

SHOOTING CONTROL

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Abstract:

The article presents proposals for changes in terminology related to fire control, which has been fully embedded in the general theory of management. Particular attention is given to replacing the commonly used term “fire control” by “shooting control”. There are pointed issues, which may be taken into account in the new instructions for artillery shooting control.

Keywords:

shooting control, fire control, effective fire, fire fight, shooting instruction

INTRODUCTION

The theory of shooting has its own history and hardly anyone wants to change anything about that. Some people call into question the value of the history and theory. Their arguments are usually based on the assumption that history has no reference to the present, and the theory is the abstract knowledge devoid of practical utility.

The aim of the article is to combine tradition with contemporary knowledge derived from other, non-military sources, by entering terminology of directing fire in the general theory of management.

Controlling fire is subject to the general theory of management. The combination of the historical context of “directing shooting” used in artillery and other types of forces with the general theory of management can help people interested in this issue to avoid errors while developing new theories. A similar situation occurred when the terms such as ballistic, meteorological and technical protection were replaced by the concepts: ballistic meteorological and technical preparation, since they had had nothing to do with ensuring safety of anybody.

The organization and management theory includes many views on the concept of controlling. It is interpreted ambiguously; several authors relate it to the concepts such as



management, administration, governance, leadership, steering, command, supervision, which are also used interchangeably. In the Armed Forces we focus mainly on the management, control and command.

Noteworthy is the J. Kurnal's definition [6], who states that controlling is an action resulting in a behavior of a human things pursuant to the intention of a directing person.

According to J. Zieleniewski [16] "...in a broader sense, controlling means any action aimed at making the functioning of other things consistent with the objective of a person leading them" and "...in a narrower sense, strictly speaking as directing people, controlling is understood as activity intended to make other people take actions consistent with the objective of a person leading them".

Commanding is actually controlling people, and through them - controlling things and processes.

Controlling and commanding requires power. Having analyzed many authors' definitions, the author assumed [8] that commanding is the process of exercising power by a commander in relation to their subordinates during the preparation and conduct of combat operations, in order to perform a combat mission received from a supervisor.

Combat missions may take the form of fire missions, hence we sometimes talk about commanding fire.

1. THE THEORY OF SHOOTING

From the moment of becoming aware that the fight is mainly the impact of fire, a human tries to intellectually cope with the phenomenon of fire. Fire is the main and sometimes the only means of destruction of enemies, causing the greatest possible damage to them and, at the same time, the most important factor that affects their activity.

Knowledge, understanding and controlled transformation of a battlefield reality fragment by means of fire from launched projectiles was and still is based on the state of knowledge and human needs. The theory of shooting and controlling it plays an important role in this respect, and it must be stated that this theory changes along with the rules of combat, the introduction of new types and designs of armaments and weapons, and its relation with other sciences.

The theory of shooting and directing it reflects fight in a certain aspect, i.e. the armed clash of opposing operational systems. This fight understood as "an organized armed clash of soldiers" and, in a wider sense, as "an organized activity of people" is generically the same subject of study – it refers to what other sciences have. Especially, organizational theory, systems theory, economics, praxeology, psychology, sociology, etc. The idea behind them is the same general objective of research, namely the development of regularity in terms of perception, reflecting and controlling the transformation of the reality.

According to S. Torecki [16], the theory of shooting deals with theoretical and practical issues of shooting with barreled and missile weapons. External ballistics is part of the



theory of shooting in the missile forces and artillery troops [10]. The theory of shooting as a component of operational research evaluates the effectiveness of ways of shooting at different targets [15].

The theory of shooting enables: measurement of effectiveness of shooting with any bullets at a given target; comparison of different ways of firing organization; determination of the impact of technical parameters of various models of armaments; determination of the impact of different ways of using complex armaments systems on the effectiveness; assessment of the troops ratio; calculation of resources needed to perform combat tasks.

The main tasks of the theory of shooting include the development of results of shooting at a target, assessment of shooting effectiveness under given conditions (the probability of hitting, mathematical expectation), planned ammunition consumption in order to perform a combat mission, finding conditions in which a given or maximum efficiency of firing is possible to achieve, evaluation of the combat properties of weapons.

