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FORMATION OF A METHODOLOGICAL APPROACH TO EVALUATING THE STATE OF MANAGEMENT OF ENTERPRISE FLOW PROCESSES

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Formation of a Methodological Approach to Evaluating the State of Management of Enterprise Flow Processes

The formation of a methodological approach to evaluating management of the state of enterprise flow processes has been considered. Proceeding from the developed and presented in literary sources theoretical propositions on organization of management of enterprise flow processes, the hypothesis of the study is correlation of quantitative and qualitative evaluations of management effectiveness and formation of the integral index on their basis. The article presents stages of implementation of a methodological approach to evaluating the state of management of enterprise flow processes, which implies indicating the components, their characteristics and methods of research. The composition of indicators, on the basis of which it is possible to evaluate effectiveness of management of enterprise flow processes, has been determined. Grouping of such indicators based on the flow nature of enterprise processes has been performed. The grouping of indicators is justified by a pairwise determination of canonical correlations between the selected groups (the obtained high correlation coefficients confirmed the author's systematization of indicators). It is shown that a specificity of the formation of a methodological approach to evaluating the state of management of enterprise flow processes requires expansion in the direction of aggregation of the results and determination of factors that influence effectiveness of flow processes management. The article carries out such aggregation using the factor analysis. Distribution of a set of objects into different classes according to the results of the cluster analysis has been presented. To obtain an integral estimation of effectiveness of flow processes management, the taxonomic index of a multidimensional object has been built. A peculiarity of the formed methodological approach to evaluating the state of management of enterprise flow processes is in the matrix correlation of integral indicators calculated on the basis of the taxonomic index of development of quantitative (characterizing the effectiveness of management of enterprise flow processes) and qualitative (determine the degree of logistization of management system elements) evaluations, which provides for justifying scenarios of the enterprise strategic behavior in functional areas of logistics.

Keywords: *flow processes, logistics approach, state of management of enterprise flow processes, methodological approach, management effectiveness.*

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Дзебко И. П., Проскурнина Н. В. Формирование методического подхода к оценке состояния управления потоковыми процессами предприятия

Рассмотрено формирование методического подхода к оценке состояния управления потоковыми процессами предприятия. Исходя из разработанных и представленных в литературе теоретических положений по организации управления потоковыми процессами предприятия, гипотезой исследования стало соотнесение количественных и качественных оценок эффективности управления и формирование на их основе интегрального показателя. В статье представлены этапы реализации методического подхода к оценке состояния управления потоковыми процессами предприятия с указанием составляющих, их характеристикой и методами исследования. Определен состав показателей, на основе которых можно оценить результативность управления потоковыми процессами предприятия. Проведена группировка таких показателей, исходя из потоковой природы предприятия. Группировка показателей обоснована попарным определением канонических корреляций между выделенными группами (полученные высокие коэффициенты корреляции подтвердили авторскую систематизацию показателей). Показано, что специфика формирования методического подхода к оценке состояния управ-

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Дзьобко І. П., Проскурніна Н. В. Формування методичного підходу до оцінювання стану управління потоковими процесами підприємства

Розглянуто формування методичного підходу з метою оцінювання стану управління потоковими процесами підприємства. Виходячи з розроблених і поданих у літературі теоретичних положень із організації управління потоковими процесами підприємства, гіпотезою дослідження є співвіднесення кількісних і якісних оцінок щодо ефективності управління та формування на їх основі інтегрального показника. У статті наведено етапи реалізації методичного підходу до оцінювання стану управління потоковими процесами підприємства із зазначенням складових, їх характеристикою та методами дослідження. Визначено склад показників, на основі яких можна оцінити результативність управління потоковими процесами підприємства. Здійснено групування таких показників, виходячи з потокової природи підприємства. Групування показників обґрунтовано попарним визначенням канонічних кореляцій між виділеними групами (отримані високі коефіцієнти кореляції підтвердили авторську систематизацію показників). Показано, що специфіка формування методичного підходу до оцінювання стану управління потоковими процесами потребує розширення в напрямку агрегування результатів та визначення тих

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ления потоковыми процессами требует расширения в направлении агрегирования результатов и определении тех факторов, которые влияют на результативность управления потоковыми процессами. В статье проведена такая агрегация с применением факторного анализа. Показано распределение совокупности объектов по разным классам в соответствии с результатами кластерного анализа. Для получения интегральной оценки результативности управления потоковыми процессами был построен таксономический показатель развития многомерного объекта. Особенность сформированного методического подхода к оценке состояния управления потоковыми процессами предприятия заключается в матричном соотнесении интегральных показателей, рассчитанных на основе таксономического показателя развития количественных (характеризующих результативность управления потоковыми процессами предприятия) и качественных (определяют степень логистизации элементов системы управления) оценок, что позволяет обосновывать сценарии стратегического поведения предприятия в функциональных областях логистики.

Ключевые слова: *потоковые процессы, логистический подход, состояние управления потоковыми процессами, методический подход, результативность управления.*

Табл.: *8.* ***Формул:*** *21.* ***Библ.:*** *10.*

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факторів, які впливають на результативність управління потоковими процесами. У статті проведено таку агрегацію із застосуванням факторного аналізу. Показано розподіл сукупності об'єктів за різними класами відповідно до результатів кластерного аналізу. Для отримання інтегральної оцінки результативності управління потоковими процесами було побудовано таксономічний показник розвитку багатовимірного об'єкта. Показано, що особливість сформованого методичного підходу до оцінювання стану управління потоковими процесами підприємства полягає у матричному співвіднесенні інтегральних показників, розрахованих на основі таксономічного показника розвитку кількісних (характеризують результативність управління потоковими процесами підприємства) та якісних (визначають ступінь логістизації елементів системи управління) оцінок, що дозволяє обґрунтовувати сценарії стратегічної поведінки підприємства у функціональних областях логістики.

Ключові слова: *потокові процеси, логістичний підхід, стан управління потоковими процесами, методичний підхід, результативність управління.*

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Issues of improvement of business management and application of more advanced approaches in management practices to meet the consumer demand while minimizing the costs of the market consumer value have become urgent in the face of the threat of negative factors. It is only possible if all enterprise processes are subordinate to realizing the enterprise potential and meeting the effective demand with a corresponding reorientation of management to the logistics approach.

General issues of building and improving the enterprise management system are represented in many works by domestic scholars (A. Voronkova, M. Kyzym, R. Lepa, B. Pastukhova, V. Ponomarenko, O. Pushkar) and foreign scientists (I. Ansoff, P. Drucker, B. Mylner, H. Mintzberg, J. Stock). These works are mainly focused on the functional paradigm and limited orientation to flow and other processes. Development of this paradigm requires more attention to specific aspects of the enterprise activity taking into account marketing, innovation and logistics management.

