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A MEASURE OF EMERGENCE OF A LOGISTIC GROUP INTERACTION

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ABSTRACT. Background: The nature of the relations between group members is a very important part of the integrity of the logistics process. The identification of rating among the participants is certainly the most necessary condition for the quality of the logistics process. It can distinguished four types of emergence rating: direct participation rating, direct impact rating, participation rating and impact rating.
The aim of this paper was to create the method to determine the mutual relationships among various elements of logistic group.
Methods: The technique is based on the processing of the matrix of pairwise interactions obtained on the basis of a questionnaire survey of all members of the group and expressed as a score on the selected scale of assessments. The computation algorithm is based in particular on the traveling salesman problem using an original method of optimization and is implemented in Visual Studio C #.
Results: 16 types of leaderships were distinguished and described by the use of statistical methods.
Conclusions: The developed method of calculating the measure of emergence can be used not only for a group of students, but also for the definition of the rate of emergence in any collective system.

Key words: emergence, influence rating, rating of participation, direct impact rating, rating of direct participation, traveling salesman problem, directed graph, simply connected contour, collective system, logistic cooperation, types of leaders.

INTRODUCTION

The aim of this paper was to create the method to determine the mutual relationships among various elements of logistic group.

The nature of the relations between group members is a very important part of the integrity of the logistics process. The identification of rating among the participants is certainly the most necessary condition for the quality of the logistics process. We can distinguish four types of emergence rating: direct participation rating, direct impact rating, participation rating and impact rating.

The first type of rating describes the qualitative and quantitative degree of relations between a group member and a group. This type of rating includes the fact of a direct relation of a one group member to another from the standpoint of their actions. Of course, this is important, but the fact of such a leadership does not carry the underlying mechanisms of mediated relations and serves only as a superficial measure of choice of a leader among the members. If you touch the logistically important mechanism for ensuring the quality of the logistics process, using only the rating of the direct participation can lead to dilettantism in the relations. The latter does not allow to prepare and pay attention to those members whose influence in the collective process of interaction is more important to train highly qualified specialists, and hence is more important for the effectiveness of the group. Direct participation rating can effectively affect only the efficiency of work among outsiders, but the

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use of only this rating can heavily damage a process of preparing and encouraging the leaders of the group. The latter is a prerequisite for evaluation of the management of the group, as only highly qualified professionals are able to embrace and implement into the society all the achievements of the scientific and technological process.

RESULTS AND DISCUSSION

Direct participation rating can be easily calculated on the basis of a simple questionnaire in the form of an evaluation from 0 to 9 in the nature of the relation of the i-th participant to the j-th participant. The score a_{ij} =0 means that there is no relationship of i with j. The score a_{ij} = 9 means that there is a very close relationship of i with j from the position of the utility of the j-th participant for the i-th participant. Obviously, the direct participation ratings determined by the value:

$$N_i = \frac{1}{N-1}\sum_j a_{ij}$$

determined by the size, ranked in ascending order, where N is the number of the participants in the group. Direct impact rating is opposite to the direct participation rating and is calculated as:

$$V_j = \frac{1}{N-1}\sum_i a_{ij}$$

with V_j ranking in descending order. This rating determines the average characteristic of the effect of the i-th participant on the relationship in the group, i.e. a measure of an operation of the system. This measure, as the average characteristic, reflects a sense which is well-known in economics as a Public Relation (PR), and characterizes the collective system vision of the character of its own operation.

The rating of participation is calculated on the basis of the matrix aij in a more complicated way, but it reflects the measure of emergence based not only on the indirect mechanism of impact of the individual participant on the logistic process, but on a definition of the mentality of the learning organization too. The last term in the logistic means a collective system in which the process of identity formation is provided not only by the "teachers", but also by the "students". Naturally, the learning organization should focus on the experience and knowledge not only of a "teacher", but also of those "students" whose mentality and leadership meet the aspirations of the state and the public. In this regard, the identification of participation rating is very important in terms of a critical approach to education, since this rating indicates a real, not the desired state of the "students". This is a kind of a litmus test by which, ably organizing the process, we can carry out the correction of the education system in the group influencing the ranked group of leadership with the periodic control of the leadership rating. Mathematically, the system of relations aij can be represented as a directed graph (Figure 1), where the arrow indicates the relation of i-th student to the j-student.

