

PRECISION LOGISTICS AS A STRATEGIC ENABLER: LESSONS FROM THE PAST, DEMANDS FOR THE FUTURE

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ABSTRACT

In the current economic and geo-strategic environment, engaging excessive amount of resources for military operations is perceived as an unacceptable decision. That is why the efficiency and the precision of logistic operations in a permanent volatile context is an objective to be achieved by every commander, in order to be both sustainable and mobile. This paper is designed to highlight the concept of precision logistics, from its original roots to the operational usage insights and future predictions. Moreover, the paper describes some relevant capabilities that might be engaged in developing a precise logistic network, considering the current and future cutting-edge technologies that may enable the processes. To achieve these objectives, relevant literature had been reviewed from the emergence of the concept to the latest theoretical approaches. Moreover, Operation Iraqi Freedom represented a case that was studied for extracting the appropriate details regarding the evolution of precision logistics for military operations, due to the lessons learned 10 years earlier, during Operation Desert Shield/Desert Storm.

KEYWORDS:

precision, logistics, distribution-based logistics, on-time delivery, defence resources, military logistics

1. Introduction

In the evolving landscape of modern military operations, logistics has emerged not only as a critical enabler of combat effectiveness but also as a strategic domain in its own right. In this area, the concept of precision logistics has gained increasing prominence, born from the hard-learned lessons depicted from previous military campaigns conducted by the US forces, like Operation Desert Shield/Desert Storm and further refined through their experience in later conflicts, like Operation Iraqi Freedom (Kross, 2003).

On the other hand, the ongoing conflict in Ukraine indicates that the current

operational environment is becoming increasingly contested. The continuous development of Anti-Access/Area Denial (A2/AD) capabilities, the precision strike capabilities enabled by drones and guided missiles, combined with the use of warning, surveillance, and detailed battlefield visualization systems through satellite or aerial means (such as drones or AWACS aircraft), are leading to a steadily decreasing survivable rate in open terrain. This phenomenon occurs not only along the frontlines but also in the rear areas, within support zones and regions responsible for economic, social and moral generation and regeneration (Petraeus & Roberts, 2023).

Thus, there is a need to operationalize innovative concepts that ensure the ability to sustain military actions in austere settings, providing a higher degree of survivability, effectiveness, and efficiency.

Surviving in this type of environment and supporting the operational objectives require, from a logistical standpoint, a high degree of precision. A frequently used term in the existing literature is “*precision logistics*”, also associated with “*precision sustainment*” (Harrison & Pond, 2023). Therefore, this paper aims at identifying the most prominent characteristics that generate the “precision” dimension to military logistics, and the ways in which it could be implemented within the current operational context. To accomplish this goal, the study is based on a qualitative research design, which highlights the evolution of the analyzed concept and the way it should be addressed by future studies. The main research questions posed by this article are: 1) *Why the precision logistics was needed in previous military operations?* 2) *Which are the main dimensions/characteristics that should define this concept in the actual security context?*

To answer these questions, the structure of the article is three-folded. For the former question, the case study method is applied in the first and second parts. The idea is to reveal the reasons that generated the appearance of this concept, and to highlight the way it was implemented by the American armed forces during the Persian Gulf War, with a focus on Operation Desert Shield/Desert Storm and Operation Iraqi Freedom, respectively. Starting from the identified reasons and characteristics, the third part of the study proceeds with critically analyzing the literature that reveals recent developments, to offer an updated picture of this concept in accordance with the actual security environment.

2. The Emergence of the Precision Logistics Concept

The end of the 20th century and the operational events associated with military actions in the Persian Gulf provided a wide range of lessons learned, including from a logistical perspective. The overestimation of the consumption created the conditions for deploying immense quantities of materials of all kinds over 10,000 miles from their peacetime locations. This led to excessive stockpiling and inefficient use of transportation resources that could have been employed elsewhere. Furthermore, visibility over shipments and material goods delivered to the theatre of operations during their transit to the end user was extremely limited. For example, during Operation Desert Shield/Desert Storm, in order to support the forces deployed in Saudi Arabia, the US Army “*had built mountains of containers at the seaport and airport of debarkation*” (Killblane, 2018) and also in the logistic bases, “*many of which were never claimed by units and lay unopened at the end of the war*” (Martin, 2018).

The problematic aspects were also highlighted in the assessment performed by General Walter Kross, Director of Operations and Logistics of the US Transportation Command during the Gulf War. For example, the requests issued by the end users reached their destination in a rather unclear manner, due to the absence of a concrete logistic support plan, the lack of in-transit visibility tools, and the absence of strict procedures regarding package labelling and content identification, which translated in inefficient logistic processes (Kross, 2003). As a result, excessive amounts of stocks directed to Operation Desert Shield were deployed in Saudi Arabia (U.S. Department of Defense, 1992), idea supported by the fact that two-thirds of the containers were opened just to clarify their content (Kross, 2003).

