# Target Acquisition Systems
## *Suitability Assessment based on Joint Fires Observer Mission Criteria Determination*

Ivan Jan, Silinger Karel and Potuzak Ladislav
*Department of Fire Support,University of Defence, Czech Republic*

Keywords: Artillery, Joint Fires Observer, Laser Pointer, Laser Rangefinder, Magnetic Orientation, Night Vision, Target Acquisition System, Thermal Imaging, True North Finder.

Abstract: Article focuses on the artillery target acquisition systems in the context of properties required for the operations of joint fires observers (JFO). The aim of the article is to determine the optimal type (variant) of the target acquisition system for equipping the joint fires observers. The choice of the optimal type (variant) is based on the evaluation of properties of the currently employed artillery target acquisition systems in the Czech Army in relation to the requirements for operation of the joint fires observers. The partial objective of the article is to illustrate, using decision criteria, the requirements for the artillery target acquisition systems in accordance with the activities of joint fires observer. Additionally, the need for shift from magnetic orientation to gyroscopic orientation is highlited and illustrated by the experiment conducted during the assesment. The result of the article is the selection of the optimal type (variant) of target acquisition system for joint fires observer in accordance to currently employed systems, so the logistics flow will remain the same.

## 1 INTRODUCTION

Despite the significant technological development of artillery weapon systems and predictions of further reductions in artillery numbers at the expense of other branches, the artillery remains the key fire support element (Šilinger, Blaha, 2017). The findings from current conflicts clearly show the importance and irreplaceability of artillery in the current concept of the armed conflicts (Pikner, Galatík, 2015).

Although the military technical systems have achieved significant level of development, the artillery observer remains an indispensable element of the artillery fire control system. (Stodola, Drozd, Křišťálová, Kozůbek, 2017). In accordance to modern trends the cooperation of military branches is deepened, especially within the individual elements of firing support. (Stodola, Mazal, 2015). Within the artillery, this trend is most evident in ever-expanding cooperation with air support elements. (Šilinger, Blaha, 2017). That is why the joint fires observer (JFO) concept is introduced in the Czech army to create a group of artillery specialists, capable of requesting and controlling target engagements by the elements of joint fire support, especially by the artillery and air force.

Since cooperation with elements of joint fire support requires specific equipment, JFOs must be equipped with appropriate systems. (Blaha, Šilinger, 2018). Artillery target acquistion units of the Czech Army have recently been equipped with adequate systems, which are evaluated as the best available means in the sensory equipment market for the needs of artillery target acquistion (TA). For this reason, the selection of the optimal type (variant) of artillery target acquistion systems is based on newly acquired types (Šilinger, Blaha, Potužák, Přikryl, 2016).

## 2 JOINT FIRES OBSERVER

Joint fire support is defined as the use of joint fires to support various types of forces (airborne, naval, ground and special) performing combat tasks. The implementation of joint fires makes it possible to maximize the capabilities of all elements of fire



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support available on the battlefield. (Pikner, Galatík, 2016). The advantage is the achievement of fire supremacy over the adversary and creation of suitable conditions for the fulfillment of tasks of friendly forces. However, in order to achieve maximum efficiency of joint fires, the interaction between individual elements of the joint fire support is crucial. This is based on the results of the planning process, activity coordination, the timely and flawless exchange of information (Šilinger, Blaha, Potužák, 2017).

Joint fires are fires delivered during the employment of forces from two or more components in coordinated actions. It could be considered as engagement of targets by units of field artillery, air support and naval artillery.

Specially trained observer, who is able to cooperate on target engagements with all joint fire assets, realizes terminal control of joint fires. In the framework of his activities, JFO must be able to detect, identify and locate targets for the purpose of joint fires assets requesting. Additionally he must be able to control the engagements and asses battle damage done by joint fire support assets. For these activities, he needs specific equipment which will enable him to provide quality, timely and accurate information to the elements he is working with on target engagement. The high-quality sensor systems that the JFO is equiped withprovides are the basic pillars of its activities. If the JFO were not equipped with adequate sensor systems and could not provide such information, the efficiency of joint fires would drop substantially. (Šilinger, Blaha, 2017).