The problem of determining the rating of participation is almost reduced to the traveling salesman problem [1] for the *j-th* member in the direction from *i* to *j* on the edges of the graph without the last edge which locks the closed bypass circuit. The essence of the traveling salesman problem is reduced to calculating the closed bypass circuit of all the nodes of a graph which has the minimum length of the edges beginning from the node *j*. In the bypass circuit you can't follow the same edge twice. This bypass circuit is called simply connected. In our problem, the movement should be performed only on those edges, the direction of which for the current node corresponds to the direction to this node. To solve this problem, we represent a graph in the form of incidence matrix a_{ij} (Fig. 2) corresponding to the graph (Fig. 1.).

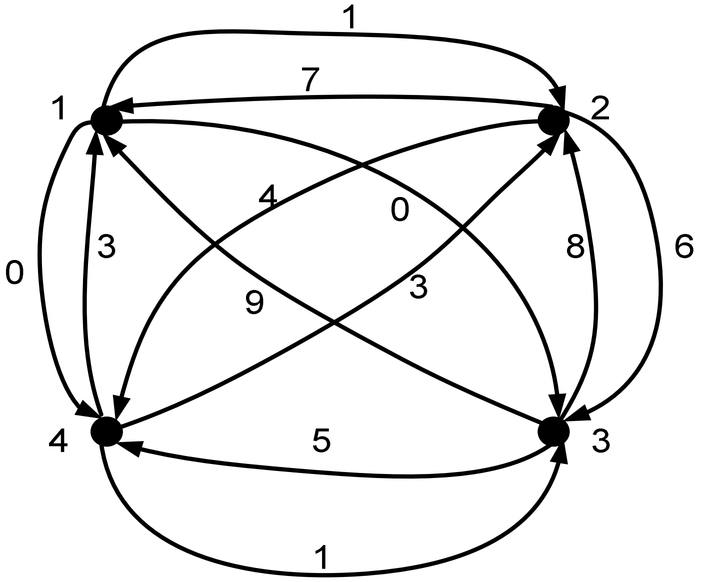

Fig. 1. Directed graph of relations
Rys. 1. Ukierunkowany wykres powiązań

The solution will be sought in the form of binary matrix x_{ij}, for which:

$$\sum_j x_{ij} = 1; \quad \sum_i x_{ij} = 1; \qquad x_{ij}=0$$

The x_{ij} solution must provide a minimum path in a sequential single circuit of all the nodes of the graph, starting from the *j-th* node with the return to the *i-th* node. In this formulation, the problem is a classical problem of the appointment, but under certain conditions, the decision may give doubly or more connected circuits, which contradicts the condition of the traveling salesman problem. To check that the circuit is simply connected it’s necessary to impose an additional condition in the decision x_{ij} which cuts off the solution with multiply circuits.

	j				
		1	2	3	4
	1	0	1	0	0
	2	7	0	6	4
i	3	9	8	0	5
	4	3	3	1	0

Fig. 2. The incidence matrix
Rys. 2. Macierz częstości

Assume that you have received an interim solution x_{ij} on going from the *j-th* node, which corresponds to the column of the matrix a_{ij}. To test that the bypass circuit is simply connected you build the supply chain by the following algorithm. Fix $k = 1$. In the element of the vector Z_k you should bring the number of initial node j. According to the decision x_{ij} you should find for the column j the row i with $x_{ij} = 1$ and the number of that line you should bring into an element of the vector $Z_k +1$.

Next you check the condition $Z_m \neq Z_k +1$ for $\forall m$ [1, k]. If this test is at least one match of Z_m with

Z_k +1, then you should fix the discrepancy of the solution x_{ij} according to the simply connected circuit. Otherwise $k = k + 1$, $j = i$ and for a new j perform the actions described above until k is less than the dimension of the matrix x_{ij}. If the examination doesn't reveal that the circuit is multiply, the solution x_{ij} will be initial, otherwise look for a new solution x_{ij} for assignment problem. The resulting solution x_{ij} is the maximum (minimum) according the length of edges bypass circuit S_j for the j node, which you should normalize by the formula $\frac{1}{N-1}S_j$ for the N group member in order to have the identity with the direct participation rating. Rating of participation is ranked in descending order by vector S_j for all

$j \in [1, N]$:

$$S_j = \begin{Bmatrix} \dfrac{maxS_j + b_{min}}{2}, если\, N_j > 4 \\ \dfrac{minS_j + b_{max}}{2}, \quad если\, N_j < 5 \end{Bmatrix}$$

where b_{min} and b_{max} – the minimum and the maximum edge in the corresponding chain traversal.