A “language”, understood as a system of terms including constitutive concepts and definitions, plays the main role in reflecting the theory, its subject matter. It is assumed that phenomena ought to be seen first, and later, during their description, concepts are to be associated with them.

Let us start with the key concept of the theory of shooting – “a shot”.

The process of expelling, throwing a projectile from the barrel and its flight along a trajectory at a given distance is called a shot. It is generally accepted that “a shot” is a complex set of processes of energy transformations occurring in a very short but finite amount of time. It can be divided into three distinctive phases (stages): propelling (expelling) a projectile; a projectile flight along a trajectory; the impact of a projectile striking a target [4]. A shot is defined in the narrower sense as a discharge. This term means processes related to expelling a projectile, while its flight on a path and the phenomena occurring when hitting a target (explosion) are considered separately.

Understanding of the conditions and determining the laws of motion of a projectile inside and outside a propellant system belong to tasks of the theory of firing called ballistics - inner and outer, respectively.

Today, the term “a projectile” reflects both a material body shaped aerodynamically as well as the quantum of energy. In certain phases of firing it constitutes a component of propellant, transporting and striking systems.

Explosive propellants are used to expel projectiles at a required distance, and rocket fuels - to drive missiles. A projectile as a system transporting energy to a particular point is characterized by: a trajectory along which it is moving; the state of kinetic energy during individual phases of its flight; the state of chemical energy stored in an explosive.

The system striking a target of a projectile will be discussed later. At this point, let us move from a shot to shooting. We recall that the operating shooting instructions do not include the term ‘shooting’. The data contained in the literature allows the identi-



fication of three characteristic definitions concerning the determination of the content and the scope of the term “shooting”.

The first one shows firing as the process of combat work [15]. It is a set of actions (a system of operations) of a single combat soldier, teams of various types of firearms, combat vehicles, subunits and units [7] in the following areas: firing preparation, shooting; assessing the results of firing. The second of them treats this as firing shots, firing projectiles and rockets. The third one determines shooting as an active impact on an enemy’s facilities, bombing, using the means of destruction.

When considering the content and the scope of the concept of firing, through the prism of the criteria and the scope of the concept of a shot, a hypothesis may be posed that it should reflect the structure of organizational and physicochemical (stages of a shot) processes related to expelling (throwing) projectiles.

The scope of firing specified in the first definition seems to go beyond the system of combat operations and touches the target striking system, i.e. fire. It should be also noted that the instruction for controlling fire does not include the concept of “fire”.

Fire is essential, and sometimes the only means for striking an enemy, a guarantee of achieving the combat objectives on land, air or sea [4]. It is a surprising fact and also a matter of concern that fire in spite of its practical use and intuitive understanding of its importance is not a clearly defined category. This is demonstrated by examples taken from the specialist literature.

It is assumed that fire is:

- firing (shooting) [14];
- a way of destroying an enemy; consisting of shooting at them with different types of weapons [7];
- the primary means of striking an enemy in the contemporary battle on land, air or sea; consisting of shooting at them with different types of weapons [12];
- all its forms - from the conventional to the nuclear one- both in terms of technical means of destruction and identifying activities related to its conduct [3].

The above examples are a rather clumsy attempt to define the concept of “fire”. W. Speisbecker even thinks [13] that fire is a generally used term that is impossible to define.

What is the difficulty and how can it be overcome?

Let us begin with the dictionary definition [11]. “Fire is a phenomenon of heat and light generation that accompanies the burning of objects, seen in the form of flames and embers; flame”.

This definition shows that fire is a phenomenon, and from the current considerations on the fire it is evident that it is a means of striking an enemy, or impact energy of a projectile acting on a given target.



Even the preliminary analysis of the current findings leads to the conclusion that fire is not shooting (firing a shot), and is related to kinetic, thermal and electromagnetic energy of a projectile necessary for destruction of a target. Fire is associated with a means of destruction. Artillery fire comes from cannons and missiles that fired their projectiles. The air bombing is a kind of air fire, since a bomb like a projectile strikes its target with energy (fire).

After this discussion, an attempt can be made to define fire.