# 3 TARGET ACQUISITION SYSTEMS IN THE CZECH ARMY

Artillery target acquisition units of the Czech army had recently been equipped with new systems. The main objective of this modernization was to replace obsolete artillery target acquistion systems with new ones that allow for more precise determination of the individual parameters as well as the technical equipment unification with the standard in NATO armies.

Operations of target acquisition units in the Czech army is based primarily on the use of vehicle platforms adapted to carry target acquisition systems. The use of vehicle platforms for the operation of artillery target acquistion units is a specific feature of the Czech Armed Forces, which has no similarity in other NATO armies.

Target acquisition systems in the Czech army are based on vehicle platforms as well as on backup target acquisition system sets, which are used in case the vehicles are unfunctional. Therefore, both the vehicle platforms and the backup sets are included in the enumeration. In the Czech army, the following systems of artillery target acquistion are currently in use:

- Sněžka-M;
- LOS-M;
- LOV-Pz;
- GonioLight V w/ Vector 21 Nite;
- Sterna V w/ Vector 21 Nite;
- Sterna V w/ JIM LR, TLS 40.

Although capabilities of target acquisition vehicles and backup set differ, they are, in all cases, a full-featured means of conducting an artillery survey.

## 3.1 Sněžka-M

Target acquisition system Sněžka-M is specific system based on modified BMP-1 tracked chassis (Modernizovaná Sněžka-M předána AČR, 2015). This system has hydraulically protruded, three-segmented arm, which carries a senzoric head accommodating target acquisition devices. Senzoric head contains these devices:

- Merlin 3 daytime surveillance camera;
- Merlin 2N night surveillance camera;
- Falcon-200 digital camera;
- THV-3000 thermal imaging camera;
- Zeiss LDM 38 laser rangefinder;
- Thales Squire ground surveillance radar.

The Sněžka-M is equipped with the GPS receiver AN/PSN-13A DAGR and the inertial navigation unit TALIN 4000 (Modernizovaná Sněžka-M předána AČR, 2015) to determine its own position and direction of observation of the sensor head. As a backup target acquisition system, Sněžka-M is equipped with Sterna V w/ Vector 21 Nite (section 3.5).

## 3.2 LOS-M

LOS-M (Light Observation System – Modernized) is tracked target acquisition vehicle based on modified BMP-1 chassis. It is the same chassis used on the Sněžka-M (Modernizovaný LOS-M pro dělostřelce, 2014).

The LOS-M uses a telescopic arm to extend the sensing head to a maximum height of 4,5 meters. Sensoric head of the LOS-M contains these devices:

- Merlin 2 daytime surveillance camera;
- HK-170 CCD camera;
- LIRC 640 thermal imaging camera;
- Zeiss LDM 38 laser rangefinder;
- Infrared pointer.

The LOS-M is equipped with the AN/PSN-13A DAGR GPS receiver and the Talin 3000 inertial navigation unit (Modernizovaný LOS-M pro dělostřelce, 2014) to determine its own position and direction of sensing heads. (Talin: Inertial Land Navigator, 2014). As a backup target acquisition system, LOS-M is equipped with Sterna V w/ Vector 21 Nite (section 3.5).

## 3.3 LOV-Pz

LOV-Pz is target acquisition vehicle based on Iveco M65E 4x4 wheeled platform (vtusp.cz, 2018).

Target acquisition devices are fixed within the LOV-Pz in a gun station located on the roof of the vehicle. Weapon station contains these devices:

- Puma FHD daytime surveillance camera;
- Falcon 135 CCD camera;
- Spirit 140 thermal imaging camera;
- Zeiss LDM 38 laser rangefinder;
- Infrared pointer.

To determine the position and direction of the weapon station's observation, LOV-Pz is equipped with the AN/PSN-13A DAGR GPS receiver and the Talin 3000 inertial navigation unit (Talin: Inertial Land Navigator, 2014). As a backup target acquisition system, LOV-Pz is equipped with Sterna V w/ Vector 21 Nite (section 3.5).

