

Importance of Logistics for Armed Forces : A Historical Perspective

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"Forget logistics, you lose." — Lieutenant General Franks, USA,
7th Corps Commander, *Op Desert Storm*.

"The line between disorder and order lies in logistics..." — Sun Tzu

Abstract

Logistics Management is that part of the supply chain which plans, implements and controls the efficient, effective forward and reverse flow and storage of goods, services and related information between the point of origin and the point of consumption in order to meet customers' requirements. Logistics as a business concept evolved only in the 1950s. On the other hand, the logistics of war have been defined as, 'the practical art of moving armies and keeping them supplied'. In military science, maintaining one's supply lines while disrupting those of the enemy is a crucial-some would say the most crucial-element of military strategy, since an armed force without food, fuel and ammunition is defenseless. First used in the eighteenth century, the word in its current meaning became popular during World War II. In 1949, the army's Field Service Regulations defined logistics as "that branch of administration which embraces the management and provision of supplies, evacuation and hospitalization, transportation, and services (maintenance being the most prominent). It envisages getting the right people and the appropriate supplies to the right place at the right time and in the proper condition. A broader understanding might encompass all measures taken by a state to raise, arm, equip, feed, move, maintain, and otherwise care for its armies in the field. In its broadest construction, logistics also properly includes the mobilization of industry and manpower, research and development, procurement, construction of facilities, personnel management, and allied tasks.

Key Words

Logistics, Defence, Management, Transportation, Materials.

INTRODUCTION

Army logistics is as old as the concept of war. In ancient times, people used to find their own knotted clubs, place of shelter and food during the time of war. Every soldier himself was responsible for obtaining his requirements. With the advances associated with time, soldiers joined larger groups and some men were assigned the task of arranging these items of necessities for their counterparts. These were among the first instances of an army logistics organization. Army logistics, also known as military logistics, refers to the art and science of the process of planning and making sure that the movement and maintenance of the armed forces is in due accordance with the laid-down plans and procedures. Army logistics deals with procurement, maintenance, distribution and replacement of personnel and material. Early in the twentieth century, Secretary of War, Elihu Root observed that for Americans the difficulties of making war lay not in the raising of soldiers, but in equipping, supplying, and transporting them. The evolution of modern warfare since 1898 amply demonstrates the truth of Root's observation. The scale and scope of modern wars, rapidly changing technology, and new military doctrines involving the rapid movement of large forces over great distances have made logistics the key to modern warfare.

OBJECTIVES AND METHODOLOGY

To trace out the origin, meaning, concept and definition of logistics; to study the importance of logistics in business management as well as for armed forces; to analyze the role played by logistics in different wars; and to give suggestions and on the basis of the findings of the study. The present paper is based on secondary sources. Various books, articles written by western and Indian scholars and statements given by the various Generals and commanders have been analyzed. Apart from this, an effort has been made to trace out meaning, definition and concept of logistics from historical perspectives.

REVIEW OF LITERATURE

The concept of logistics is very old. Its origin can be traced back in Greek wars. Logistics as a business concept evolved only in the 1950s. Lots of books, articles and research papers have been published in various journals related to business logistics but not much has been written on the issues of military logistics.

James A. Huston's (1966), book 'The Sinews of War: Army Logistics 1775-1953', is focused on some important aspects of army logistics during the wars fought

from 1775 to 1953. Citing "the three big M's of warfare - material, movement, and maintenance", he has also given some examples of wars that have been won or lost because of logistic management.

John A. Lynn (1993) in his book 'Feeding Mars: Logistics in Western Warfare from the Middle Ages to the Present', has focused on the importance of logistics in western wars. He has described the problems faced by the armed forces in managing the supply chains.

Julia Millen (1997), in his book 'Salute to Service: A History of the Royal New Zealand Corps of Transport and its Predecessors (1860-1996)', has discussed the history of New Zealand's armed forces' problems of carrying out transport operations. Being a country surrounded by waters it has to face different types of means in logistic management.

Dale S. Rogers and Rudolf Leuschner (2004), in their article 'Supply Chain Management: Retrospective and Prospective', have highlighted the supply chain management retrospectively and given some valuable suggestions to improve the supply chain system for armed forces.

