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ASSESSMENT THE REQUIREMENT OF SUPPLY LOGISTICS PROCESSES IMPROVEMENT

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Summary. *In the present paper a method has been presented, through which it can be determining the requirement of improvement of supply logistics' processes in the organization. The need for developing and implementation of this method is revealed. Also the essence of functioning of the method is represented. It can be described as a process which passes through three main stages. Each stage is built of several steps. At first stage explanation how the comparison between the set forth goal of improvement and the actual state of the current logistics processes is made. The formulas through which it can be calculated coefficients of „efficiency of maximized measures" and coefficients of "efficiency of minimized measures" are described. Methodology of calculating the coefficient of overall efficiency of the supply logistics, coefficient of single-dimension efficiency of the supply logistics and coefficient of multi-dimension efficiency of the supply logistics which are necessary for determining the general requirement of improvement are reviewed. Next stage is based on assessment the efficiency of sub-processes which build up supply logistics' processes. Second stage starts only after the need of optimization on first stage is established. The explanation, how the comparison between targets sub-processes and their corresponding real sub-processes are performed. Coefficients and methodology of calculation of the "absolute goal" for improvement are discussed, through which the requirement of supply logistics sub-processes improvement is ascertained. In the third stage a few steps are presented, through which it can determine the priority of improvement of each supply logistics sub-process in the organization. The explanation, how the comparison between targets sub-processes and their corresponding real sub-processes are performed. Coefficients and methodology of calculation of the "absolute goal" for sub-process improvement in single and in all measurements are introduced.*

Keywords: *supply logistics, supply logistics' process, supply logistics' sub-process, optimization, requirement of improvement, methodology*

ОЦІНКА ВИМОГ ПОКРАЩЕННЯ ПРОЦЕСІВ ПОСТАЧАННЯ ЛОГІСТИКИ

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Анотація. *У цій статті представлений метод, за допомогою якого можна визначати необхідність покращення процесів логістики поставок в організації. Виявлено необхідність розробки і впровадження цього методу. Представлена сутність функціонування методу. Його можна описати як процес, який проходить три основні стадії. Кожен етап складається з декількох підетапів. На першому етапі пояснюється, як робиться порівняння між поставленою метою покращення і фактичним станом поточних логістичних процесів. Описано формули, за якими можна розрахувати коефіцієнти «ефективності максимізованих заходів» і коефіцієнти «ефективності мінімізованих заходів». Розглядаються методологія розрахунку коефіцієнта загальної ефективності логістики поставок, коефіцієнта одновимірної ефективності логістики поставок і коефіцієнта багатовимірної ефективності логістики поставок, які необхідні для визначення загальної потреби поліпшення. Наступний етап заснований на оцінці ефективності підпроцесів, які формують процеси логістики поставок. Другий етап починається тільки після того, як на першому етапі встановлюється необхідність оптимізації. Пояснення, як виконується зіставлення підпроцесів цілей і відповідних їм реальних підпроцесів. Обговорюються коефіцієнти і методика розрахунку «абсолютної мети» для поліпшення, за допомогою якої уточнюється потреба в підпроцесами логістики поставок. На третьому етапі представлено кілька кроків, за допомогою яких він може визначити пріоритет поліпшення кожного подпроцеса логістики поставок в організації. Пояснення, як виконується порівняння між підпроцесами цілей і відповідними їм реальними підпроцесами. Введено коефіцієнти і методика розрахунку «абсолютної мети» для поліпшення підпроцеса в одиничних і у всіх вимірах.*

Ключові слова: *логістика поставок, процес логістики поставок, підпроцес логістики поставок, оптимізація, вимоги поліпшення, методологія*

Formulation of the problem. Logistics processes can be viewed as specific business processes across the organization. Each phase of the logistics can be further decomposed into several levels in case of expanding of the analysis. For improvement of logistics activities in the organization mathematical apparatus that allows the identification and reorganization of the critical elements in logistics processes can be used. The feedback which established customer's satisfaction by logistics service and the amount of logistics costs, provides the necessary signal that starts process of logistics system improving. This signal moves in the opposite direction of the running logistics processes. In order to respond the customer's needs, organizations starts optimization in one or all logistics phases. The optimization should be carried out with the help of methodology in conformity with the company structure, as well as with the strategy chosen.