## 3.4 GonioLight V w/ Vector 21 Nite

Target acquisition set of the GonioLight V and laser rangefinder Vector 21 Nite was delivered to the Czech army as a backup target acquisition system for first pieces of Sněžka-M and LOS-M vehicles (Modernizovaný LOS-M pro dělostřelce, 2014). For other manufactured pieces, this kit has already been replaced by the Sterna V based set (section 3.5).

This target acquisition set is based on the GonioLight digital magnetic compass (DMC) complemented by the Vector 21 laser rangefinder (LRF), AN/PSN-13A DAGR GPS receiver, data terminal for processing and transferring of gained data (GONIOLIGHT: Digital observation station, 2018). Vector 21 Nite is night vision capable so this device gives target acquisition units night time operations capability (VECTOR FAMILY: Rangefinder Binoculars, 2017).

## 3.5 Sterna V w/ Vector 21 Nite

The Sterna V w / Vector 21 Nite is manufactured by Safran Vectronix as well as the previous set (STERNA: Gyroscope based target acquisition system, 2018). Unlike the previous target acquisition set, this type is based on the Sterna V gyroscopic true north finder (TNF).

The only difference between the two kits is different basic device used for the determination of bearings. Difference between GonioLight V and Sterna V is significant. GonioLight V is based on the use of a digital magnetic compass (DMC), the accuracy of which is strongly influenced by metallic objects in its vicinity, making it impossible to use near combat vehicles. On the other hand, the Sterna V true north finder, uses a gyroscopic system that is not affected by metallic objects. When functioning in proximity of combat vehicles, use of electronic devices can significantly affect measuring accuracy. This affection is demonstrated on measurement by DMC, with active cell phone in its vicinity (chapter 3.7).

Sterna V TNF uses gyroscopic system which is not affected by these devices. Because of this, delivery plan had been changed, because of this aspect and it was decided not to buy more target acquisition sets based on GonioLight V. Effects of electronic devices on DMC measurement was confirmed by experiment, whose resuls are stated in section 3.7.

Like the previous target acquisition set, Sterna V w/ Vector 21 Nite is complemented by AN/PSN-13A DAGR and data terminal (STERNA-V: Výnosná souprava dělostřeleckého pozorovatele, 2015).

## 3.6 Sterna V w/ JIM LR, TLS 40

Last evaluated target acquisition set used by the Czech army is the Sterna V w/ JIM LR, TLS 40 (JIM LR: Long-range multifunction cooled infrared binoculars, 2017). Just as the previous set is based on the use of the true north finder Sterna V, but its own observation device is different. In this case it is a combination of multifunction long range cooled infrared binocular JIM LR and LRF Zeiss TLS 40 (TLS 40: Target Acquisition Binoculars, 2007).

This set is complemented by AN/PSN-13A DAGR and data terminal.

### 3.7 Example of Direction Measuring Affection of DMCs

Various metallic objects and electronic devices in vicinity of magnetic device can affect magnetic orientation. For these reasons, magnetic orientation can be very inaccurate when basic principles are not followed.

Magnetic orientation is used for aiming of target acquisition systems. Different kind of orientation should be prefered because of presence of areas with magnetic anomalies, irregular course of magnetic lines during the day and year, progresive increase of infrastructure and time needed to use of magnetic orientation.

Results of conducted experiment demonstrate the influence of cell phones on magnetic orientation. Purpose of the experiment was to determine the influence of selected cell phones on local deformation of magnetic line.

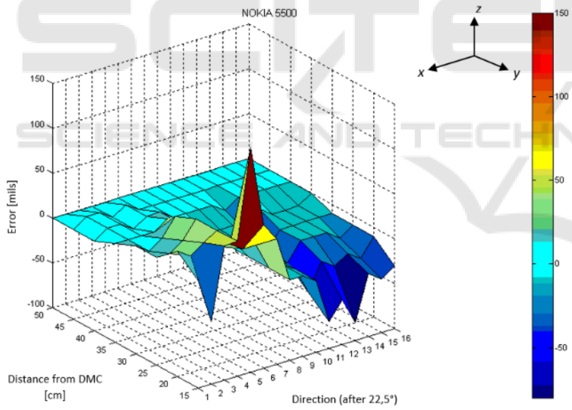


Figure 1: Errors of magnetic azimuths caused by NOKIA 5500.

