International Journal of Trend in Scientific Research and Development (IJTSRD)

International Open Access Journal

ISSN No: 2456 - 6470 | www.ijtsrd.com | Volume - 1 | Issue – 5

The Elaboration Algorithm for Selectionand Functions Distribution of Multifunctional Personnel

Irakli Basheleishvili
Department of Computer Technology
AkakiTsereteli State University, Kutaisi, Georgia

Sergo Tsiramua
School of IT, Engineering and Mathematics
University of Georgia, Tbilisi, Georgia

ABSTRACT

The work refers to elaboration of model selection and functions distribution of multifunctional personnel; It contains a detailed described algorithm for the optimal selection and functions distribution of the multifunctional personnel. The results of the work of algorithm are presented on thedifferenttype matrix of functional capabilities.

Keywords: *Multifunctionalpersonnel, matrix of Functional capacities, selection, functions distribution, algorithm, Optimal*

I. Introduction

Multifunctional Operator (MFO) is called a specialist with a Functional abundance who has the ability to perform one definite f function in the timing of its functional capacities

$$F_a = \{f_e / e \in [1,k]\},\ k>1 \quad (1)$$

Compared to monofunctional operator,multifunctional operators allow us to create organizational structures of systems that have ability, in case of partial failure of any specialist, to re-adjust the whole system and facilitate its successful functioning[1,2,3].

The partial failure of the MFO is the case when he/she loses the ability to perform the function assigned to him/her but maintains the ability to perform other functions imposed on the system based on his/her functional capabilities and may be altered to perform other functions. [1-6] It has been shown in the work that multifunctional staff has a much higher performance indicator than a system composed by mono functional specialists.

II. Problem Definition

We need to develop an algorithm that provides multifunctional personnel optimal selection and functions distribution based on the matrix of functional capabilities [1,3].

The functional capability matrix is the result of the assessment of the personnel that is organized by matrix. It contains the probability of each Personnel to perform each function. The functional capability matrix has the following format:

$$\begin{array}{c} \\ a_1 \\ a_2 \\ \ldots\ldots \\ a_{m-1} \\ a_m \end{array} \begin{array}{c} \begin{array}{ccccc} f_1 & f_2 & \ldots\ldots & f_{n-1} & f_n \end{array} \\ \begin{pmatrix} p_1(f_1) & p_1(f_2) & \ldots\ldots & p_1(f_{n-1}) & p_1(f_n) \\ p_2(f_1) & p_2(f_2) & \ldots\ldots & p_2(f_{n-1}) & p_2(f_n) \\ p_i\ldots\ldots & \ldots\ldots & \ldots\ldots & \ldots\ldots & \\ p_{m-1}(f_1) & p_{m-1}(f_2) & \ldots\ldots & p_{m-1}(f_{n-1}) & c_{m-1,n-1} \\ p_m(f_1) & p_m(f_2) & \ldots\ldots & p_{m-1}(f_{n-1}) & p_m(f_n) \end{pmatrix} \end{array} \quad (2)$$

Where

$a_i, i = 1,..,m$ - Personnel (human-operator);

$f_j\ , j = 1,..,n$- Functions;

Whereas $p_i(f_j)$ is a probability of the performance by personnela_i Of the function f_j from the set (1).

The matrix of the functional capability is mxn size, which should satisfy the following condition n <= m, because selection and function distribution are required to perform the number of personnel more or equal to the number of functions**.**

III. Matematical model of selection and functions distribution

Structure of selection and functions distribution problem is similar to the structure of the assignment problem.

The assignment problem is one of the fundamental combinatorial optimization problems in the branch of optimization or operations research in mathematics.

Selection and functions distribution problem:

$$\prod_{i=1}^{m}\prod_{j=1}^{n} p_i(f_j)x_{ij} \rightarrow \text{Max} \quad (3)$$

Where

$$\sum_{j=1}^{n} x_{ij} = 1, i = 1, \dots, m$$

$$\sum_{i=1}^{m} x_{ij} = 1, j = 1, \dots, n$$

$$x_{ij} = \begin{cases} 1, if\ i\ operator\ assigned\ j\ function \\ 0, \ if\ i\ operator\ not\ assigned\ \ j\ function \end{cases}$$

We use the Hungarian algorithm for the personnel selection and functions distribution.

The Hungarian method is a combinatorial optimization algorithm that solves the assignment problem in polynomial time and which anticipated later primal-dual methods. It was developed and published in 1955 by Harold Kuhn, who gave the name "Hungarian method" because the algorithm was largely based on the earlier works of two Hungarian mathematicians: DénesKőnig and JenőEgerváry.[6-8] James Munkres reviewed the algorithm in 1957 and observed that it is (strongly) polynomial.[6-8] Since then the algorithm has been known also as the Kuhn–Munkres algorithm or Munkres assignment algorithm.