The extensive use of the logistics approach resulted in a number of studies that highlight the logistics methodology (B. Anikin, A. Gadzhinskiy, M. Gordon, V. Sergeev, A. Semenenko, M. Oklander), logistics management (P. Larina, J. F. Magee, A. Trydid, L. Frolova, J. Heskett, N. Chukhrai, L. Shemayeva) and role of enterprise flow processes (D. J. Bowersox, A. Butrin, J. Becker, M. Grigorak, V. Yeliferov, O. Zborowskaya, E. Krykavskiy, I. Popovichenko, V. Repin).

To find a solution, the problem of increasing adaptability and optimization capacity of enterprise flow processes requires an appropriate scientific and methodological research.

The aim of the article is studying the process of formation of a methodological approach to evaluating the state of management of enterprise flow processes.

The implementation of the proposed in [1] theoretical positions contributes to a technological, economic, organizational and informational unity of flow processes within controlling actions of the relevant management mechanism (MMFPE). Formation of such a mechanism should be based on evaluation of the enterprise readiness to its introduction. Therefore, the stages of the proposed methodological approach to evaluating the state of management of enterprise flow processes are presented in Table 1. This methodological approach is focused on a combination of quantitative evaluation of indicators contained in the National Depository «SMIDA» with the results of the expert survey of specialists from the enterprises selected for the analysis.

Table 1

The stages of implementation of the methodological approach to evaluating the state of management of enterprise flow processes

Stage	The components of the stage	Characteristic of the stage	Research methods
1. Defining the characteristics and conditions of implementation of the logistics approach to management of enterprise flow processes	1.1. Describing problems in logistics management	Describing mutual challenges of the environment and elements of flow processes	Cognitive modelling
	1.2. Developing an analytical basis	Selecting and grouping indicators for a further analysis	Abstract and logical method. Analysis of the frequency of references in literary sources
	1.3. Confirming the grouping of indicators	Defining interdependent influences between the selected groups of indicators	Building canonical correlations
	1.4. Evaluating conditions of implementation of the logistics approach	Determining the factors influencing the effectiveness of management of flow processes	Multivariate factor analysis
	1.5. Defining management scenarios	Distributing enterprises according to the approach to management of flow processes and its effectiveness	Cluster analysis
2. Determining the effectiveness of management of flow processes	2.1. Integral estimation of management effectiveness	Forming a vector-standard and evaluating the distance of the analyzed enterprises from it	Building taxonomic indicators of development
	2.2. Qualitative estimation of integral characteristics	Forming a linguistic scale for interpretation of the integral index value	Building histograms. Determining the numerical values of distribution.
3. Evaluating the state of logistization	3.1. Evaluating the state of logistization	Questioning workers and managers of the enterprises	Expert methods. Rasch scale
	3.2. Interpreting the results	Transferring the integral estimation into the linguistic variable	Forming proportional scales
4. Evaluating the state of management of flow processes	4.1. Evaluating the state of management	Correlating integral values of the obtained parameters	Matrix methods of positioning
	4.2. Defining scenarios of enterprise behavior	Justifying rules and regulations of implementation of enterprise flow processes	Monographic and abstract and logical methods

The first stage of the proposed methodological approach involves determining characteristics and conditions of implementation of the logistics approach. Its basis is identification of problems in logistics management of national enterprises (Stage 1.1), which was presented in detail in [2]. The next step (Stage 1.2) is determination of composition of indicators, which form the basis for evaluating the effectiveness of management of enterprise flow processes. In the process of choosing such indicators the presence of financial and material flows at the enterprise should be taken into account. The enterprise's participation in value chains should also be considered as well as evaluating the effectiveness of management of flow processes at their inputs (efficiency of interaction with suppliers), outputs (evaluating of the effectiveness of interaction with customers) and directly during the movement of flow processes should be performed.

The proposed structure of indicators and their aggregation are presented in Table 2. For choosing the indicators the method for evaluating frequency of mentioning of the indicators in economic literature is used and selecting groups and distributing indicators is held by the abstract and logical method. A peculiarity of the author's proposals is in considering the logistic content of traditional indicators presented in [3] and using the variability level of individual indicators of the activity effectiveness.

We will prove the given in Table 2 grouping of indicators with the help of a pairwise determination of canonical correlations between the selected groups (corresponds to Stage 1.3 in Table 1). The model of canonical correlations is developed as a system of equations of two canonical variables, which summarize characteristics of the first (described by the following variables: $X_1, X_2, ..., X_q$) and second (described by following variables: $Y_1, Y_2, ..., Y_p$) objects:

$$\begin{aligned} U &= a_1X_1 + a_2X_2 + ... + a_qX_q, \\ V &= b_1Y_1 + b_2Y_2 + ... + b_pY_p, \end{aligned} \quad (1)$$

The results of the corresponding calculations made with the help of a software product Statgraphics Centurion are presented in [1]. The obtained high coefficients of the correlation proved the author's systematization of indicators. The reliability of the calculations is confirmed by a zero value of the indicator of probability of deviation from the null hypothesis (the indicator of P-values), which corresponds to a 95 percent level of confidence. Let us consider the obtained results in more detail.

First of all, we will determine the mutual influence of the material flow characteristics given in Table 2. The results of calculating canonical correlations between the characteristics of movement of material flow (*MMF*) and parameters of support of business processes (*SBP*) are presented in [1]. The coefficient of canonical correlation is 0.816. The following dependence is obtained:

Table 2

The grouping of indicators for evaluating effectiveness of management of enterprise flow processes