Analysis of recent research and publications. The function of each enterprise is to carry out transformation of inputs (raw materials and supplies), through the production factors (buildings, machines, labor), into a product/service designated to satisfy the customer's need according Angelov [1, p.6]. Transformation is related to the running of various business processes according Harmon[2, p.19], processes as per Deckler [3, p.5]; Haist [4, p.92]; Harrington [5, p.31]; Ould [6, p.6]; Lowenthal [7, p.1]; Süssenguth [8, p.18] and activities by McDonald [9, p.4]; Portougal [10, p.22], united in production cycles. Logistics processes are an important part of business processes in the organization divided into three phases according to Dimitrov [11, p.25] - logistics of supply, logistics of production and logistics of distribution. Rosemann says that logistics processes crossing through individual units and they are oriented along to the information and materials flow passing through the supply chain [12, p.132].

Remaining components of the overall problem. In order to implement optimization of the supply logistics in the organization, it is necessary to determine whether actual need of improvement exists. The signal is broadcast from the production system of the organization which is supply logistics customer within the overall logistics process. One way to establish guidelines for improvement is by applying the method of defining of requirement of supply logistics improvement. To that end, it is necessary the actual and the desired state of the processes of supply logistics to be presented by vectors - real and target ones. Brüggemann claims that the real vector represents an aggregate of elements, describes all processes and activities building the supply logistics [13, p.43]. Each element is represented as a partial vector with the relevant coordinates. Papula says that the coordinates describe the real values of the parameters characterizing various aspects of process effectiveness [14, p.300]. By summing up the vectors the common (resultant) vector is obtained. The target vector has been built by marking the coordinates of the goal on the coordinate system, the measurements of which are defined by the parameters derived from feedback received from customers. From the initial point of the coordinate system to the point marking the desired improvement a vector is built, called target vector. If comparison between the vector which represent the real process and the vector which represent the target process shows deviation in favor of the target vector, then it is necessary to perform a thoroughgoing analysis and improvement of the supply logistics process. Otherwise, it is assumed that the parameters of the existing company process of supply logistics are better than the goal set forth; therefore, improvement is not needed. The comparison between coordinates of both vectors enables the determination of the overall requirement of improvement as well the requirement of sub-process improvement for supply logistics' process. Furthermore, it can be assessment the requirement of improvement of each sub-process, which builds up the entire supply logistics process through calculating their efficiency beside the target goal. In order to achieve overall and sustainable improvements, it is necessary optimization to pass sequential the following stages:

Stage 1. Assessment of the overall requirement of supply logistics improvement;

Stage 2. Assessment of the requirement of supply logistics sub-process improvement;

Stage 3. Assessment of the priority of supply logistics sub-process improvement.