William G. T. Tuttle (2007), in his paper 'Defense logistics for the 21st century', has discussed the logistic problems for the naval forces and has analyzed some important aspects of logistics management.

A.P. Revi (2008), in his article 'Revolution in Military Logistics', has discussed the problems faced by the Indian armed forces in carrying out military operations in border areas and highlighted some of the important steps taken by military in improving supply chain.

Vijay Sakhujia, (2010), in his paper 'Naval Logistic Supply Chains : Adopting best Business Practice', has tried to analyze the logistics supply chains of Indian naval forces. Stressing on the problems faced by Indian navy and coast guards, he has given some valuable suggestions to strengthen the logistic system for Indian navy.

CONCEPT

The word 'logistics' originates from the ancient Greek logos (λόγος), which means "ratio, word, calculation, reason, speech, and oration". In ancient Greek, Roman and Byzantine empires, there were military officers with the title 'Logistikas' who were responsible for financial and supply distribution matters. The Oxford English dictionary defines logistics as, "The branch of military science having to do with procuring, maintaining and transporting material, personnel and facilities." Another dictionary defines logistics as "The time related positioning of resources." As such, logistics is commonly seen as a branch of engineering which creates "people

systems" rather than "machine systems".

Logistics is a concept considered to have evolved from the military's need to supply themselves as they moved from their base to a forward position. First used in the eighteenth century, the word in its current meaning became popular during World War II. In 1949, the army's Field Service Regulations defined logistics as "that branch of administration which embraces the management and provision of supplies, evacuation and hospitalization, transportation, and services (maintenance being the most prominent). It envisages getting the right people and the appropriate supplies to the right place at the right time and in the proper condition." In his 1966 history of army logistics, James A. Huston points out that logistics is the application of time and space factors to war and consists of "the three big M's of warfare - material, movement, and maintenance." A broader understanding might encompass all measures taken by a state to raise, arm, equip, feed, move, maintain, and otherwise care for its armies in the field. In its broadest construction, logistics also properly includes the mobilization of industry and manpower, research and development, procurement, construction of facilities, personnel management, and allied tasks.

Logistics has been defined by many but some of the important definitions for 'logistics' are as "Logistics is... strategically managing the procurement and movement of goods and storage of inventory in all forms." According to Field Marshall Wavell, 'A real knowledge of supply and movement factors must be the basis of every leader's plan; only then can he know how and when to take risks with these factors, and battles and wars are won by taking risks.'

Logistics is the lifeblood of any Army. Changing how we fight influences changes in how we support. The Chief of Staff of the Army (CSA) has stated "the transformation objective is to field a force that is strategically responsive and dominant every point on the spectrum of operations."

"American military might must draw on new technologies and strategies in the 21st century. ... We must build forces based on revolutionary advances in the technology of war that will allow us to keep the peace by redefining war on our terms. ... a future force that is defined less by size and more by mobility and swiftness. That force will be easier to deploy and sustain and will rely heavily on U.S. advantages in stealth, precision weaponry and information technologies."

In simpler words, "Logistics is the delivery of the required goods, at required place, at required time, in required state and to the required person...efficiently." In short, logistics is the application of time and space factors to war. It is the economics of warfare, and it comprises, in the broadest sense, the

three big M's of warfare - material, movement, and maintenance. If international politics is the "art of the possible," and war is its instrument, logistics is the art of defining and extending the possible. It provides the substance that physically permits an army to "live and move and have its being."

LOGISTICS BOTH AS AN ART AND A SCIENCE

Logistics has now evolved itself as an art and a science, the science of planning and carrying out the movement and maintenance of forces. However, it cannot be termed as an exact science as it does not follow a defined set of principles or adhere to previously laid guidelines in the same manner each time. It does not even follow a pre-defined set of tables as in case of science. Military logistics is dynamic in nature. Therefore, a particular solution cannot be prescribed for every similar situation. It is primarily concerned with ensuring services and supplies at the right time, at the right place, when and where needed, in the most optimal and economical way and by making use of the best available options to do the task. A logistics manager performs his duties and responsibilities based on his educational experiences, skills, past experiences and intuition. These skills are nourished by a constant application of the same by him for the betterment of his organization. The logistics manager ensures that the company is benefited by an effective and efficient system of logistical management.