The impact rating T_j is calculated similarly to the rating S_j, but with the condition of the bypass circuit which is opposite to the bypass condition to S_j and the recalculation by the formula:

$$T_j = \begin{Bmatrix} \dfrac{maxT_j + b_{max}}{2}, если\, V_j > 4 \\ \dfrac{minTS_j + b_{min}}{2}, \quad если\, V_j < 5 \end{Bmatrix}$$

The impact rating T_j ranked in ascending order determines, in contrast to the direct impact rating V_i, a real and but not visible mechanism of operating in the system. Obviously, it is the most important not for "students", but for "teachers", as it allows to influence indirectly the members of the process.

A measure of emergence is determined by the comparative evaluation of the vectors V, T, N, S. Consider for systematization the extreme special cases. For the participant i we will take a leader as a value 0, and an outsider as 1. Since the number of M = 0111 means the leadership in V and the outsider in T, N, S. It is clear that M is a 4-bit binary number with 16 possible options from 0000 to 1111 in terms of [Kosareva, Zirer 2005, Scriptunova 2002].

The value of M_i = 0000 is a variant of leadership under the code name "player", as for the four types of leadership the participant i is a leader. Obviously, the "teachers" need to focus precisely on this leader in terms of his mentality of relations with other "students."

The value of M_i = 0001 describes "the player-narcissus." In this case the "teaching" staff should use all the means of advertising that leader, even more so if the group has no leader with a higher rating.

The value of M_i = 0010 describes "the player-pedantic". Obviously, such a situation characterized too strict requirements of the "teachers" to that group member.

The value of M_i = 0011 defines a "player-bear", which means his too strong advertising by "teachers."

The value of M_i = 0100 reveals a Democrat among the members of the group. To be a leader, such party must provide great mechanisms of indirect influence on the team.

The value of M_i = 0101 defines a Democrat-narcissus. From the perspective of teachers such a leader requires caution in his PR-advertising.

The value of M_i = 0110 defines a Democrat-pedant. Obviously, in this case it is necessary to take all necessary advertising impact on the group of participants from the standpoint of a moral approach to the leader.

The value of M_i = 0111 defines a Democrat-bear. In this case, the best option may be conducting of advertising company of the leader by the "teachers".

The value of M_i = 1000 characterizes the enforcer-Democrat. To become a leader this member needs measures of enabling advertising that increasingly seems to release and underscore the merits of this leader.

The value of M_i = 1001 characterizes the enforcer-narcissus. Such a leader can be promoted in the rating at the expense of decreasing its influence on the members of the group in the sense of their operation.

The value of M_i = 1010 defines an enforcer-pedant and his promotion in the rating scheme can be possible due to more democratic attitude to the participants of the process.

The value of M_i = 1011 characterizes the enforcer-bear and his promotion in the rating scheme can be possible, as in the previous case, due to a more democratic attitude to the participants of the process.

The value of M_i = 1100 defines PR-man. his promotion in the rating scheme is possible due to more moderate approach to its self-advertising.

The value of M_i = 1101 defines the narcissus. Obviously, such a leader must pay attention to the nature of his indirect relations with the group of the participants.

The value of M_i = 1110 defines a charismatic personality, who has the definition of "pedant" in his scheme of leadership. Obviously, the rating of his leadership increases by more balanced attitude toward the members of the group.

The value of M_i = 1111 describes an extremely charismatic personality, called in the system of leadership as a "bear", i.e. the party whose sense of leadership is determined only by obtaining the benefit from others.

These 16 types of leadership are extreme in grades $M^0 = \{V, T, N, S\}$. While conducting a survey we used 9-point scheme for the evaluation of relations from 0 to 9, which can be mathematically characterized by the number of 10-symmetric system of calculation from 0 to 9. Thus, under certain $M^0 = \{V, T, N, S\}$ the rating of leadership is determined by the sorting in ascending numerical value of M^0. In addition for any numeric value of M^0 you can easily identify an indicative type of a leader. In this case, you have to convert the number of M^0 into the number of M by the following rule: each grade M_i^0 of the number M^0 corresponds to a value of 0 of the grade M_i, if $M_i^0 \leq 4$ and M_i=1, if $M_i^0 \geq 5$. Here is an example for M^0=7483: since 7>4, M_0=1, since 4<5, M_1=0, since 8>5, M_2=1 since 3<5, M_3=0.The result is a number M = 1010, which corresponds to the enforcer-pedant.

Implementation of the proposed method obviously depends on the meaning of the questionnaire. We have considered the description proposed above on the basis of the usefulness of the *j-th* participant for the *i-th* participant. But this method can be used, for example, for identifying the leadership of tolerance, i.e., the degree of sociability of the group members in non-business relationship.