Indicators of effectiveness of managing the enterprise material flow ($I_{MF} = f(MMF, SBP, IOP)$)			**Indicators of effectiveness of managing the financial flow ($I_{FF} = f(MFF, SFF)$)**	
G_1 – formation and movement of material flow ({*MMF*})	G_2 – support of business processes as application of different types of activities to the flow movement ({*SBP*})	G_3 – interest of the market in the output of the flow process ({*IOP*})	G_4 – characteristics of movement of the financial flow ({*MFF*})	G_5 – stability and liquidity of financial flow ({*SFF*})
MMF_{IT} – inventory turnover, as a characteristic of duration and speed of the material flow (x_1)	SBP_{FATR} – fixed assets turnover ratio as a characteristic of the state and effectiveness of the implementation of low-circulating material flows (x_6)	IOP_{LO} – the level of overstocking (the ratio of revenue to finished product) as effectiveness of the flow output (x_{11})	MFF_{RTR} – receivables turnover ratio as a characteristic of the effect from advancing funds in receivables (x_{16})	SFF_{CA} – coefficient of the enterprise autonomy as ability to form a start to the financial flow movement (x_{21})
MMF_{LUP}– the level of unfinished production in stock (x_2)	SBP_{VFA} – validity of fixed assets as a characteristic of a possibility and duration of influence on the flow parameters (x_7)	IOP_{LSP} – the level of suitable product as a ratio of finished products to material cocts (x_{12})	MFF_{PTR} – payables turnover ratio as the ability to raise funds to support the flow (x_{17})	SFF_{WFETA}– working capital financed by equity to total assets ratio as evaluation of the enterprise independence (x_{22})
MMF_{ISR} – inventory-sales ratio as a share of inventory in the cost of products sold (x_3)	SBP_{CLR} – capital-labor ratio as a characteristic of reflection of low-circulating flows of the industrial enterprise and ability to influence the processes (x_8)	IOP_{SGR} – sales growth rate as revealing the potential of high-circulating material flows (x_{13})	MFF_{VSR}– variability of sales revenue as a characteristic of movement of financial resources (x_{18})	SFF_{CL} – current liquidity as the ability to maintain a balance in the process of the financial flow movement (x_{23})
MMF_{RM} – return on material or production output per 1 UAH of material costs as effectiveness of the flow movement (x_4)	SBP_{PL} – productivity of labor as a characteristic of a possibility of intensifying the material flow movement (x_9)	IOP_{SE} – sales efficiency as reflecting the effectiveness of organization of marketing interaction management (x_{14})	MFF_{ITF} – intensity of turnover of funds (revenue to the balance sheet total) as a characteristic of the financial flow speed (x_{19})	SFF_{AL} – absolute liquidity as the ability to maintain financial balance in the flow process movement (x_{24})
MMF_{VIL} – variability of the inventory level (x_5)	SBP_{RA} – return on assets as a characteristic of a possibility of intensifying the material flow movement (x_{10})	IOP_{POC} – production output per1 UAH of material costs as evaluation of embeddedness of the flow output in the target market segment (x_{15})	MFF_{ETR} – equity turnover ratio as evaluating the activization of financial flow reserves (x_{20})	SFF_{VRRP} – variability of the ratio of receivables to payables (x_{25})

$$\begin{cases} U_1 = 0.767MMF_{IT} - 0.257MMF_{LUP} + 0.422MMF_{ISR} + \\ +0.825MMF_{RM} + 0.227MMF_{VIL}, \\ V_1 = 0.727SBP_{FATR} - 0.172SBP_{VFA} + 1.044SBP_{CLR} - \\ -1.633SBP_{PL} + 0.056SBP_{RA}, \end{cases} \quad (2)$$
$$r_{U_1V_1} = 0.816.$$

The building of the rating of weighting coefficients showed the most intimate relationship between the indicator of production output per 1 UAH of material costs (MMF_{RM}), and capital-labor ratio indicators (SBP_{CLR}), and productivity of labor (SBP_{PL})

$$MMF_{RM} > MMF_{IT} > MMF_{ISR} > MMF_{LUP} > MMF_{VIL}$$
$$SBP_{PL} > SBP_{CLR} > SBP_{RA} > SBP_{FATR} > SBP_{VFA} \quad (3)$$

Further, the correlation between the characteristics of movement of material flow (*MMF*) and interest of the market in the output of such flow (*IOP*) is determined. The following dependences are obtained:

$$\begin{cases} U_1 = 0.250MMF_{IT} - 0.191MMF_{LUP} + 0.522MMF_{ISR} - \\ -0.949MMF_{RM} - 0.194MMF_{VIL}, \\ V_1 = 9.075IOP_{LO} - 8.783IOP_{LSP} - 0.163IOP_{SGR} - \\ -0.446IOP_{SE} + 0.206IOP_{POC}, \end{cases} \quad (4)$$
$$r_{U_1V_1} = 0.877.$$

As can be seen from formula (4), there is an intimate relationship between *MMF* and *IOP*, which is confirmed by the coefficient of canonical correlation being at the level of 0.877. The building of a rating of weighting coefficients showed the most intimate relationship between the indicator of production output per 1 UAH of material costs (MMF_{RM}) and level of overstocking (IOP_{LO}), and level of suitable product (IOP_{LSP}).

$$MMF_{RM} > MMF_{ISR} > MMF_{IT} > MMF_{VIL} > MMF_{LUP}$$
$$IOP_{LO} > IOP_{LSP} > IOP_{SE} > IOP_{POC} > IOP_{SGR} \quad (5)$$

As a final step of considering the mutual influences of the selected groups of material flow characteristics, let us calculate canonical correlations between the parameters of support of business processes (*SBP*) and the interest of the market in the output of flow processes (*IOP*). The following dependence is obtained:

$$\begin{cases} U_1 = 0.191SBP_{FATR} + 0.697SBP_{VFA} + 0.139SBP_{CLR} - \\ -0.982SBP_{PL} - 0.409SBP_{RA}, \\ V_1 = -3.717IOP_{LO} + 4.321IOP_{LSP} - 0.167IOP_{SGR} - \\ -0.101IOP_{SE} - 0.524IOP_{POC}, \end{cases} \quad (6)$$
$$r_{U_1V_1} = 0.794.$$

The dependence mentioned in formula (6) is characterized by a high coefficient of canonical correlation, which is equal to 0.794. While the rating of weighting coefficients presented by formula (7) shows the most intimate relationship between the productivity of labor (SBP_{PL}) as a form of directing the staff efforts to implementation of business processes and level of a suitable product (IOP_{LSP}) as the output of such efforts.

$$SBP_{PL} > SBP_{VFA} > SBP_{RA} > SBP_{FATR} > SBP_{CLR}$$
$$IOP_{LSP} > IOP_{LO} > IOP_{POC} > IOP_{SGR} > IOP_{SE} \quad (7)$$

After determining the mutual influences of the material flow components, the relationship between the presented in Table 2 characteristics of the financial flow should be studied in a similar way. On the basis of these calculations there was obtained a relatively high coefficient of canonical correlation equal to 0.929 (which is relevant taking into account the indicators' composition) and the following dependence:

$$\begin{cases} U_1 = 0.164MFF_{RTR} - 0.191MFF_{PTR} - 0.089MFF_{VSR} + \\ +0.483MFF_{ITF} - 1.158MFF_{ETR}, \\ V_1 = 0.898SFF_{CA} + 0.570SFF_{WFETA} - 0.455SFF_{CL} - \\ -0.169SFF_{AL} - 0.451SFF_{VRRP}, \end{cases} \quad (8)$$
$$r_{U_1V_1} = 0.929.$$

The building of the rating of weighting coefficients showed the most intimate relationship between the equity turnover ratio (MFF_{ETR}) and coefficient of the enterprise autonomy (SFF_{CA}), and ratio of working capital financed by equity to total assets (SFF_{WFETA})

$$MFF_{ETR} > MFF_{ITF} > MFF_{PTR} > MFF_{RTR} > MFF_{VSR}$$
$$SFF_{CA} > SFF_{WFETA} > SFF_{CL} > SFF_{VRRP} > SFF_{AL} \quad (9)$$