“Fire is a phenomenon, which creates energy striking a target taking the form of:

- kinetic energy of a projectile hitting a target;
- kinetic energy of shrapnels hitting a target;
- thermal energy and kinetic energy of the shock wave created by the explosion of a projectile striking a target;
- electromagnetic energy striking a target” [4].

The in-depth analysis of the above definition conclusively proves that fire is not shooting. The shots are made from cannons. Fire strikes a target. A distance of tens of kilometers often separates a cannon and a target.

2. ORDERING TERMINIOLOGY

The essence of firing is transporting projectiles (bombs, torpedoes) by different types of weapons to a target so as to achieve a desired effect (inertia, destruction, demolition, causing fire, lighting, smoke, creating noise, etc).

The fire fight against an enemy is performed with striking fire. It can be devastating, overwhelming, destructive and harassing. The effectiveness of striking fire is achieved by its timeliness, accuracy, surprise as well as the right choice of means of destruction and ways of its implementation [2]. It follows that artillery fire should be effective. So what to do with the instructional “correction of effective fire”? The solution seems simple - call it differently.

Let us consider the following entry [2]: “while shooting, the settings for the effective fire are guided precisely on the basis of derogation values of explosions of each battery”. Why? This is due to the fact that effective fire proved inefficient. However, the efficiency of striking fire, which reached a target but not effectively enough, can be improved. The improvement of fire fight effectiveness takes place by changing the settings on cannons (point-finder, level, direction) and re-shooting. We do not interfere here in the phenomenon of fire, but just change the points where projectiles fall.

The basis of a combat artillery operation is an effective fire fight against an enemy. The effectiveness of striking should be related to the impact of fire on a specific object (target) of an enemy. That is because it shows to what extent it has been struck (what irreversible losses have been suffered). The effectiveness of striking an object is a parameter characterizing the final result of the impact of fire on a given object (target). It is expressed as the probability “P” in the case of destroying single targets (objects)



and the mathematical expectation “M” when there have been destroyed elementary targets of a given object while striking group objects.

The firing efficiency was mentioned above. It is therefore necessary to clarify that the concept of effectiveness should take into account the overall result of the impact of means of destruction on a given enemy’s group of forces, achieved through striking fire on a certain number of objects (targets) with the appropriate degree of their destruction, as well as other activities of the means: remote mine laying, use jamming transmitters, fogging (glaring), etc.

The fire striking an enemy is obtained as a result of shooting. What is shooting?

“Firing is a set of activities of a single soldier, teams of servicing various types of weapons, armed subunits and units, from the time of receiving a fire mission (self-detection of a target and taking decision on the attack against it) until the expel of a projectile or a series of projectiles in order to perform this task (striking a target effectively)”.

In one of the previous definitions shooting was seen as firing shots, sending projectiles and missiles. It referred to the very act of giving a shot (releasing a trigger, a triggering device, etc.). It is known that this act is preceded by a number of activities, which in the literature is called the preparation for firing.

The preparations for firing includes the following undertakings [2]:

- identification and determination of coordinates of targets;
- meteorological preparations;
- ballistic preparations;
- technical preparations;
- surveying preparations;
- the organization of shooting;
- determination of settings.

Not every firing is preceded by all of these undertakings. When subunits and units reach readiness for shooting, it is enough to indicate a target (determine its coordinates) define settings and give a command and then shooting can be realized. When the target of firing has been achieved one can talk about a fire task completion.

The main normative document of artillery distinguishes two concepts: “a task of fire” and “a fire mission” [2].

A task is a set of activities ordered or determined independently in order to achieve a goal. A task is adopted for the implementation with full awareness.

Fire has no awareness and does not accept any action for execution, and certainly does not perform any on its own initiative. Therefore, there are not and cannot be any tasks of fire. These are tasks given to commanders, subunits or units.

The current instruction is lacking in a definition of a fire mission. The authors of the previous edition of the instruction for firing [2] indicate that “a task carried out with artillery fire is called a fire mission”. A fire mission’ is often identified with “a shooting



task”; it can be put in the form of designation of the type of targets to combat (destruction) in a given fire responsibility zone.

“A fire mission is the system of actions specified independently or commanded to perform by a supervisor, leading to destruction, demolition, overwhelming or harassment of a target with fire from a particular cannon, subunit or unit” [4].