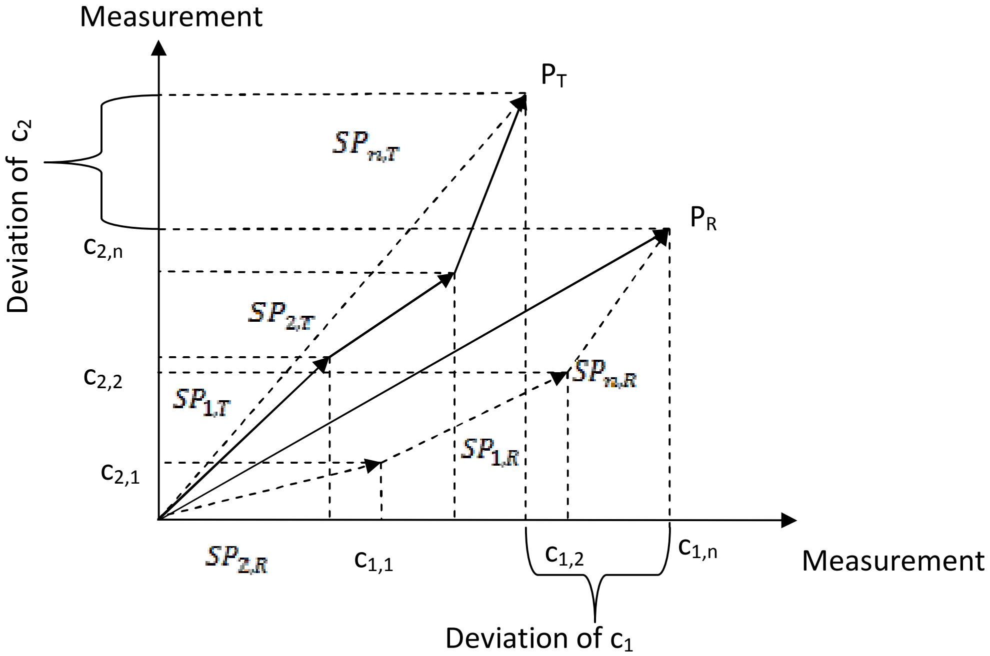
The aim of paper. The aim of the present paper is to present a method of assessment the requirement of supply logistics improvement in the organization.

The main material research. The identification of the requirement of supply logistics improvement starts with graphic presentation of the real and the target processes. It is aimed at visualization of both vectors' (processes') measurements. In Figure 1(Fig. 1) the real process of supply logistics (resultant vector) and an idealized target process (target vector), the sub-processes building them, with the relevant coordinates in chosen measurements are displayed. Various criteria and indicators characterizing the performance of the supply logistics may be selected as measurements, such as "supply dependability", "supply lead time", "supply service", "supply process costs", "inventory cost", etc. The choice of parameters to be used as measurements of the coordinate system is in compliance with the underlying logistics strategy of the organization, the improvement goal set forth, as well as with the requirement to follow up the deviations in their values. The idealized target vector representing the sum of the partial target vectors (sub-processes). The coordinates and number of target sub-processes can be obtained from the feedback or by other specialized sources (specialized literature, newspapers, journals, scientific conferences, Internet sources, etc) [15, p. 297].

Stage 1. Assessment of the overall requirement of supply logistics improvement

The procedure for assessment of the overall requirement of supply logistics improvement can be presented as a sequence of several steps.

Step 1 - Determining the coordinates of all real partial vectors, which build process (vector) of the supply logistics in the organization at all studied measurements.



P_T – target process | c_i – measurements of the processes

P_R – real process | j = 1... n – number of considered sub-process

$SP_{1,R}$, $SP_{2,R}$,...$SP_{n,R}$ – real sub-process | i= 1...m – number of considered measurement

Figure 1.- Real and Target supply logistics process visualization

Step 2 - Checking the nature of each measurement. If the improvement is expressed into increasing value of relevant measurement, must be proceed with calculation of the coefficient of efficiency of supply logistics process at maximizing measurements – „$EPSL_{max,i}$" in step 3. The coefficient of efficiency of supply logistics process at minimizing measurements ("$EPSL_{min,i}$") is calculated, provided that all characteristics of the processes must be reduced during the improvement in step 4[1].

[1] Differentiating the vectors' parameters into "maximizing" (e.g. "supply dependability", "supply lead time", etc.) and "minimizing" (for instance "process's costs", "inventory cost", etc.) is done on an earlier stage of the improvement. Maximizing measurements are these, the values of

Step 3 – Calculation the coefficient of efficiency of supply logistics process at maximizing measurements. "$EPSL_{max,i}$" is a coefficient of efficiency of maximizing measurements and it reflects the quotient of the maximizing characteristics of the coordinates of the target vector to the resultant one at one studied measurement (1).