Further we need to study the relationships between the components of material and financial flows. First, we will calculate the level of correlation between characteristics of movement of material flow (*MMF*) and a pair of groups of indicators of financial flow management effectiveness: characteristics of movement of financial flow (*MFF*) and its stability and liquidity (*SFF*). The calculation results allowed to obtain the following dependence between the selected groups of characteristics:

$$\begin{cases} U_1 = 0.972MMF_{IT} - 0.013MMF_{LUP} + 0.099MMF_{ISR} - \\ -0.254MMF_{RM} - 0.085MMF_{VIL}, \\ V_1 = 0.251MFF_{RTR} - 0.095MFF_{PTR} + 0.135MFF_{VSR} + \\ +0.786MFF_{ITF} + 0.043MFF_{ETR}, \end{cases} \quad (10)$$
$$r_{U_1V_1} = 0.947.$$

$$\begin{cases} U_1 = -0.037MMF_{IT} - 0.108MMF_{LUP} - 0.717MMF_{ISR} + \\ +0.159MMF_{RM} + 0.950MMF_{VIL}, \\ V_1 = 0.762SFF_{CA} - 0.314SFF_{WFETA} - 0.137SFF_{CL} + \\ +0.140SFF_{AL} + 0.748SFF_{VRRP}, \end{cases} \quad (11)$$
$$r_{U_1V_1} = 0.778.$$

The building of the rating of weighting coefficients by formula (10) showed the most intimate relationship between the inventory turnover (MMF_{IT}) and intensity of turnover of funds (MFF_{ITF}) with the value of canonical correlation coefficient of 0.947. In relation to stability and liquidity of financial flow (*SFF*), a strong dependence of characteristics of movement of financial flow (*MFF*) with the canonical correlation coefficient of 0.778 is also revealed. The ratings of weighting coefficients represented by formula (13) found the most intimate relationship of the variation of stocks (MMF_{VIL}) and coefficient of autonomy (SFF_{CA}), and variability of correlation of receivables and payables of the enterprise (SFF_{VRRP}).

$$MMF_{IT} > MMF_{RM} > MMF_{ISR} > MMF_{VIL} > MMF_{LUP}$$
$$MFF_{ITF} > MFF_{RTR} > MFF_{VSR} > MFF_{PTR} > MFF_{ETR} \quad (12)$$

$$MMF_{VIL} > MMF_{ISR} > MMF_{RM} > MMF_{LUP} > MMF_{IT}$$
$$SFF_{CA} > SFF_{VRRP} > SFF_{CL} > SFF_{AL} > SFF_{WFETA} \quad (13)$$

The next step of the analysis of canonical correlations will be consideration of the relationship of a pair of characteristics of the financial flow and parameters of support of business processes (*SBP*) of the enterprise. First, let us consider the relationship of *SBP* with characteristics of movement of financial flow (*MFF*). The results show a high correlation coefficient (0.852) and the dependencies have the following form:

$$\begin{cases} U_1 = 1.207SBP_{FATR} - 0.028SBP_{VFA} + 0.366SBP_{CLR} - \\ -0.510SBP_{PL} + 0.255SBP_{RA}, \\ V_1 = -0.278MFF_{RTR} + 0.211MFF_{PTR} - 0.219MFF_{VSR} + \\ +1.143MFF_{ITF} - 0.034MFF_{ETR}, \end{cases} \quad (14)$$
$$r_{U_1V_1} = 0.852.$$

The building of the ratings of weighting coefficients found the most intimate relationship between the fixed assets turnover ratio (SBP_{FATR}) and intensity of turnover of funds (MFF_{ITF}):

$$SBP_{FATR} > SBP_{PL} > SBP_{CLR} > SBP_{RA} > SBP_{VFA}$$
$$MFF_{ITF} > MFF_{RTR} > MFF_{VSR} > MFF_{PTR} > MFF_{ETR} \quad (15)$$

In view of this relationship, a relatively high correlation coefficient (0.651) is quite relevant. It was obtained by calculating canonical correlations between the parameters of support of business processes (*SPB*) and characteristics of the stability of financial flow (*SFF*):

$$\begin{cases} U_1 = 0.126SBP_{FATR} + 0.510SBP_{VFA} + 0.951SBP_{CLR} - \\ -0.822SBP_{PL} + 0.610SBP_{RA}, \\ V_1 = 0.649SFF_{CA} - 1.331SFF_{WFETA} + 1.250SFF_{CL} - \\ -0.807SFF_{AL} + 0.384SFF_{VRRP}, \end{cases} \quad (16)$$
$$r_{U_1V_1} = 0.651.$$

The building of the rating of weighting coefficients showed the most intimate relationship between the capital-labor ratio (SPB_{CLR}), ratio of working capital financed by equity to total assets (SFF_{WFETA}) of the enterprise and its current liquidity (SFF_{CL}).

$$SBP_{CLR} > SBP_{PL} > SBP_{RA} > SBP_{VFA} > SBP_{FATR}$$
$$SFF_{WFETA} > SFF_{CL} > SFF_{AL} > SFF_{CA} > SFF_{VRRP} \quad (17)$$

As a final step of the determination of relationships between characteristics of the movement and effectiveness of management of the enterprise financial and material flows, we will calculate the correlation dependence between the interest of the market in the output of such material flow (*IOP*) and a pair of groups of indicators of financial flow management effectiveness: characteristics of movement of financial flow (*MFF*) and those of its stability and liquidity (*SFF*). The calculation results allowed to obtain the following dependence between the selected groups of characteristics:

$$\begin{cases} U_1 = -1.353IOP_{LO} + 1.252IOP_{LSP} + 0.363IOP_{SGR} + \\ +3.129IOP_{SE} - 4.161IOP_{POC}, \\ V_1 = 1.993MFF_{RTR} - 0.219MFF_{PTR} - 2.007MFF_{VSR} + \\ +0.225MFF_{ITF} + 0.232MFF_{ETR}, \end{cases} \quad (18)$$
$$r_{U_1V_1} = 0.897.$$

$$\begin{cases} U_1 = -1.146IOP_{LO} + 0.849IOP_{LSP} - 0.098IOP_{SGR} - \\ -0.999IOP_{SE} + 1.283IOP_{POC}, \\ V_1 = -1.020SFF_{CA} + 1.133SFF_{WCFETA} - 0.012SFF_{CL} - \\ -0.135SFF_{AL} + 0.712SFF_{VRRP}, \end{cases} \quad (19)$$
$$r_{U_1V_1} = 0.641.$$

The building of the rating of weighting coefficients by formula (18) showed the most intimate relationship between the variability of sales revenues (MFF_{VSR}) and sales efficiency (IOP_{SE}), and production output per 1 UAH of material costs (IOP_{POC}) with a value of canonical correlation coefficient of 0.897. With respect to the financial stability and liquidity of financial flow (*SFF*), a moderate relationship of characteristics of movement of material flow (*MMF*) is found with the canonical correlation coefficient of 0.641. The ratings of weighting coefficients presented by formula (21) found the most intimate relationship of the production output per 1 UAH of material costs (IOP_{POC}), and level of overstocking (IOP_{OOP}) with ratio of working capital financed by equity to total assets (SFF_{WFETA}) and coefficient of autonomy (SFF_{CA}).

