Logistics and the armed forces from antiquity to the future

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Logistics and the armed forces have always been related, and this relation sometimes follows, sometimes determines the developments in the civilian world. This contribution is an abstract from a published book ‘Van Marketenster tot logistiek systeem’ (‘From camp follower to network logistics’)\(^1\), which discusses the development of logistic thinking throughout the ages.

Introduction

Frequently in historical dissertations there is a search for factors that have caused watersheds in gradual developments. Likewise, the present article sets out to identify these watersheds in the relation between logistics and the armed forces, from antiquity to the future. There are two angles from which this can be done. On the one hand, there is the perspective of certain factors that cause conflicts, and on the other there is that of innovative developments in knowledge or learning.

The causes for conflicts can be divided into social factors, which find their origin in differences in ideology, culture, religion or other aspects of life. Another category is more related to political or economic power, such as scarcity of money, raw materials or energy.

Good examples of innovative developments in knowledge or learning are orientation at sea by means of the sextant, the ability to calculate a bullet’s trajectory and its destructive power, matters Simon Stevin occupied himself with. But of course there are also such areas as planning and simulation in logistics or the invention of gunpowder, the breech loader and the bomb.

According to Thorpe, apart from strategy and tactics logistics is particularly relevant for victory or defeat in conflict. Beside the materiel component logistics also has a supply chain component. In materiel logistics it is all about the differentiation in technical means; in the supply chain it is the differentiation in the availability at the right moment, the right quantity and quality and place. In his strategic positioning Porter distinguishes cost leader or differentiation strategy, on the one axis, and in-focus or scale strategy, on the other. For logistics in the armed forces this distinction can also be made. Either the organization goes for cost leadership, so economical and intelligent handling of scarce means, based on the existing school of thought, or it follows the differentiation strategy, which is directed at innovative, creative thinking and acting. This innovation can be directed at weapon systems (materiel logistics) or supply chain networks.
This contribution presents a concise description of logistics, combat service support, from ancient history until recent history, followed by a number of conclusions.

Logistics from antiquity until 1550
The Greek philosopher Socrates stated that the general is responsible for the supply of food, the provision of his men and for all other matters needed to wage war. Add to this the words of Vegetius that more people have died from lack of food than by the sword and it becomes clear that in antiquity, with the increase in size of armies, the food problem became one of the most important factors in the preparation for war. When, subsequently, it is borne in mind that transport over land in those days was many times more difficult than over water, it is clear that control of the waters yielded an important advantage in the choice of the most suitable place and time for engaging in battle. As in this time the soldiers lived mainly off the land they moved through, it is plausible that the opponent would use ‘scorched earth’ tactics. This was the reason why the soldiers often had to carry their own food supplies with them, sometimes even for up to twenty days! Already in early antiquity merchants and craftsmen could be found in the army train. Attacks on separate food convoys necessitated the protection by armed soldiers. The use of protected places and forts for food storage already indicated that the allocation of supplies had the full attention of the army leaders at the time.

It is not surprising that the Romans attributed an equal importance to supplying the soldier in the form of food, drink and fodder for the animals. For a large part the food was transported on foot, not only because of the fact that the men carried most of it themselves, but also because cattle herds were in the train, together with the draught animals and beasts of burden. What is also remarkable was the need for wood, especially firewood for the kitchens.

The Romans' pursuit of perfection is striking, e.g. the precise calculation of supplies to be taken along on the basis of an organic division into contuberia (groups of eight soldiers). The formula gave one modius of 8.37 litres of grain every day per contubernium. The beasts of burden were allocated per contubernium.

With the Romans, too, there were merchants that moved along with the legions. Living off the land was bound by strict rules, and this also applied to the setting up and breaking down of the army camps. Incidentally, the use of the word 'administration' in Anglo-Saxon countries for logistics until the 20th century may be related to the fact that in the Roman era there was already an elaborate administration. It is fitting to conclude this brief survey by mentioning the enormous effort the Romans put into realizing a good infrastructure, an elaborate system of roads and waterways, which is often still in use nowadays. An infrastructure is of great importance for a human being's mobility, in
this case armies and their logistic support. It is this infrastructure, in particular, that made it possible for such a large empire as the Roman to last for so long.