$$\mathbf{EPSLmax,i} = \frac{\sqrt{\left[\sum_{j=1}^{n}(P_{j,max,T})^2\right]}}{\sqrt{\left[\sum_{j=1}^{n}(P_{j,max,R})^2\right]}} \quad (1)$$

where

$P_{j,max,T}$ – value of the target process in maximizing measurements

$P_{j,max,R}$ – value of the real process in maximizing measurements

j = 1 ..... n – number of considered sub-processes

i= 1 .....m – number of considered measurements

Step 4 - Calculation the coefficient of efficiency of supply logistics process at minimizing measurements. "$EPSL_{min,i}$" is a coefficient of efficiency of minimizing measurements and it reflects the quotient of the minimizing characteristics of the coordinates of the target vector to the resultant one at one studied measurement (2).

$$\mathbf{EPSLmin,i} = \frac{\sqrt{\left[\sum_{j=1}^{n}(P_{j,min,T})^2\right]}}{\sqrt{\left[\sum_{j=1}^{n}(P_{j,min,R})^2\right]}} \quad (2)$$

where

$P_{j,min,T}$ – value of the target process in ,minimizing measurements

$P_{j,min,R}$ – value of the real process in minimizing measurements

j = 1 ..... n – number of considered sub-processes

i= 1 .....m – number of considered measurements

Step 5 – Calculation coefficient of single-mesurements efficiency rate of the supply logistics "$ERSL_{SD}$". This coefficient serves to facilitate the calculation of coefficient of "overall efficiency rate of the supply logistics" in consequence. "$ERSL_{SD}$" accepts the value of coefficients of efficiency of supply logistics process at maximizing and minimizing measurements depending on their character. „$ERSL_o$" accepts the value of coefficient of single-measurements efficiency rate of the supply logistics at step 11.

Step 6 - Checking for trade-off about all of measurements. In this situation it is assumed that the deviations in the various measurements are balanced among them, since the characteristics of the process (vector) contribute to different extent for the achievement of the supply logistics' goal. If all examines measurements are trade-off, the coefficient of "overall efficiency rate of supply logistics" („$ERSL_o$") is calculated in step 7. Otherwise, proceed to step 8, and step 7 is not performed.

Step 7 – Calculation the coefficient of "overall efficiency rate of supply logistics".

Step 8 - Checking for lack of offset between all of the characteristics of the supply logistics' process. If this is so, algorithm passes to step 11. It is assumed that if one of measurement needs to be improved, then the entire real process needs improvement. There is a third case in which, part of the measurements are trade-off, and part of them – aren't. Then, it is need to make subsequent verification of measurements which aren't trade-off in step 9.

Step 9 - Checking for existence of measurements which aren't trade-off and at the same time there are no need of improvement. If there are such measurements algorithms proceed with calculation of coefficient of efficiency rate of multi-measurements of the supply logistics for the measurements that are trade-off in step 10. Otherwise, it pass to step 11.

Step 10 - Calculation of coefficient of efficiency rate of multi-measurements of the supply logistics only for measurements that are trade-off and need optimization. The coefficient is marked with "$ERSL_{MD}$" and calculated by formula 3. For this purpose, the measurements of supply logistics' processes are divided into two sets – superset "C_i" describing all

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which should be increased as a consequence of the improvement, and minimizing – those, the values of which should be reduced. The differentiation is done in accordance with the logistics strategic goals of the organization.

measurements and subset "A_q" describing only measurements that are trade-off. “A_q” is subset of “C_i” (all examined measurements) and its elements assume values for q =1,...., m. The coefficient is “$ERSL_{MD}$” is calculated like „$ERSL_o$”, but only for those measurements that are trade-off. After calculating the coefficient algorithm passes to step 11.