Implementation of the proposed method requires special software and can be solved in the environment of Visual Studio C # [Novikov, Balytko, Korsuk 2011] with the additional algorithms for programming the supply chain of the definition whether the circuit is simply connected in the traveling salesman problem and by sorting the options in the problem of the assignment (Listing 1).

Listing 1.

```
using System; using System.Collections.Generic; using System.ComponentModel;
using System.Data; using System.Drawing; using System.Linq;
using System.Text; using System.Windows.Forms; using System.IO;
namespace WindowsFormsApplication7
{
   public partial class Form1 : Form
   {
```

```
public int[,] a=new int[200,200];  public int[,] b = new int[200, 200];
public decimal[,] bbb = new decimal[18, 18];
public bool[,] xx = new bool[200, 200];  public bool[,] xxx = new bool[18, 18];
public decimal[] c = new decimal[200]; public decimal[] yc = new decimal[200];
public int[] Nc = new int[200];  public int[] jjc = new int[200];
public int n;  public string DFF, RFF, FFF;
public int[] z = new int[200]; public int Dl; public int TMM = 0;
byte jf=5; // длина блока
   public Form1()
{ InitializeComponent(); }

private void button1_Click(object sender, EventArgs e)
{
   int i0,i1,k0;  string sss,ss1; string[] buf;
   if (Convert.ToByte(maskedTextBox1.Text) < 4) maskedTextBox1.Text = "4";
   if (Convert.ToByte(maskedTextBox1.Text) > 7) maskedTextBox1.Text = "7";
   jf = Convert.ToByte(maskedTextBox1.Text);
   OpenFileDialog MyDialog = new OpenFileDialog();
   if (MyDialog.ShowDialog() == DialogResult.OK)
   {   DFF = MyDialog.InitialDirectory; FFF = MyDialog.FileName;
      StreamReader fr = new StreamReader(MyDialog.FileName);
      string st = "", st1;
      while ((st1 = fr.ReadLine()) != null) st += st1+"\r";
      fr.Close();
      i0 = st.IndexOf("<matrix>")+9;   i1 = st.IndexOf("</matrix>") - 1;
      sss = st.Substring(i0, i1 - i0 + 1);   i0 = sss.IndexOf("\r") +1;
      Boolean kod = true; k0 = 0;
      while (kod)
       {
          i1 = sss.IndexOf("\r",i0)-1;  ss1 = sss.Substring(i0,i1-i0+1);
          buf = ss1.Split(';');  n = buf.Length-1;
          for (int i = 1; i < n; i++) a[k0, i-1] = Convert.ToInt32(buf[i]);
          k0++; i0 = i1 + 2;
          if (i0 >= sss.Length) kod = false;
       }
      n--;
   }  }

private void button2_Click(object sender, EventArgs e)
{
   decimal hhhh;   int kkkk;
   b = a;
   int[] NNN = new int[50];  int SNN = n;
   if (Convert.ToByte(maskedTextBox1.Text) < 4) maskedTextBox1.Text = "4";
   if (Convert.ToByte(maskedTextBox1.Text) > 7) maskedTextBox1.Text = "7";
   jf = Convert.ToByte(maskedTextBox1.Text);
   for (int i = 0; i < 50; i++)
      {
      if (SNN < jf) { NNN[i] = SNN; SNN = 1; break; }
      NNN[i] = jf; SNN -= NNN[i];
```

```
         if (SNN == 0) { SNN = i + 1; break; }
         if (SNN <= i+1) { for (int j = 0; j < SNN; j++) NNN[j]++; SNN=i+1; break; }
         if (SNN < jf) { NNN[i + 1] = SNN; SNN = i + 2; break; }
          }
     for (int i = 0; i < n; i++) { b[i, i] = 0; Nc[i] = i + 1; }
     for (int i = 0; i < n; i++)
     {
        c[i] = 0;
        for (int j = 0; j < n; j++) c[i] += b[i, j];
        yc[i] = c[i] / (n - 1);
        c[i] = Math.Round(yc[i])*10;
     }
     for (int i = 0; i < n - 1; i++)
        for (int j = i + 1; j < n; j++)
        {
           if (yc[i] > yc[j])
           {
              hhhh = yc[i]; yc[i] = yc[j]; yc[j] = hhhh;
              hhhh = c[i]; c[i] = c[j]; c[j] = hhhh;
              kkkk=Nc[i]; Nc[i]=Nc[j]; Nc[j]=kkkk;
              for (int k = 0; k < n; k++)
              {
                 kkkk=b[i,k]; b[i,k]=b[j,k]; b[j,k]=kkkk;
              }
              for (int k = 0; k < n; k++)
              {
                 kkkk=b[k,i]; b[k,i]=b[k,j]; b[k,j]=kkkk;
              } } }
     int Nath = 0; int Kon = NNN[0]; Dl = NNN[0];
     for (int kop = 0; kop < SNN;kop++ )
     {
        bbb[0, 0] = 0;
        for (int i0 = 1; i0 <= Dl; i0++)
           for (int i1 = 1; i1 <= Dl; i1++)
              bbb[i0, i1] = b[Nath + i0 - 1, Nath + i1 - 1];
        for (int i0 = 1; i0 <= Dl; i0++)
           {
           bbb[i0,0]=0;
           for (int i1 = 0; i1 < Nath; i1++) bbb[i0, 0] += b[Kon + i0 - 1, i1];
           if (Nath > 0) bbb[i0, 0] = Math.Round(bbb[i0, 0] / Nath);
           }