The concepts: activity, operation and undertaking can be treated as synonymous. There may be more or less activities or undertakings depending on the degree of readiness (preparation) for firing.

Fire missions set out the system function components, among which there can be distinguished mental and practical activities (organizational and manual ones of commanders and the operational personnel).

Let us consider the artillery tasks such as: lighting, smoking, distorting, causing fires, spreading propaganda materials, scattered mine laying and identifying targets. Are these fire missions? Probably not. Let us call them other – apart from striking fire at targets - tasks of artillery (cannons, subunits, units). If there were not p.2 of the instruction the problem would not exist, since Chapter 5 treats them in the above mentioned way [2].

If we are theorizing, the term “light protection of combat operations” should be noted. The task is not aimed at doing security for someone, but simply lighting the area and setting parameters or a light axis. A similar problem appeared when developing the instruction currently in force. After many endeavors such terms as meteorological and surveying protection have been successfully replaced by the terms: meteorological preparation; surveying preparation. A similar solution should concern lighting.

From the time when the directions of officers’ education were tied to the organization and management, particular analyses covered the concepts of “directing” and “commanding”. Science from outside the military tightened the perception of professional soldiers and contributed to criticism in their activities. A great number of imperfections in the literature have been identified, however the release cycle of normative documents hampers the removal of all the faults on time. This is probably the reason for the absence of the concept “directing” in the instruction for directing.

“Managing is the information and decision-making impact of a directing body, transmitted through information channels shaped by organizational relations (rules) to objects of management (people, things), aimed to make them function so that a controlling person can achieve its objective by means of available instruments, rules and procedures” [8].

The definition of managing presented above is the result of the synthesis of at least dozens of concepts contained in the literature. The authors used only one definition worthy of attention to avoid citing a series of concepts in the publication.

Managing is activity resulting in a human (people) or things behavior in line with the intention of a manager [6].



These two and all of the other definitions are linked together by the fact that a human (people) and thing can be managed.

- An entity of managing is always a human: a director, a commander, a chief, a commandant, a supervisor, a senior etc;
- An entity (object) of managing can be a human (e.g. a subordinate, a junior) or a thing (a tank, a cannon, a plane, etc.) as well as a group of people and things;
- Managing is possible towards behaviors of one person, activities of groups or teams of people, or the operation of various types of devices or mechanisms. In order to be able to manage people, one needs to have power over them. Therefore, managing boils down to holding and exercising authority. Managing a thing (a machine, a mechanism) requires appropriate qualifications and licenses;
- The feedback should take place between a subject and an object of management and be in the form of information transmitted both ways orally, by technical means of communication, signals, signs, etc;
- Having acquiring the knowledge (while teaching students of “Organization and Management”), the author sat down as a retired artilleryman by the fireplace and was watching flames (fire) when the thought came to him about managing fire, about what he lived serving in the artillery. Unfortunately, the conclusion was sad, one cannot manage fire;
- Fire is neither a human nor a thing, just a phenomenon;
- We have no power over fire. Managing power continues until a shot is given. Then the power is taken over by someone else; hence the folk wisdom can be used here: “a man is shooting but devil controls the bullets”;
- After giving a shot, feedback as one of the management factors is gone. Only in the case of firing a guided anti-tank missile one can have control over it and feedback occurs during the flight, which as a thing is possible to be managed. We are not dealing here with the concept of guided anti-tank fire.

Amateurs insist that fire can be controlled. So a task for them can be to make a bonfire and obtain rectangular flames. And I want to remind professionals that unexploded ordnance has happened in their practice and if they had power over fire they would get the explosion and associated fire. Here the thought comes to the mind that a projectile designer has great influence on fire. For example, the forced fragmentation is expected to bring a certain amount of shrapnel; if not used, a projectile shell can be divided into several parts during the explosion and the assumed effect of fire will not be achieved. When firing with cluster munitions for scattered mine laying one also does not have any impact on the fire fight of mines; if a target in the form of a tank or an armored personnel carrier is not within a striking distance they will not achieve the desired result of operation, and after a certain period of time they will be self-destructed.



Thus, what to do with this state of knowledge? Nothing simpler than replace the term “fire control” with “shooting control”. The author realizes what this means - a habit, tradition, and besides he explained the concept of “*uprawlienije ogniom*” a few years earlier.