Influence of two selected cell phones on deformation of the local magnetic line during direction measuring by DMC was measured on type Leica Vector IV DMC/LRF. Measurement of influence had been conducted in various directions (22,5° jump) and distances (5 cm jump) from the DMC. Affecting devices were cell phones NOKIA 5500 and NOKIA 6300. These two types were most widely used at a time this experiment was done. Cell phone was placed in the same height as the DMC and was oriented in the same direction (display pointing toward grid north). Results of measurement are stated in figures 1 and 2. X-axis represents each direction with interval of 22,5° (determined to clearly show the course of errors). Direction 1 represents the direction of magnetic north. Distance of cell phone from center of DMC is stated on Y-axis. Minimal distance of measurement is 15 centimeters because due to the DMC dimensions it was not possible to get it closer.
Calculated errors of magnetic azimuths on given observed point are represented by the Z axis.

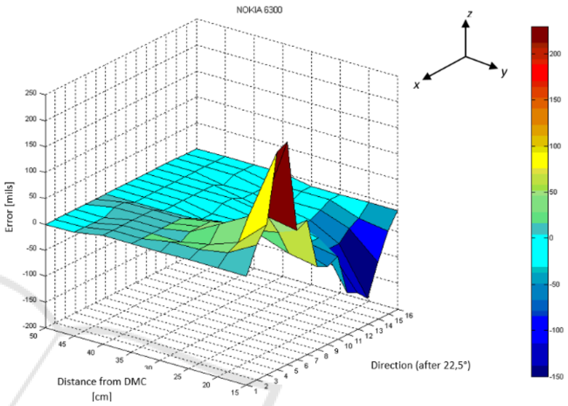


Figure 2: Errors of magnetic azimuths caused by NOKIA 6300.

Based on information stated in figures 1 and 2, it is clear, that influence of cell phones on measurement by DMC are widely different (even in case of the same producer). Influence had been manifested up to distance of 45 cm from DMC. Within this distance, there is usually cell phone in pocket of uniform, upper compartment of backpack or during work in sitting position in pocket of pants. Because the DMC functions in the same manner as the compass needle, these results are to be considered the same for these and similar devices.

According to results of the experiment, it is clear that errors in measurement can be caused by ignorance, inconsistency, or unruliness of the operators. Accuracy of measurement is affected, not only by cell phones, but also by power lines, computers, GPS receivers, calculators, radios and all objects containing metal components (combat vehicles, helmets, pens, watches, knives, weapons etc.) This equipment is necessary in combat situations, and because of this, it is better to use different kind of orientation (in case it is possible).

# 4 MULTI-CRITERIA EVALUATION OF VARIANTS

The most appropriate and at the same time the most accurate way of choosing the optimal variant is use of the mathematical methods. The goal is to assess the suitability of the use of individual TA systems for JFO activity. Before this mathematical evaluation, it is important to determine basic elements of the assessment process. Goal of the assessment is to select most suitable target acquisition system for JFO needs. Assessment object are target acquisition systems, with limiting condition that as an object are considered only target acquisition systems used by the Czech army. Because overall assessment is conducted on its basis, evaluation criteria are one of the most importatnt elements. Evaluation criteria define basic requirements on target acquisition systems according to features needed for JFO work. Target acquisition systems used by the Czech army represents evaluated variants.