$$IOP_{POC} > IOP_{SE} > IOP_{LO} > IOP_{LSP} > IOP_{SGR}$$
$$MFF_{VSR} > MFF_{RTR} > MFF_{ETR} > MFF_{ITF} > MFF_{PTR} \quad (20)$$

$$IOP_{POC} > IOP_{LO} > IOP_{SE} > IOP_{LSP} > IOP_{SGR}$$
$$SFF_{WFETA} > SFF_{CA} > SFF_{VRRP} > SFF_{AL} > SFF_{CL} \quad (21)$$

The determination of mutual influences between the groups of characteristics of the flow process management effectiveness represented by formulas (2) – (21) needs to be expanded towards the aggregation of the results and identification of the factors that affect the effectiveness of flow processes management. Let us perform this aggregation using the factor analysis corresponding to Stage 1.4 of the methodological approach proposed in Table 1. For the factor analysis we will use a software product Statgraphics Centurion and indicators presented in Table 2. There are 6 factors, which influence parameters of the use and potential of flow processes at the enterprise and in aggregate explain the accumulated dispersion by 91.65 %. The matrix of factor loadings is presented in Table 3.

The calculations presented in Table 3 are the basis for determining the factors influencing the effectiveness of management of the enterprise flow processes. It should be noted that in the course of the analysis the factors are presented as combinations of all indicators presented in Table 3. The corresponding models of the influence factors are presented in Table 4.

The next stage of the proposed methodological approach is classifying enterprises by the results of the cluster analysis (Stage 1.5 of the characteristic of the developed methodological approach given in Table 1). This analysis is usually conducted to distribute a set of objects by different classes. In view of the purpose of the study, such classification should divide enterprises according to the effectiveness of management of flow processes. Consequently, as a basis for this analysis we suggest using those variables from Table 2, which have the largest values in the ratings of weighting coefficients with the canonical variables from formulas (2)–(21).

To implement this proposal, the following set of indicators was chosen: return on material (MMF_{RM}) – had the biggest impact in formulas (3) and (5); productivity of labor (SPB_{PL}) –

Table 3

The matrix of factor loadings

Set of indicators formed on the basis of Table 2		Loading of factors					
		F_1	F_2	F_3	F_4	F_5	F_6
x_1	Inventory turnover	-0.2941	0.0317	0.0525	**0.7567**	-0.1666	0.1909
x_2	The level of unfinished production in stocks	-0.1912	-0.0823	0.0359	**-0.5738**	-0.0159	0.0203
x_3	Inventory-sales ratio	**0.9535**	-0.1119	-0.0784	-0.2073	0.0090	-0.1207
x_4	Production output per 1 UAH of material costs	-0.0673	-0.1042	**0.8813**	-0.1730	0.0054	-0.2269
x_5	Variability of inventory level	**0.8175**	0.1550	0.0513	0.0975	0.0198	-0.0169
x_6	Fixed asset turnover ratio	-0.2313	0.1265	-0.2848	**0.5983**	0.0161	-0.1228
x_7	Validity of fixed assets	-0.0845	-0.1609	-0.0513	-0.1071	-0.1725	**0.6666**
x_8	Capital-labor ratio	-0.0793	0.0617	**0.6552**	-0.3175	-0.0568	0.5762
x_9	Productivity of labor	-0.2169	-0.0180	-0.0925	0.1585	0.2796	**0.8666**
x_{10}	Return on assets	-0.0236	0.0962	0.0332	0.5079	**0.7101**	0.2636
x_{11}	Overstocking	**0.9496**	-0.2009	-0.0746	-0.1339	-0.0395	-0.1033
x_{12}	The level of suitable product	**0.9252**	-0.2271	-0.0064	-0.1583	-0.0319	-0.1329
x_{13}	Sales growth rate	0.2989	-0.1945	0.0146	0.2912	**0.6001**	-0.0761
x_{14}	Sales efficiency	-0.0995	0.1254	-0.0879	-0.3119	**0.8931**	0.0159
x_{15}	Production output per1 UAH of material costs	-0.0924	0.0945	-0.0302	-0.2677	**0.9281**	0.0053
x_{16}	Receivables turnover ratio	0.0201	0.0008	**0.9626**	-0.0246	-0.1919	-0.0116
x_{17}	Payables turnover ratio	-0.0220	0.1364	**0.9444**	-0.0514	0.1210	-0.0094
x_{18}	Variability of sales revenue	-0.0405	0.3159	-0.0385	0.2093	0.1067	**0.5370**
x_{19}	The intensity of turnover of funds	-0.2686	0.0706	-0.2265	**0.9180**	-0.0900	0.0673
x_{20}	Equity turnover ratio	0.0813	**0.6467**	-0.0337	0.2493	-0.0826	-0.0632
x_{21}	Coefficient of enterprise autonomy	-0.0025	**0.8984**	0.2473	0.1298	-0.0101	0.1515
x_{22}	Ratio of working capital financed by equity to total assets	-0.1253	**0.9269**	0.0033	0.0682	0.1837	-0.0710
x_{23}	Current liquidity	-0.1142	**0.7707**	-0.0699	-0.0811	0.0126	0.2539
x_{24}	Absolute liquidity	-0.2302	**0.6610**	-0.0447	-0.0503	0.0539	-0.2837
x_{25}	Variability of the ratio of receivables and payables	0.1605	0.1038	0.0447	-0.1435	0.0659	**-0.7457**

Table 4

The models of factors influencing the effectiveness of management of enterprise flow processes

	Factor	Components of factors influencing the effectiveness
F_1	Parameters of material flow movement	$0.9535x_3 + 0.8175x_5 + 0.9496x_{11} + 0.9252x_{12}$
F_2	Reliability of financial flow movement	$0.6467x_{20} + 0.8984x_{21} + 0.9269x_{22} + +0.7707x_{23} + 0.6610x_{24}$
F_3	The impact of the correlation degree of multidirectional flows on implementation of the enterprise resource potential	$0.8813x_4 + 0.6552x_8 + 0.9626x_{16} + 0.9444x_{17}$
F_4	Intensity of flow processes	$0.7567x_1 - 0.5738x_2 + 0.5983x_6 + 0.9180x_{19}$
F_5	Correspondence of material flow to the requirements of end users	$0.7101x_{10} + 0.6001x_{13} + 0.8931x_{14} + 0.9281x_{15}$
F_6	Efficiency of the organization of low-circulating flows	$0.6666x_7 + 0.8666x_9 + 0.5370x_{18} - 0.7457x_{25}$

had the biggest impact in formulas (3) and (7); production output per 1 UAH of material costs (IOP_{POC}) – had the biggest impact in formulas (20) and (21); intensity of turnover of funds (MFF_{ITF}) – had the biggest impact in formulas (12) and (15); coefficient of autonomy of the enterprise (SFF_{CA}) – had the biggest impact in formulas (9) and (13).

