INTER–ORGANIZATIONAL COLLABORATIVE CAPACITY OF PUBLIC SECTOR INSTITUTIONS'CONTROL ENTITIES IN EMERGENCY SITUATIONS

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Environmental challenges and natural disasters demand new tools to support the performance of public institutions in emergency situations. This paper contributes to one of the fundamental objectives – inter–organizational collaboration, namely to the objective to share experience from the implementation of methods and tools and latest research results in support of management in the new security environment. In addition, it focuses on the cognitive and human aspects of collaboration. The goal of the paper is to investigate the impact of different factors and tools for understanding, explaining, and measuring collaborative capacity of public sector institutions' control organism in emergency situations. The paper will present intermediate results from the research on "Inter–organizational collaborative capacity of public sector institutions' control entities in emergency situations". Based on a theoretical model, a draft instrument was developed (i.e., a questionnaire) for data collection that can be used to 1) investigate the impact of different factors, 2) localize inefficiencies in public sector institutions' control organs, and 3) determine measures to achieve better organizational effectiveness of public sector institutions' control entities in emergency situations.

Key words: *collaboration, collaborative capacity, means, Surface Measurement Overall Performance.*

1. INTRODUCTION

Emergency management is one of the main tasks of the Bulgarian government aimed at protecting the population from the impact of natural disasters and accidents and liquidation of their consequences. This activity involves the structures of central and local government as well as non–governmental organizations, such as the Red Cross and others. Historically, the management of emergency situations has always required consolidation of efforts of all relevant actors in order to achieve the desired effect in protecting the population.

This paper studies the control entities of the three Bulgarian organizations that have roles and responsibilities to protect the population in emergency situations, namely the Ministry of Defence with its structures at strategic and operational level, the Ministry of Interior primarily through the General Directorate Fire Safety and protection of the population (GDFSPP), and the central leadership of the Bulgarian Red Cross (BRC). The methodology used aims to assess the organizational factors for inter–organizational collaborative capacity of control entities dealing with emergency management in these three departments and their dependence on operational objectives and environmental factors.

A questionnaire was used to conduct empirical research. Measurement was done on a 6–degree Likert scale. The scales used for measuring the variables are in a pattern that covers hypothetically the main factors influencing the process of cooperation.

The reliability of the scales was checked after calculating Cronbach's alpha. In search of empirical confirmation of the reliability of the method and proof of its validity a factor analysis was conducted. To determine the relationships between the input variables and the level of cooperation between organizations, a regression analysis, analysis of variance (ANOVA), post hoc Tukytest and correlation analysis were used.

2. INTER-ORGANIZATIONAL COLLABORATIVE CAPACITY

Interorganizational collaborative capacity depends on 13 factors that are associated with the five organizational domains, described in the model of Galbraith [1] for effective organization and adapted by Hosevar, Thomas and Jensen [2]. Each of these domains is associated with a different number of factors influencing the collaboration, represented as follows:

- Purpose and Strategy – Felt Need to Collaborate, Strategic actions for collaboration and Resource Investment in Collaboration;
- Processes – Collaborative Learning, Collaborative Tools and Technologies, Social capital and Information sharing;
- Incentive &Rewards System – Rewards and Incentives;
- Structure – Structural flexibility, Support for individual collaboration efforts, Metrics for collaboration and Collaboration Structures;
- People – Individual Collaborative Capacities.

The values of factors derived from empirical study are shown in Tables 1,2 and 3 and they refer respectively to the Ministry of Defence, the Ministry of Interior and the Bulgarian Red Cross (BRC).

