# Approach of Assessment the Overall Necessity of Supply Logistics Processes Improvement

**YANGYOZOV Petko**
University "Prof. As. Zlatarov", Bulgaria, petkoiangiozov@abv.bg
**DIMITROVA Adile**
University "Prof. As. Zlatarov", Bulgaria, adiledimitrova@abv.bg

**Abstract**
In the present paper an approach has been presented, through which it can determine the necessity of improvement of supply logistics in the organization. The need for developing and implementation of this approach is revealed. Through it starts the process of optimization of supply logistics and passes through the remaining steps. The paper continues with explanation how the comparison between the set forth goal of improvement and the actual state of the current logistics processes is made. The essence of functioning of the approach is presented. The formulas through which it can be calculated coefficients of „efficiency of maximized measures" and coefficients of "efficiency of minimized measures" are described. Algorithm and 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 that are necessary for determining the general necessity of improvement are reviewed.

**Keywords**
supply logistics, optimization, necessity of improvement, coefficient of efficiency, algorithm, deviation, methodology

## 1. Introduction

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 [1]. Transformation is related to the running of various business processes [2], processes [3, 4, 5, 6, 7] and activities [8, 9], united in production cycles. Logistics processes are an important part of business processes in the organization divided into three phases - logistics of supply, logistics of production and logistics of distribution [10]. In this connection, they 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. Logistics processes crossing through individual units and they are oriented along to the information and materials flow passing through the supply chain [11]. 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 that established (reporting) 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.

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 that is supply logistics customer within the overall logistics process.

One way to establish guidelines for improvement is by applying the approach of de-fining of general necessity 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. The real vector represents an aggregate of elements, describes all processes and activities building the supply logistics [12]. Each element is represented as a partial vector with the relevant coordinates. The coordinates describe the real values of the parameters characterizing various aspects of process effective-ness [13]. 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 that 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 be-tween coordinates of real and target vectors enables the determination of the overall necessity of supply logistics processes improvement. It is establish by calculation of the efficiency of processes of the supply logistics compared to the set forth goal. In order to achieve overall and sustainable improvements, it is necessary optimization to pass sequential the following steps:

- ✓ assessment of the overall necessity of supply logistics improvement;
- ✓ assessment of the necessity of sub-process improvement;
- ✓ assessment of the priority of sub-process improvement.

The aim of the present paper is to present an approach of assessment the overall necessity of supply logistics improvement in the organization.

## 2. Identification of the Overall Necessity of Supply Logistics Improvement

The identification of the necessity 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. Various criteria and indicators characterizing the efficiency of the supply logistics may be selected as measurements, such as "accuracy of deliveries from suppliers", "time of supply", "high maintenance", "low process's costs", "low cost reserves", 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 necessity to follow up the deviations in their values. Figure 1 shows the real process (resultant vector) and an idealized target process (target vector), the sub-processes building them, with the relevant coordinates.

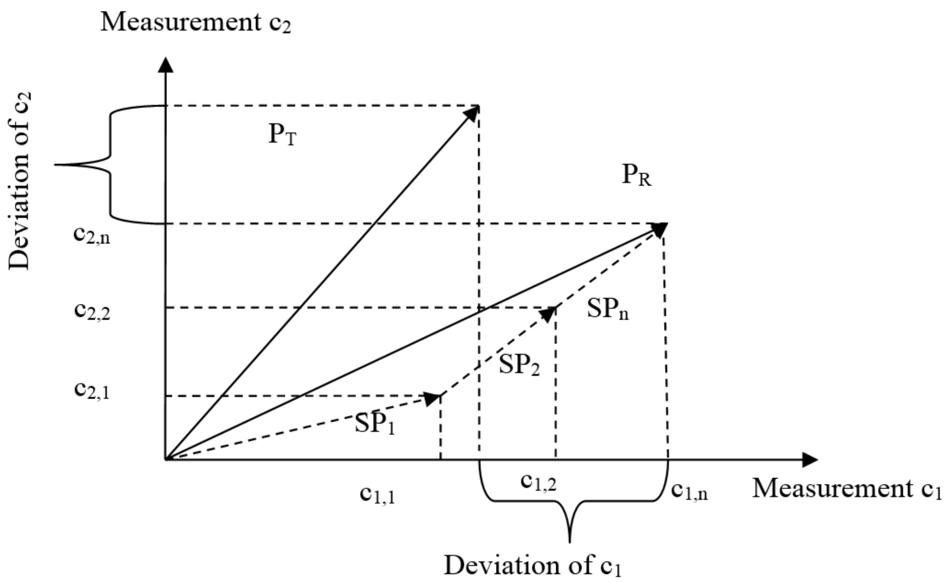



Fig. 1. Real and target supply logistics process visualization

$P_T$ – target process; $P_R$ – real process; $SP_1$, $SP_2$, ... $SP_n$ – real sub-process; $SP_{i,j}$ – coordinates $i$ to vector $j$; $c_i$ – measurements of the processes; $j$ = 1 ... $n$ – number of considered sub-processes; $i$ = 1 ... $m$ – number of considered measurements

