d_{ij} = \sqrt{\sum_k (Z_{ik} - Z_{jk})^2} \tag{19}.$$

The obtained distance matrix characterizes the distances between the individual objects, each of them is a separate cluster in Figure 2.

The next distances are counted from the newly

created cluster to all other remaining indicators. Thus, a new distance matrix is obtained, and in the next stage again the more similar clusters are merged and the distance matrix is recalculated. Noteworthy is that this process is repeated until one single cluster is formed.

Table 14. Matrix of standardized values for selection of social package values

Data standardization						
1	0,96	0,55	1,43	-0,14	0,57	-0,14
2	1,34	0,12	1,00	0,29	0,00	-0,43
3	-0,07	-0,02	1,00	1,72	0,29	0,57
4	1,59	1,69	0,86	1,72	1,00	1,00
5	1,59	1,41	1,29	1,43	1,72	1,72
6	-0,32	-2,16	0,72	-2,29	-0,72	-1,86
7	-0,58	-0,73	-1,15	-0,43	-0,43	0,29
8	-0,96	-0,02	-0,43	0,29	-1,15	-1,86
9	0,32	0,55	0,00	0,29	-0,72	-0,43
10	-0,32	-0,02	-1,15	-0,43	-0,14	-0,72
11	0,32	0,41	-0,43	0,29	0,29	-1,15
12	-1,60	-1,44	-0,43	-1,15	-1,43	-1,15
13	-0,32	0,69	-1,86	-1,15	-1,86	-0,43
14	-0,96	-0,30	-0,43	-1,15	0,29	-0,72
15	-0,96	-0,73	-0,43	-1,15	-1,15	-1,15

Table 15. Calculate the mean and standard deviation

Mean value	82,53	85,13	83,00	82,13	81,40	80,00
Standard deviation	7,82	7,02	6,98	8,12	6,76	7,00

Euclidean distance matrix															
1	0	0,72	1,25	1,43	1,08	3,08	3,26	2,73	1,57	2,93	1,97	3,74	3,54	2,81	2,97
2	0,72	0	1,41	1,59	1,34	2,84	3,01	2,72	1,50	2,72	1,78	3,63	3,36	2,75	2,84
3	1,25	1,41	0	2,39	2,21	2,17	2,32	1,69	1,22	2,16	1,54	2,54	2,96	1,71	1,83
4	1,43	1,59	2,39	0	0,52	4,30	3,82	3,34	1,92	3,26	2,22	4,66	3,48	3,49	3,75
5	1,08	1,34	2,21	0,52	0	4,09	3,90	3,40	2,01	3,41	2,36	4,62	3,76	3,52	3,75
6	3,08	2,84	2,17	4,30	4,09	0	2,36	2,51	2,87	2,83	2,88	1,86	3,84	2,27	1,94
7	3,26	3,01	2,32	3,82	3,90	2,36	0,00	1,08	1,94	0,76	1,62	1,44	1,62	0,92	0,81
8	2,73	2,72	1,69	3,34	3,40	2,51	1,08	0,00	1,46	0,96	1,35	1,56	1,72	0,28	0,71
9	1,57	1,50	1,22	1,92	2,01	2,87	1,94	1,46	0,00	1,43	0,45	2,80	1,97	1,60	1,86
10	2,93	2,72	2,16	3,26	3,41	2,83	0,76	0,96	1,43	0,00	1,05	2,04	1,01	1,00	1,20
11	1,97	1,78	1,54	2,22	2,36	2,88	1,62	1,35	0,45	1,05	0,00	2,67	1,59	1,46	1,71
12	3,74	3,63	2,54	4,66	4,62	1,86	1,44	1,56	2,80	2,04	2,67	0,00	2,87	1,31	0,96
13	3,54	3,36	2,96	3,48	3,76	3,84	1,62	1,72	1,97	1,01	1,59	2,87	0,00	1,86	2,12
14	2,81	2,75	1,71	3,49	3,52	2,27	0,92	0,28	1,60	1,00	1,46	1,31	1,86	0,00	0,43
15	2,97	2,84	1,83	3,75	3,75	1,94	0,81	0,71	1,86	1,20	1,71	0,96	2,12	0,43	0,00

Figure 2. Distance matrix

Noteworthy is that the necessary and sufficient number of clusters, into which the original set of indicators is divided, is found by analyzing the distance between clusters, at which the clusters were merged. In the obtained matrices, the distances between clusters can be determined in different ways (Fig. 3.).

Thus, the use of cluster analysis allowed identifying two groups of objects, into which 15 selected social benefits can be divided. In particular, the first cluster is 1,2,3,4,5,9 and 11 – social benefits; the second cluster – 6, 7, 8, 10, 12, 13, 14 and 15 – benefits. The first cluster is called a group of basic benefits, and the second cluster – a group of additional benefits.

