

# A Screening Method for C2 Expert Assessment

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**Abstract.** Although it is widely recognized that simulations based on particular scenarios are the best Measures of Force Effectiveness (MoFE) and Measures of Command and Control Systems (C2) Effectiveness (MoCE), a generalized assessment of the entire C2 system or certain its parameters for particular practical and research purposes is required. Current report presents a screening method for C2 expert assessment, built on the basis of a detailed analysis of the Doctrine of the Bulgarian armed forces in its chapter "Leadership, command and control of the armed forces". The Measures of Performance (MoP), namely the focus on internal system structure, characteristics and behaviour and the Dimensional Parameters (DP) - the focus on the properties or characteristics inherent in the physical C2 systems are used as underlying, intrinsic principles. The purpose of constructing and applying the method is to present a general rough picture of the state of C2 and to mark the areas of its strengths and weaknesses. Through changes in the instruction and in certain items, the questionnaire can be applied to different contexts. The separate structural blocks of the questionnaire assess aspects of the three levels of commands and the complex capabilities of their bodies, the practical and technical parameters of the available Communication and Information system (CIS), etc. After a validation process, the method can be used as a convenient tool for educational, scientific and practical purposes.

**Keywords:** expert evaluation, C2, CIS, screening method.

## I. INTRODUCTION

Command and control system (C2) represent complex systems of amplification of the basic human decision-making processes through procedures, organizations, equipment, threat assessment, and resource allocation to manage human factor and logistics in a real-world environment and actual time to achieve a defined strategic, operational, or tactical objective [1]. Their architectural complexity and focus on the achievement of multidirectional goals and tasks in the context of scenarios with different intensity and multifactorial contextual expressiveness excludes the existence of a single conceptual framework for the construction of a methodology that evaluates the overall effectiveness and performance of C2 in particular situations [2]. Regardless

of the fact that the method of modelling and testing scenarios is perceived as an invariable means of predicting the sequence of events in a real theater of combat operations, for educational and practical purposes there is a need to construct simplified tools for carrying out certain analyses.

## II. MATERIALS AND METHODS

In current report, simplification in developing measurement instrument (questionnaire) was achieved through the application of three criteria: doctrinal, screening and expert. The Doctrine of the Bulgarian Armed Forces (BAF) is "an officially approved national publication describing how the acquired capabilities can be used in contemporary circumstances, taking into account the particular organization and technologies introduced. Therefore, its primary purpose is to assist commanders in the performance of their major functions of command and control of troops". Chapter 9 of the document presents precisely the structure, principles and other main characteristics of the BAF's C2 [3, p. 6].

The second characteristic of the developed questionnaire is its screening nature. In general, screening instruments are short and easy to administer, used as the first step in the assessment process [4]. Their purpose is to determine the degree or likelihood that a particular object or subject of assessment possesses a particular characteristic, potential needs, strengths or limitations. Objects selected at this first step undergo further formal in-depth evaluation. Professionally constructed screening questionnaires have high sensitivity to the intended measurement questions and poor specificity in adopting a broader perspective of measurement.

The third feature of the newly created tool is the application of the potentialities of expert assessment [5]. The experience and knowledge of well-chosen experts who are able to quickly and accurately identify certain problems is important for deriving their prioritization and conclusions for overcoming.

The purpose of the tool presented below is to provide a rough assessment of the degree of functionality of the

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Bulgarian C2: the extent to which the principles of C2 functioning defined in the Doctrine of the BAF are actually available and implemented in the form of resources, infrastructure, information connectivity, interaction between the three levels of the chain of command and so on [7]. The objectives of the study is to identify areas of deficits and strengths, as well as to obtain a screening assessment of the system's readiness to perform functions in a wartime environment, military situation or military crisis.

