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CONSIDERATION ABOUT THE UTILITY OF USING THE TOPSIS METHOD IN DEFENSE RESOURCES MANAGEMENT

Dumitru IANCU, Associate Professor, PhD

"Nicolae Balcescu" Land Forces Academy/Sibiu/Romania

Abstract:
The decisions are the trigger of all human action and calls for choice optimal variant based on multiple criteria or more decision-makers. TOPSIS method leads to facilitate this process and generate a solution for final decision-maker closer to the reality of context. The complexity of phenomena that NATO faces in the current period, especially in the next, require to conjugate the ideas of all allies to identify the most appropriate solutions for the future. Why is this approach necessary? The direction in which Alliance is moving, or the activities that will be held by it, depend on the interests and potential of each country to support it.

Key words: intercultural communication, military, stereotypes, pre-deployment training, cultural awareness

1. Introduction

In the last years, NATO military actions have undergone profound transformations in relation to their characteristics, on the one hand: dynamic, scale, structural components involved, and on the other hand, the types of missions followed and the geographic area where were conducted. Without these aspects be detailed, it is quite obvious that the challenges arising out of these perspectives military action calls for military leaders to find solutions that increase more efficient in defense resources management. "*Military spending and burden sharing have been perennial and interrelated sources of tension within the Atlantic Alliance and within the political systems of its members. That should hardly be surprising in democratic political systems that routinely and transparently weigh the trade-offs between guns and butter. Obviously, no government ministry ever manages to acquire the resources it strives to obtain in order to achieve its goals. Thus, defense ministers oftentimes at least quietly agree with the critical voices of their allies that their governments are not spending sufficiently on national and allied defense, but they enjoy only limited leverage to wring out more resources from their government's national budgets*"[**1**].

NATO consists of 28 states with own economies, volume of population, varied and different interests, but each in own way contribute to the proper functioning of the Alliance. Therefore, in decision making process, the "voice" of each country must be heard and translated into the final decision.

2. Perspectives of the Defense Resources Management in NATO

Affiliation to a political-military alliance suppose, besides advantages and opportunities, a lot of responsibilities towards its objectives. Among the most important responsibilities we REMIND reminder: the participation in decision making within the alliance and the financial support process, in proportions adopted, for its activities. But an alliance will never work within normal parameters if there isn't a high cohesion of its members, based on knowledge of each of them characteristics. "*An effective defense planning process is essential to deliver the collective political, military and resource advantages expected by NATO members. By participating in the NATO Defense Planning Process (NDPP), and without compromising their national sovereignty, Allies can harmonize their national defense plans with those of NATO to identify, develop and deliver a fair share of the overall forces and capabilities needed for the Alliance to be able to undertake its full range of missions. The NDPP is designed to influence national defense planning efforts and identifies and priorities NATO's future capability requirements, apportions those requirements to each Ally as targets, facilitates their implementation and regularly assesses progress. It provides a framework for the harmonization of national and Alliance defense planning activities aimed at the timely development and delivery of all the capabilities, military and non-military, needed to meet the agreed security and defense objectives inherent to the Strategic Concept*". [**2**]

It is known that the harmonization of member's interests and actions in an organization depends on how the decision-making process is developed, as well as the participant's motivation in this process. Moreover, it has demonstrated, over the time, that a collective decision is much better than an individual decision.

NDPP is the result of analyzing and selecting among alternatives, based on a variety of criteria that could be interpreted differently by each country, member of NATO, and NDPP must be closer to the potential of everyone to carry it out.

"*Members of the Alliance contribute in different ways to the three NATO run budgets: the civil budget, the military budget and the Security Investment Programme. Each of these is underwritten by individual contributions from member states based on previously agreed ratios related to per capita GDP, the size of the national economy and several other factors. The military budget is NATO's largest. It covers the operational costs of the international military staff in Mons, Belgium, and the various NATO commands in Europe and North America. It also underwrites the costs of maintaining and deploying the NATO AWACs fleet, the NATO pipeline system and the Maintenance and Supply Agency*."[**3**]

The resources at disposal to achieve the NATO objectives will never be unlimited. Contrary, in relation with the contemporary period affected by the global financial and economic crisis, it is demonstrated that there are limits in connection with the allocation of resources into the Alliance.

