MCA–KIPA ANALYSIS OF MILITARY TRANSPORT

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Abstract: Military transport is as old as warfare itself, as rations, weaponry and other necessary equipment had to be provided for the soldiers even in ancient times. Military transport has a long history through the ages since the spread of wars involving long distance troop movements the transportation of soldiers, sustenance, weaponry and equipment for camp placement has become increasingly important. It is defined as the transfer of higher unit, unit, subunit, institutions, subdivisions, military materials and technical devices from one area to another through various transport sectors. Moreover, military transport includes not only the transfer of materials and devices but the transportation of personnel as well. The paper examined the strategic significance of each mode of transport at the army. Therefore, the KIPA analysis was performed for prioritisation, which was used to determine the transport sector that has the greatest role in the life of the army.

Keywords: military transport, strategic transport, KIPA analysis, aerial military transport.

1. Introduction

The transport and accumulation of the strategic stock and the satisfaction of a given military operation's stock, fuel, spare part, ammunition and provision demand requires precise and high capacity logistics. Naturally, the difficulty of a certain task depends on several factors for example speed and the size of the army deployed to the field and the length of the operation. The efficiency of strategic transports depends on the kind of infrastructure available for the troops (Moretti *et al.,* 2018).

2. Presentation of Strategic Transport by Transport Sectors

Following we can see in detail the strategic transport by transport sectors in the life of army.

2.1. Strategic Transport on Water

The best case scenario for military logistics personnel is if well-established ports are available which are capable of receiving several low-hulled vessels nearby to the destination. Strategic naval transport can be divided into a few groups. One of these branches is the American Military Sealift Command's forward storage vessel system. Essentially, vessels are positioned at strategic points of the ocean with enough equipment, fuel and ammunition to last 30 days for the navy to execute both aerial or land operations. As each ship is equipped with its' own crane system, the usage of adequate ports is possible.

The other naval transport possibility is the transport vessels that make up the backbone of strategic transport. Container transport

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vessels, tanker ships and Ro-Ro floating units-specially designed units capable of transporting vehicles and helicopters-are widely used by military forces with sufficient coastline, navy and ability to lead expeditions. The system's main liability is vulnerability; a well-executed attack could lead to the destruction of essential supplies (Trautmann, 2016).

2.2. Aerial Strategic Transport

If the destination country does not have a coastline or a port at its' disposal, strategic aerial transportation might be the best solution. However, this is the most expensive approach out of all the possibilities and only a limited number of countries possess aeroplanes suitable of real aerial transport. Not to mention, only a few countries manufacture them. AN-225 Mrija, the largest strategic aerial transport plane.

Strategic aerial planes are capable of transporting even heavy military vehicles. Airports are the only stable and safe transportation possibility in Afghanistan. Even though the path starting from Pakistan leading through the Khyber Pass would be a considerably cheaper route it's also much more dangerous as countless trucks and deliveries have been high-jacked by armed Taliban attackers. Another important factor to take into consideration is the refuelling of the planes. The possible range of each laden plane decreases as the effective load is divided between the cargo and the fuel (Thayer, 1965).

2.3. Strategic Railway Transport

Railway transportation could be the ideal compromise in principle considering it encapsulates the load capability and

inexpensive cost per tonne of naval transport and the swiftness of aerial transport (Nesic *et al.,* 2017). Though, this means of transport is only credible in cases of continental conveyance or countries with an advanced infrastructure however these are not the areas that are in need of this transport. The EU's well-established railway system is taken into account by the NATO's North European defence plans and other countries rely on their own railways like Japan, China, Russia etc. However, there are a number of operative areas with virtually no or hardly any railway lines equipped with sufficient load capacity and reliable rolling stock (locomotives, freight wagons, trolleys) can be found. Afghanistan, Iraq, or most of Africa, are not part of the area with the appropriate infrastructure (Trautmann, 2016).