$$ERSL_{MD} = \frac{\dfrac{\sqrt{\sum_{q=1}^{m}\left[\sum_{j=1}^{n}(P_{j,max,T})\right]^2}}{\sqrt{\sum_{q=1}^{m}\left[\sum_{j=1}^{n}(P_{j,max,R})\right]^2}}}{\dfrac{\sqrt{\sum_{q=1}^{m}\left[\sum_{j=1}^{n}(P_{j,min,T})\right]^2}}{\sqrt{\sum_{q=1}^{m}\left[\sum_{j=1}^{n}(P_{j,min,R})\right]^2}}} \quad (3)$$

where

$P_{j,max,T}$ – value of the target process in maximizing measurements

$P_{j,max,R}$ – value of the real process in maximizing measurements

$P_{j,min,T}$ – value of the target process in minimizing measurements

$P_{j,min,R}$ – value of the real process in minimizing measurements

j = 1 ..... n – number of considered sub-processes

q = 1 .....m – number of considered measurements, where $A_q \subseteq C_i$

Step 11 – In this step the coefficient of "overall efficiency rate of the supply logistics"($ERSL_o$) is calculated using the formula (4)

$$ERSL_o = \frac{\dfrac{\sqrt{\sum_{i=1}^{m}\left[\sum_{j=1}^{n}(P_{j,max,T})\right]^2}}{\sqrt{\sum_{i=1}^{m}\left[\sum_{j=1}^{n}(P_{j,max,R})\right]^2}}}{\dfrac{\sqrt{\sum_{i=1}^{m}\left[\sum_{j=1}^{n}(P_{j,min,T})\right]^2}}{\sqrt{\sum_{i=1}^{m}\left[\sum_{j=1}^{n}(P_{j,min,R})\right]^2}}} \quad (4)$$

where

$P_{j,max,T}$ – value of the target process in maximizing measurements

$P_{j,max,R}$ – value of the real process in maximizing measurements

$P_{j,min,T}$ – value of the target process in minimizing measurements

$P_{j,min,R}$ – value of the real process in minimizing measurements

j = 1 ..... n – number of considered sub-processes

i= 1 .....m – number of considered measurements

Furthermore, the coefficient of "overall efficiency rate of the supply logistics" may accepts the values of both coefficient of “single-measurements efficiency rate of the supply logistics” and coefficient of “efficiency rate of multi-measurements of the supply logistics” respectively calculate in steps 8, 9 and 10.

Step 12 – In this step, the already calculated coefficient’s values for „$ERSL_o$” is compared to “one”. With “coefficient of overall efficiency rate of supply logistics” greater than “one”, the target process of supply logistics is more efficient than the real one. Therefore, it is necessary to take immediate measures of its improvement and optimization process passes to Stage 2. The processes, where “$ERSL_o>1$” is defined as critical for the supply logistics process chain in the organization. Where “$ERSL_o=1$” the real process is as effective as the goal set forth. In this case improvement is not necessary. The monitoring of those processes must continue. If the value of “$ERSL_o<1$” conclusion that the real process of supply logistics is more efficient than the target one is drawn. It follows that the current process is not critical for the supply logistics process chain in the organization, it is better than the target one and improvement is not necessary.

Stage 2. Assessment of the requirement of supply logistics sub-process improvement

The methodology can be presented as a sequence passes through the three steps.

Step 1 – The requirement of supply logistics sub-process improvement. In order to determine this need of improvement, it is necessary to calculate the difference of the coordinates of the partial target vector and the real vector which corresponds to it. This difference represents the “absolute” target of improvement for each sub-process. The newly created vector is noted by “Δ_{abs}“ and coordinates ”$d_{m,n}$”. This vector is calculated under the following formula 5.

$$\Delta_{abs} = \frac{1}{n}P_T - SP_{i,j,R} = (c_{1,1,T}; c_{2,1,T}; \cdots ; c_{m,n,T} - c_{1,1,R}; c_{2,1R}; \cdots ; c_{m,n,R}) = (d_{1,1}; d_{2,1}; \cdots ; d_{m,n})$$

where

n – number of partial real and target vectors

Step 2 - Check of the nature of all measurements. If all characteristics of the supply logistics processes are maximizing, algorithm continue to step 3. Otherwise, all values of the new vector’s coordinates (Δ_{abs}) are multiplied by (-1).