        for (int i0 = 1; i0 <= Dl; i0++)
        {
           bbb[0, i0] = 0;
           for (int i1 = 0; i1 < Nath; i1++) bbb[0, i0] += b[i1,Kon + i0 - 1];
           if (Nath > 0) bbb[0, i0] = Math.Round(bbb[0, i0]/Nath);
           if (Nath == 0) bbb[0, i0] = 9;
        }
           for (int mmm = 1; mmm <= Dl; mmm++)
           {
```

```
                decimal func = 1000000, func0 = -10000; ;
                decimal ff, fg0 = 10000, fg1 = -10000, bb0, bb1, hhh, bmin=0,bmax=0;
                bool kod = true;
                while (XXXX0(ref kod))
                {
                   if (gg(Dl+1, mmm))
                   {
                      for (int i = 0; i <= Dl; i++) xxx[i, mmm] = false;
                      ff = 0; bb0 = 1000; bb1 = -1000;
                      for (int i = 0; i <= Dl; i++) for (int j = 0; j <= Dl; j++)
                         {
                          if (xxx[i, j])
                            {
                    if (bb0 > bbb[i, j]) bb0 = bbb[i, j];  if (bb1 < bbb[i, j]) bb1 = bbb[i, j];
                   ff += bbb[i, j];
                            }
                         }
                      hhh = ff * (bb1 - bb0);
                      if (hhh > fg1) { func = ff; fg1 = hhh; bmin = bb0; }
                      hhh = ff * (9-bb1 + bb0);
                      if (hhh < fg0) { func0 = ff; fg0 = hhh; bmax = bb1; }
                   }  }
      if (c[mmm+Nath-1] < 50) c[mmm+Nath-1] += Math.Round((func0 / Dl+bmax)/2);
      if (c[mmm+Nath-1] >= 50) c[mmm+Nath-1] += Math.Round((func / Dl+bmin)/2);
             }
          Nath = Kon;  Kon += NNN[kop + 1];  Dl = NNN[kop + 1];
       }

          decimal kk;
          for (int j = 0; j < n; j++)
          {
             kk = 0;
             for (int i = 0; i < n; i++) kk += b[i, j];
             yc[j] = (9 * (n - 1) - kk) / (n - 1);
             c[j] += Math.Round(yc[j]) * 1000;
          }

       for (int i = 0; i < n - 1; i++)
          for (int j = i + 1; j < n; j++)
          {
             if (yc[i] > yc[j])
             {
                hhhh = yc[i]; yc[i] = yc[j]; yc[j] = hhhh;
                hhhh = c[i]; c[i] = c[j]; c[j] = hhhh;
                kkkk = Nc[i]; Nc[i] = Nc[j]; Nc[j] = kkkk;
                for (int k = 0; k < n; k++)
                {
                   kkkk = b[i, k]; b[i, k] = b[j, k]; b[j, k] = kkkk;
                }
                for (int k = 0; k < n; k++)
```

```
                {
                   kkkk = b[k, i]; b[k, i] = b[k, j]; b[k, j] = kkkk;
                }
             }  }
          Nath = 0;  Kon = NNN[0]; Dl = NNN[0];
          for (int kop = 0; kop < SNN; kop++)
          {
             bbb[0, 0] = 0;
             for (int i0 = 1; i0 <= Dl; i0++)
                for (int i1 = 1; i1 <= Dl; i1++)
                   bbb[i0, i1] = b[Nath + i0 - 1, Nath + i1 - 1];
             for (int i0 = 1; i0 <= Dl; i0++)
             {
                bbb[i0, 0] = 0;
                for (int i1 = Kon; i1 < n; i1++) bbb[i0, 0] += b[Kon + i0 - 1, i1];
                if (Kon < n) bbb[i0, 0] = Math.Round(bbb[i0, 0] / (n-Kon));
                if (Kon == n) bbb[i0, 0] = 9;
             }
             for (int i0 = 1; i0 <= Dl; i0++)
             {
                bbb[0, i0] = 0;
                for (int i1 = Kon; i1 < n; i1++) bbb[0, i0] += b[i1, Kon + i0 - 1];
                if (Kon < n) bbb[0, i0] = Math.Round(bbb[0, i0] / (n-Kon));
                            }
             for (int mmm = 1; mmm <= Dl; mmm++)
             {
                decimal func = -1000000, func0 = 100000;
                decimal ff, fg0 = 10000, fg1 = -10000, bb0, bb1, hhh, bmax = 0, bmin = 0; ;
                bool kod = true;
                while (XXXX0(ref kod))
                {
                   if (g(Dl+1, mmm))
                   {
                      for (int i = 0; i <=Dl; i++) xxx[mmm, i] = false;
                      ff = 0; bb0 = 1000; bb1 = -1000;
                      for (int i = 0; i <=Dl; i++) for (int j = 0; j <=Dl; j++)
                         { if (xxx[i, j]) {
                           if (bb0 > bbb[i, j]) bb0 = bbb[i, j]; if (bb1 < bbb[i, j]) bb1 = bbb[i, j];
                            ff += bbb[i, j];
                            } }
                      hhh = ff* (9-bb1 + bb0);
                      if (hhh > fg1) { func = ff; fg1 = hhh; bmax = bb1; }