Two types of measures are applied in the description of the system: Measures of Performance (MoP) that focus on internal system structure, characteristics, and behavior and Dimensional Parameters (DP) that focus on the properties or characteristics inherent in the C2 system [6]. Pursuant to NATO COBP the structural representation of DP and MoP among other MoMs can be seen in fig. 1.

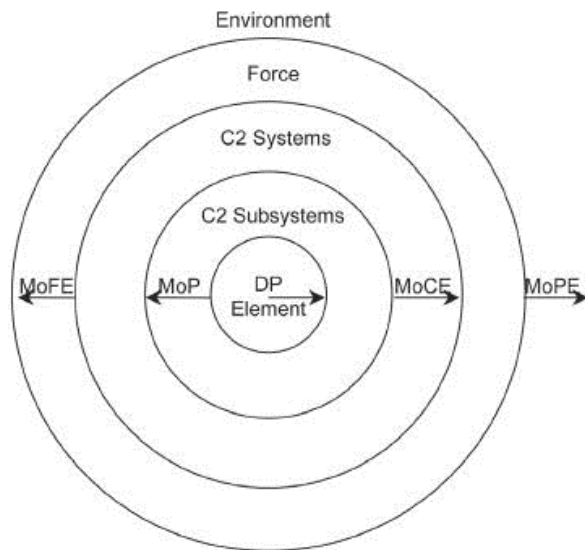


Fig. 1. Relationships of Measures of Merit (MoM)

According to the authors all the structural components of the system included for measurement in the questionnaire (the three levels of command, infrastructure, CIS) could be considered as characteristics of DP, while the items on capabilities to make connections between the individual components of the C2 could rather be perceived as related to the level of performance of the system at the task level (without a specified final desired state), therefore appear to be more relevant to the MoP.

Generally, MoMs are used to compare different options on equal terms and serve a wide range of purposes. Regarding the presented questionnaire, the following objectives are relevant:

- Establishing a standard or expectation of performance (for new requirements);
- Establishing the performance limits of the system, as well as the effects of the imposed restrictions;
- Evaluation of the use of a system in new or unexpected areas of application;
- Identifying potential weaknesses in specific areas of a system;

- Evaluation of the effectiveness of human decision-making in the C2 cycle.

The Expert Assessment Card is intended for completion by experts holding positions in the Directorates of the Ministry of Defense and commanders of military formations. In the current report, the items are oriented to the experts' assessments of the possibilities of transforming the C2 from a peacetime to a wartime variant. Five points Likert scale response options are used: *weak, rather weak, medium, rather high, high* for all questions. The original form of presentation of the questionnaire for assessment by the experts is in tabular form.

Eight blocks of questions that concern different aspects of C2 functioning will be presented.

The complete theoretical model on which the questionnaire is built is presented in Table 1.

TABLE 1. MODEL OF QUESTIONNAIRE

Data Types	Table Column Head
	Assessment of the:
Q/N	C2 contribution to the <i>strategic level</i> of command of the BAF
Q/I	Complex capabilities/the most pronounced deficits of C2 to support <i>strategic</i> level authorities
Q/N	C2 contribution to the <i>operational</i> and <i>tactical</i> level of command of the BAF
Q/I	Complex capabilities / the most pronounced deficits of C2 to support <i>operational</i> level authorities
Q/N	Complex capabilities of C2 to support <i>operational</i> level bodies of the BAF: JFC, LF, AF, N, JSOC, LSC, CISDC, SDSMD
Q/I	Complex capabilities / the most pronounced deficits of C2 to support <i>tactical</i> level authorities
Q/N	Complex capabilities of C2 to support <i>tactical</i> level bodies of the BAF: JFC, LF, AF, N, JSOC, LSC, CISDC, SDSMD
Q/N	General capabilities of C2 to support the <i>strategic level</i> of command of the BAF
Q/N	C2 infrastructure
Q/N	Elements and principles of C2 functioning
Q/N	Available CIS in the BAF as a core element of C2
Q/N	CIS capabilities available to the BAF compared to the ideal one
Q/N	Technical parameters of the CIS available to the BAF compared to the ideal one

Abbreviations: Q/N (quantitative questions); Q/I (qualitative questions); Bulgarian Armed Forces (BAF); Joint Forces Command (JFC); Land Forces (LF); Air Force (AF); Navy (N); Joint Special Operations Command (JSOC); Logistics Support Command (LSC); Communications and Information Support and Cyber Defence Command (CISDC); The structures directly subordinated to the Minister of Defence (SDSMD).