The previous discussion on fire and resulting conclusions are complicated by some instructional entries. Here are some examples: fire can be planned and carried; one can decide about fire; it can be centered and suppressive; the efficiency of fire can be improved; however, fire cannot be unplanned, a fire mission can be unplanned; settings for fire cannot be talked about either, they are on sights of cannons and they are for individual numbered targets; it seems that fire cannot be ceased, one can cease shooting, then a shot will not take place and as a result there will be no fire; shooting can be started with the command “shot” or “fire”, the more that not every shooting aims at obtaining fire.

“Shooting control is a system of activities of fire decision-makers, located over various levels of their hierarchical structure, aiming to complete fire missions from the moment of receiving them or independent decisions on their execution until their fulfillment with the assumed efficiency”.

The system of measures when controlling shooting includes:

- receiving fire missions (selection of targets for destruction);
- the analysis of fire missions and conditions for their implementation;
- taking a decision to carry out fire missions;
- ordering fire missions;
- control over the preparation and execution of fire missions.

Shooting control is the process of the impact of an authority in charge (a fire decision maker) on a controlled object (all elements of the shooting control system). Shooting control has tactical and technical aspects. [The technical aspect has nothing to do with the technical preparation of shooting, but it defines the nature of activities associated with the execution of fire missions during controlling shooting]. A fire decision maker tackles the tactical aspect. This can be a general military or artillery commander, who is currently at the head of the structure, responsible for shooting control. In the process of shooting control they issue dispositions and orders to the elements of the shooting control system according to a tactical situation on the battlefield. The technical aspect is unrelated to the technical preparation of shooting; it determines the nature of the activities that constitute the execution of mission tasks during shooting control.

The technical aspect is dealt with by all elements of the shooting control system. The system of each element’s activities should be developed in the form of an algorithm, regardless of a tactical situation. As for the technical aspect, the process of controlling is cyclical.

If a fire decision-maker is an artillery squadron commander, their duties include tactical decisions and possible cooperation with a general military commander.



At the head of the shooting control system elements at the squadron level there are as follows:

- Squadron Commander;
- Squadron Executive Officer;
- Squadron Chief of Reconnaissance;
- Reconnaissance Platoon Leader;
- Reconnaissance Groups Leaders;
- Squadron Chief of Communications;
- Battery Commanders;
- Fire officers;
- Cannon Commanders.

If an artillery squadron is ready for shooting control, in case of receiving a fire mission it is not necessary to perform all the operations that make up the shooting preparation. However, operations of particular shooting control subsystems must be conducted. We can call them technical activities, since they are always executed, regardless of the type of tactical operations. The algorithm of these actions can be turned into a model (type, number, sequence) and apply the computer aided shooting control process. Shooting control is a cyclic process of command, realized within a timeframe, which is defined in the set of time standards.

The aim of the shooting control process is the choice of effective methods of action under given conditions leading to the effective fire fight of an enemy. Combat capabilities constitute the basis for achieving this goal.

The effectiveness of any activity is assessed on the basis of certain indicators: the degree of achievement of objectives and incurred costs, this also applies to the process of controlling shooting (effectiveness and cost-efficiency).

In order to efficiently command the artillery operation there has been developed the organizational structure of forces, which includes their units and subunits, as well as the organizational structure of the units and subunits. Within its framework, there is a network of vertical and horizontal relations representing channels, along which orders and dispositions flow, while the memos and reports go in the reverse direction. These channels connect commanding at various levels of the military body by reaching each of them with adequate information. The range of this action should indicate the scope of the impact of a commander.

Contemporary science has yet to unambiguously determine the definition of information. Researchers freely choose its different terms depending on the field in which research is conducted and categories of tasks for which the concept of information is introduced. Here are some examples:

Information is the name of the content culled from the outside world, as we get adjusted to it and as we adapt our senses to it [9].



Information is messages given about things, phenomena, people and rules (principles) that have been appropriately perceived [1].

The author has not attempted to create a new definition of information, considering that there are so many of them and one can always choose one to match the needs. Just suffice to say that the information is what we do not know, and we want to know. Once acquired it becomes for us a collection of facts, events, features objects, etc.; it allows us to respond to the situation and take appropriate action (decisions). The term “fact” is a single event or state of affairs localized in space and time.