"*The budget for the NATO Security Investment Programme helps support selected allied military installations and construction projects. In recent years, this fund has underwritten projects that encourage transformation away from the old static defense postures toward crisis control, anti-terrorism and more mobile military structures. In practical terms, the fund finances various NATO functions including command, control and communications initiatives, software packages, logistics, training installations and transportation. Specific projects are funded through open bidding procedures and are NATO controlled and audited (Ek)*".[**4**]

Therefore, it appears the need to prioritize the targets against the level of resources allocated, in order to improve the efficiency of Alliance activities management. It is necessary a collective decision.

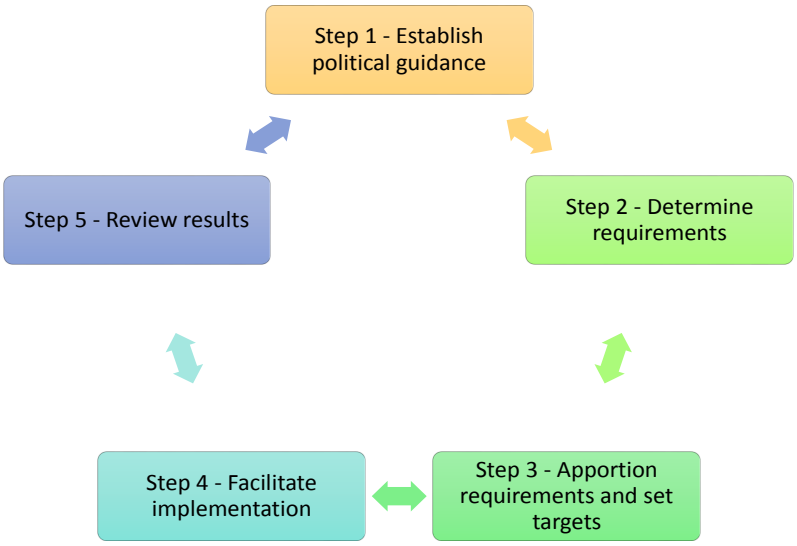

Fig. nr. 1 Steps of NATO Defense Planning Process (NDPP)

When we speak of the need and utility of collective decision in NDPP we ought to make some required clarifications. Obviously, that we meet throughout the NDPP multiple collective decision, but they are different categories:

- In step 1, it is found in the collective decision of all the NATO countries; "*Political guidance aims at defining the number, scale and nature of the operations the Alliance should be able to conduct in the future (commonly referred to as NATO's Level of Ambition). It also defines the qualitative capability requirements to support this ambition. By doing so, it steers capability development efforts within the Allies and NATO. It defines associated priorities and timelines for use by the planning domains. Political guidance is normally reviewed every four years*." [**5**]

- In step 2, we could discuss the collective decision taken on the Allied Command Operations (ACO) and Allied Command Transformation (ACT); *"NATO's capability requirements (current and future) are consolidated into a single list called the Minimum Capability Requirements. These requirements are identified by the planning domains and the two Strategic Commands (ACO and ACT). ACT has the lead in determining the requirements. The process is structured, comprehensive, transparent and traceable and uses analytical tools coupled with relevant NATO expert analysis. This is done once every four years, although out-of-cycle activity for particular capabilities can be undertaken as circumstances dictate."*[**6**]

- In step 3 of the collective decision is still at the ACO and ACT, but also needs the opinion of each country; *"The Strategic Commands (with ACT in the lead) develop a target package for each Ally for existing and future capabilities, with associated priorities and timelines. Targets are expressed in capability terms and are flexible enough to allow innovative solutions to be developed rather than replacing "like with like". Once each Ally has been consulted, the International Staff replaces the Strategic Commands in leading the process. Target packages are forwarded to Allies with a recommendation of which targets should be retained or removed. Allies review these packages during a series of Multilateral Examinations and agree a target package for each Ally on the basis of "consensus minus one", meaning that a single Ally cannot veto what otherwise would be a unanimous decision on its own target package.*"[**7**]