Step 3 – Comparison with zero the newly calculates vectors’ coordinates, describing the “absolute” goal of improvement. If the coordinate of the newly created vector is bigger than zero, then the target sub-process$_j$ in measurement$_i$ is more efficient than the real one$_j$. In this case, optimization of the respective measurement of the real supply logistics sub-process is needed and optimization process passes to Stage 3. In case that „$d_{i,j}$” is less than zero, it means that the existing sub-process$_j$ in measurement$_i$ is more efficient than the target one$_j$ and improvement is not needed. In the third case „$d_{i,j}=0$”, which means that the real sub-process$_j$ is as efficient, as the target one$_j$ in measurement$_i$. Again optimization is not needed.

Stage 3. Assessment of the priority of supply logistics sub-process improvement.

Step 1 - Checking for trade-off about all of measurements. In this situation it is assumed that the deviations in the various measurements are balanced among them, since the characteristics of the supply logistics process (vector) contribute to different extent for the achievement of the supply logistics’ goal. If all examines measurements are trade-off, the coefficient „δ_j” is calculated in step 2. Otherwise, proceed to step 3, and step 2 is not performed.

Step 2 - Calculation the coefficient „δ_j” that describes the requirement of supply logistics sub-process optimization in all measurements – calculated by formula 6.

$$\delta_j = \sum_{i=1}^{m} d_{i,j} \tag{6}$$

where

$d_{i,j}$ – measurement$_i$ to vector$_j$

j = 1... n – number of considered sub-process

i= 1...m – number of considered measurement

Step 3 - Checking for lack of offset between all of the characteristics of the supply logistics’ process. If this is so, algorithm passes to step 6. It is assumed that if one of measurement needs to be improved, then the entire real process needs improvement. There is a third case in which, part of the measurements are trade-off, and part of them – aren’t. Then, it is need to make subsequent verification of measurements which aren't trade-off in step 4.

Step 4 - Checking for existence of measurements which aren’t trade-off and at the same time there are no need of improvement. If there are such measurements algorithm proceed with calculation of coefficient „δ_j” only for the measurements that are trade-off in step 5. Otherwise, it pass to step 7.

Step 5 - Calculation of coefficient „δ'_j” only for measurements that are trade-off and need optimization. The coefficient is marked with “δ'_j” and calculated by formula 7. For this purpose, the measurements of supply logistics’ processes are divided into two sets – superset "C_i" describing all measurements and subset "A_q" describing only measurements that are trade-off. “A_q” is subset of “C_i” (all examined measurements) and its elements assume values for q =1,..., m. The coefficient is “δ'_j” is calculated like “δ_j”, but only for those measurements that are trade-off. After calculating the coefficient algorithm passes to step 7.

$$\delta'_j = \sum_{q=1}^{m} d_{q,j} \tag{7}$$

where

$d_{q,j}$ – measurement$_i$ to vector$_j$

j = 1... n – number of considered sub-process

q= 1...m – number of considered measurement

Step 6 - The coefficient "δ_j" accepts the values of coordinates of vector „Δ_{abs}" which has need of improvement.

Step 7 - By the last operation all values of „δ_j" are ranked by size in descending order. A sub-process of supply logistics which coefficient is highest gets rank "one". It must be optimized first, since in practice is "outermost" from the set forth target process.

Then the algorithm stops.

Conclusion. In this paper a method that can determine the overall requirement, the requirement and priority of supply logistics' sub-processes improvement was presented. It is based on establishing the efficiency of the real running processes compared to the set forth target efficiency by the calculation of a several coefficients. Depending on the derived value, it drowns a conclusion whether optimization of the supply logistics' process is necessary. The main advantage upon the application of this method is that the measurements, under which the optimization is done, can be m-number as per the actual need. Also, the calculation procedures for the determination of the coefficients have been substantially simplified. This way integrity of the monitoring and representativeness of the defined conclusions is achieved. Main shortage of the described method is that upon increase of the examined process measurements the visualization shall be hindered.

The realization of the all three stages of the method of assessment the requirement of supply logistics' process improvement (assessment of the overall requirement of supply logistics improvement; assessment of the requirement of supply logistics sub-process improvement and assessment of the priority of supply logistics sub-process improvement) could lead to achievement of efficient and stable improvements of the supply logistics processes in the organization.

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