## 4.1 Determination of Evaluation Criteria

When using multi-criteria decision-making methods, we distinguish two types of criteria, both quantitative and qualitative. The quantitative criteria are expressed by a numerical value representing the the exact amount of specific value. Qualitative criteria are expressed verbally, because numerical expression is complex or not possible at all. Subsequent conversion of qualitative criteria to numerical expression is not complicated, however, there is a certain distortion. For the assessment of the suitability of the individual types (variants) of artillery TA systems, specific criteria were established. The criteria were determined on the basis of the practical experience and knowledge of the authors of the joint fires in order to achieve a reliable assessment. Authors of this article created following criteria:

- accuracy of own position grid determination;
- orientation accuracy;
- horizontal angles measurement accuracy;
- distance measurement accuracy;
- night obseravation capability;
- low visibility observation capability;
- speed of system preparation;
- laser pointing capability.

Determining the location coordinates is an indispensable element necessary for the operation of target acquistion units. These coordinates are the underlying information that determines other data, especially the coordinates of the targets and other observed objects. This criterion is labeled as $C_1$ and it is quantitative, minimazing type of criterion.

The accuracy of device's orientation is an important aspect for the precision of any data collected by means of an artillery TA units. When measuring directions, the error system is defined by the deviation in the orientation of the device and the deviation in the determination of the directions. The sum of the two deviations is the resulting error in the measurement of horizontal angles. The resulting error then negatively affects the accuracy of the observed points (targets) coordinates. This criterion is labeled as $C_2$ and it is a quantitaive, minimizing type of criterion.

Accuracy in horizontal angles measurement is a key ability of target acquisition systems. Location of targets or other points is determined on basis of direction to these points (see criterion $C_2$). This criterion is labeled as $C_3$ and it is quantitative, minimizing type of criterion

Accuracy of distance measurement is another key capability of TA systems. Distance to observed target (point) is another value used for target coordinates determination. The deviation in the measured distances is then reflected in the accuracy of the calculated point coordinates. This criterion is labelled as $C_4$ and it is quantitative, minimizing type of criterion.

Night observation is an essential capability of artillery TA systems for securing continuous ability to request and guide joint fires. This criterion is labeled as a $C_5$ and it is qualitative, maximizing type of criterion.

Low visibility observation capability is another important capability of each TA system for ensuring of continuous operation of target acquisition units in all weather and visibility conditions. This criterion is labeled as a $C_6$ and it is qualitative, maximizing criterion.

Speed of systems preparation for work is important for effective support of maneuever units. This criterion is labelled as a $C_7$ and it is quantitative, minimizing type of criterion.

Marking of targets by laser is one of the basic capabilities that greatly facilitates the designation of targets for the purpose of aircraft guidance. This criterion is labelled as a $C_8$ and it is qualitative, maximizing type of criterion. Total inventory of criteria used for target acquisition systems evaluation is stated in table 1.

Table 1: Evaluation criteria.

| Criteria | Form | Type |
|---|---|---|
| $C_1$: accuracy of own position grid determination | quantitative | minimizing |
| $C_2$: orientation accuracy | quantitative | minimizing |
| $C_3$: horizontal angles measurement accuracy | quantitative | minimizing |
| $C_4$: distance measurement accuracy | quantitative | minimizing |
| $C_5$: night observation capability | qualitative | maximizing |
| $C_6$: low visibility observation capability | qualitative | maximizing |
| $C_7$: speed of systems preparation for work | quantitative | minimazing |
| $C_8$: laser pointing capability | qualitative | maximizing |

## 4.2 Criteria Weight Determination

First step in multi-criteria evaluation is determination of criteria weight. Due to the nature of the theme itself, criteria and variants, the authors decided to use Saaty's method for weighting the criteria. This method consists of assessing the preferential relationship of criteria among themselves, and the subsequent calculation of the criteria weight. In table 2, individual values of importance between each criterion are stated.