In order to identify the necessity of the real process (supply logistics) improvement, it must calculate "coefficient of overall efficiency rate of supply logistics", which is denoted by "ERS-$L_o$" and is calculated using the formula (1)

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

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;
$P_{j,min,T}$ – 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.

With how much each process must improve is determined upon the calculation of the efficiency of the sub-processes. It is defining in case of available overall necessity of supply logistics improvement.

Then calculated coefficient value is com-pared to “one” (Table 1). 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. This is done in the subsequent stages of the optimization process. 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.

Table 1. Interpretation of *“ERSL$_o$”*

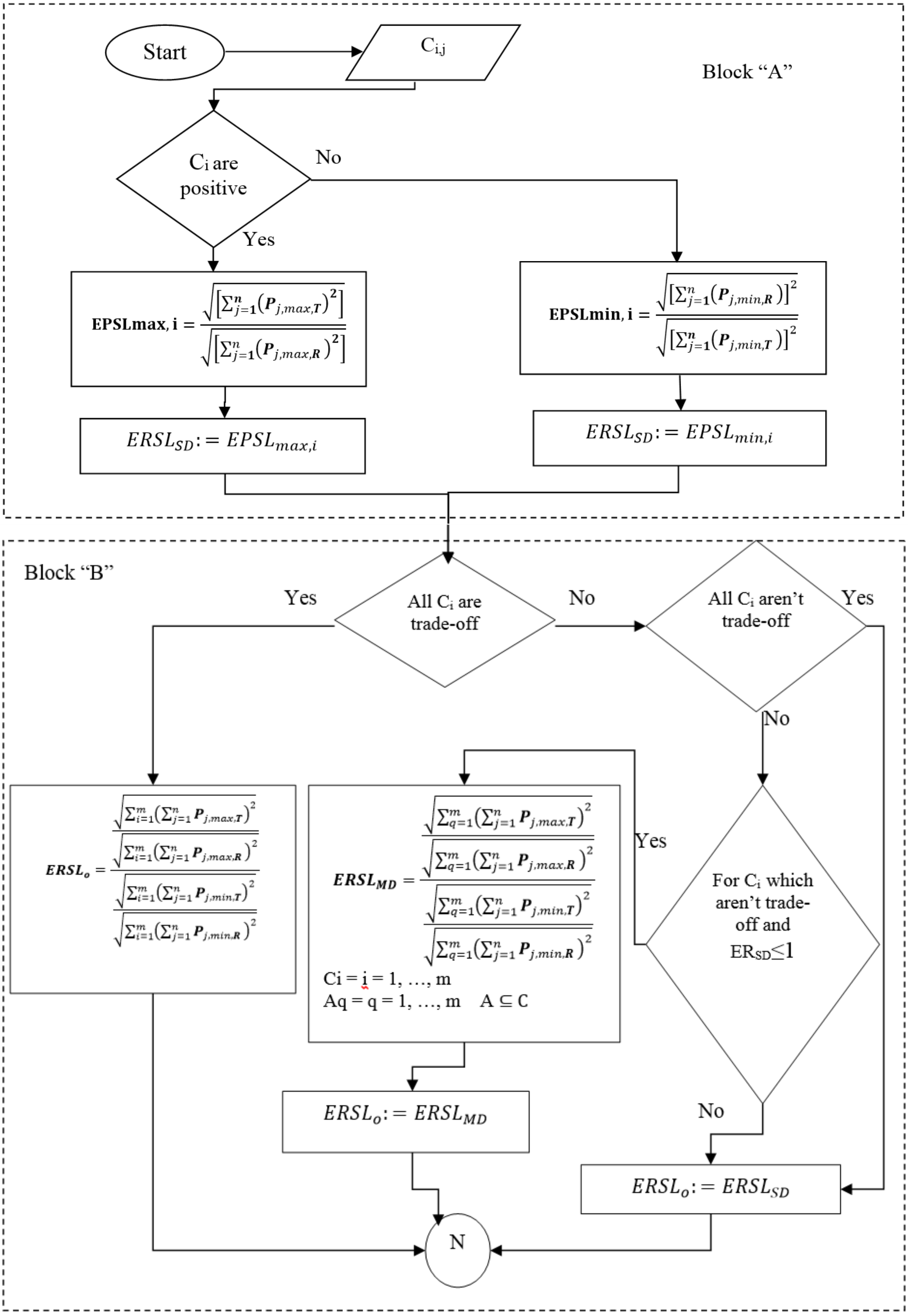
| Correlations | | Interpretation |
|---|---|---|
| $ERSL_o \geq 1$ | $P_{Target} > P_{Real}$ | Real process is more inefficient than the target one. There is necessity of improvement |
| $ERSL_o = 1$ | $P_{Target} = P_{Real}$ | Real process is as efficient as the target one. There is not necessity of improvement |
| $ERSL_o < 1$ | $P_{Target} < P_{Real}$ | Real process is more efficient than the target one. There is not necessity of improvement |