The best delivery is the one that has already been done, which means that strategic stock has previously been accumulated for future application areas. This solution makes a more flexible and faster start of an operation possible, since only the soldiers have to be delivered to the scene. The US military has built several similar forward depots around the world from the Middle East through Europe to Asia. As a result of increased Russian threat, Americans, for example, have relocated the installation of a completely mechanized brigade to Europe, but its' supervision, the continuous maintenance of equipment and vehicles stored there, and the task of keeping them in combat ready condition requires both man and financial power. At the same time, reparation of vehicles in the depot's maintenance centre is still much cheaper and simpler than for example carrying a brigade worth of military vehicles across the Atlantic two at a time by cargo planes (Van Eekeren *et al.,* 2018).

3. KIPA Analysis of Methods of Military Transport

The KIPA method was developed at the Budapest University of Technology and Economics, the acronym comes from the names of its' creators József Kindler and Ottó Papp. Based on its basic philosophy, it can be classified into European schools, which examines the advantages and disadvantages of the systems to be compared with each other. It also determines the order of preference based on the benefits and disadvantages. As a result, the literature uses the term „optimum" instead of „better" and looks for an optimal solution from the set of alternatives (Kindler and Papp, 1977).

The method characterized by a five-stage verbal scale based on the considerations of the comparable alternatives. The scales ratio is usually determined by the weighting process, that is the scale unit usually suggests the weight itself. This means that the bad grade is zero-point, the corresponding grade is the weighting value itself, the middle grade is two times its' weight, the good grade is three times its weight, and the very good grade is four times the weight. Table 1. shows the basic table of KIPA (Esztergár-Kiss and Csiszár, 2012).

Table 1
The Basic Table of KIPA

Alternatives	Viewpoints and weightings					
	C_1		...		C_j	
	w_1				w_j	
	verbal	value	verbal	value	verbal	value
A_1		p_{11}				
...						
A_i						p_{ij}

Source: (Own Editing).

It is calculated by adding the weight of the criteria, where A_i is preferred or indifferent to A_j, and the amount is divided by the sum of the weight numbers.

3.1. Calculation

To perform the KIPA method we first determined the comparative alternatives, in this case the military transport sectors:
- A_1 = road military transport;
- A_2 = air military transport;
- A_3 = railway military transport;
- A_4 = waterborne military transport.

To this end, we defined an 8 viewpoints system, which can be used to compare each transport sector, as a result, which sector is "optimal" or most appropriate for carrying out military deliveries (Ivković *et al.,* 2018). The considerations are as follows:

- C_1 = cost, how expensive it is to transport the unit of goods;
- C_2 = investment demand for proper operation;
- C_3 = energy demand (fuel);
- C_4 = capacity constraint of a given transport;
- C_5 = speed;
- C_6 = applicability of dangerous or combat areas;
- C_7 = special tooling for the removal of military materials;

- C_8 = making great distances is the most efficient way.

For the analysis, the weight of the specified criteria must be given, as well as the comparisons done in Table 2, which has been studied in the most objective way possible through various expert opinions and the studies we have done so far. The weights were determined on a scale of 5, 5 being the worst and 40 the best (Karádi *et al.,* 2015), (Bölükbaş *et al.,* 2012).

Table 2

Comparison Table for Weight Numbers and Alternatives

Viewpoints	Weighting	A_1	A_2	A_3	A_4
C_1	5	large	very large	average	low
C_2	20	average	large	large	low
C_3	15	large	large	average	low
C_4	30	low	average	very large	very large
C_5	40	average	very large	large	low
C_6	35	large	very large	average	low
C_7	25	low	large	average	very large
C_8	10	low	veri large	average	large

Source: (Own Editing).

With the help of this table, the performance of later analysis will be easier. For weights, we chose 5 as the scale's unit for easy calculation. According to the principle of KIPA, and in the comparative table, we can see in the basic tables defined in Table 3/a and b, for better transparency it is represented in two parts (Gyarmati, 2003; Heinitz and Hirschberger, 2017).