                      hhh = ff * (bb1 - bb0);
                      if (hhh < fg0) { func0 = ff; fg0 = hhh; bmin = bb0; }
                   }
                }
   if (c[mmm+Nath-1] >= 4100) c[mmm+Nath-1] += Math.Round(9  - (func / Dl+bmax)/2) *
100;
   if (c[mmm+Nath-1] < 4100) c[mmm+Nath-1] += Math.Round(9  - (func0 / Dl+bmin)/2) *
100;
```

```
                }
                Nath = Kon;  Kon += NNN[kop + 1]; Dl = NNN[kop + 1];
            }
              b_Click();
        }
         private bool STHETH0(bool kl)
        {
            if (kl) { for (int i = 0; i <= Dl+1; i++) jjc[i] = 0; return true; }
            else
            {
                jjc[0]++;
                for (int i = 0; i <= Dl + 1; i++)
                    if (jjc[i] >= Dl + 1) { jjc[i + 1]++; jjc[i] = 0; }
                        else break;
                if (jjc[Dl+1] == 1) return false;
                else return true;
            }
        }
        private bool XXXX0(ref bool kod)
        {
            bool ku;
            if (kod) { ku = STHETH0(true); kod = false; }
            ku = STHETH0(false);
            do
            {
                for (int i = 0; i <= Dl; i++) for (int j = 0; j <= Dl; j++) xxx[i, j] = false;
                for (int i = 0; i <= Dl; i++) xxx[jjc[i], i] = true;
                for (int i = 0; i <= Dl; i++) { int kt = 0; for (int j = 0; j <= Dl; j++) if (xxx[i,
j])kt++; if (kt != 1) goto da; }
                return true;
            da: ku = STHETH0(false);
            } while (ku);
            return ku;
        }
        private void b_Click()
        {
                int kkkk; decimal hhhh; string FileName;   int i1 = FFF.LastIndexOf(".");
                StreamReader frr = new StreamReader(FFF);
                FFF = FFF.Substring(0, i1);  FFF += ".out"; FileName = FFF;
                StreamWriter fr = new StreamWriter(FileName);
                string st = "", st1;
                while ((st1 = frr.ReadLine()) != null) st += st1 + "\r\n";
                frr.Close();
                st += "\r\n\r\n";
                string sas;
                for (int i = 0; i < n-1; i++)
                    for (int j = i+1; j < n; j++)
                    {
                        if (Nc[i] > Nc[j])
                          {
```

```
                    kkkk = Nc[i]; Nc[i] = Nc[j]; Nc[j] = kkkk;
                    hhhh = c[i]; c[i] = c[j]; c[j] = hhhh;
                  }
            }
         for (int i = 0; i < n ; i++) { sas = String.Format("{0,4:0000}",c[i]);
                     st += Convert.ToString(Nc[i]) + ".  " + sas + "\r\n"; }
         decimal ggg = 0, ggg1 = 0,gggm=0,gggp=0,ggg0=0;
         decimal[] C0 = new decimal[200];
         for(decimal ikk=1000; ikk>=1; ikk=Math.Round(ikk/10))
      {
         ggg = 0;
         for (int i = 0; i < n; i++)
           {
              C0[i] = c[i] % ikk; c[i] = Math.Floor(c[i] / ikk);
           }
         for (int i = 0; i < n; i++) ggg += c[i];
         ggg = Math.Round(ggg/n);
         for (int i = 0; i < n; i++)
            ggg1 += (ggg - c[i]) * (ggg - c[i]);
ggg1 = Math.Round(Convert.ToDecimal(Math.Sqrt(Convert.ToDouble(ggg1))/(n-1)));
 ggg0 += ggg * ikk;  gggm += (ggg - ggg1)*ikk;  gggp += (ggg + ggg1)*ikk;
         for (int i = 0; i < n; i++) c[i]=C0[i];
      }
         sas = "\r\n\r\n-----      " + String.Format("{0,4:0000}", gggm) + "\r\n";
         st += sas;
         sas = "00000     " + String.Format("{0,4:0000}", ggg0) + "\r\n";
         st += sas;
         sas = "+++++    " + String.Format("{0,4:0000}", gggp) + "\r\n";
         st += sas;
          fr.Write(st);
         fr.Close();
    }
    public bool gg(int a, int n)
    {
       int i;   z[0] = n;   int m = n; bool kk = true;
         for (i = 1; i < a; i++)
      {
         for (int j = 0; j < a; j++)
         if (xxx[m,j])
            {
             m = j; z[i] = j; goto a2;
            }
       kk = false; return kk;
       a2: for (int ii = 0; ii < i - 1; ii++)
                if (z[ii] == m) return false;
      }
       return kk;
    }
    public bool g(int a, int n)
    {
```

```
int i;  z[0] = n;   int m = n;  bool kk = true;
 for (i = 1; i < a; i++)
{
   for (int j = 0; j < a; j++)
     if (xxx[j,m]) {  m = j; z[i] = j; goto a2; }
kk = false; return kk;
a2: for (int ii = 0; ii < i - 1; ii++)
             if (z[ii] == m) return false;
}
return kk;
} }}
```