Logistics from 1550 to 1870
This period is known as the age of siege warfare. The 16th century is regarded as the New Era, during which the role of the mounted arm par excellence, the cavalry, was pushed more and more to the background. The discovery of gunpowder as a propellant for projectiles (guns, muskets, pistols and mines) made its presence felt in the construction of reinforcements and the art of warfare. Transport of ammunition (still relatively modest in volume) and towed artillery began to gain ground. The influence of terrain and weather on the conduct of warfare remained dominant, which lent added importance to natural passages in the terrain. This is the reason why these locations, castles and walled settlements, later known as fortresses, were picked as the centers of protection against possible invasions. Moreover, natural barriers, for instance in the form of inundations were widely used. This approach to safeguarding one’s possessions determined military operations in the period up to 1870, and it gave form and substance to the organization of the logistic function. The Eighty Years War showed a concentration of the battle around fortified cities, functioning as war munitions depots, all prepared for lengthy sieges. Almost without exception these fortresses were situated on crossroads, usually on or near big rivers. Transport by water was of eminent importance in this. The river cities formed the basis of a network of waterways for Maurice and William Louis for the transportation of guns, ammunition, materiel and food. This implied that their Spanish adversaries were forced more and more to make use of transport over land, with all the disadvantages attached to it. Their responsiveness was drastically decreased because of the long, slow supply lines. In general the basins of the big rivers were preferred as routes of advance, because of the great advantage they offered with respect to the transport of munitions of war. An added advantage was the much larger loading capacity of ships compared to wagons. The total length of the required army train was sometimes up to 20 kilometers! This is where Stevin comes in with his mathematical calculations for transports over land and water. In particular the transport of artillery over land required many horses, reserve horses and also their fodder. Barren regions were avoided or traversed as quickly as possible. Supply sometimes took place from faraway supply points, with all the ensuing dangers of raids on these (logistic) transports. This is in fact one of the reasons why the barren Kempen region hindered an expansion of the Republic to the South.

In the second half of the 17th century the aspirations of Louis XIV led to the introduction of a logistic system that built on a method that had already been in use on a lim-
ited scale. This so-called warehouse system comprised a number of pre-established warehouses in the hinterland. From here the troops could be supplied on a regular basis, using a fleet of wagons (équipage de vivres) that had been incorporated into the army train. Later this system was expanded into fixed warehouses, with the required quantities of food, ammunition and materiel for a campaign calculated beforehand. Here, too, use was made of cattle (that transports itself) in order to provide for the need of meat. In 1672 this system was used to supply the large armies on the march. Once again, the long supply lines proved to be the weak points. They invited an adversary to attack the logistic installations, which was a tactic used frequently by William II. This sort of operations was to be elevated into official strategy in the later wars against France. Nevertheless, the French logistic system was adopted by other European countries.

In the second half of the 18th century the French military thinker Comte de Guibert argued for an increased influence of the army leadership on logistics. He wanted to put an end to a strategy in which the routes of advance were chosen along a series of existing warehouses. In his view logistics should follow the strategy, and not the other way round! These views would later be implemented by Napoleon in his campaigns. In transports the rivers played a less prominent role than during the Eighty Years War, whereas roads began to assume a certain prominence, and the role of fortresses seemed to be over. In the Napoleonic era that followed conquering territory became the paramount objective, together with the destruction of enemy units.

Transport went by road, but whenever possible also by water. The supply lines were divided into ‘étapes’, daily stages between the stopping places. Napoleon’s major contribution to the development of logistics was the relatively controlled way in which the living off the land, as an addition to the warehouse system, without resorting to going on a foray or looting, enhanced his operational mobility.

Logistics from 1870 up to 1945
The invention of the steam engine and the use of electricity constituted the technological push behind the strategic views on land and sea warfare. Taken together, the introduction of the railway and the steam ship as means of transport for personnel as well as materiel, raw materials and goods; telegraphy and cable for the transmission of electric signals and aerial balloons for observations to be transmitted by cable, can be seen as a watershed in the development of (military) logistics. The greatly increased independence of terrain, climate (weather and wind) and the improved information supply enhanced the flexibility of military operations to a large extent.

Add to this the strongly improved weapon systems, brought about by the replacement
of muzzle loaders by breech loaders (gun, rifle and machine gun) and the introduction of the high explosive trench and armor piercing shell, and it is evident that combat power of armies had increased enormously. The technological influences did not fail to have an effect on command and control, the operations themselves and the logistic support. A clear example of this is the first use of the (steam) train in military operations in the Franco-Prussian war of 1870-71. In the period leading up to WWI the Netherlands retained its neutrality, renovating its outdated fortress system, improved its mobility and increased the size of the field army, which was allocated the area outside 'Fortress Holland' for its area of operations. The transport of troops by railway was pre-planned, as well as the supply of the troops in the field and in the fortifications/fortresses.