Table 2: Saaty´s comparison chart (Grasseová, Mašlej and Brechta, 2010).

| C | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| **1** | 1 | 3 | 5 | 5 | 3 | 9 | 7 | 7 |
| **2** | 1/3 | 1 | 3 | 3 | 5 | 9 | 7 | 7 |
| **3** | 1/5 | 1/3 | 1 | 1 | 5 | 9 | 7 | 7 |
| **4** | 1/5 | 1/3 | 1 | 1 | 5 | 9 | 7 | 7 |
| **5** | 1/3 | 1/5 | 1/5 | 1/5 | 1 | 7 | 7 | 7 |
| **6** | 1/9 | 1/9 | 1/9 | 1/9 | 1/7 | 1 | 1/5 | 1/5 |
| **7** | 1/7 | 1/7 | 1/7 | 1/7 | 1/7 | 5 | 1 | 1/5 |
| **8** | 1/7 | 1/7 | 1/7 | 1/7 | 1/7 | 5 | 5 | 1 |

Depending on the nature of the desired result, the arithmetic average equation was used to determine the criteria weights.

$$v_i^{'} = \sqrt[n]{x_{i1} \times x_{i2} \times x_{i3} \ldots \times x_{in}} \quad (1)$$

where:

- $v_i^{'}$ is the criterion non-standardized weight;
- $i$ is the criterion 1, 2, …, n;
- $n$ is the number of criteria;
- $x_{in}$ is the criterion value of importance.

After calculating the non-standardized weights, the final step is to calculate the standard weights of the criteria. This is done by use of following equation.

$$v_i = \frac{v_i^{'}}{\sum_{i=1}^{n} v_i^{'}} \quad (2)$$

where:

- $v_i$ is the criterion standardized weight;
- $v_i^{'}$ is the criterion non-standardized weight;
- $n$ is the number of criteria.

Table 3 lists the resulting calculations, non-standardized and standardizedzed weights, and the overall ranking of the criteria for the evaluation of the individual TA systems.

Table 3: Resulting criteria weighs.

| Criteria | Non-standardized weight | Standardized weight | Order |
|---|---|---|---|
| **$C_1$** | 2,053 | 0,202 | I. |
| **$C_2$** | 1,733 | 0,171 | III. |
| **$C_3$** | 1,866 | 0,184 | II. |
| **$C_4$** | 1,866 | 0,184 | II. |
| **$C_5$** | 0,994 | 0,098 | VI. |
| **$C_6$** | 1,145 | 0,113 | IV. |
| **$C_7$** | 1,118 | 0,110 | V. |
| **$C_8$** | 0,665 | 0,065 | VII. |

## 4.3 Determination of Variants

Variants are a key component of evaluation process. Variants mean specific things, activities, options or other elements that we decide on. As an evaluated variants, target acquisition systems used in the Czech army were selected. These systems have been described in chapter 3 of this article. Variants are as folows:

- $V_1$: PPK Sněžka-M;
- $V_2$: PzS LOS-M;
- $V_3$: LOV-Pz;
- $V_4$: GonioLight V w/ Vector 21 Nite;
- $V_5$: Sterna V w/ Vector 21 Nite;
- $V_6$: Sterna V w/ JIM LR.

In addition to specifying the individual variants, their partial evaluation must be performed in accordance with the criteria set out in Chapter 4.1. Within the individual criteria, their ratings will be as follows:

- $C_1$: maximal deviation in position determination in meters;
- $C_2$: maximal angular deviation in orientation in mils;
- $C_3$: maximal angular deviation in horizontal direction measurement in mils;
- $C_4$: maximal distance measurement deviation in meters;
- $C_5$: this qualitative criterion will be rated "0" if the device does not have the nigh vision capability and "1" if it possesses that capability.;
- $C_6$: this qualitative criterion will be rated "0" if the system does not have the thermal imaging capability and "1" if it possesses that capability.;
- $C_7$: minimal time needed for target acquisition system preparation in seconds;
- $C_8$: this qualitative criterion will be rated "0" if the device does not have the laser pointing capability and "1" if it possesses that capability.;

### 4.4 Variants Evaluation

Variants evaluation is the last step in the process of choosing the optimal variant. Within the evaluation process, it is important to distinguish the composition of criteria in terms of its type (qualitative / quantitative). Since eight criteria, three qualitative and five quantitative, have been identified in this article, the selection of methods has been considerably narrowed.

The most appropriate method for selecting a suitable variant for mixed criteria is a method based on direct expert assessment of partial evaluations.This method multiplies the values of each variant by the weight of given criteria.