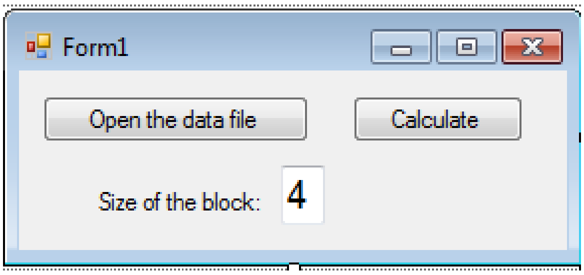

Fig. 3. Dialog window of the program
Rys. 3. Okno dialogowe programu

When you run the program it has the only dialog window in Figure 3. When you push the button "to open the data file," the reading if the matrix data from file is performed. When you push the button "calculate", the calculation and recording of the results to a file with a name that is identical to the data file into the same folder are performed. The number "size of the block" is indicated before calculation and means the length of the block clustering. Then smaller this number, then greater is the accuracy and less the calculation time. The maximum block length is limited by the conditions of the time of getting result.

The data file contains a list of a group and a matrix of relationships typed in a notebook. An example of the data file is shown in Listing 2.

Listing 2.

<Persone>

1. Ivanov Ivan Ivanovich

2. Petrov Petr Petrovich

3. Cidorov Cidor Cidorovich

4. Krivitski Nikolya Evgen’evich

5. Ermakov Eremej Pavlovich

6. Glaburda Irina Nikolaevna

</Persone>

<matrix>

0 ; 1; 2 ; 3 ; 4; 5 ; 6 ;

1 ; 0; 8 ; 8 ; 5; 4 ; 6 ;

2 ; 9; 0 ; 6 ; 4 ; 0 ; 6 ;

3 ; 9; 9 ; 0 ; 5 ; 7 ; 7 ;

4 ; 9; 9 ; 9 ; 0 ; 4 ; 8 ;

5 ; 6; 4 ; 9 ; 5 ; 0 ; 6 ;

6 ; 7; 9; 7 ; 6 ; 5 ; 0 ;

</matrix>

As its final results, the program displays the list of the four-digit numbers for the each party to the file with the extension .out inside the folder that contains the executable code.