### III. RESULTS AND DISCUSSION

The quantitative and qualitative blocks of questions are presented below.

#### 1. Assessment of the C2 contribution to the strategic level of command of the BAF

Instruction: How do you assess the capabilities of BAF C2 to support strategic command in the wartime activities/areas described below?

1A). Q/N. (10 items): Increasing of the BAF's combat and operational readiness/ Implementation, supplement, adaption or creation of new strategic plans/ Creation of command and control models adequate to the situation and the pursued goals in: a scenario with a dominant participation of the LF component/ a scenario with a dominant participation of the AF component/ a scenario with a dominant participation of the N component/ a scenario of joint operations/ Adoption of adequate and expedient decisions that operate within the adversary's decision cycle/ Accurate assessment of the parameters of the BAF' participation in operations (operational command, authority, command structure)/ Effective coordination with the commands at the operational level (the commander of the JFC, the commanders of the military services) and his directly subordinate formation/ Effective management of information, psychological and special operations/ Accurate assessment of the moment to activate forces and their composition in operations/ Identification of the proper application of the rules of engagement of military forces / Development of effective strategies to adapt to the challenges of urban warfare.

1B). Q/l. *How do you assess the complex capabilities of C2 to support strategic-level authorities in a wartime situation? In which area are the most pronounced deficits observed?*

## **2. Assessment of the C2 contribution to the operational and tactical level of command of the BAF**

*Instruction: How do you assess the capabilities of BAF C2 to support operational and tactical command in the wartime activities/areas described below?*

2A). Q/N. (13 items): Implementation of strategic command's plans by operational command/ Planning and operations' conduct by the JFC and the military services' commands at the operational level/ Provision of effective coordination and interaction of the JFC with the military services' commands and assigned formations/ Support for the integration of the operation unit with the JFC and the military services' headquarters/ Coordination and interaction at the operational level of the military services' commands components and the SF component/ Coordination and interaction of the military services' commands components with the main combatant headquarters staff and the deployment staff/ Provision of information and expertise from the AF command to the military services' commands components/ Conduct of independent or joint N command operations through the Maritime Operations Center/ Conduct of special reconnaissance and surveillance by the SF component command/ Undertake direct action and military support by the SF component command/ Conduct of the SF command coordination with the JFC and the military services at the operational level/ Accomplishment of command and control by the SF command in the case of conducting independent or joint operations with specialized coalition/alliance military forces/ Coordination between the operational command and the tactical command/ Accomplishment of the tactical command and control by the commanders of military formations with their subordinate military formations.

2B). Q/l. *How do you assess the complex capabilities of C2 to support operational level authorities in a wartime situation? In which area are the most pronounced deficits observed?*

2C). Q/l. *Please rate the complex capabilities of C2 to support the operational level authorities of the BAF in a wartime situation of: the JFC, the LF, the AF, the N, the JSOC, the LSC, the CISCDC, and the SDSMD.*

2D). Q/l. *How do you assess the complex capabilities of C2 to support tactical-level authorities in a wartime situation? In which area are the most pronounced deficits observed?*

2E). Q/l. *Please, assess the complex capabilities of C2 bodies to support the tactical level of the BAF in a wartime situation of: the JFC, the LF, the AF, the N, the JSOC, the LSC, the CISCDC, and the SDSMD.*

## **3. General assessment of the capabilities of C2 to support the command of the BAF**

*Instruction: What is your assessment of the BAF C2's capabilities to support command and control in the wartime activities/areas described below?*