- In step 5 the results obtained will determine a collective decision, from time to time about what to do next; *"Every two years, Allies complete a Defense Planning Capability Survey which seeks data on Allies' national plans and policies, including efforts (national, multinational and collective) to address their capability targets. The survey also seeks information on the national inventory of military forces and associated capabilities, any relevant non-military capabilities potentially available for Alliance operations and national financial plans. […] The assessments are submitted for examination to the Defense Policy and Planning Committee (DPPC) for review and approval during a series of multilateral examinations. In parallel with and based on the Strategic Commands' Suitability and Risk Assessment, the Military Committee develops a Suitability and Risk Assessment. It effectively provides a risk assessment on the military suitability of the plans and the degree of military risk associated with them in relation to political guidance for defense planning.*"[**8**]

Through identification of the place and role of the collective decision in NDPP, we believe that the decision-making process is very important in the management of defense resources, especially, that the adopted decisions will have implications in the medium and long term in life of Alliance.

3.TOPSIS method - theoretical explanations

The decision adopted by the group may be the result of a combination of individual solutions (the compromise). It may be the result of a selection (by consensus, majority vote or qualified by decision-making powers of each participant) of one individual solutions. The solution adopted by collective decision-maker combination is not necessarily the "best" solution considered optimal individual by points of view, different possibilities of knowledge and logic of the decision taken by each participant.

The TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) method was developed by Hwang and Yoon in 1981. This method involves the concepts of calculating Euclidian distances. TOPSIS method gives the solution that is closest to the hypothetically best [**9**]. This method is used to solve a multi-criteria decision-making under deterministic conditions.

The algorithm for application TOPSIS method:

a) establish the variants (V_1, V_2,…V_i), where i = (1,p), the criteria/ attribute (Q_1, Q_2, …Q_j), where j = (1,t) and the decision-makers (D_1, D_2, …D_d), where d = (1,m);

b) determine the scales of assessment criteria / attributes and variants;

c) determine the size (importance) criteria / attributes depending on the scale of assessment established:

$$k_i = (\sum_{d=1}^{m} n_{id})/m$$

where k_i – average score of each decision maker for the variant V_i
n_{id} – note of the decision maker d given to version V_i
m – number of decision makers
after will normalized the importance of each criterion as against k_i, obtaining the k_i^*.

d) calculate the average marks given by each decision maker for each variant, according to each criterion / attribute based on the assessment scale established:

$$l_i = (\sum_{d=1}^{m} N_{id})/m$$

where l_i – the average marks given by each decision maker for variant V_i, under the criterion / attribute Q_j

N_{id} – Note the decision maker d given to version V_i under the criterion / attribute Q_j

m – number of decision makers

e) build the decision table with variants versus criteria / attributes x_{ij};

f) determine the normalized matrix, such:

$$r_{ij} = x_{ij} / \sqrt{\sum_{i=1}^{p} x_{ij}^2}$$

g) calculate the normalized weighted matrix, using the formula:

$$a_{ij} = r_{ij} * k_i$$

h) determine the ideal solution and the negative ideal solution:

The ideal solution: V_j^+:

$$v_j^+ = \begin{cases} \max_{1\le i\le p}(a_{ij}) \cdot if \cdot C_j it \cdot is \max \\ \min_{1\le i\le p}(a_{ij}) \cdot if \cdot C_j it \cdot is \cdot \min \end{cases}$$

The negative ideal solution: V_j^-:

$$v_j^- = \begin{cases} \min_{1\le i\le p}(a_{ij}) \cdot if \cdot C_j it \cdot is \cdot \max \\ \max_{1\le i\le p}(a_{ij}) \cdot if \cdot C_j it \cdot is \cdot \min \end{cases}$$

i) calculate the distances from the ideal solution and negative ideal solution:

$$S_i + = \sqrt{\sum_{j=1}^{t}(a_{ij} - v_j^+)^2}$$

$$S_i - = \sqrt{\sum_{j=1}^{t}(a_{ij} - v_j^-)^2}$$

j) calculate the near of ideal solution and carry out a hierarchy of variants in descending order:

$$C_i = \frac{S_i^-}{S_i^+ + S_i^-}$$

4. TOPSIS method - practical explanations (hypothetical data)

a) Suppose we have the following data:

a.1. Variants:

V_1 – develop the Minimum Capability Requirements
V_2 – develop the Capability Requirements
V_3 – develop some capabilities and postpone others capabilities;

a.2. Criteria / attributes:

Q_1 – budget
Q_2 – time implementation
Q_3 – forces
Q_4 – accomplished capabilities

a.3. Decision makers:

D_1 – Defense Policy and Planning Committee (DPPC) representative
D_2 – ACT representative
D_3 – ACO representative
D_4 – NATO Office of Resources (NOR) representative.

b) Determine the scales of assessment criteria / attributes and alternatives

Quality	Very very low	Very low	Low	More than low	Medium	Less than high	High	Very high	Very very high
Notation	0,05	0,10	0,15	0,20	0,25	0,30	0,35	0,40	0,45

Table no. 1 Assessment grid of the criteria's importance

Quality	Minimum	More than minimum	Satisfying	Less than extraordinary	Extraordinary
Notation	1	3	5	7	9

Table no. 2 Assessment grid of variants

c) Determine the size (importance) criteria / attributes depending on the scale of assessment established:

Decidents \ Criteria	D_1	D_2	D_3	D_4	k_i	k_i^*
Q_1	0.4	0.1	0.3	0.15	0.24	0.209
Q_2	0.3	0.3	0.4	0.25	0.31	0.275
Q_3	0.15	0.45	0.25	0.4	0.31	0.275
Q_4	0.25	0.2	0.35	0.3	0.28	0.242

Table no. 3 Determine the importance of the criteria

d) Calculate the average notes given by each decision maker for each variant, according to each criterion / attribute based on the assessment scale established:

Decidents\ Variant	D_1	D_2	D_3	D_4	l_i
V_1	4	5	3	5	4.25
V_2	7	7	9	5	7.00
V_3	8	7	6	5	6.50

Table no. 4 Calculate the average notes for criterion Q_1 (budget)

Decidents\ Variant	D_1	D_2	D_3	D_4	l_i
V_1	3	6	5	4	4.50
V_2	6	7	5	6	6.00
V_3	5	8	6	6	6.25

Table no. 5 Calculate the average notes for criterion Q_2 (time implementation)

Decidents\ Variant	D_1	D_2	D_3	D_4	l_i
V_1	6	8	7	7	7.00
V_2	6	7	8	7	7.00
V_3	4	3	2	4	3.25

Table no. 6 Calculate the average notes for criterion Q_3 (forces)

Decidents\ Variant	D_1	D_2	D_3	D_4	l_i
V_1	4	5	6	6	5.25
V_2	6	7	8	7	7.00
V_3	8	7	8	6	7.25

Table no. 7 Calculate the average notes for criterion Q_4 (accomplished capabilities)

e) Construct the decision table „variants versus criteria / attributes ”x_{ij};

Criteria \ Variants	Q_1	Q_2	Q_3	Q_4
V_1	4.25	4.50	7.00	5.25
V_2	7.00	6.00	7.00	7.00
V_3	6.50	6.25	3.25	7.25

Table no. 8 Decision table

f) Determine the standard matrix, such:

Criteria \ Variants	**Q_1**	**Q_2**	**Q_3**	**Q_4**
V_1	$(4.25)^2$	$(4.50)^2$	$(7.00)^2$	$(5.25)^2$
V_2	$(7.00)^2$	$(6.00)^2$	$(7.00)^2$	$(7.00)^2$
V_3	$(6.50)^2$	$(6.25)^2$	$(3.25)^2$	$(7.25)^2$
$\sum(x_{ij})^2$	109.3125	92.25	108.5625	129.125
$\sqrt{\sum(}$	10.455	9.605	10.419	11.363

Table no. 9 Calculation of standard matrix (1)

**Criteria **	**Q_1**	**Q_2**	**Q_3**	**Q_4**

Variants				
V_1	4.25/ 10.455	4.50/ 9.605	7.00/ 10.419	5.25/ 11.363
V_2	7.00/ 10.455	6.00/ 9.605	7.00/ 10.419	7.00/ 11.363
V_3	6.50/ 10.455	6.25/ 9.605	3.25/ 10.419	7.25/ 11.363

Table no. 10 Calculation of standard matrix (2)

Criteria \ Variants	**Q_1**	**Q_2**	**Q_3**	**Q_4**
V_1	0.406	0.468	0.672	0.462
V_2	0.670	0.625	0.672	0.616
V_3	0.622	0.651	0.312	0.638

Table no. 11 Standard matrix

g) Calculate the normalized weighted matrix:

Criteria \ Variants	**Q_1**	**Q_2**	**Q_3**	**Q_4**
V_1	0.406*0.210	0.468*0.272	0.672*0.272	0.462*0.246
V_2	0.670*0.210	0.625*0.272	0.672*0.272	0.616*0.246
V_3	0.622*0.210	0.651*0.272	0.312*0.272	0.638*0.246

Table no. 12 Calculation of standardized weighted matrix

Criteria \ Variants	**Q_1**	**Q_2**	**Q_3**	**Q_4**
V_1	0.085	0.127	0.183	0.114
V_2	0.141	0.170	0.183	0.152
V_3	0.131	0.177	0.085	0.157

Table no. 13 Standardized weighted matrix

h) Determine the positive ideal solution and the negative ideal solution:
Considering the criteria, it will follow:

- Maximize the criterion Q_4
- Minimize the criterion Q_1 , Q_2 and Q_3

Ideal solution: V_j^+:

$v_j^+ = (0{,}085;0{,}127;0{,}085;0{,}157)$

Ideal negative solution: V_j^-:

$v_j^- = (0{,}141;0{,}177;0{,}183;0{,}114)$

i) Calculate the distances from the positive ideal solution and negative ideal:

Criteria \ Variants	**Q_1**	**Q_2**	**Q_3**	**Q_4**	$\sum(a_{ij}-v_j+)^2$
V_1	$(0.085-0.085)^2=0$	$(0.127-0.127)^2=0$	$(0.183-0.085)^2=0.0096$	$(0.114-0.157)^2=0.0018$	0.0114
V_2	$(0.141-0.085)^2=0.0031$	$(0.170-0.127)^2=0.0018$	$(0.183-0.085)^2=0.0096$	$(0.152-0.157)^2=0$	0.0145
V_3	$(0.131-0.085)^2=0.0021$	$(0.177-0.127)^2=0.0025$	$(0.085-0.085)^2=0$	$(0.157-0.157)^2=0$	0.0046

Table no. 14 Calculation of S_i+

Criteria \ Variants	**Q_1**	**Q_2**	**Q_3**	**Q_4**	$\sum(a_{ij}-v_j-)^2$
V_1	$(0.085-0.141)^2=0.0031$	$(0.127-0.177)^2=0.0025$	$(0.183-0.183)^2=0$	$(0.114-0.114)^2=0$	0.0056
V_2	$(0.141-0.141)^2=0$	$(0.170-0.177)^2=0$	$(0.183-0.183)^2=0$	$(0.152-0.114)^2=0.0014$	0.0014
V_3	$(0.131-0.141)^2=0.0001$	$(0.177-0.177)^2=0$	$(0.085-0.183)^2=0.0096$	$(0.157-0.114)^2=0.0018$	0.0115

Table no. 15 Calculation of S_i-

$$S_i+ = (0{,}1068;0{,}1204;0{,}0678)$$

$$S_i- = (0{,}0748;0{,}0374;0{,}1072)$$

j) Calculate approximation of the ideal solution and provides a ranking of variants in descending order:

Variant	**V_1**	**V_2**	**V_3**
S_i+	0.1068	0.1204	0.0678
S_i-	0.0748	0.0374	0.1072
(S_i+)+(S_i-)	0.1816	0.1578	0.1750
(S_i-)/(S_i+)+(S_i-)	0.412	0.237	0.613

Table no. 16 Determination of the distance from the ideal solution

Resulting the hierarchy variants $V_3>V_1>V_2$

Thus, based on the views of decision makers, chosen criteria and types of variants delimited the best option is using TOPSIS method, V_3 – *develop some capabilities and postpone others capabilities*

4. Conclusion

For getting the consensus in NATO making decisions is, usually, a lengthy process and require information adjustments and readjustments who standing on NPDD making. Therefore, by establishing the precise landmarks from which views makers will be nuanced to be closer at their contexts, will lead to establish a decisions that will satisfy all beneficiaries.

TOPSIS method can help the decision makers to take into consideration all the views of those involved in the decision making process at this scale, we refer to defense resource management in NATO. Thus, we believe that if they match the necessary conditions to offer of all information and viewpoints of those interested in the best decision in NPDD, TOPSIS method can provide a solid base of starting in the negotiating process of the NPDD final version.

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