In the German mobilization for WWI the railways played an important role. They were used to move troops, ammunition, and other goods and materiel, on the outbreak of hostilities, from the rear to the collection points. The goods were collected by the army corps to be subsequently distributed among the regiments (indirect supply). Apart from the railways the horse and wagon remained the most important means of transport. During the initially rapid advance of the German armies it appeared that the French had also prepared their mobilization well, in an operational as well as logistic sense. The method used did not essentially differ from that of the German units. Railways, motorized transport and horse traction played an important role here. A typical difference, perhaps, was the fact that the French means of transport were commandeered, and because of a mixed bag of brands and state of maintenance showed a low reliability. In 1914 the war of movement came to a standstill when the German advance bogged down on a front from the Swiss border to Nieuwpoort. In particular because of the good organization of the French railway net for military use and partially because of the lack of ammunition of the Germans, the latter could not exploit their advantage of better and heavier artillery in the Battle of the Marne. Not until the autumn of 1918 would the front begin to move again. The superiority on the side of the allies forced the Germans to surrender.

A new phenomenon in this war was the introduction of maintenance and repair of weapon systems and vehicles; for the first time tanks were used by the allies. The increasing complexity of the weapons brought about the introduction of repair units and the supply of spare parts. A reconsideration of a structured adoption of logistics in command and control seemed called for most urgently; most certainly so in relation to the national industries. The involvement of the state in the production of munitions and their transport to the battlefield was not just a military concern.

Immediately after WWI there was little interest in developing military doctrines and logistic concepts. With hardly any attention for logistic preparation, Hitler attacked France, Belgium and the Netherlands on 10 May 1940. Although the combined armies
of these countries were not inferior to the Germans, Hitler gained great advantage from
the unity of command and a combat power generated from a concentrated deployment
of fast-operating armored units, supported from the air. Where the French organized
their logistics in detail, the Germans used the 'Auftragstaktiek', with great flexibility and
a high degree of improvisation. On 14 May after the bombing of Rotterdam, the
Netherlands capitulated, on 28 May Belgium followed. The German armies made quick
progress. The re-supply (fuel and ammunition) and the necessity to secure the open
flanks forced a slowing down of the advance through France. On 22 June 1940 the
armistice was signed.

German expectations at the beginning of the battle against the Russian Bear, in mid
1940, were so high that the war industry was scaled down in volume; once again, a fail-
ure to appreciate the necessary basis for a ready, well equipped logistic supply in a camp-
aign that had also proven to be fateful for Napoleon so many years ago. In addition, the
poor infrastructure of road and rail made the movement of personnel, materiel and
goods an unexpected effort. The Russian scorched earth tactics, helped by weather and
climate, to a large extent reduced the possibilities of living off the land and using possible
spoils of war. The Russian advantageously traded off space against time. The morale
of the German home front was seriously affected, but the industrial production capaci-
ty remained in tact. After the surrender of the German Sixth Army the East Front all but
collapsed. Hitler's strategy in 1942 and his logistics incompetence to a large extent con-
tributed to the disastrous course of the operation in Russia.

On 6 June 1944 the largest amphibious operation so far unfolded on the five most
important beaches in Normandy. After a slow advance along a number of marching
routes, the borders of the German Reich (Siegfried Line) were reached at the end of
September 1944. The logistics, especially the supply of fuel and ammunition, was high-
ly stretched. Initially, the use of artificial harbors ensured an almost continuous supply.
The Allies had counted on a quick occupation of the harbors in Normandy, Brittany and
the Channel Coast. This optimism proved to unfounded and the Americans suffered
most for it, because of the Easterly direction of their advance. Brest and Le Havre were
soon too far away from the front. The poor structure of the logistic function quickly
became evident when the advance, difficult at first, gained momentum. Especially after
crossing the River Seine the logistics difficulties became enormous, due to lack of
means of transport, which hindered the exploitation of the success. There was only a
limited number of trains available because of damage due to the bombardments. Lack
of fuel became the order of the day.

The use of ammunition remained below estimate because the German units got lit-
tle opportunity to re-group and fight. Where the organization of logistics had insuffi-
cient flexibility to support the operations adequately, an ad hoc supply line, the 'Red Ball
Express' provided the daily re-supply of fuel and ammunition. The coat was cut according to the cloth; for weeks on end emergency rations (compact and requiring little space) provided the necessary food, as well as captured German supplies. In August 1944 American and French units landed on the Côte d'Azur, supported by airborne units. Their main objective was the port of Marseilles (for supply purposes) and the protection of Eisenhower's South flank in his advance on the Rhine. By the end of August the River Seine was crossed and Paris fell. The importance of aerial transport for supplies required the capturing, repair or construction of air fields. Sometimes planes were withdrawn from operational deployment and used for supply purposes. The battles of Zuid-Beveland and Walcheren were fought for logistic reasons: the Allies wanted an unopposed passage through the River Schelde to Antwerp.