Results of variants evaluation is stated in table 4. From the table, it is possible to read individual partial evaluation of variants within the given criteria.

The partial evaluation of the variants was determined on the basis of the production documentation supplied by the manufacturers of the individual devices.

Table 4: Variants partial evaluation.

| Variants/ Criteria | $C_1$ | $C_2$ | $C_3$ | $C_4$ | $C_5$ | $C_6$ | $C_7$ | $C_8$ |
|---|---|---|---|---|---|---|---|---|
| $V_1$ | 2,4 | 0,5 | 0,4 | 5 | 1 | 1 | 6 | 0 |
| $V_2$ | 2,4 | 1 | 0,8 | 5 | 1 | 1 | 6 | 1 |
| $V_3$ | 2,4 | 1 | 0,8 | 5 | 1 | 1 | 5 | 1 |
| $V_4$ | 2,4 | 5 | 0,1 | 5 | 1 | 0 | 3 | 0 |
| $V_5$ | 2,4 | 1,8 | 0,1 | 5 | 1 | 0 | 4 | 0 |
| $V_6$ | 2,4 | 1,8 | 0,1 | 5 | 1 | 1 | 4 | 1 |

Due to the character of the evaluation of the variants, the criteria were omitted for all variants of the same values. These are the following criteria:

- $C_1$: accuracy of own position grid determination;
- $C_4$: distance measurement accuracy;
- $C_5$: night observation capability.

Same values at criterion $C_1$ are caused by use of GPS receiver AN/PSN-13A DAGR by all of evaluated target acquisition systems (rockwellcollins.com, 2018). Match within $C_4$ criteria was reached even though evaluated systems use different types of laser rangefinders. All used types of laser rangefinders has the same value of maximal distance measurement deviation. Within $C_5$ criterion, all target acquisition systems are capable of night observation.

Resulting variants evaluation are stated in table 5. Based on the multicriterial evaluation of the variants, the most appropriate variant of the target acquisition system for JFO activities is a set based on Sterna V complemented by JIM LR and TLS 40.

## 5 CONCLUSION

Need for observer, who is able to request and control strikes of artillery and air assets is based mainly on practical experience of the Czech army as well as other NATO partner countries. Given that the JFO concept is a relatively new project under the Czech army conditions and whose aspects are currently being specified, it is necessary, besides training and combat deployment, to specify the target acquisition system whose capabilities most closely correspond to the nature of JFO activity.

Since artillery units have recently been equipped with new target acquisition systems, which are characterized as one of the most advanced in the current market for military sensors, it is advantageous for the selection of system for the work of JFO to be based on the experience of use of these types. On the basis of multi-criterion evaluation methods of the variants, the implemented means were evaluated according to the needs of JFO The result of the analysis is determination of optimal variant of target acquisition system for JFO needs which is the set of Sterna V w/ JIM LR and Zeiss TLS 40.

Table 5: Results of multi-criteria evaluation of target acquisition systems.

| Variants/ Criteria | $C_2$ | $C_3$ | $C_6$ | $C_7$ | $C_8$ | SUM | Order |
|---|---|---|---|---|---|---|---|
| $V_1$ | 0,769 | 0,074 | 0,113 | 0 | 0 | 0,956 | III. |
| $V_2$ | 0,684 | 0 | 0,113 | 0 | 0,065 | 0,862 | V. |
| $V_3$ | 0,684 | 0 | 0,113 | 0,11 | 0,065 | 0,972 | II. |
| $V_4$ | 0 | 0,129 | 0 | 0,33 | 0 | 0,459 | VI. |
| $V_5$ | 0,547 | 0,129 | 0 | 0,22 | 0 | 0,896 | IV. |
| $V_6$ | 0,547 | 0,129 | 0,113 | 0,22 | 0,065 | 1,074 | I. |
| Form | quantitative | quantitative | qualitative | quantitative | qualitative | | |
| Type | max | max | max | max | max | | |
| Weight | 0,171 | 0,184 | 0,113 | 0,110 | 0,065 | | |

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