Before calculate the coefficient of "overall efficiency rate of the supply logistics" it is necessary passing through the activities and calculations of auxiliary coefficients, which can be represented as an algorithm (Figure 2).

The algorithm is divided into three blocks. In block “A” whether measurements are maximizing or minimizing is checked. Also the value of “$EPSL_{max,i}$”, “$EPSL_{min,i}$” are calculated. In block “B” whether measurements are trade-off are determined. According to that circumstance the value of coefficients “$ERSL_{SD}$” (single-dimensions efficiency rate of the supply logistics), “$ERSL_{MD}$” (efficiency rate of multi-dimensions of the supply logistics) or “$ERSL_o$” (overall efficiency rate of the supply logistics). In block “C” general necessity of improvement of the supply logistics is determined by comparing the calculated values of the coefficient “$ERSL_o$” to one.

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

Step 2 - Checking the nature of each dimension. If the improvement is expressed into increasing value of relevant measurement, must be proceed with calculation of the coefficient of efficiency of


Start
$C_{i,j}$
Block "A"
$C_i$ are positive
No
Yes
$\mathbf{EPSLmax,i} = \frac{\sqrt{\left[\sum_{j=1}^{n}\left(P_{j,max,T}\right)^2\right]}}{\sqrt{\left[\sum_{j=1}^{n}\left(P_{j,max,R}\right)^2\right]}}$
$\mathbf{EPSLmin,i} = \frac{\sqrt{\left[\sum_{j=1}^{n}\left(P_{j,min,R}\right)\right]^2}}{\sqrt{\left[\sum_{j=1}^{n}\left(P_{j,min,T}\right)\right]^2}}$
$ERSL_{SD} := EPSL_{max,i}$
$ERSL_{SD} := EPSL_{min,i}$
Block "B"
Yes
All $C_i$ are trade-off
No
All $C_i$ aren't trade-off
Yes
No
$ERSL_o = \frac{\frac{\sqrt{\sum_{i=1}^{m}\left(\sum_{j=1}^{n} P_{j,max,T}\right)^2}}{\sqrt{\sum_{i=1}^{m}\left(\sum_{j=1}^{n} P_{j,max,R}\right)^2}}}{\frac{\sqrt{\sum_{i=1}^{m}\left(\sum_{j=1}^{n} P_{j,min,T}\right)^2}}{\sqrt{\sum_{i=1}^{m}\left(\sum_{j=1}^{n} P_{j,min,R}\right)^2}}}$
$ERSL_{MD} = \frac{\frac{\sqrt{\sum_{q=1}^{m}\left(\sum_{j=1}^{n} P_{j,max,T}\right)^2}}{\sqrt{\sum_{q=1}^{m}\left(\sum_{j=1}^{n} P_{j,max,R}\right)^2}}}{\frac{\sqrt{\sum_{q=1}^{m}\left(\sum_{j=1}^{n} P_{j,min,T}\right)^2}}{\sqrt{\sum_{q=1}^{m}\left(\sum_{j=1}^{n} P_{j,min,R}\right)^2}}}$
Ci = i = 1, …, m
Aq = q = 1, …, m  A ⊆ C
Yes
For $C_i$ which aren't trade-off and $ER_{SD} \leq 1$
No
$ERSL_o := ERSL_{MD}$
$ERSL_o := ERSL_{SD}$
N