Therefore, the front-line commanders did not have a clear picture related to resources at their disposal and they kept ordering new amounts of goods (Kross, 2003), placing a lot of pressure on the limited transportation, warehousing and distribution capabilities. To solve some specific situations that facilitated the timely resupply from the area outside the theatre of operations, a strategic decision was made to involve two C-141 aircrafts, also known as “*Desert Express*”. These had daily sorties from Charleston, South Carolina, to the Gulf Area (Kross, 2003).

The transported amounts were not significant from a quantitative perspective, but they provided the adequate minimal conditions to respond to urgent resupply needs and to maintain the logistic lines of support in a continuous state of functioning (Kross, 2003).

Characterized by some authors as “*Brute Force Logistics*” (Martin, 2018), the approach related to the logistic support of the Gulf War becomes unacceptable and totally opposed to the one specific to the concept of precision logistics, introduced earlier, but not taken into consideration in that operation (Stewart, 1998). The need for such an approach was signalled in 1998 by the US Maj. Gen. Joseph D. Stewart, who mentioned in one of his works that logistics required some changes, to respond to the operational context created by a “*dispersed, lethal and fast-paced battlefield*” (Stewart, 1998). In his view, such a vision, though idealistic, could contribute to the smartest way of delivering logistic support in military operations, the principal benefits being associated with reduced time for response in processes associated with resupply and maintenance (Stewart, 1998).

The concept evolved as time went by, generating an increased interest in both military and civil areas, especially as it became aligned with the private sector’s approach to supply chain management.

The evolutionary line focused on eliminating redundancy in forces and

resources, in the context of an increased market competition, and on streamlining distribution processes, in response to the growing phenomenon of globalization. Therefore, precision logistics was defined in 1999 as the benefit of “*having the exact product in the exact place, at the exact time, and in the exact amount, under rapidly changing conditions within the supply chain*” (Anderson, 1999).

Moreover, the precision logistic was associated with an enhanced level of control of movement and services that are part of the supply chain (demand chain) (Anderson, 1999). This implies the ability to control activities and capabilities that contribute to a more precise way of delivering logistic support, fact which generates a continuous interest in this area, and never-ending efforts (Anderson, 1999), permanent innovation being needed to reach the highest level of efficiency.

In 1999, Maj. Gen. Garry McKissock, the commander at that time of the US Marine Corps Materiel Command, analyzed the way military logistics had been approached previously. On this occasion, he reached to the conclusion that creating over-sized stocks was seen as an insurance that the warfighter would have his needs covered entirely, taking into account “*the lack of commercial distribution systems and associated information*” (McKissock, Trammell & Strock, 1999).

Based on the analysis of the way private entities managed to develop distribution and market demand satisfaction processes, it was concluded that a highly efficient operational supply chain management would create the premises to reduce the logistic footprint and enhance the level of forces mobility and flexibility. Additionally, two operational characteristics were brought into attention, namely the speed of delivering logistic support and the informational accuracy, which provides a realistic volume of logistic resources (McKissock, Trammell & Strock, 1999).

3. Precision Logistics Implementation Phase – Operation Iraqi Freedom

The events of 1990-1991 and the substantial logistic effort associated with Operation Desert Shield/Desert Storm generated some important lessons learned which were put into practice through the implementation of adequate solutions and the development of precise logistical tools. Nearly a decade after the Gulf War, the US Armed Forces succeeded in implementing a logistic system capable to respond to a new security context, in which “*everything that moves must be tagged*”, as General Paul Kern, the Commander of the Army Materiel Command, had declared (Kross, 2003). By prioritizing the development of capabilities for ensuring in-transit visibility (ITV), and movement control, the Operation Iraqi Freedom became one of the first military actions in which the new approach was implemented, offering the possibility to capitalize the concept of precision logistics, and also to develop new ones, like distribution-based logistics and on time delivery (Kross, 2003).

In that operation, the focus was on reducing the logistic footprint by decreasing the number of SDOS (Standard Day of Supply) at the level of logistic bases created to support the operational effort, and on streamlining processes, so that the resupply process was conducted without interruptions and the goods and services reached the final beneficiaries in a timely manner. To operationalize this vision, transportation capabilities were augmented by civil contractors, making use of the instruments provided by the Logistics Civil Augmentation Program (LOGCAP) (Killblane, 2018). It was the moment when the Kellogg, Brown and Root (KBR) company was integrated, along with other companies involved through the host nation support (HNS) mechanisms, 1,500 contracted vehicles being used to execute resupply according to the developed plans (Killblane, 2018).