A lack of fuel finally stopped the advance at the Siegfried Line (Rhine). After the Rhine, Weser and Elbe had been crossed the German Reich capitulated in the night of 8 and 9 May 1945.

Logistics during the Cold War from 1945-1990
After the surrender of the German Reich the Netherlands armed forces slowly took form by establishing naval, ground and air forces, whereas logistics was composed of transport, supply and repair units. The defense of the Netherlands was undertaken according to pre-1940 views - on the rivers Yssel and Meuse. This structure was the basis for the allocation of supplies, i.e. the warehouses. The volume of the stores was a direct result of the views on the possible duration of a future war, bearing in mind the time-consuming re-supply from overseas, from England and France. As a direct result of the experiences gained in WWII the value of a well-equipped and trained air force was deemed high.

The strategic concepts were: the defence on the Yssel ('50-'58), the Weser ('58-'63), the defense of the Northern flank on the Elbe ('63-'69), and the delaying battle on the North-German plain ('69-'90). They all had the primary objective of building up of the defense, including the necessary re-supply from the US. The above-mentioned concepts required a certain logistic independence of the units involved on the various organizational levels and the allocation of supplies in depots and warehouses.

Changes in the organization of the logistic function often originated from changing operational concepts and problems in the systems logistics, e.g. keeping maintenance-sensitive, mobile weapon systems, such as the tank in a state of readiness. As a consequence the organizational changes also concerned the automated support of stock control, the physical supply of spare parts and maintenance planning. The 'logistic tripartite' - provide, maintain and dump - introduced by the Working Group Material Logistic
Concepts in the 1980s is one of the causes of this.

This was in fact a customer-unfriendly, materiel-oriented approach based on the life cycle of the materiel. The political wish, a high availability of materiel, lay (too) much emphasis on the integral quality of the armed forces. Only in the 1990s did supply chain management receive scientific attention (DMKL/KMA/TNO) as well as practical application in, for instance, the monograph ‘Physical Distribution’. From an operational as well as a logistic perspective, operations at a large distance from home are only possible due to excellent air and sea transport systems, with governments/countries that give facilities for the operational and logistic support with a high degree of short-term availability. Well-structured lines of communications and an adequate information supply are minimum requirements for a ready control of the supply chain.

Logistics from 1990 to 2000
The end of the Cold War was characterized by the fall of the Berlin Wall, the dissolution of the Warsaw pact, the re-unification of Europe and Germany and the ensuing strong decline of the East-West opposition. It marked the beginning of a political, military and also logistic revaluation. Conscription was phased out and the ‘outlook on the East’ was broadened, in a political sense, to global proportions. It was directed at peace operations, in principle everywhere in the world, with various deployment options in an international context.

The modes of operating, on the one hand, distinguish themselves by the nature of the means employed, and the nature of the operation of the warring parties, the method of fighting, on the other. The means of fighting may be WMDs of conventional weapons, the methods may vary from regular to irregular. In regular operations both sides deploy organized units, massive, coordinated and on the basis of a certain doctrine. Irregular operations usually involve smaller units, often acting with surprise and with locally high violence intensity. The British terminology defines as ‘unconventional operations’ irregular operations, such as guerilla warfare and terrorism. The logistic achievements and the necessity to control the entire supply chain from the home base to the area of operations are of enormous importance. The application of advanced, automated tools (tracking and tracing) and satellite communication in mobile applications appears to be essential for a tailored logistic support. A seamless fine-tuning between the three Services, whether or not in an international context, is a condition sine qua non.

Changing paradigms
In logistics everything turns around Reliability, Responsiveness (the extent to which it
is possible to react to the changing circumstances) and Resourcefulness (the innovative, improvising self-learning capacity). Retention (the ability to carry on), established in the logistic basic pattern and Relations, fixed internally in an organization and externally dependent on the power or dependency relations, are leading. Together they are known as the five Rs.

Watersheds
The watersheds that are taken as starting points, in particular from the interaction between logistics and the armed forces, result in five distinct periods, the first of which runs from antiquity until about 1500 AD. The objectives of the powers that be in this period were primarily directed at maximizing self-benefit, the preservation of one’s own group and the delineation of one’s own territory. These objectives evolved more and more from a defensive to an offensive perspective. The guiding principle for acquiring the necessary means was living off the land, which developed from local use to appropriating someone else’s possessions. Movement was preferably done by water transport in coastal waters. If it was necessary to go by land, there was the choice of carriers, beasts of burden, such as donkeys or draught animals, such as oxen. The latter hampered the progress of an army, and with it flexible movement, but they did give the possibility for large-scale transport. The armies put great pressure on the capacity to adjust to local circumstances, in other words the Resourcefulness of the learning organization.