Table 1. Results– Ministry of Defence control organs

Scale	Mean	Standard deviation	t–value	# questions	Cronbach's Alpha
Felt Need to Collaborate	4.76	1.16	–0.050	5	0.88
Strategic actions	3.91	1.29	–0.109	5	0.86
Resource Investment in Collaboration	3.78	1.46	–0.777	3	0.80
Structural flexibility	4.08	1.33	–1.238	4	0.88
Rewards and Incentives	2.87	1.37	–0.319	4	0.94
Metrics for collaboration	4.05	1.38	–1.108	3	0.87
Information sharing	3.87	1.35	–1.463	3	0.88
Collaborative Learning	3.13	1.34	–0.770	5	0.84
Social capital	4.04	1.50	–0.535	3	0.84
Individual Collaborative Capacities	4.28	1.20	–0.299	7	0.88
Support for individual collaboration efforts	4.03	1.41	–0.572	4	0.87
Collaboration Structures	3.84	1.41	–1.213	3	0.85
Collaborative Tools and Technologies	3.49	1.41	–1.604	3	0.84

Table 2. Results– Ministry of Interior control organs

Scale	Mean	Standard deviation	t–value	# questions	Cronbach's Alpha
Felt Need to Collaborate	4.92	1.39	1.849	5	0.86
Strategic actions	4.22	1.58	0.244	5	0.82
Resource Investment in Collaboration	3.79	1.55	1.511	3	0.61
Structural flexibility	3.79	1.65	–0.442	4	0.83
Rewards and Incentives	2.87	1.65	0.822	4	0.81
Metrics for collaboration	3.71	1.67	2.587	3	0.86
Information sharing	4.15	1.35	1.757	3	0.65
Collaborative Learning	3.35	1.47	0.122	5	0.93
Social capital	3.96	1.49	–0.821	3	0.77
Individual Collaborative Capacities	4.55	1.36	0.868	7	0.87
Support for individual collaboration efforts	3.48	1.60	0.767	4	0.88
Collaboration Structures	4.18	1.48	–0.208	3	0.80

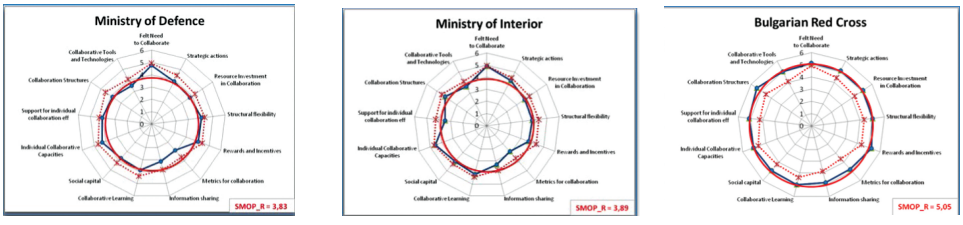
Table 3. Results– Bulgarian Red Cross control entities

Scale	mean	Standard deviation	t–value	# questions	Cronbach's Alpha
Felt Need to Collaborate	5.14	0.80	–0.196	5	0.72
Strategic actions	5.10	0,77	–0.444	5	0.62
Resource Investment in Collaboration	5.10	0.87	0.077	3	0.85
Structural flexibility	5.03	0.72	–0.510	4	0.67
Rewards and Incentives	4.77	0.95	0.234	4	0.88
Metrics for collaboration	5.23	0.81	0.278	3	0.77
Information sharing	4.99	0.62	0.829	3	0.51
Collaborative Learning	4.81	0.81	–0.067	5	0.79
Social capital	4.90	0.70	–0.794	3	0.77
Individual Collaborative Capacities	5.06	0.80	–1.381	7	0.82
Support for individual collaboration efforts	5.12	0.67	–0.118	4	0.54
Collaboration Structures	5.42	0.70	–0.735	3	0.75
Collaborative Tools and Technologies	5.01	0.75	0.711	3	0.02

The series of block diagrams depict the values of the thirteen factors for both institutions — the Ministry of Defence and the Ministry of Interior — and the NGO the Bulgarian Red Cross and graphically illustrate the profile of the ability to cooperate with the surveyed control entities– the blue polygon. In block diagram no. 1 the arithmetic average is shown – the dotted polygon, and the circumradius of the Surface Measurement Overall Performance – (SMOP_R – radius of the circumcircle).

The mean is the average of the three organizations and the circle refers to the disputed organization. It crosses the axis at the points where the indicators would be situated if they were equal (but not necessarily equal to the mean of the organizations or mechanical mean of the scale – 3.5).