The proposed program was reliably tested and validated on the data from a group of 26 students. The test was based on survey of all students in the group, who were given an identical questionnaire with the single question: "Set as a score from 0 to 9 the usefulness of the business relationships with each of the students (0 - no business relationships, 9 - business relationships are extremely useful for me). The final result correlates very well with the practical observations of the group during a period of 6 months [5].

The methods of calculating the measure of emergence can be used not only for a group of students, but also for the definition of the rate of emergence in any collective system.

SUMMARY

The computer programme was developed, which enables to determine the ranking of dependencies among all members of the group. The programme was tested by the use of a few examples and can be used in practical implementations.

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POMIAR POWSTAWANIA RELACJI W OBRĘBIE GRUPY LOGISTYCZNEJ

STRESZCZENIE. **Wstęp:** Istota zależności pomiędzy członkami grupy jest ważnym elementem spójności procesu logistycznego. Identyfikacja oceny poszczególnych uczestników jest bez wątpienia najważniejszym warunkiem zapewnienia jakości procesu logistycznego. Można wyróżnić cztery rodzaje ocen relacji: bezpośredniego uczestnictwa, bezpośredniego wpływu, uczestnictwa oraz wpływu.
Celem pracy było opracowanie metody ustalania wzajemnych zależności pomiędzy poszczególnymi elementami grupy logistycznej.
Metody: Zastosowana metoda jest oparta na macierzy wzajemnych interakcji, jakie zostały otrzymane w wyniku badania ankietowego, obejmującego wszystkich członków grupy i przedstawionego wartościowo na podstawie przyjętej skali pomiarowej. Algorytm wyliczeniowy został w głównej mierze oparty na problemie przedstawiciela handlowego w podróży służbowej jak oryginalna metoda optymalizacji przy użyciu Visual Studio C #.
Wyniki: Zostało zidentyfikowanych i opisanych 16 typów przywódczych poprzez zastosowanie odpowiednich metod statystycznych.
Wnioski: Uzyskana metoda oceny może być stosowana nie tylko w przypadku grupy studentów ale również w każdym innym złożonym systemie.

Słowa kluczowe: powstanie, ocena wpływu, ocena uczestnictwa, ocena bezpośredniego wpływu, ocena bezpośredniego uczestnictwa, problem przedstawiciela handlowego w podróży, wykres dedykowany, prosty profil, system złożony, współpraca logistyczna, typy przywódców.

RELATIONSENTSTEHUNG UND DEREN MESSUNG INNERHALB EINER LOGISTIK-GRUPPE

ZUSAMMENFASSUNG. Einleitung: Das Wesen der gegenseitigen Abhängigkeiten zwischen den Mitgliedern einer Gruppe stellt ein wichtiges Element der Kohärenz eines logistischen Prozesses dar. Die Ermittlung und Beurteilung dessen einzelnen Teilnehmer bildet zweifelsohne die wichtigste Voraussetzung für die Gewährleistung der Qualität innerhalb jedes Logistik-Prozesses. Die Beurteilung der einzelnen auftretenden Relationen lassen sich in vier Arten unterscheiden: als direkte Beteiligung, direkte Beeinflussung, Beteiligung, Beeinflussung.
Das Ziel der Arbeit war es, eine Methode für die Festlegung von gegenseitigen Abhängigkeiten zwischen den einzelnen Bestandselementen einer Logistik-Gruppe auszuarbeiten.
Methoden: Die angewandte Methode stützt sich auf die Matrix der gegenseitigen Zusammenhänge, die anhand eines Umfrage-Verfahrens, welches alle Mitglieder der Gruppe umfasst und wertmäßig auf Grund einer in Anspruch genommenen Messungsskala projiziert wird, ermittelt wurden. Der Logarithmus für die erfolgte Messung bezog sich hauptsächlich auf den Fall eines auf Dienstreisen befindlichen Handelsvertreters, wobei dafür das Programm des Visual Studio C # als originale Optimierungsmethode angewendet wurde.
Ergebnisse: Es wurden 16 Leader-Typen unter Anwendung unterschiedlicher statistischer Methoden identifiziert und beschrieben.
Fazit: Die ausgearbeitete Bemessungsmethode kann nicht nur im Falle einer Studentengruppe, sondern auch in jedem komplexeren System angewendet werden..

Codewörter: Entstehung, Beurteilung einer Beeinflussung, Beurteilung einer Beteiligung, Beurteilung einer direkten Beeinflussung, Beurteilung einer direkten Beteiligung, Problemfall eines auf Dienstreise befindlichen Handelsvertreters, einfaches Profil, komplexes System, logistische Interaktion, Leader-Typen.

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