It can be seen that these indicators cover each of the presented in Table 2 group of indicators (one indicator from each group). The correspondent results of the calculations are given in [1], which presents standardized values of the selected variables and results of distribution of enterprises by four clusters. The result is confirmed by high distances between the clusters (Euclidean distance from the first to the second cluster is 0.946, to the third one is 1.191, and to the fourth one is 2.247). The list of participants and characteristics of the obtained clusters are presented in Table 5.

Table 5

Characteristics of the clusters obtained as a result of analysis

Number	Enterprises that joined the cluster members	Characteristics of the cluster	
		Indicators of management effectiveness for each of the groups from Table 2	In average for the cluster
I	PJSC PE "Techmash", PJSC "Kharkiv Plant of Dies and Molds", PJSC "Lutsk Bearing Plant", PJSC "Poltavhimmash", PJSC "Verhnedneprovsky Machine Building Plant"	Return on material (MMF_{RM})	1.58
		Variability of inventory level (MMF_{VIL})	62.56
		Productivity of labor (SBP_{PL})	369.07
		Production output per1 UAH of material costs (IOP_{POC})	1.21
		Intensity of the turnover of funds (MFF_{ITF})	1.25
		Variability of sales revenue (MFF_{VSR})	66.58
		Coefficient of autonomy (SFF_{CA})	0.68
		Absolute liquidity (SFF_{CA})	0.92
II	PJSC "Svitlo Shakhtarya Machine Building Plant", SSPE "Corporation Kommunar", PJSC "Chervonyi Zhovten" PJSC SPA "Kholod", PJSC "SPA "Elektronprylad", PJSC "Konnektor", PJSC "Volchansk Aggregate Plant" PJSC "Kremenchug Plant of Road Machines"	Return on material (MMF_{RM})	2.81
		Variability of inventory level (MMF_{VIL})	45.60
		Productivity of labor (SBP_{PL})	164.63
		Production output per1 UAH of material costs (IOP_{POC})	1.36
		The intensity of the turnover of funds (MFF_{ITF})	0.96
		Variability of sales revenue (MFF_{VSR})	33.47
		Coefficient of autonomy (SFF_{CA})	0.84
		Absolute liquidity (SFF_{CA})	2.16
III	PJSC "Kharverst", PJSC "Transport Equipment Plant", PJSC "Korosten Machine Building Plant", PJSC Lviv Locomotive Repair Plant", PJSC "Dniprovazhmash", PJSC "Poltava Turbomechanical plant", PJSC "Zaporozhtransformator", PJSC "Sumy Frunze Machine Building SPA"	Return on material (MMF_{RM})	2.07
		Variability of inventory level (MMF_{VIL})	43.31
		Fixed assets turnover ratio (SBP_{FATR})	3.80
		Productivity of labor (SBP_{PL})	205.14
		Production output per1 UAH of material costs (IOP_{POC})	1.27
		The intensity of the turnover of funds (MFF_{ITF})	0.85
		Variability of sales revenue (MFF_{VSR})	30.72
		Coefficient of autonomy (SFF_{CA})	0.37
		Absolute liquidity (SFF_{CA})	0.52
IV	PJSC "Motor Sich", PJSC "Dnipropetrovsk Aggregate Plant", PJSC "Turboatom", PJSC "Ukrelektroaparat"	Return on material (MMF_{RM})	2.22
		Variability of inventory level (MMF_{VIL})	53.74
		Productivity of labor (SBP_{PL})	339.21
		Production output per1 UAH of material costs (IOP_{POC})	1.84
		The intensity of the turnover of funds (MFF_{ITF})	0.92
		Variability of sales revenue (MFF_{VSR})	54.14
		Coefficient of autonomy (SFF_{CA})	0.58
		Absolute liquidity (SFF_{CA})	1.11

As can be seen from Table 5, we received four clusters. The first cluster consists of 5 members with the lowest indicators of the effectiveness according to selected totality from 25 enterprises. The average sales efficiency for these companies is 16.8 %. This cluster is characterized by a high variability of inventory level (62.5 % on average for all enterprises) and sales revenue (66.5 % on average for cluster). The coefficient of absolute liquidity of the cluster members is on average 0.92.

The effectiveness of management of flow processes of enterprises in the second and third cluster can be identified as «medium». Thus, the second cluster includes 8 enterprises, with an average sales efficiency being at the level of 25.4 % and absolute liquidity – 2.16. The average level of variability of inventory level is 45.6 %, and sales revenue – 33.47 %. The indicator of production output per 1 UAH of material costs for participants in this cluster is on average 1.36 UAH. The third cluster, in turn, also includes 8 enterprises, which have a slightly lower sales efficiency in relation to the second cluster (but higher than enterprises from the first cluster). The average sales efficiency for members of this cluster was 20.5 % and the absolute liquidity – 0.52. The variability of inventory levels is on average 43.31 % with maintaining sales revenues at a relatively constant level (30.75 % variability of sales revenue).

Members of the fourth cluster showed the highest level of effectiveness of management of flow processes. 4 enterprises with the highest indicators of sales efficiency were included in this cluster. On average, for the cluster this indicator amounts to 45.5 %. This high value is caused by a high level of production output per 1 UAH of material costs (1.84 UAH). Although the enterprises in this cluster are characterized by a high variability of inventory levels. On average for the cluster it amounts to 53.74 %.

The distribution of the enterprises given in Table 5 is the basis of the second stage of the proposed methodological approach to the evaluation of the state of management of the flow processes of the company. This stage, according to Table 1, consists of two steps: direct determination of the integral value of management effectiveness (Stage 2.1) and provision of quality characteristic of the obtained value (Stage 2.2).

To obtain the integral value of management effectiveness of flow processes we will use a well-known method [4] of building taxonomic index of multidimensional object development, which value at the level of 1 point indicates the maximum management efficiency of flow processes. A detailed description of the procedure of calculation of this index is not given in view of the prevalence of this approach, the essence of which is the formation of vector-standard and determination of the distance to it of each of the analyzed enterprises. In the case of this study, a standardized value by indicators of the set of selected enterprises is more appropriate to be used as a vector-standard (the given approach assumes that this value of a certain parameter can be achieved). In addition, we propose to perform individual calculations of the level of management effectiveness of material (I_{MF}) and financial (I_{FF}) flows. The integral value ($I_{EM} = f(I_{MF}, I_{FF})$) is calculated as the average of the calculated parameters.