Additionally, in order to reduce pressure on transportation capabilities and

ensure on-time fuel supply for the operation, including support for the offensive and the advance of forces into Iraqi territory, the Inland Pipeline Distribution System (IPDS) was employed. The development of this capability involved transporting 1,300 ISO containers housing system components, and also installing 220 miles of fuel pipeline across both Kuwaiti and Iraqi territory after the start of the offensive (Finlayson, 2018).

The operational advantages of employing this capability were impressive. To meet the fuel demand, estimated at 1 million gallons per day, the IPDS was able to deliver over 60 million gallons of fuel directly from Kuwaiti refineries to the fighting forces. In doing so, it effectively replaced the need to deploy 3 to 5 fuel transportation companies to the theatre of operations (Finlayson, 2018). This method of fuel distribution to the operational force structure not only achieved economy of force and resources required to generate the same effect, but also ensured the on-time supply characteristic of precision logistics.

By developing transportation capabilities and actively employing them for resupply operations, movement control within the theatre of operations became an element requiring focused attention. To address this operational need, three Movement Control Battalions were deployed during Operation Iraqi Freedom (Killblane, 2018). At the same time, drawing on the experience gained from previous exercises and operations in Bosnia, Kosovo and Rwanda, and by implementing technologies used by commercial operators to achieve a higher degree of visibility over material assets during distribution, the conditions were created for enabling a significant operational force multiplier (Kross, 2003).

The automation of cargo tracking processes during transit, the implementation of barcode labelling and scanning systems, as well as the use of radio frequency identification (RFID) tags (Killblane, 2018), represented a significant technological advancement for operational logistics in

support of Operation Iraqi Freedom, one that created unprecedented operational advantages. Thus, logisticians at all levels were able to “*get ground truth at ground zero and everywhere else*” (Kross, 2003), with the ability to order supplies by staying in front of a computer and to receive them in maximum 24 hours (Killblane, 2018). What is more, by using scanners along the main supply and resupply routes, cargo could be tracked throughout its entire journey, from dispatch to final destination, providing “*almost instant in-transit visibility*”, which facilitated the comparison of the US Army with “Federal Express” (Killblane, 2018).

Nevertheless, there were also some deficiencies, which showed the limitations associated with on-time delivery, capable of generating important effects at the operational level. For instance, transportation assets were used beyond acceptable limits, equipment belonging to KBR and the host nation was not operational in time, some units ran out of water and fuel reserves, and attacks on vulnerable lines of communication could have disrupted logistical flows for a significant period of time. Moreover, the reliance on technology led to instances where certain shipments could not be tracked due to RFID tag failures, depleted batteries, or equipment incompatibility (Killblane, 2018).

Therefore, although the operation was successful, the concept of on-time delivery applied in support of the forces advancing toward Baghdad was not fully validated, even though it did improve efficiency. What can be extracted from the lessons learned during this operation, is that in-transit visibility represented a vector for the success of on-time delivery approach, while the biggest problem was represented by the insufficient number of trucks (Killblane, 2018).

4. Precision Logistics – The Way Ahead

By analyzing the operational context and the motivation behind the emergence of the precision logistics concept, as well as

the way it was implemented in operational setting, with its associated advantages and limitations, the question that arises is: What comes next?

Since the days of Desert Storm and Iraqi Freedom operations, both the concepts, tools and methods related to the art and science of warfare, as well as technological and commercial elements, have evolved. For example, the ongoing conflict in Ukraine may offer authentic and actual pictures of the way modern operational logistics should or should not be developed. Additionally, the multi-domain approach to operations and the development of new technologies, both in support of and developed to challenge logistical activities, are undoubtedly influencing the precision of operational logistics.

Today, both practitioners and theorists of operational logistics acknowledge that “*cannot rely on past practices to sustain modern maneuvering*”, and mention both precision and predictive capacity as operational requirements for combat service support structures, that facilitate the identification of needs before their appearance (Hoyle, 2023). The ability to forecast logistical requirements is, on the other hand, a key condition of precision sustainment, as an integral part of precision logistics, given the well-known fact that “*the most important action to improve the efficiency and effectiveness of the logistics process is to improve the quality of the logistics demand forecasts*” (Xin & Bao, 2008).

At the same time, forecasting must occur at all echelons, and information must flow, analyzed and leveraged quickly and efficiently up to the operational level that is responsible for meeting the anticipated need. To achieve this, and to address the requirements issued by maneuver units, it is essential to develop and integrate capabilities that generate, enhance, and give value to logistical predictability, specifically those intended for collecting, storing, distributing, visualising and analyzing information (Bates, 2024). It becomes obvious that all

these capabilities require an integrated informational logistics platform, where the recognized logistic pictures at all echelons converge and form the foundation for decision-making.