Table 3/a

The First Half of the Defined KIPA Basic Table

	Viewpoints/Weightings							
	C_1		C_2		C_3		C_4	
	U1 (5)		U2 (20)		U3 (15)		U4 (30)	
Alternatives	Verbal	Value	Verbal	Value	Verbal	Value	Verbal	Value
A_1	average	10	good	60	acceptable	15	acceptable	30
A_2	acceptable	5	acceptable	20	average	30	average	60
A_3	good	15	averages	40	good	45	good	90
A_4	very good	20	very good	80	very good	60	very good	120

Source: (Own Editing)

Table 3/b
The Second Half of the Defined KIPA Basic Table

	Viewpoints/Weightings							
	C_5		C_6		C_7		C_8	
	U5 (40)		U6 (35)		U7 (25)		U8 (10)	
Alternatives	Verbal	Value	Verbal	Value	Verbal	Value	Verbal	Value
A₁	average	80	good	105	very good	100	acceptable	10
A₂	very good	160	very good	140	good	75	very good	40
A₃	good	120	average	70	average	50	average	20
A₄	acceptable	40	acceptable	35	acceptable	25	good	30

Source: (Own Editing)

As a next step for producing the KIPA matrix is calculating the preference indicators, c_{ij}, and the disqualification indicators, d_{ij}.

The benefit indicator examines the benefits of i-th alternatives to j-eds and is calculated for each and every relation. Its value comes from summing up the percentages of the valuation criteria, for which the initial alternative is preferred or indifferent (the value added in the base table is greater than or equal to) to the compared alternative. The downside indicators are also calculated for all ij ratios, but the calculation should take into account that only the evaluation aspect for which preference intensity is the highest. The calculation of the benefit and deficit indicators is not specified in the article. The advantage and downside indicators can be used to produce the KIPA matrix, which is included in Table 4.

Table 4
The Generated KIPA Matrix with Percentages

	A₁	**A₂**	**A₃**	**A₄**
A₁		27,78	44,44	55,56
		25	18,75	18,75
A₂	72,22		61,11	61,11
	12,5		18,75	18,75
A₃	55,56	38,89		55,56
	15,63	21,88		12,5
A₄	44,44	38,89	44,44	
	15,63	25	25	

Source: (Own Editing)

The ranking of the preference order and the ranking of transport sectors can be based on the data of the matrix. The preference threshold is 60 percent, so $c_{ij} \geq 60\%$ and the disqualification threshold at 30%, $d_{ij} \leq 30\%$, which level was a total of 3 pairs of comparisons (green in the table). With these, the assortment graph can also be plotted, the vertices of the graph are made up of the alternatives, the comparable element was controlled by pairs of pairs, they start from the preferred alternative and point to the other member. The graph can be used to determine the order of variations and to illustrate the results, the best alternative is the one all the arrows are pointing from and the worst version is the one most of the arrow are pointing at. Fig 1. shows assortment graph of the KIPA analysis.
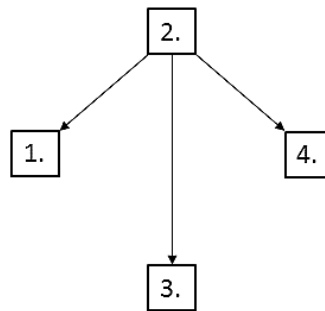

Fig. 1.
Assortment Graph of the KIPA analysis
Source: (Own Editing)

As a result of the KIPA analysis we have found that air transport is the most optimal for the army, taking into account the specificities of military transport. It also confirms why the development of the cargo plane fleet is an important topic for the Hungarian Defence Forces.

4. Conclusion

In the article we examined the strategic significance of each mode of transport at the army, and KIPA analysis was performed for prioritisation, which was used to determine the transport sector that has the greatest role in the life of the army. In order to make the calculation, we took into account 8 criteria as a function of the factors that best determine the choice between the different transport sectors. As a result of this calculation, we have found that military air transport is the most favourable transport sector to serve today's military operations. At the same time, you should not forget the other modes of transport, especially in a small country like Hungary. It is not possible to rely on just one strategic transport, although the analysis has proved that, that today's air transport capacity is very important and is an indispensable investment in our country. Today's efforts to develop air capacity are very important steps to be a strong and independent army for our country.

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