Prince Maurice and Simon Stevin’s school can be seen as a clear watershed in the relation between logistics and the armed forces. They were the first to store the goods they needed. The importance of reliability was recognized and the goods were stored in warehouses, preferably near crossroads. In Maurice’ case these were usually waterways, which allowed him to generate an enormous capacity for movement, as opposed to the Spaniards who were more bound to movement by land. The emphasis clearly lay on the storage of food and fodder. The battle was waged in spring and summer, whereas the autumn and winter served as preparation periods. As a mathematician Stevin made valuable contributions to the successes of Maurice and his successors. In the days of Louis XIV storage was perfected in the so-called warehouse system, in which goods were geographically spread out and stored with a view to strategic objectives. Napoleon introduced the so-called stage system, in which goods were stored along the march routes. The storage point lay at fixed distances from each other, which made re-supply possible during and after the advance. The introduction of these logistic basic patterns enabled the military to guarantee a greater Retention.

The Franco-Prussian war can be seen as the beginning of a new phase. The Industrial Revolution and the introduction of the railways as a means of transport allowed the
transport of enormous quantities of industrially produced goods from the hinterland to
the front. The introduction of the military service that went along with it, made a true
increase in scale possible. In this war logistics principles were used for the first time.
Whereas in Napoleon’s stage system, as described by Jomini, there were junctions with
identical transfer and storage functionalities along the route, in the supply chain there
was a so-called hierarchy of mutually dependent points. First, the supplies were trans-
ported to the final railway station and subsequently distributed from there to local col-
lection points. In the flow of goods, fuel became increasingly important alongside
ammunition. In WWI the offensive bogged down because the generals expected a short
war. Retention became all important. The industry had to be reformed into a war indus-
try before the stalemate could be broken. The supply to the final stations at the front still
had to be done by horsepower as motorized transport had not really made the break-
through. During the Blitzkrieg in WWII the situation repeated itself, the advance
bogged down once more. The transport to the collection points, however, had by that
time been replaced by the lorry; the principle remained the same, though.

After WWII a new period began with the advent of the Cold War. The danger came
from the East and the defense supply chain was based on a predictable, as it were, con-
lict with its own desired retention: for a battalion, 1 week; a brigade, 2; a division 4
weeks, an army corps 2 months and a national supply several years. Even water wells in
the North German plane were allocated and the transport of fuel was organized in a sub-
terranean pipeline system. In the basic pattern there was a certain built-in responsive-
ness.

When the Berlin Wall fell, the predictability thinking went with it, and this event can
be seen as the start of entirely new period. Traditional logistics thinking should be
replaced by the so-called responsive network thinking (see the contribution of Pauline
Thoolen in this NL Arms edition). The reasons for this lay in the nature of conflict. It
could be stated that in the period leading up to 1990 the type of conlict was more sym-
metrical. The warring parties fought with the same means on the battlefield. As such,
the Gulf War can perhaps be considered the last of the symmetrical conlicts. What fol-
lowed is the era of asymmetrical wars and the attack on the World Trade Center on 9/11
will have convinced the last sceptic of that. In an asymmetric conlict there is always a
sort of ‘underground’ network, which makes use of the geographical situation; in
Vietnam it was the jungles, in the Balkans the mountains, and in Afghanistan the desert
and the mountains. These underground networks operate in cells which repeatedly
carry out harassing attacks. Pirates, centuries ago even supported by Dutch safe havens,
can be seen as precursors of the present-day terrorist groups. The hunt for Bin Laden
even starts from the premise of a ‘global’ underground movement rather than a nation-
ally based group. In these conlicts, then, the emphasis lies on Retention, in all possible
situations. Reliability and responsiveness in operations, everywhere, always and in every possible manner is a precondition.

 Probably, successful commanders will re-discover the ancient value of Resourcefulness. In an extremely unpredictable asymmetrical conflict the local commander will have to be able to use the improvising, innovative and therefore self-learning capacities of his men. Transparency in the availability of all means is a precondition for this. That is why the American armed forces have begun to actively develop systems based on internet technology that are expected to provide this transparency e.g. JTAV.

 Logistics will have to organize itself differently in these conflicts. Network thinking, in particular transparent, responsive networks, will begin to replace the predictable world of the supply chains. This offers great challenges to military leaders to develop the right supply chain for future combat service support.

Note
1 Roos, H. e.a. red. (2002), Van marktenster tot logistiek systeem [From camp follower to network logistics], uitgeverij Boom