BUSINESS LOGISTICS

Logistics is the one important function in business today. No marketing, manufacturing or project execution can succeed without logistics support. For companies, 10 per cent to 35 per cent of gross sales are logistics cost, depending on business, geography and weight /value ratio. Logistics is comparatively a new term, but not the operation. Logistics has existed since the beginning of civilization. Raw material and finished products had always to be moved, though on a small scale. Things began changing with the advance in transportation. Population began moving from rural to urban areas and to business centers. No longer did people live near production centers, nor did production take place near residence centers. The geographical distance between the production point and consumption point increased. And logistics gained importance. Another factor has come into play recently. Since the early 1990's, the business scene has changed. The globalization, the free market and the competition has required that the customer gets the right material, at the right time, at the right point and in the right condition... at the lowest cost.

Logistics Management is that part of the supply chain which plans, implements and controls the efficient, effective forward and reverse flow and storage

of goods, services and related information between the point of origin and the point of consumption in order to meet customers' requirements. Logistics as a business concept evolved only in the 1950s. This was mainly due to the increasing complexity of supplying one's business with materials and shipping out products in an increasingly globalized supply chain, calling for experts in the field who are called Supply Chain Logisticians. This can be defined as having the right item in the right quantity at the right time at the right place for the right price and is the science of process and incorporates all industry sectors. The goal of logistic work is to manage the fruition of project life cycles, supply chains and resultant efficiencies.

MILITARY LOGISTICS

The origin of the term 'Logistics' goes back to 18th century France. The concept of logistics was first introduced in a book by *Baron De Jomini*, a staff officer of Napoleon, entitled 'The Art of War' published in 1836 and the term 'Logistics' was derived from the title of one of Napoleon's generals, *the Major General Des Logis*. The duties of an officer were originally limited to the management of troop lodging and camp preparation. They realized proper preparation for war was critical element to success on the battlefield. Soon this position became one of the Napoleon's most important generals. The logistics of war have been defined as, 'the practical art of moving armies and keeping them supplied'. In military logistics, experts manage how and when to move resources to the places they are needed. In military science, maintaining one's supply lines while disrupting those of the enemy is a crucial-some would say the most crucial-element of military strategy, since an armed force without food, fuel and ammunition is defenceless.

The *raison d'être* for any military logistic system is to ensure that the correct item and service is provided to the end user, at the right time, place, and in correct quantity and quality required for the situation. In the final analysis, most military campaign failures could be attributed to mismatch between the operational plan and the logistic support capabilities. This could be well illustrated with examples of over-stretched logistics, from world military history. The defeats of the British in the American War of Independence, and the defeat of Rommel in World War II, have been largely attributed to logistical failure. The historical leaders Hannibal Barca, Alexander the Great and the Duke of Wellington are considered to have been logistical geniuses.

PRINCIPLES OF LOGISTICS IN ARMED FORCES

Although logistical organization and procedures vary among the services, the logistical systems of the army, navy, marine corps, and air force all respond to

the same set of logistical principles. Most students of military affairs are familiar with the nine "Principles of War"-Mass, Objective, Simplicity, Unity of Command, Manoeuvre, Offensive, Surprise, Security, and Economy of Force-developed to serve as guides to the conduct of strategy and tactics. The principles governing the conduct of logistics are less well known but no less important. Many commentators have tried to formulate the "principles of logistics." James A. Huston, for example, proposes fourteen principles based on the American experiences in war, and the army officially adheres to the nine set forth in chapter 3 of Army Regulation 11-8: Principles and Policies of the Army Logistics System (1976). Both are too long and complex for practical purposes, but can conveniently be summarized under five headings : Concentration, Austerity, Visibility, Mobility, and Flexibility.

Concentration is the key, and its accomplishment involves the positioning of superior combat power at the decisive time and place. The successes of Allied forces in World War II, and more recently during the Persian Gulf War in 'Operation Desert Storm' were due to observing just this principle. Resources are always limited, and thus, logisticians must always observe the principle of Austerity, which has two aspects.