Analyzed indicators –Block–graphic no.1



The assessment methodology which Hosevar, Thomas and Jensen [2, 3] have used takes for a boundary the middle of the measurement scale that is the mechanical mean, which in this case is 3.5. The mechanical mean of the scale (3.5) is not indicative. Moreover, this is not a natural mean. In addition, if respondents evaluate other organizations or know that someone else is going to assess their organizations, they have a natural tendency to overestimate their organization "to make it a leader".

Psychologically, a comparison with the mechanical average is not justified also because of the natural tendency to get oriented according to the mean and to give assessment mainly on one side of the scale. It would be different if things were measured independently from the attitude of the evaluator.

It can be assumed that a comparison with the average for the system of the Republic of Bulgaria (including all organizations) is more indicative for several reasons:

1. It eliminates the effect of overestimation (underestimation) of organizations. The comparison between organizations could be done since all are equally undervalued (overvalued). Overestimation (underestimation) may be due to the "psychology" (we are all Bulgarians), also due to misinformation and misunderstanding of the aims and objectives – "qualities" that are also (perhaps) equally distributed.

2. If we compare to the value of 3.5, it may seem that all are "above average" and there is nothing to improve, but this is hardly the case and hardly anyone would benefit from such a delusion. It would be more indicative to make a comparison to the average of all organizations instead to the mechanical medium.

3. It is also significant that a formula may be offered to what extent an organization must improve its assessment of

the respective indicator to reach the average (not the average at the moment, but a new average in the future). Here, we take into account that improving the value of a specific organization, we raise the average level.

Let us assume that f_i, $i=1, 2,...n$ are values of the factor f for each of n organisations, and $\bar{f}$ is the mean at the current moment. Supposedly, $f_k < \bar{f}$, i.e. the k–th organisation is lagging behind compared with the mean.

The goal is to define Δf_k — the required increase in the value of the factor of the k–th organisation so that f_k' — the new value of the factor k is equal to the new mean ($f_k' = f_{new}$). It is obvious that

$$\Delta_\kappa = \frac{n}{n-1}\left(\bar{f} - f_\kappa\right) \quad (1)$$

It is obvious that

$$\bar{f}_{new} = \frac{f_k' + \Sigma_{i=1}^{n} f_i}{n} = \frac{f_{new} + \Sigma_{i=1}^{n} f_i}{n} \quad (2)$$

It follows that

$$\bar{f}_{new} = \frac{\Sigma_{i=1}^{n} f_i}{n-1} = f_k' \quad (3)$$

and finally

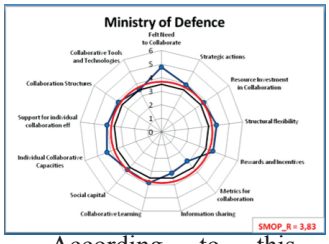
$$\Delta f_1 = \bar{f}_{new} - f_k = \frac{\Sigma_{i=1}^{n} f_i}{n-1} - f_k \quad (4)$$

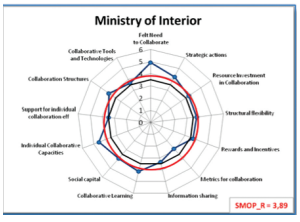
Here is another argument in favor of a comparison with the average for all organizations, not the mechanical average 3.5 – in order to reach the national average (the average for all organizations, including the researched) the arithmetic average of other organizations should be reached.

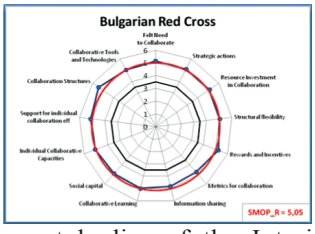
Despite the above mentioned, graphics and **Block no. 2** will be presented with mechanical average of scale – 3.5 –a thick black polygon; SMOP_R (radius of the circumcircle) – a red circle. This was done to compare with block graphics no.1, where the arithmetic average of the three organizations is shownwhich clarifies how the number of factors–barriers for collaboration was changed as a result of the method used for measurement. For the purpose of this survey an average mechanical 3.5 will be used as a criterion, as for the first time similar studies are conducted in Bulgaria and not enough number of organizations have yet been tested to have a reliable medium for the system of the Republic of Bulgaria to be used for a criterion.