The calculation results of forming the vector-standard for the totality of the enterprises are presented in Table 6 as well as correspondence of the enterprises to the results of their distribution by means of the cluster analysis (see Table 5). It is clear that enterprises in the fourth cluster have the highest value of the integral index of the management effectiveness of flow processes. The largest value of this index at the level of 0.681 is peculiar for the PJSC "Ukrelektroaparat", which is included into the fourth cluster. Accordingly, the members of the first and third clusters have smaller than the average value of the integral index of effectiveness. This is proved by the value of I_{EM} at the level of 0.067 at PJSC "Kharverst" (the third cluster) and the I_{EM} value at the level of 0.067 at PJSC "Kharkiv Plant of Dies and Molds" (the first cluster).

On the basis of the obtained correlation of the integral estimates and results of the cluster analysis there can be made an assumption about the appropriateness of formation of the vector-standard within each cluster presented in Table 5. The results of calculating the integral index of flow processes management under conditions of formation of various vector-standards are presented in Table 7. It demonstrates that enterprises with better integral values in the formation of the vector-standard within the cluster have a much worse effectiveness of management of flow processes in the case of forming the vector-standard for the totality of enterprises. An example of this situation is PJSC "Dniprovazhmash" with a value of integral index of 0.509 and 0.323 with regard to the approach to the formation of the vector-standard. The opposite situation is characteristic for PJSC «Motor Sich» with the corresponding values of I_{EM} amounting to 0.133 and 0.523.

An important issue of the second stage of the proposed methodological approach is qualitative evaluation of the obtained integral characteristics. Here, according to the defined in Table 1 Stage 2.2, it is necessary to form a linguistic scale for interpreting the value of the integral index (I_{EM}). Further in the work it is proposed to distinguish three levels of the integral value: «high», «medium» and «low». The formation of quantitative values for the linguistic scale will be carried with the help of building histograms of distribution of integral index values and using numerical characteristics of the distribution values. For example, the scale for the medium level of I_{EM} will be determined as the average value of the integral index increased and reduced by half of the standard deviation. An example of the justification of the linguistic scale for integral estimation of the totality of enterprises is presented in Table 8.

The justification of the given in Table 8 approach is based on works by A. O. Niedosiekin [5]. It should be noted that the scales presented in Table 8 are designed to be used in relation to the results from Table 6. The relevant values of the scale for calculating the vector-standard within a separate cluster are singled out in Table 7. It can be claimed that the degree of approximation of an enterprise to the reference value depends on the usage of logistics principles in the enterprise activities and level of optimization and rationality of flow processes. The compliance with such requirements can be interpreted on the basis of the works by V. V. Amitan [6] and O. M. Zborowska [7; 8] and [9; 10] as logistization of the enterprise activities. Accordingly, estimating the state of management of enterprise flow processes should include determining the level of logistization of such management as it is provided by Stage 3 in Table 1. The purpose of further research is the identification of indicators and criteria for evaluation of management efficiency at every stage of the value creation chain, which has not been properly developed yet.

Table 6

The value of the integral index of the effectiveness of managing enterprise flow processes (based on the vector-standard for the totality of the selected enterprises)

Enterprise name	Cluster from Table 5	Value of the index of effectiveness of flow processes management					
		By material flow		By financial flow		Integral value	
		I_{MF}	Character of evaluation	I_{FF}	Character of evaluation	I_{EM}	Character of evaluation
PJSC "Kharverst"	3	0.062	Low level	0.072	Low level	0.067	Low level
PJSC "Svitlo Shakhtarya"	2	0.530	High level	0.280	Low level	0.405	Medium level
SSPE "Corporation Kommunar"	2	0.330	Medium level	0.370	Medium level	0.350	Medium level
PJSC "Transport Equipment Plant"	3	0.207	Low level	0.187	Low level	0.197	Low level
PJSC "Korosten Machine Building Plant"	3	0.201	Low level	0.514	High level	0.358	Medium level
PJSC "Chervonyi Zhovten"	2	0.506	Medium level	0.538	High level	0.522	High level
PJSC "Lviv Locomotive Repair Plant"	3	0.321	Medium level	0.319	Medium level	0.320	Low level
PJSC PE "Techmash"	1	0.182	Low level	0.464	Medium level	0.323	Low level
PJSC SPA "Kholod"	2	0.364	Medium level	0.784	High level	0.574	High level
PJSC "SPA "Elektronprylad"	2	0.231	Low level	0.266	Low level	0.249	Low level
PJSC "Motor Sich"	4	0.538	High level	0.507	High level	0.523	High level
PJSC "Dnipropetrovsk Aggregate Plant"	4	0.818	High level	0.314	Medium level	0.566	High level
PJSC "Poltava Turbomechanical plant"	3	0.408	Medium level	0.421	Medium level	0.415	Medium level
PJSC "Kharkiv Plant of Dies and Molds"	1	0.258	Low level	0.325	Medium level	0.292	Low level
PJSC "Turboatom"	4	0.760	High level	0.273	Low level	0.516	High level
PJSC "Konnektor"	2	0.434	Medium level	0.573	High level	0.504	High level
PJSC "Volchansky Aggregate Plant"	2	0.738	High level	0.435	Medium level	0.587	High level
PJSC "Zaporozhtransformator"	3	0.586	High level	0.089	Low level	0.337	Low level
PJSC "Sumy Frunze Machine Building SPA"	3	0.458	Medium level	0.147	Low level	0.302	Low level
PJSC "Dniprovazhmash"	3	0.387	Medium level	0.259	Low level	0.323	Low level
PJSC "Ukrelektroaparat"	4	0.811	High level	0.550	High level	0.681	High level
PJSC "Kremenchug Plant of Road Machines"	2	0.386	Medium level	0.675	High level	0.531	High level
PJSC "Lutsk Bearing Plant"	1	0.299	Low level	0.405	Medium level	0.352	Medium level
PJSC "Poltavhimmash"	1	0.174	Low level	0.685	High level	0.430	Medium level
PJSC "Verhnedneprovsky Machine Building Plant"	1	0.382	Medium level	0.658	Medium level	0.520	Medium level

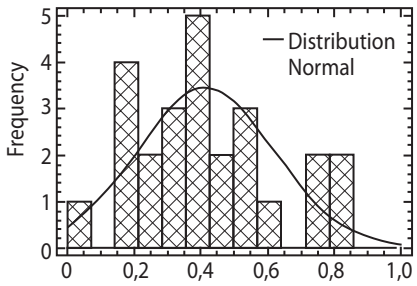
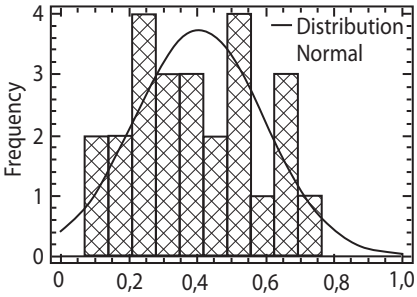
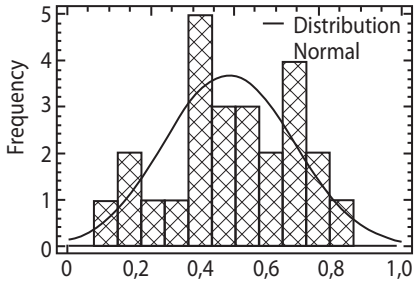
Table 7