The first is economy - the conservation of available resources before battle and the economical distribution of material to other, less vital, areas. Economy involves avoiding both excessive expenditure and unnecessary duplication of resources. The second is simplicity. Simplicity of doctrine, organization, equipment, and plans is essential to the successful logistical support of combat operations. The third principle is that of Visibility. Because the inability to locate a critical item is tantamount to not having it at all, the successful commander or logistician must always know what he or she has and where it is. Mobility is the fourth principle. In so far as mobile troops are essential to success on the modern battlefield, adequate transportation must be provided for all military operations and all military equipment must be designed for agility and transportability. The final principle is Flexibility, or the capacity to accommodate the unforeseen. This can be accomplished by flexibility of organization, plans, and material, and, above all, by flexibility of mind.

LOGISTICS IN ANCIENT TIMES

In the West, feudalism was a means to provide for the logistic support of the armoured horseman in peacetime. However, when medieval armies took the field their logistic provision was usually scanty. During the Crécy campaign of 1346 an English knight wrote : 'we have lived off the countryside with great difficulty and much harm to our men.' The chevauchée was a tactic which enabled a force to

sustain itself by moving through enemy territory, thereby solving its own logistic problems and stripping its opponent of resources. Sieges posed particular problems. While the besieged would generally have to stock provisions, the besieger would usually end up his rations quickly, and then have to send foraging ever wider to find more.

Both Philip of Macedon and Alexander the Great improved upon the art of logistics in their time. Philip realized that the vast baggage train that traditionally followed an army restricted the mobility of his forces, so he did away with much of it and made the soldiers carry much of their equipment and supplies. He also banned dependants. As a result the logistics requirements of his army fell substantially, as the smaller numbers of animals required less fodder, and a smaller number of wagons meant less maintenance and a reduced need for wood to effect repairs. Added to that, the smaller number of cart drivers and lack of dependants meant less food needed to be taken with them, hence fewer carts and animals and a reduced need to forage.

The armies in the medieval times were generally small. But as armies grew bigger in the 17th century so their problems multiplied. Primitive logistics turned the armies of the Thirty Years' War into huge destructive maggots that gnawed their way across the countryside, biting ever deeper if others had passed that way before. Cardinal Richelieu wrote that 'History knows more armies ruined by want and disorder than by the efforts of their enemies'. By 1700, an army of 60,000 men needed 45 tons of bread a day, the product of 60 portable bread-ovens and 200 wagonloads of fuel. Its 40,000 horses consumed 500 tons of fodder a day in the campaigning season, falling to 250 tons in winter quarters. The French war administrator Michel le Tellier took the lead in calculating the ration requirements of an army, arranging for civilian contractors to supply food, and setting up a wagon train with provision reserves. His son Louvois developed the magazine system, already used since classical times, to ensure that frontier fortresses were well stocked with supplies which could be moved out to the armies by wagon or barge.

One of the reasons for the defeat of the British in North America in 1776 was the length of time involved in replenishing the forces from a home base some 3,000 miles (4,827 km) away. The same was true of Russia's defeat in the Russo-Japanese war, with a 4,000 mile (6,436 km) supply line along a single track railway. While the distances involved may still be great in today's operational environment, logistic philosophies and systems are being geared to be more responsive in a way that could not have been previously envisaged.

Napoleon was able to take advantage of the better road system of the early 19th century and the increasing population density, but ultimately still relied upon

a combination of magazines and foraging. While many Napoleonic armies abandoned tents to increase speed and lighten the logistic load, the numbers of cavalry and artillery pieces (pulled by horses) grew as well, thus defeating the object. The lack of tents actually increased the instance of illness and disease, putting greater pressure on the medical system. Despite careful preparation, Napoleon failed the logistics test when he crossed the Nieman in 1812 to start his Russian campaign. He started with around 450, 000 men and reached Moscow with just over 100, 000 excluding stragglers. The battle of Borodino only partly explains the shortfall. He had known the logistics system would not sustain his army on the road to Moscow and keep it there. He gambled that he could force the Russians to the negotiating table and dictate terms. He failed, and so had to retreat, a venture which logistic breakdown (as much as the weather or Russian pursuit) turned into a rout. The pursuing Russian army did little better, starting at Kaluga with 120, 000 men and finally reaching Vilna with 30,000.