The profile of collaboration capabilities –the blue polygon, depicted in the diagram, shows us which factors are barriers. Where the values of the factors are under the criterion of mechanical average marked with black polygon drawn of level 3.5, we have an indication of barriers to collaboration. Because their values are lower than the benchmark, we assume that these are the factors which would most impede collaboration. Specifically for authorities of MoD these are *rewards and incentives, collaborative learning, collaborative tools and technologies*. The graph shows the factors that are above the level of 3.5, but are very close to that limit, which is an indication to other not well developed capabilities for collaboration, such as *social capital and resource investment in collaboration.*

Analyzed indicators – Block–graphic no.2







According to this methodology, factors–barriers for control entities of the Ministry of Interior are also *rewards and incentives*, *collaborative learning*, and unlike the authorities of MoD *support of individual collaboration efforts*. The management bodies of the Interior Ministry have a number of factors beyond the criterion of 3.5, but are very close to it – the *collaborative tools and technology, resource investment in collaboration*, *structural flexibility and metrics for*

collaboration. These factors also could hinder cooperation.

3. INTER-ORGANIZATIONAL COLLABORATION RESEARCH RESULTS

The results of the five areas examined are shown in **Table 4** and in Figures 1, 2 and 3. All values with the exception of the system for remuneration are over 3.5, indicating agreement with the statements that characterize the ability for cooperation. The highest capacity for cooperation through the individual abilities of their employees have the management bodies of the MoD and MoI, forming domain **People**, while the employees of BRC have the highest scores in domain **Structure** and the value in the domain **People is** higher than in the other two bodies. This is understandable in the light of the high results obtained by BRC as a whole. The lowest score of the governing bodies of the Red Cross – 4.77 is much higher than the highest scores of the MoD and MoI.

Table 4. Inter–organizational collaboration research results

Domain	MoD		MoI		BRC	
	mean	Standard deviation	mean	Standard deviation	mean	Standard deviation
Purpose and Strategy	4.15	1.30	4.31	1.50	5.11	0.81
Processes	3.56	1.40	3.78	1.45	4.93	0.72
Incentive & Rewards System	2.87	1.37	2.87	1.65	4.77	0.95
Structure	4.00	1.38	3.79	1.60	5.20	0.72
People	4.28	1.20	4.55	1.36	5.06	0.80

The overall values of the variables that characterize the areas of cooperation in the Defence and Interior Ministries are very close. The charts given as an illustration of statistical calculations with very few exceptions follow the same profile which indicates the existence of similar factors contributing to the development of cooperation and those hindering it (see **Figures 1 and 2**).

To answer the question of the size of cooperation capacity, an overall composite indicator must be designed combining the values of individual domains in one value. The most widespread method to achieve this is the linear summation of indicators for all organizational areas. However, this method brings with it some undesirable characteristics of additive aggregation.

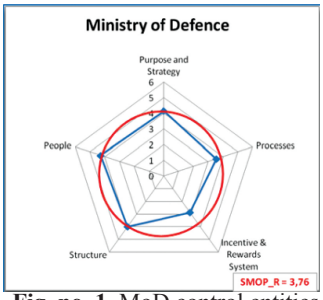


Fig. no. 1. MoD control entities

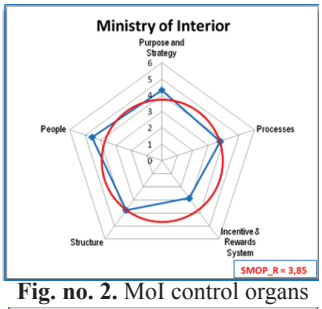


Fig. no. 2. MoI control organs

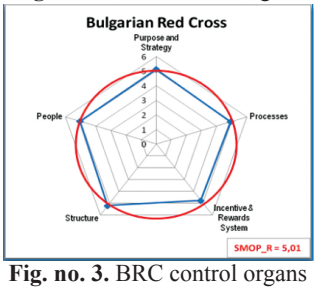


Fig. no. 3. BRC control organs

For example, the extremely low values of some parameters can be compensated by high enough values of other indicators. A possible solution to this problem could be geometric aggregation because it does not allow such a large compensation. As an alternative solution to this problem, however, another method will be applied which is suitable for the purposes of this study – the so–called Surface Measurement Overall Performance (SMOP), developed by Mihailov [1]. The method allows weighing of all constructs, however here will be used equal weights. This means that all dimensions of cooperation capacity are of equal importance.