Q/N. (15 items): Joint fire support/ Vertical and horizontal coordination of fire support/ Adoption of measures appropriate to the risks and threats to ensure the security of troops and forces/ Provision of reliable, accurate and timely Intelligence information/ Provision of reliable, accurate and timely information by the Counterintelligence / Coordination of the JFC and the military services commands with the intelligence's command and control/ Coordination of the JFC and the military services commands with the counterintelligence's command and control/ Coordination with allied, coalition and multinational operations/ Functional analysis of the operational requirements necessary to perform a given task and determining the necessary CIS for support/ Logistics assurance to ensure efficient use of resources/ Management of the missile defence for the airspace defence/ Management of the rear services protection/ Management of the critical infrastructure protection/ Ensure of the coordination with other governmental bodies and the private sector/ Ensure of the adequate electronic protection of troops.

## **4. Assessment of the C2 infrastructure**

*Instruction: What is your vision for the BAF's capabilities to build the infrastructure for wartime C2 operations?*

Q/N. (13 items): Deployment of stationary control posts for the LF command component during independent military operations/ Deployment of field control posts of the LF command component during independent military operations/ Deployment of protected control posts for the Navy operations/ Support for the functionality of the Maritime Operations Center for the implementation of independent or joint Navy operations/ Maintainment of the operation of the Maritime Operations Center as an outsourced control posts for the JFC/ Maintainment of the fire support and liaison centers/ Deployment and maintainment of the stationary and mobile CIS outposts

with deployment capabilities/ Deployment and maintainment of a CIS that is integrated with weapons control systems and sensor systems/ Deployment and maintainment of a network-centric information environment, providing integration of the used information networks, access to a common operational picture and sharing of the extracted information/ Deployment and maintainment of the logistics support units/ Deployment and maintainment of the strategic CIS/ Deployment and maintainment of an operational CIS/ Deployment and maintainment of a tactical CIS.

### **5. Assessment of the elements and principles of C2 functioning**

*Instruction: Please provide your comprehensive assessment of the overall performance of BAF's C2 and its base structural components in a wartime situation.*

Q/N. (19 items): The extent to which the number of the personnel involved in C2 ensures its effective functioning/ The degree to which the preparedness of the personnel involved in C2 ensures its effective functioning/ The capabilities of C2 equipment ensures its effective functioning/ The capabilities of C2 equipment ensures its effective functioning/ The degree to which the clarity, detail and comprehensiveness of the procedures governing C2 ensures its effective functioning/ The degree of resilience of C2 (the capabilities and resources to timely increase the number of control points that the adversary will seek to neutralize/reduce)/ The degree of resilience of the C2 communication networks/ The degree of stability of the interrelationships between the C2 headquarters/ The capabilities of the BAF' command staff to maintain the principle of continuity in leading the subordinate troops and forces/ The preparedness of the BAF' command staff to implement the principle of operability in a wartime situation (timely response to changes in the situation and successful implementation of the assigned tasks)/ The capabilities of C2 to keep it secret, including the concept (plan) of the operation, the main arrangements for the preparation and conduct of the operations/ The designed interrelationships between C2 structural components are simplified and logical/ The flexibility and speed of C2 in its transition from peacetime operation to wartime operation/ The flexibility of C2 in the "supported" - "supporting" relation and the possibility of reconfiguring part of the system in the course of operations/ The degree to which the clear chain of command of C2 regulated in the normative documents is able to guarantee the efficiency of the system's functioning/ The capabilities of C2' all elements (personnel, infrastructure, equipment, technical support, procedures) to continue functioning in an adverse environment, under threat, and to recover after inflicted losses (principle - continuity of C2)/ The extent to which the reserve is able to ensure C2 continuity/ The extent to which substitution rights in the chain of command are clearly defined for all levels of command/ The degree to which the complex capabilities of the command structure is able to integrate various military components or structures while at the same time being itself integrated into other structures/ The possibilities of procedures (orders) to regulate decentralized task execution.