Therefore, according to the results of the conducted research, the statement can be made about significant difference in the motivation observed among the personnel at the machine-engineering enterprises. Low-skilled workers view work as a way to make money, but the attitude to work as something more, what is a way for self-realization is observed mainly for manager personnel.

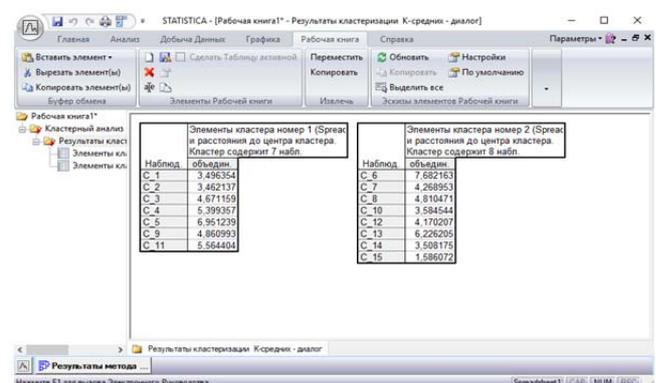


Figure 3. Results of K-means method of cluster analysis application for modeling of social package

The amount and nature of benefits should be set according to the employee's merits. The higher the position of the employee is and the longer the length of service is, the more benefits he receives. We offer to reformat benefits included in the social package into packages with six benefits for each, namely "Basic", "Standard", "Bonus" and "Elite". We assume that implementation of the social package by this method will be a powerful tool for increasing motivation level of workers at industrial enterprises.

We propose to share the availability of outlined packages depending on the coefficient obtained by the Comprehensive Employee Performance Assessment (CEPA). The CEPA is calculated by the results of the annual work:

$$CEPA = S_{WF} (A_{CP} + L_{PP} + Q_{BO} + P_T) \leq 1, \quad (12)$$

where A_{CP} – activity in the corporate portal; L_{PP} – level of professional perspective; Q_{BO} – the business and organizational qualities of the employee at the enterprise shown during the year; P_T – level of performance of the planned task; S_{WF} – specific weight of each factor makes 0.25 if $CEPA \leq 1$.

In the proposed model, the indicators for assessing employee's performance and competencies in the coming month are selected (quarterly or other reporting period, depending on the position) and

recorded in the personal performance table (Table 16.).

Therewith, the competences are equal to the qualitative results of the employee’s activity. The manager of the employee, focusing on his own priorities, assigns a specific weight of 0 to 1 to each of the selected indicators. The total weight of all indicators should be 1. For analyzing all indicators, three efficiency thresholds are noted, in particular: 1) the base is the worst possible admissible value, in other words a zero point; 2) the norm indicates the level to be pursued, given by the particular circumstances in the external market and the personal qualities of the employee; 3) the target is a level above the norm, the most desirable point of achievement.

Table 16. The template of the employee personal performance chart

Indicator (CEPA)	Symbol	Weight CEPA	Basis	Norm	Goal	Fact (individual result, %)
Activity in the corporate portal	A _{CP}	0,25	0-0,2	0,4-0,6	0,8-1	–
Level of professional perspective	L _{PP}	0,25	0-0,2	0,4-0,6	0,8-1	–
The business and organizational qualities of the employee at the enterprise shown during the year	Q _{BO}	0,25	0-0,2	0,4-0,6	0,8-1	–
Level of performance of the planned task	P _T	0,25	0-0,2	0,4-0,6	0,8-1	–
Comprehensive Employee Performance Assessment	CEPA		0-0,2	0,4-0,6	0,8-1	≥1

Noteworthy is that after the end of the quarter the actual value of CEPA is determined, and it is evaluated by points, the use which allows flexible estimating the CEPA, for example: base - from 0 to 0.30, norm - from 0.40 to 0.70, the target is from 0.80 to 1 point. Also, it is noteworthy that all assessments are deciphered for employees to understand the nature of the assessment rules and to be able to anticipate future results.

Thus, we conducted a survey of employees at industrial enterprises in order to determine the components of the compensation package. The analysis of the survey and its results allowed to identify the most important social benefits and to

formulate, on the basis of the cluster analysis method, two groups of basic and additional social benefits. The hierarchy of social benefits represented four types of compensation packages – basic, standard, bonus, elite [20].

An employee may receive a package depending on the coefficient obtained by the Comprehensive Employee Performance Assessment (CEPA). Packages have a specified set of basic and additional benefits (totally six benefits in a package), and their set, within six, is selected by the employee individually.