ISSUES OF LOGISTICS IN MODERN WARS

Modern developments have led to enhanced army logistics performance due to less use of time and financial resources. This has raised the standard of the armed forces and in a way, has proved to be beneficial for their overall growth and development. Accuracy and speed are the major factors nowadays for the flow of information and materials from its providers to its users. Functionally, the US, French and the British systems are similar to each other. All of them have created a dedicated logistics cadre. The US and British armies have opted for inducting officers at the junior levels from the Quarter Master (QM) and Master General of Ordnance (MGO's) branches into the logistics branch. But they have been allowed to retain their parent branch status and specialisation - to enable them continuity, promotional prospects, and also to retain their skills and emotional/regimental bonding with their original branch. The French and the Germans have an Armament Branch separate from the Combat Arms. The point to note here is that in all these countries, the promotion prospects in the Combat Arms and the Support Services are comparable. From the outset, USSR (now Russia) and China have had a dedicated logistic branch to support the military. The erstwhile Soviet military had a dedicated Marshal of Soviet Union as Deputy Minister of Defence, responsible for the logistics of the entire Armed Forces. He was also the coordinating authority at the national level. Indian military is perhaps the only modern armed forces in the world, which has the distinction of not believing in a joint logistics organisation.

Wars have been won and lost through logistics capability or lack of it. Generals have understood the importance of logistics since early days, but the

business has learnt it fairly recently. And the logistics capability gives an edge to the business. The American civil war foreshadowed future warfare, particularly as regards logistics. Both sides were determined, with large populations to draw recruits from, and (more notably in the case of the North) the means to equip them. This laid the foundations for a long war, one which would not be determined by one or two battles but by several campaigns, and which would hinge upon the will to sustain the war-fighting capability (material and morale). This meant that a logistics infrastructure would have to be set up to cater for the movement of large armies, as well as the supply of food, ammunition, equipment, spare parts, fresh horses and their fodder, and the evacuation of casualties. In the 1991 Gulf War, the US and allies airlifted half a million people and over half a million tonnes of materials over 12,000 km and moved additional 2.3 million tonnes of equipment by sea, in a short time frame. That kind of movement is more than physical handling. That is logistics. Wars have been won and lost through logistics capability or lack of it.

The end of the Cold War has had profound effects upon the philosophy and approach to military logistics. The long-held approach of stockpiling of weapons, ammunition, and vehicles at various strategic sites around the expected theatre of operations and in close proximity to the lines of communications which was possible when the threat and its axes of attack were known, is no longer the optimum method in the new era of force projection and manoeuvre warfare. Apart from these 'High tech' weapons are also difficult to replace.

For security reasons, World War II, like all wars, concentrated command decisions in relatively few hands. This war was different in many respects, however, resulting in several changes in the process of strategic military decision making. Since the war was a far-ranging military effort, it became necessary to think in global terms. Complex logistical challenges required planners to consider how large volumes of material were produced and distributed timely and efficiently. The development and use of critical path planning models such as PERT and CPM helped strategists determine in advance the nature, timing, and interrelationship of key future decisions. Enhanced communications provided the glue by which strategic decisions could be made and implemented.

INDIAN SCENARIO

Like all other modern armed forces, the Indian Army has been considerably influenced by the Revolution in Military Affairs (RMA) and the great strides are being made in the development of technology. This has necessitated a transformation in strategic thinking along with a paradigm shift in organization and conduct of operations. The territorial vastness and the geographical diversity of India preclude

application of a standard logistic template. The road and rail communications infrastructure in border areas is under developed and availability of local resources is largely inadequate. Thus, inter and intra -theatre moves are time-consuming and switching of logistic resources is difficult to execute. From the operational point of view, such conditions call for adequate stocks to be maintained at the theatre and sector levels to undertake operations at short notice.

Even in the recent years, the Comptroller and Auditor General (CAG) has been critical of many aspects of the Indian military's logistics and supply chain setup - from planning and procurement to storage and supply. As per the CAG reports, although tabled in the Parliament and are not available publicly, these shortcomings do not get the requisite attention in the media. The processes and systems governing military logistics and supply chain, as with most other aspects of the Indian defence services, belong to an archaic era. Indian Armed Forces have, however, continued to grow, basically under the same original framework. One major restructuring was attempted post Kargil War. Even that has remained still-born due to lack of political will to appoint the Chief of Defence Staff (CDS).