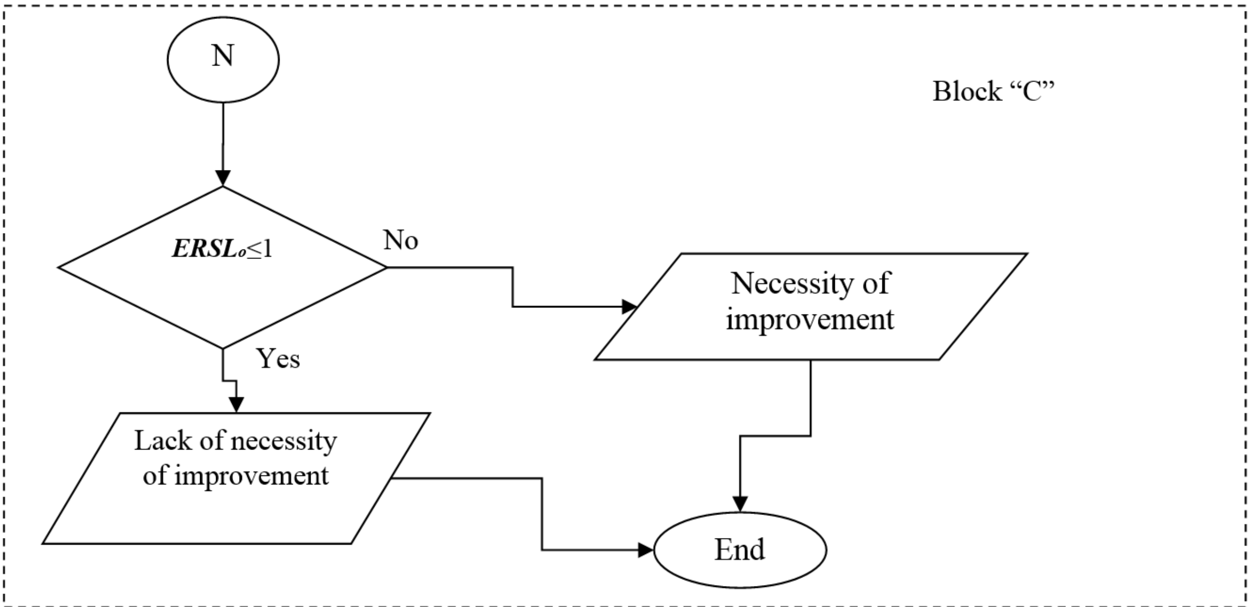



Figure 2. Algorithm for calculation of overall necessity of supply logistics improvement

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. Differentiating the vectors' parameters into "maximizing" (e.g. "accuracy of deliveries from suppliers", "time of supply", etc.) and "minimizing" (for instance "low process's costs", "low cost re-serves", etc.) is done on an earlier stage of the improvement. The differentiation is done in accordance with the logistics strategic goals of the organization.

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 (2):

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

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;

$j = 1 \ldots n$ – number of considered sub-processes;

$i = 1 \ldots m$ – 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 (3):

$$\mathbf{PSLmin, i} = \frac{\sqrt{\left[\sum_{j=1}^{n}\left(\boldsymbol{P}_{j,min,\boldsymbol{T}}\right)^2\right]}}{\sqrt{\left[\sum_{j=1}^{n}\left(\boldsymbol{P}_{j,min,\boldsymbol{R}}\right)^2\right]}} \tag{3}$$

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;

$j = 1 \ldots n$ – number of considered sub-processes;

$i = 1 \ldots m$ – number of considered measurements.

Step 5 – Calculation coefficient of single-dimensions 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-dimensions efficiency rate of the supply logistics at step 11.

Steps from 1 to 5 describe block "A" of the algorithm.

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 pass 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 are not. Then, it is need to make subsequent verification of measurements that are not 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 algorithm proceed with calculation of coefficient of efficiency rate of multi-dimensions 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-dimensions 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 (4). 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 $q = 1, \ldots, m$. The coefficient is "$ERSL_{MD}$" is calculated like „$ERSL_o$", but only for those measurements that are trade-off:

$$\boldsymbol{ERSL_{MD}} = \frac{\dfrac{\sqrt{\sum_{q=1}^{m}\left[\sum_{j=1}^{n}\left(\boldsymbol{P}_{j,max,\boldsymbol{T}}\right)\right]^2}}{\sqrt{\sum_{q=1}^{m}\left[\sum_{j=1}^{n}\left(\boldsymbol{P}_{j,max,\boldsymbol{R}}\right)\right]^2}}}{\dfrac{\sqrt{\sum_{q=1}^{m}\left[\sum_{j=1}^{n}\left(\boldsymbol{P}_{j,min,T}\right)\right]^2}}{\sqrt{\sum_{q=1}^{m}\left[\sum_{j=1}^{n}\left(\boldsymbol{P}_{j,min,R}\right)\right]^2}}} \qquad (4)$$

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;

$j = 1 \ldots$ n – number of considered sub-processes;

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

After calculating the coefficient algorithm passes to step 11.