Introduction of new or improvement of existing type of economic activity, development and application of management tools of any type, as well as to any economic system, is to be based on fundamental knowledge of economic science, facts, studying possibilities of practical application of mechanisms modeled in this toolbox, and their inlay into the management concept used at the enterprise. The development and implementation of controlling activities at home machine-engineering enterprises undoubtedly requires the reorganization of the entire existing information system of the enterprise – the organization of functional coordination in economic work.

In order to increase the depth and poly-consistency of the analysis performed for controlling the motivation, we have developed a model of three-level efficiency evaluation of the personnel motivation system, the schematic image of which is shown in Fig. 4.

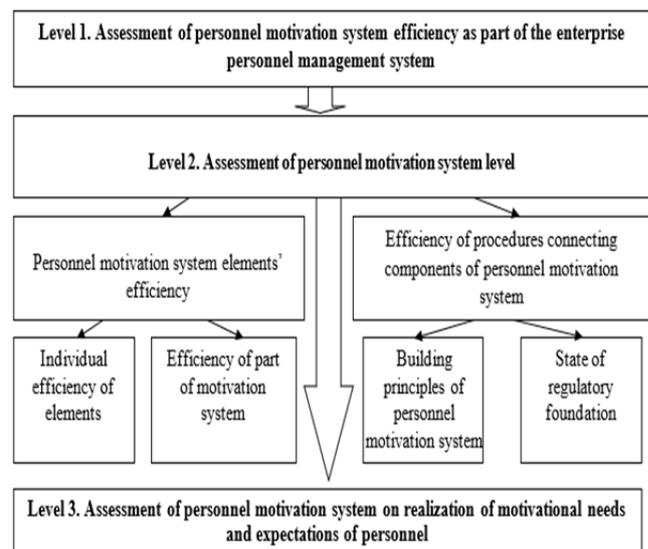


Figure 4. Model of three-level efficiency evaluation of the personnel motivation system

Model of three-level efficiency evaluation of the personnel motivation system is grounded on the coherent and systematized principles in theory and practice of management, principles, approaches and characteristics of creation and implementation of

effective motivation systems. Conducting motivational audit on the basis of three-level evaluation model allows to obtain comprehensive information about the institutional, internal and social effectiveness for the personnel motivation system in the organization. Forming the effectiveness of the motivation system is performed with consideration of the effectiveness revealed at all three levels; therewith the primary attention is given to data obtained at the first level for its key-value. Within the frames of the model the three-level efficiency evaluation of the personnel motivation system at the company is performed consequentially from the first level to the third. If one of the levels in the model identifies problems that make the further research pointless or difficult, the audit evaluation is suspended until the problem is resolved [21].

4. Conclusion

The conducted research of the current state and tendencies in development of industrial enterprises testifies of considerable problems that hinder formation of an effective system of motivation for the personnel at the enterprise. The efficiency of the enterprise development depends to a large extent on the state of the enterprises and on the introduced motivation techniques, which contribute to meeting the personal needs of employees and thus increasing efficiency of work. In addition, the significant correlation is substantiated between the main factors of production, and peculiarities of their influence on the personnel motivation at the enterprise are revealed, in particular, poor working conditions and insufficient motivation of the personnel at the enterprise is defined to affect the productivity of workers, decrease the level of production profitability and so on.

The formation of social package at industrial enterprises is substantiated on the base of using the cluster analysis method, which allowed to define the optimal complex of its constituent elements (benefits, rewards and services), determine priorities and divide them into basic and additional groups. In order to ensure the progressive growth of employees' motivation for work and to achieve the highest results at work, variety of social packages has been developed to determine their content and structure.

The introduction of controlling personnel motivation is suggested to be assessed by using a system of key indicators. The indicator value is argued to be effective in condition of appropriate strategy of the company, correct ranking of the performance indicators and assigning their weights. The importance of continually reviewing dynamics of key indicators with consideration of changes at the

enterprise is emphasized. The positive effect of introducing the system of key indicators into implementation of controlling personnel motivation is explained by increasing its overall effectiveness, since each employee is linked between his specific responsibilities and operational and strategic goals of the company.

Developed recommendations for forming compensation package as a personnel motivation technique at industrial enterprises will allow to: create appropriate regulatory statements for activities of individual departments and enterprises; streamline personnel management; ensure effective management decisions; standardize the activity of the whole enterprise.