The idea of calculating the overall composite indicator as surface measurement is suggested by radar charts. The values of individual group indicators are applied on a beam radar chart and the value of the composite indicator is equal to the surface closed by the chart. The method of Surface Measurement

Overall Performance (SMOP) is convenient and simple to build composite indicators but has some drawbacks. It should be noted that the method is useful when the values are positive and are measured according to the same scale, while at the same time they are not weighed because the use of different scales and weights lead to a different scale for the various rays of the diagram.

Another problem is the lack of invariance in respect to the sequence of the rays. In this case, all the values of the private indicators are positive, which makes the method applicable to this feature. With regard to the second flaw, it is the reason for the results from the surface representation to depend not only on the values of group performance but on their sequence along the axes of the chart as well. The problem with the lack of invariance in terms of the arrangement of the axes has a simple solution–it is sufficient to calculate the average area of all polygons, namely of polygons that are formed at all the possible permutations of the axes. Mihailov suggests the following formula for calculating the average size:

$$S_{cp} = \frac{1}{n-1}\sin\frac{2\pi}{n}\sum_{\{i;j\}\in C} w_i I_i w_j I_j \qquad (5)$$

where n is the number of group indicators (number of axes), I_i and I_j, $i \neq j$ are the values of the group indicators, and w_i and w_j are their weights. The summation is of the set C of all unordered pairs of indicators $\{i;j\}$. (The set C includes all k–combinations of n elements, $k=2$). Obviously, the lack of invariance deprives SMOP method of graphical presentation of results on a radar chart, which can be considered as a disadvantage. It would be better if the calculated composite indicator was standardized and Z–transformation is a good solution. Changing the ratios between the values, which is another significant disadvantage of the method SMOP, is not possible to be overcome by standardization. The connection is quadratic – twofold amendment of group performance leads to a fourfold change the values of the area (composite indicator). It shifts the values of the middle part of the scale and accumulates them to the ends of the range.The best solution to the problem of non–linearity of the indicator calculated by the method SMOP is to replace the calculated area with the radius R of the circle of a regular simple polygon with the same area (i.e. equal magnitude of the indicators) [1]. The following formula is used to calculate the radius R:

$$R = \sqrt{\frac{2S_{ср}}{n\sin\left(\frac{2\pi}{n}\right)}} \qquad (6)$$

where $S_{ср}$ is the average surface, calculated by the aforementioned formula, n – the number of the group indicators (the number of axes in the diagram). Table 5 shows the results of the composite indicator of inter–organizational collaborative capacity calculated by four methods. None of the methods shows a big difference in the results. This is due to the fact that the measuring scale of individual factors is small (1 to 6) and the values obtained from the respondents are within only a few units. In a larger scale with a range from 1 to 10, for example, and large differences in the values of some of the indicators the lack of invariance would lead to different range of values in different methods where the effect of SMOP method would be visible.

Table 5. Results of the composite indicator of inter–organizational collaborative capacity

	MoD	MoI	BRC
Arithmetic mean	3.77	3.86	5.01
Geometric mean	3.73	3.81	5.01
SMOP — average surface	33.67	35.23	59.76
SMOP_R — radius	3.76	3.85	5.01

Although the results of the four methods are very close, the composite index measured with radius R depicted about the equate–surface polygon shall be considered the most reliable measure. Besides calculating the composite indicator of public institutions' control entities collaborative capacity in emergency situations, the Surface measurement overall performance method can have wide application in many fields of social sciences and management. It would be very appropriate for the evaluation of course of action in operational planning.

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