Step 11 – The coefficient of "overall efficiency rate of the supply logistics" accepts the values of both coefficient of "single-dimensions efficiency rate of the supply logistics" and coefficient of "efficiency rate of multi-dimensions of the supply logistics" respectively calculate in steps 8, 9 and 10.

Steps from 6 to 11 describe block "B" of the algorithm.

Step 12 – In this step, the already calculated coefficient's values for „$ERSL_o$" is compared to "one" (Table 1). According to ratio of the coefficient with "one" it establishes overall necessity of supply logistics improvement in the organization or lack thereof. In case that “$ERSL_o \leq 1$” the process of improvement stops.

## 3. Conclusions

In this paper an approach that can determine the overall necessity of supply logistics 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 the coefficient of "overall efficiency rate of the supply logistics". Depending on the derived value, it drowns a conclusion whether optimization of the supply logistics’ process is necessary. The identification of the overall necessity of improvement represents the starting point of the supply logistics processes optimization. The main advantage upon the application of this approach is that the measurements, under which the optimization is done, can be *m*-number as per the actual necessity. Also, the calculation procedures for the determination of the coefficients have been substantially simplified. The presentation of the entire method as algorithm make possible to examined and evaluated all possible combinations in the values of the initial coefficients – “$EPSL_{max}$“ (coefficient of efficiency of supply logistics process at maximizing measurements) and “$EPSL_{min}$“ (coefficient of efficiency of supply logistics process at minimizing measurements) – and of the resultant coefficient “$ERSL_o$” (coefficient of overall efficiency rate of the supply logistics). This way integrity of the monitoring and representativeness of the defined conclusions is achieved. Main shortage of the described approach is that upon increase of the examined process measurements the visualization shall be hindered.

The identification of the overall necessity of supply logistics improvement represents the first stage of the optimization process. Satisfying customer needs supposes the improvement process to pass a few additional steps, namely assessment of the necessity of sub-process improvement and assessment of the priority of sub-process improvement. The realization of said stages of the optimization process could lead to the achievement of efficient and stable improvements of the supply logistics processes in the organization.

## References

1. Angelov, K. (2008): *Реинженеринг на стопанските процеси* (*Reengineering business processes*). TU Sofia Press, ISBN 978-954-438-723-5, Sofia, Bulgaria (in Bulgarian)
2. Harmon, P., Davenport, T. (2007): *Business Process Change*. Morgan Kaufmann Publishers, ISBN 978-0-12-374152-3, Burlington, USA, p. 9-20
3. Deckler, G.J. (2003): *Achieving Process Profitability: Building the IT Profit Center*. iUniverse Inc., ISBN 0-595-28970-3, Lincoln, USA, p. 5-15
4. Haist, F., Fromm, H. (2001): *Qualität im Unternehmen: Prinzipien, Methoden, Techniken*. Carl Hanser, ISBN 3446164103, München, Germany, p. 88-92 (in German)
5. Harrington, H. J. (2005): *Business Process Improvement*. McGraw-Hill, ISBN 0070600031, New York, USA
6. Ould, M. A. (2005): *Business Process Management. A Rigorous Approach*. British Computer Society, ISBN 1906124329, Swindon, UK, p. 15-18 (http://www.isbnplus.com/9781906124328)
7. Lowenthal, J.N. (2003): *Defining and Analyzing a Business Process: A Six Sigma Pocket Guide*. ASQ Quality Press, ISBN 0-87389-551-7, Milwaukee, USA, p. 1-6
8. McDonald, M. (2010): *Improving Business Process*. Harvard Business School Publishing, ISBN 978-1-4221-2973-9, Boston, MA, USA, p. 3-11
9. Portougal, V., Sundaram, D. (2006): *Business Process. Operational Solutions for SAP Implementation*. IRM Press, ISBN 1-59140-979-9, USA
10 Dimitrov, Iv, Dimitrova, Ad. (2015): *Логистичен мениджмънт* (*Logistics management*). Avangard Prima, ISBN 978-619-160-448-7, Sofia, Bulgaria (in Bulgarian)
11. Rosemann, M. (1996): *Koplexitätsmanagement in Prozessmodellen*. Springer Verlag, ISBN 978-3-322-99232-1, Wiesbaden, Germany (in German)
12. Brüggemann, J., Heinrich, B., Sobczak, R. (1998): *Mathematik*. Cornelsen, ISBN 978-3464412015, Berlin, Germany (in German)
13. Papula, L. (2001) *Mathematk für Ingenieure und Naturwissenschaftler*. Friedrich Vieweg und Sohn Verlagsgesellschaft, ISBN 3528349379, Braunschweig, Germany (in German)

Received in June 2016