### **6. Assessment of the available CIS in the BAF as a core element of C2**

*Instruction: Please provide your comprehensive assessment of the overall performance of the BAF's CIS and its basic wartime structural components.*

Q/N. (12 items): Overall CIS effectiveness (timeliness, stealth, combat readiness, resilience and mobility)/ Timeliness of CIS - the possible state of the system due to the impact of the enemy's means of striking/ Resilience of the CIS - the ability of the system to perform the assigned tasks in conditions of impact of all the confounding factors of the enemy/ Modern capabilities of the CIS to enter data for: terrain with locality data; the types of armament, the organizational units, the order of battle, the scenario of combat operations/ Degree of information connectivity of the command system/ Structural reliability of the system of control posts/ Opportunity of all the elements of Bulgarian army divisions to share and exchange information about the operational situation/ Possession of the complete package of capabilities for integration and management of the combat potential of all the elements of the battle space/ Availability of a relation between support capabilities and operational activities/ Reliability of control posts/ Information connectivity of control posts (degree of information accessibility of a control posts to each information direction).

### **7. Assessment of CIS capabilities available to the BAF compared to the ideal one**

*Instruction: How do you assess the CIS capabilities available to the BAF compared to the ideal?*

Q/N (22 items): Tactical picture management/ Support planning and decision making/ Operational management (management of combat or non-combat operations)/ Peacetime, wartime and crisis resource planning and management/ Creation, formatting, authentication and sending of orders, reports and messages/ Dissemination of information and data in real time/ Maintain information layers including planning and control of tactical maneuver, intelligence, order of battle, paint sustainment, chemical defense, and air defense and air defense operations/ Personnel management/ Analysis of the area, conditions for the movement of forces, transport/ Storing the information and having resources to use it to support planning and decision-making processes/ Force organization management/ Sustaining non-military operations/ Fire support planning and management/ Air defense planning and management/ Holds functions providing peacekeeping operations, including civil-military interaction/ Holds perfectly working communication/ The staff is fully competent to work with the system/ Requests to higher levels do not require waiting, but are processed promptly/ The necessary decision support systems are available/ Holds functions providing continuous information about air, land and water/ None of the wars C2 is leading is not effective against its own forces/ The available CIS is integrated, provides opportunities to build an object model, a dynamic model and a functional model [9, 10].

### **8. Assessment of technical parameters of the CIS available to the BAF compared to the ideal one**

*Instruction: How do you assess the technical parameters of the CIS available to the BAF compared to the ideal?*

Q/N (9 items) Data transfer rate/ Transmission time/ Sensor coverage/ Detection capabilities/ Mean time between failures/ Average recovery time/ Speed (planning time, order time, response time)/ Accessibility (availability)/ Situational clarity (timeliness of situational update, timeliness of distribution of orders) [9, 10].

#### CONCLUSION

The rapidly changing geostrategic environment and the rhetoric of our official authorities to make progressive contribution to NATO's collective defence require an accelerated development of national defence capabilities [10]. In the considered context of objective circumstances, the proposed tool can be used as a screening method for a quick assessment of strengths and deficiencies in the C2. Decision making is at the heart of the command and control process. CIS as a core element of C2 must be designed primarily to provide effective and responsive decision support. To achieve this goal, the system must include support for personnel whose mission is to provide the various inputs needed to make command and control decisions, some driven by the personnel's functional responsibilities and others by specific inquiries posed by the commander [11]. All these characteristic are included as options for assessment in the questionnaire.

So far, the methodology has been approved by a small number of experts. A future step in its development is validation in a larger sample of experts occupying command positions. Subsequent addition and modification of the content of the items will follow. After completing the validation process, the methodology can be used as a tool for educational, scientific and military expert purposes.

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