IPY value based on the vector-standard formed for the enterprises participating in the obtained clusters

Enterprise name	Material flow		Financial flow		Integral estimation		Comparison of the integral estimation	
	I_{MF}	Level of indicator	I_{FF}	Level of indicator	I_{EM}	Level of indicator	I_{EM} from Table 6	Deviation I_{EM} from I_{EM} from Table 6
I_{EM} for the 1-st cluster and the rating scale	[0; 0.247; 0.489; 1]		[0; 0.302; 0.536;1]		[0; 0.215; 0.547; 1]		–	
PJSC PE "Techmash"	0.175	Low	0.406	Medium	0.291	Medium	0.323/Low	Lower by 0.032
PJSC "Kharkiv Plant of Dies and Molds"	0.311	Medium	0.150	Low	0.231	Medium	0.292/Low	Lower by 0.092
PJSC "Lutsk Bearing Plant"	0.492	High	0.250	Low	0.371	Medium	0.352/Med.	Larger by 0.048
PJSC "Poltavhimmash"	0.152	Low	0.554	High	0.353	Medium	0.430/Med.	Larger by 0.030
PJSC "Verhnedneprovsky Machine Building Plant"	0.585	High	0.735	High	0.660	High	0.520/Med.	Larger by 0.337
I_{EM} for the II-nd cluster and the rating scale	[0; 0.267; 0.462; 1]		[0; 0.356; 0.616;1]		[0; 0.341; 0.509; 1]		–	
PJSC "Svitlo Shakhtarya"	0.640	High	0.259	Low	0.450	Medium	0.405/Med.	Larger by 0.127
SSPE "Corporation Kommunar"	0.217	Low	0.167	Low	0.192	Low	0.350/Med.	Lower by 0.131
PJSC "Chervonyi Zhovten"	0.409	Medium	0.549	Medium	0.479	Medium	0.522/High	Larger by 0.156
PJSC SPA "Kholod"	0.286	Medium	0.754	High	0.520	High	0.574/High	Larger by 0.197
PJSC "SPA "Elektronprylad"	0.033	Low	0.245	Low	0.139	Low	0.249/Low	Lower by 0.184
PJSC "Konnektor"	0.411	Medium	0.587	Medium	0.499	Medium	0.504/High	Larger by 0.176
PJSC "Volchansk Aggregate Plant"	0.580	High	0.428	Medium	0.504	Medium	0.587/High	Larger by 0.181
PJSC "Kremenchug Plant of Road Machines"	0.337	Medium	0.901	High	0.619	High	0.531/High	Larger by 0.296
I_{EM} for the III-d cluster and the rating scale	[0; 0.337; 0.583; 1]		[0; 0.351; 0.607;1]		[0; 0.396; 0.543; 1]		–	
PJSC "Kharverst"	0.224	Low	0.243	Low	0.234	Low	0.067/Low	Lower by 0.089
PJSC "Transport Equipment Plant"	0.170	Low	0.410	Medium	0.290	Low	0.197/Low	Lower by 0.033
PJSC "Korosten Machine Building Plant"	0.214	Low	0.964	High	0.589	High	0.358/Aver.	Larger by 0.266
PJSC "Lviv Locomotive Repair Plant"	0.416	Medium	0.468	Medium	0.442	Medium	0.320/Low	Larger by 0.119
PJSC "Poltava Turbomechanical plant"	0.606	High	0.748	High	0.677	High	0.415/Med.	Larger by 0.354
PJSC "Zaporozhtransformator"	0.863	High	0.217	Low	0.540	Medium	0.337/Low	Larger by 0.217
PJSC "Sumy Frunze Machine Building SPA"	0.619	High	0.334	Low	0.477	Medium	0.302/Low	Larger by 0.154
PJSC "Dniprovazhmash"	0.572	Medium	0.446	Medium	0.509	Medium	0.323/Low	Larger by 0.186
I_{EM} for the IV-th cluster and the rating scale	[0; 0.375; 0.679; 1]		[0; 0.181; 0.328;1]		[0; 0.293; 0.487; 1]		–	
PJSC "Motor Sich"	0.080	Low	0.186	Medium	0.133	Low	0.523/High	Lower by 0.190
PJSC "Dnipropetrovsk Aggregate Plant"	0.715	High	0.180	Low	0.447	Medium	0.566/High	Larger by 0.124
PJSC "Turboatom"	0.589	Medium	0.177	Low	0.383	Medium	0.516/High	Larger by 0.060
PJSC "Ukrelektroaparat"	0.722	High	0.474	High	0.598	High	0.681/High	Larger by 0.275

Table 8

Justification of the linguistic scale of interpretation of integral index values of the effectiveness of flow processes management

The histogram of the distribution of integral index values	Justification of components of the linguistic variable	
	Parameter	**Value**
Integral estimation of the effectiveness of material flow management (I_{MF})		
	Average value of the $\overline{I_{MF}}$ index	0.415
	Root-mean square deviation (σ)	0.104
	Scale for a low value of the integral index [0; $\overline{I_{MF}} - \sigma$]	[0; 0.310]
	Scale for a medium value of the integral index [$\overline{I_{MF}} - \sigma$; $\overline{I_{MF}} + \sigma$]	[0.311; 0.518]
	Scale for a high value of the integral index [$\overline{I_{MF}} + \sigma$; 1]	[0.519; 1]
Integral estimation of the effectiveness of financial flow management (I_{FF})		
	Average value of the $\overline{I_{FF}}$ index	0.404
	Root-mean square deviation (σ)	0.095
	Scale for a low value of the integral index [0; $\overline{I_{FF}} - \sigma$]	[0; 0.308]
	Scale for a medium value of the integral index [$\overline{I_{FF}} - \sigma$; $\overline{I_{FF}} + \sigma$]	[0.309; 0.500]
	Scale for a high value of the integral index [$\overline{I_{FF}} + \sigma$; 1]	[0.501; 1]
The histogram of the distribution of integral index values	Justification of components of the linguistic variable	
	Parameter	Value
Integral estimation of the effectiveness of flow processes management (I_{EM})		
	Average value of the $\overline{I_{EM}}$ index	0.415
	Root-mean square deviation (σ)	0.074
	Scale for a low value of the integral index [0; $\overline{I_{EM}} - \sigma$]	[0; 0.341]
	Scale for a medium value of the integral index [$\overline{I_{EM}} - \sigma$; $\overline{I_{EM}} + \sigma$]	[0.341; 0.489]
	Scale for a high value of the integral index [$\overline{I_{EM}} + \sigma$; 1]	[0.490; 1]

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