Commanders at various levels of command have different information needs. The range of information needs of individual commanders, on the basis of which they could make decisions, has not been developed so far. The catalogue of information reaching a commander at a given level of command can be written off through studying combat orders, dispositions and commands in the course of tactical operations and shooting control.

Commanding takes place during combat operations. Daily operations of a commander in peacetime are the duties of a manager, such as in any other institution.

Commanding is mainly the information impact on own troops. It is leading groups of people in the specific conditions of the battlefield [5].

A commander exercises power differently in wartime and in peacetime. The authority includes personal qualities or those related to the position, which are the basis of the potential impact of a leader. Differences in commanders’ approach to exercising power are associated with a management style.

A fixed way of a leader’s impact, in certain situations, on subordinates using available instruments in order to induce them to take actions consistent with his / her objectives is called a style of management. A management style is the sum of a leader’s impact on subordinates in the field of “task force”, “interpersonal” and “motivational” spheres, defining the decision-making, information and interpersonal roles of a leader [8].

During combat operations the commander’s individual conduct of proceedings in relation to subordinates may prove to be insufficient and in some situations the forced implementation of tasks may take place. Such a situation may occur while controlling shooting, this is why one can talk about commanding shooting in the course of combat operations, the more that in the literature there is already the concept of ‘fire command’.

3. SHOOTING INSTRUCTION

The publication presents comments on the theory of shooting, and each theory should be applied in practice. Many of these comments were well-known and proclaimed at the end of the 20th century, when the missile forces and artillery troops flourished. Apparently in everyday rush, due to the great amount of problems and publications they have not been noticed. The current instruction for shooting does not contain key definitions for shooting and controlling. Maybe they were not needed, or maybe simp-



ly there were not any. The author addressed the need and besides comments, often critical, attempted to define a number of terms. But this raises the question: should all terms and definitions be in the instruction? Perhaps a better solution would be to develop a handbook containing the whole theory. And what to do with the instruction?

An instruction is a set of regulations laying down procedures in a given field [11]. In the field of shooting and controlling it there is “a set of activities of a single soldier, teams of various types of weapons, armed subunits and units ...”, which must be done to meet the objectives set. The instruction needs to mention all the artillery activities and apply enumeration of activities that make up the implementation of each of them. The model for the new instruction development may be a manual for any device, e.g. a PC. Let it be a small-size document, which officers in charge will take with them to a war. If it is to be taken to a war it must be devoid of peaceful, content, rules and explanations, which should be moved to a handbook.

Chiefs and commanders are at the head of elements of the shooting control system, and this is their way of conduct, which should be covered by instruction regulations with reference to the implementation of mission tasks and other artillery operations. Decisions made at each level of command are associated with the complex process of thought, as well as with the ability to present information in various forms: graphic, written, verbal, on magnetic tapes, in the computer memory etc. With the increasing range of information based on intuition and mental analysis, the size and complexity of computing, simulation and optimization tasks are growing. In modern automated command systems, it is possible to perform those tasks at all levels of command. While the instruction provisions must take into account the activities that will be performed by individual officers in charge personally, without and with the computer-aided decision-making process, so that the decision of each of them would provide the sense of completion of the decision-making process and certainty as to the way of performing combat tasks and objectives.

CONCLUSIONS

In this article the in-depth analysis of the concepts of the theory of shooting has been conducted. The introduction of the subject “Organization and Management” to the programs of education of officers has implied the need for a thorough review of documents and military manuals for standardization of the approach to the issues of steering. Such a review carried out by the author has resulted in another need related to re-defining a number of terms and presenting arguments justifying it.

In the article there are proposed solutions to the following main problems:

- the replacement of the term “fire control” with the term “shooting control”;
- the replacement of the term “improving the efficiency of effective fire” with the term “improving the efficiency of fire fight”;
- the proposition of a form of “Shooting Instruction” for artillerists in military units.



In connection with the new approach to the issue of shooting control there has been shown the number of missing definitions. This makes the article practical and possible for use in the development of further study on problems associated with controlling, and not just the critical one.

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