IV. Algorithm for Selection and Functions Distribution of Multifunctional Personnel

Steps of the algorithm for the selection and functions distribution of multifunctional personnel:

Step 1: In matrix of functional capabilities each element multiplicationon (-1). Go to Step 2;

Step2: Find the element whose absolute (abs) value is the most max and add the found value to every element in the matrix. Go to Step 3;

Step 3: Make the matrix a square matrix, to fill it with the column of zero elements. Go to Step 4;

Step 4: For each row, find the lowest element and subtract it from each element in that row. Go to Step 5;

Step5: For each column, find the lowest element and subtract it from each element in that column.Go to Step 6;

Step6: Cover all zeros in the resulting matrix using a minimum number of horizontal and vertical lines. If m lines are required, an optimal assignment exists among the zeros. The algorithm stops. If less than m lines are required, continue with Step 7.

Step 7: In the resulting matrixfind the smallest element that is not covered by a line in Step 6. Subtract found element from all uncovered elements, and add to all elements that are covered twice.Go to Step 6;

The algorithm presented in the work is implanted in the programming language c #.

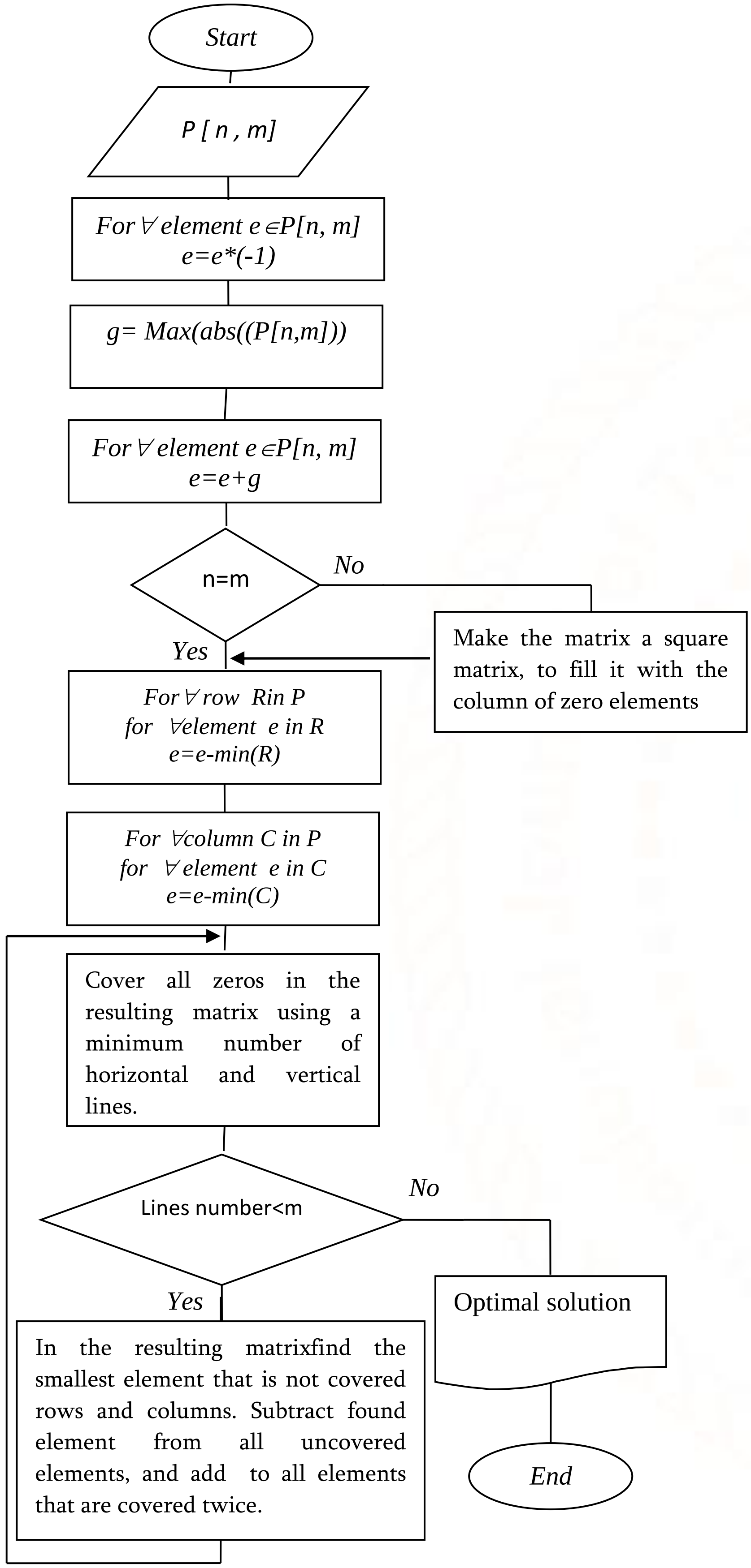

Fig 1: Algorithm block flow diagram

Consider the performance of the algorithm on a variety of functional capacities matrix:

a) Table 1. matrix of functional capacities 6x6

	f_1	f_2	f_3	f_4	f_5	f_6
a_1	0.8	0.7	0.74	0.6	0.7	0.9
a_2	0.7	0.58	0.71	0.87	0.95	0.6
a_3	0.84	0.95	0.75	0.85	0.9	0.74
a_4	0.84	0.41	0.89	0.7	1	0.6
a_5	0.69	0.86	0.47	0.96	0.74	0.5
a_6	0.6	0.58	0.75	0.69	0.85	0.47

	f1	f2	f3	f4	f5	f6
a1	0,8	0,7	0,74	0,6	0	0,9
a2	0,7	0,58	0,71	0,87	0,95	0,6
a3	0,84	0,95	0,75	0,85	0,9	0,74
a4	0,84	0,41	0,89	0,7	1	0,6
a5	0,69	0,86	0,47	0,96	0,74	0,5
a6	0,6	0,58	0,75	0,69	0,85	0,47

Fig 2: Program execution result

The selection and the functions distribution have the following look:

$$a_4 \rightarrow f_1;$$
$$a_3 \rightarrow f_2;$$
$$a_6 \rightarrow f_3$$
$$a_5 \rightarrow f_4$$
$$a_2 \rightarrow f_5$$
$$a_1 \rightarrow f_6$$

b)

Table 1: matrix of functional capacities 6x3

	f_1	f_2	f_3
a_1	0.8	0.7	0.74
a_2	0.7	0.58	0.71
a_3	0.84	0.95	0.75
a_4	0.84	0.41	0.89
a_5	0.69	0.86	0.47
a_6	0.6	0.58	0.75

	f1	f2	f3
a1	0,8	0,7	0,74
a2	0,7	0,58	0,71
a3	0,84	0,95	0,75
a4	0,84	0,41	0,89
a5	0,69	0,86	0,47
a6	0,6	0,58	0,75

Fig.3 Program execution result

The selection and the functions distribution have the following look:

$$\boldsymbol{a_1 \rightarrow f_1;}$$
$$\boldsymbol{a_3 \rightarrow f_2;}$$
$$\boldsymbol{a_4 \rightarrow f_3;}$$

c)

Table 3: matrix of functional capacities 6x4

	f_1	f_2	f_3	f_4
a_1	0.8	0.7	0.74	1
a_2	0.7	0.58	0.71	0.9
a_3	0.84	0.95	0.75	0.8
a_4	0.84	0.41	0.89	0.7
a_5	0.69	0.86	0.47	0.9
a_6	0.6	0.58	0.75	1

	f1	f2	f3	f4
a1	0,8	0,7	0,74	1
a2	0,7	0,58	0,71	0,9
a3	0,84	0,95	0,75	0,8
a4	0,84	0,41	0,89	0,7
a5	0,69	0,86	0,47	0,9
a6	0,6	0,58	0,75	1

Fig.4 Program execution result

The selection and the functions distribution have the following look:

$$\boldsymbol{a_1 \rightarrow f_1;}$$
$$\boldsymbol{a_3 \rightarrow f_2;}$$
$$\boldsymbol{a_4 \rightarrow f_3}$$
$$\boldsymbol{a_6 \rightarrow f_4;}$$

V. CONCLUSION

The proposed algorithm for selection and functions distribution of personnel allows Implementation multifunctional personnel the optimal selection and functions distribution.

The algorithm is designed to be used successfully in the personnel evaluation and selection computer system.

REFERENCES:

[1]. I. Basheleishvili. Management Information System of Multifunctional Personnel Assessment. VIII International Scientific and Practical Conference "Internet and Society". Kutaisi, 2017. Pp. 161-165

[2]. S. Tsiramua, I. Basheleishvili. Model of Reliability of Structural Reconfiguration Multifunctional Systems. VII International Scientific and Practical Conference "Internet and Society". Kutaisi, 2015. Pp. 175-178

[3]. S.Tsiramua. Computer System of Evaluation and Management of Multi-functional Staff of Agricultural Units. Perspectives of Modern Information and Communication Systems in Agriculture, Food Production and Environmental Control (Volume B). Second European Conference of the Federation for Information Technology in Agriculture, Food and the Environment. September 27-30, 1999, Bonn, Germany. pp. 819-827.

[4]. Tsiramua S.G., Kashmadze R.V. Designing of Highly Effective "Human-Computer" Systems, Based on Multifunctional Elements. Proceedings of the Fifth International Conference on Human-Computer Interaction, Orlando, Florida, 1993.

[5]. Tsiramua S.G, Chikashua E.A., Tsiramua Z.G. Logical-Probabilistic Modeling, Optimization and Analysis. Computing and Computational Intelligence. Proceeding of the European Computing Conference (ECC '09). Proceeding of the 3rd International Conference on Computational Intelligence (CI '09). Tbilisi. 2009. P. 345-347.

[6]. Murthy Rama P. OPERATIONS RESEARCH.Published by New Age International (P) Ltd., Publishers, .2007

[7]. Wayne L. Winston, Operations Research AP P L ICAT ION S AND ALGORITHMS, FOURTH EDITION. 2004.

[8]. https://en.wikipedia.org/wiki/Hungarian_algorithm