In the contemporary world, commercial-military partnerships are a common practice. For instance, in the US, the Defense Logistics Agency, which provides worldwide logistics support to the US military, works in close association with equipment suppliers and contractors, even on the battlefield, to lower logistics costs and provide a faster, more reliable service. This has resulted in streamlining the delivery of materials and services and shifted its responsibilities from 'managing supplies' to 'managing suppliers' thus, concentrating on reducing the inventory at the supply depots and improving forecasting. These business practices are being imbibed the world over and can be adopted as a blueprint for future Indian military logistics programmes.

CONCLUSION

Logistic is a command function and is the lifeline of an operational plan. And without a sound logistic plan no operational plan can succeed. Besides, commanders must view that operations and logistics are being inter-dependent. The major responsibilities of a military high command are to create, support and employ combat forces. Therefore, all military decisions need a blend of strategy and logistics which are indispensable. The Kargil War in 1999 between India and Pakistan also referred to as 'Operation Vijay' is one of the most recent examples of high altitude warfare in mountainous terrain that posed significant logistical problems for the combating sides. The stallion which forms the bulk of the Indian Army's logistical vehicles proved its reliability and serviceability with 95% operational availability

during the operation.

Therefore, a centralized agency is required for higher direction, control and coordination of the logistic effort amongst the three services and to provide an interface between service headquarters and other government and non-government agencies. Concurrently there is a need to optimally utilize the considerable infrastructure of the private sector, trade and local resources to enhance the military logistic capability

References

- <http://www.search.com/reference/Logistics>
<http://www.archive.org/details/armyfieldservice00unit>
<http://www.almc.army.mil/alog/issues/SepOct04/tamp.html>
<http://www.projectsmonitor.com/detailnews.asp?newsid=6968>.
 Lynn, John, A. (1993), *Feeding Mars : Logistics in Western Warfare from the Middle Ages to the Present*, Oxford.
 Eric, K. Shinseki (8 March 2000), Congressional Statement on The Army Transformation, Statement presented to the 106th Congress, 2nd Session.
http://www.iwar.org.uk/rma/resources/logistics/Piggee_A_F_02.pdf
 James, A. Huston (1966), *The Sinews of War : Army Logistics 1775-1953*, University Press of the Pacific.
<http://www.projectsmonitor.com/detailnews.asp?newsid=6968>
<http://www.cscmp.org/Website/AboutCSCMP/Definitions/Definitions.asp,CSCMP2005>.
 The complete title of the Maréchal général des logis de l'armée was Maréchal général des logis des camps et armées du Roi. This rank corresponded to the rank of chief of staff. He is responsible with his aides to make troops execute all the operations decided by the general. His functions were very large and required proportionate talents.
 Dale, S., Rogers; and Rudolf, Leuschner (2004), Supply Chain Management : Retrospective and Prospective, *Journal of Marketing Theory and Practice*, p. 61
 William, G. T. Tuttle (2007), *Defense Logistics for the 21st Century*, Naval Institute Press, Annapolis, p. viii.
 Revi, A. P. (2008), Revolution in Military Logistics, *Indian Defence Review*, Vol. 23, No. 3, New Delhi.
<http://www.encyclopedia.com/topic/Logistics.aspx>
 The Battle of Crécy (occasionally written the Battle of Cressy in English) took place on 26 August 1346 near Crécy in northern France, and was one of the most important battles of the Hundred Years' War. The combination of new weapons and tactics has caused many historians to consider this battle the beginning of the end of classic chivalry.

A chevauchée was a raiding method of medieval warfare for weakening the enemy, focusing mainly on wreaking havoc, burning and pillaging enemy territory, in order to reduce the productivity of a region; as opposed to siege warfare or wars of conquest.

The Thirty Years' War (1618-1648) was fought primarily in what is now Germany and at various points involved most countries in Europe. It was one of the most destructive conflicts in European history.

Julia Millen (1997), *Salute to Service : A History of the Royal New Zealand Corps of Transport and its Predecessors (1860-1996)*, Victoria University Press, *Wellington*, p.12.

<http://www.projectsmonitor.com/detailnews.asp?newsid=6968>

<http://www.mcmahanrealestate.com/writing/Historical%20Perspective.pdf>

<http://pragmatic.nationalinterest.in/2008/11/05/indian-military-logistics-needs-an-overhaul/>

Vijay, Sakhuja (2010), *Naval Logistic Supply Chains : Adopting Best Business Practices*, Paper No. 1492, at www.southasiaanalysisgroup.com

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