Acknowledgements

This work has been supported Department of Personnel Management and Labor Economics of Khmelnytskyi National University, Ukraine

References

- [1]. Pokrovskaja, N. N., Petrov, M. A., & Gridneva, M. A. (2018). Diagnostics of Professional Competencies and Motivation of the Engineer in the Knowledge Economy. in *Proc. 2018 Third International Conference on Human Factors in Complex Technical Systems and Environments (ERGO)s and Environments (ERGO)*, 2018, Russia, 28-31.
- [2]. Choi, B., Ravichandran, T., & O'Connor, G. C. (2019). Organizational Conservatism, Strategic Human Resource Management, and Breakthrough Innovation. *IEEE Transactions on Engineering Management*, 66(4), 529 – 541.
- [3]. Anguelov, K. (2019). Motivation Strategies of Human Resources in ICT Companies. in *Proc. 2019 International Conference on Creative Business for Smart and Sustainable Growth (CREBUS)*, 2019, Bulgaria, 1-4.
- [4]. Vedernikov, M., Chernushkina, O., Volianska-Savchuk, L. & Zelena, M. (2019). Modern Aspects of Industrial Enterprises' Production Efficiency Management. in *Proc. 6th International Conference on Strategies, Models and Technologies of Economic Systems Management (SMTESM 2019)*, 2019, Ukraine, 444-449.
- [5]. Dergachova, V., Kravchenko, M., Kuznietsova, K., Dergachova, A. & Melnykova, V. (2019). Systemic-structural analysis of the machine-building enterprises economic sustainability formation mechanism. *Problems and Perspectives in Management*, 17(3), 395-409.
- [6]. Pacheco, D., Pergher, I., Jung, C. F. & Caten, C. S. (2014). Strategies for increasing productivity in production systems. *Independent Journal of Management & Production*, 5(2), 344-359.

- [7]. Nakamura, K., Kaihatsu, S. & Yagi, T. (2018). Productivity Improvement and Economic Growth, Bank of Japan Working Paper Series, 18-E-10.
- [8]. Manjunath, U., Sunil Kumar, C.N. & Kailashnath, M.S. (2016). Comparison of Cost Structure, Package Rates and Financial Feasibility for Selected Surgeries Covered under Social Health Insurance Schemes: A Case Study. *Journal of Health Management*, 18(1), 134-160.
- [9]. Alfons, A. & Templ, M. (2012). Estimation of Social Exclusion Indicators from Complex Surveys: The R Package Laeken. KU Leuven, Faculty of Business and Economics Working Paper. Available at SSRN.
- [10]. Tang, S., Gong, L., Xie, J., & Liu, Y. (2017). A competitiveness evaluation method of product based on technology maturity and development trend. in *Proc. 2017 12th IEEE Conference on Industrial Electronics and Applications (ICIEA)*, 2017, Cambodia, 675 – 680.
- [11]. Salun, M. & Palyanychka, Y. (2018). Features and principles of monitoring of industrial enterprise competitiveness. *Economics of Development*, 17(3), 74-82.
- [12]. Boiko, J., Tolubko, V., Barabash, O., Eromenko, O. & Havrylko, Y. (2019). Signal processing with frequency and phase shift keying modulation in telecommunications. *Telkomnika*, 17(4), 2025-2038.
- [13]. Peng, M. W. & Luo, Y. (2000). Managerial Ties and Firm Performance in a Transition Economy: The Nature of a Micro-Macro Link. *Academy of Management Journal*, 43(3), 486-501.
- [14]. Seneta, E. (1987). Chuprov on finite exchangeability, expectation of ratios, and measures of association. *Historia Mathematica*, 14(3), 243-257.
- [15]. Belsley, D. A., Kuh, E. & Welsch, R. E. (1980). *Regression Diagnostics: Identifying Influential Data and Sources of Collinearity*. New York: Wiley.
- [16]. Malina, W. (2001). Two-parameter Fisher criterion. *IEEE Transactions on Systems, Man, and Cybernetics, Part B (Cybernetics)*, 31(4), 629 – 636.
- [17]. Riccucci, N. M. (2012). *Public Personnel Management*. Taylor & Francis.
- [18]. Pererva, P., Hutsan, O., Kobieliiev, V., Kosenko, A. & Kuchynskyi, V. (2018). Evaluating elasticity of costs for employee motivation at the industrial enterprises. *Problems and Perspectives in Management*, 16(1), 124-132.
- [19]. Breu, H., Gil, J., Kirkpatrick, D. & Werman, M. (1995). Linear time Euclidean distance transform algorithms. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 17(5), 529-533.
- [20]. Andersen, L. B., Eriksson, T. & Kristensen N. (2012). Attracting public service motivated employees: how to design compensation packages. *International Review of Administrative Sciences*, 78(4), 615-641.
- [21]. Qi, F. & Wang, W. (2016). Employee involvement, public service motivation, and perceived organizational performance: testing a new model. *International Review of Administrative Sciences*, 84(4), 746-764.