The digitalization of processes becomes essential for the development of capabilities specific to predictive operational logistics. Monitoring stock levels, mission essential equipment readiness status, and even the elements of logistical infrastructure (such as warehouses, lines of communication, supply routes bridges, etc.), as well as fuel levels in vehicle tanks or supply unit reservoirs, all require digitalization by using sensor systems and tools that integrate this information and transform it into actionable, processable data. What is more, the operational requirements of the utilised information platform should include alert features that highlight values exceeding the acceptable thresholds and notify the operator accordingly.

Moreover, the use of artificial intelligence could enable logistics platforms to generate valid courses of action to address the identified deficiencies. In the traditional logistics case, a soldier at squad or platoon level reports a shortage of material goods, the battalion logistics section consolidates the reported deficits and forwards them to the brigade. At that level, data is being consolidated, compared with the existing stocks and the remaining shortages are reported to the division or corps level, according to the organizational structure. Nevertheless, such a complex flow of information is not adequate, in the process specific to precision logistics of the current operational context. Accurate, digitalized and constantly updated information, that can be accessed and visualized in a processed and highly intelligible form, from any echelon, is needed.

The requirements mentioned above are supported by an US Army regulation specific to multi-domain operations. Thus, three main elements that enable precision logistics are defined: a digital and predictive resource planning decision support system,

a real-time operational logistic picture to support decision-making process, and a significant reduction in demand, aimed at decreasing the resupply needs, while increasing mobility and operational sustainability (U.S. Army Training and Doctrine Command, 2018).

The same source proposes a comprehensive definition for the concept of precision logistics, as following: *“the art of delivering support forward utilizing a combination of sensor-driven predictive analysis, condition-based maintenance at the point of need, and robotic autonomous delivery combined with the beneficial results of demand reduction to enable multi-domain formations to present a credible deterrence during competition, to transition to armed conflict with speed and agility, and to execute Multi-Domain Operations in depth, including resupply of formations conducting independent maneuver to extend time and reach of protracted operations”* (U.S. Army Training and Doctrine Command, 2018). Therefore, several key characteristics emerge for precision logistics, such as: sensor-based, autonomous, fast, agile, and capable of supporting in-depth operations.

The technological development specific to our times offers diverse perspectives for approaching precision logistics. A wide range of cutting-edge technologies stand out as enablers of the most important characteristics of logistics: speed, agility, accuracy, autonomy, and sustainability. In this respect, an article published by the Institute of Land Warfare as early as 2019 highlighted the emergence of capabilities with development potential that could be game-changers for precision logistics, namely: autonomous systems, 3D printing technology (Additive Manufacturing/AM), alternative sources for water, fuel and energy supply, as well as cloud computing (Cooper, 2019). Of course, quantum technology could be added, but its possibilities are still being explored and revealed, along with image segmentation capabilities.

Taken one by one, autonomous systems so widely promoted and increasingly used today, such as aerial, ground, or maritime drones, can dramatically augment traditional transport capabilities, especially at the tactical level operations (Cooper, 2019). Being able to resupply a subunit under enemy fire with small quantities of essential materials, in situations where survival time in open terrain is becoming increasingly limited, is invaluable. Equally important is the impact of employing 3D printing capabilities, particularly in the area of spare parts supply (Cooper, 2019). A single 3D printer can substitute for an entire material depot and, more importantly, can significantly shorten supply routes for certain types of products (Cooper, 2019).

Water, a highly demanded resource in operational contexts, holds a significant place among the materials that require constant resupply. Alternative water sources, particularly water purification capabilities, are among the most relevant tools for reducing daily supply needs and minimizing the logistical footprint deployed in the area of operations. At the same level of importance are the alternative solutions for fuel and energy supply, in general. The impact of using such capabilities is reflected not only in the supply chains and logistical footprint, but also in the level of self-sustainability and mobility of units, concurring to the sustainability of military operations (Cooper, 2019).

Furthermore, computer networks and shared, comprehensive, and secured databases, with accessibility that is both controlled and geographically extended, are essential for ensuring the precision of modern operational logistics, as past operations have already demonstrated. However, quantum technology, with its impact on processing speed, data encryption, and network resilience, can offer significant advantages in providing logistical visibility and supporting the specific processes related to planning and decision-making (NATO Science & Technology Organization, 2020).

Thus, digital technologies, enhanced by additional capabilities such as image segmentation (Ferreira & Reis, 2023) create real conditions for enabling the automation of logistics activities, maintaining an accurate recognized logistics picture (through real-time monitoring of stock levels and equipment movement), and even supporting command and control processes. In this way, the development and integration of digital and automated capabilities “*can pave the way for a future where automation and human expertise work hand in hand to drive logistics toward unparalleled efficiency and success*” (Ferreira & Reis, 2023).

The soldier of the future is a concept where precision logistics naturally finds its place. Multiple sensors aggregation (Anghel, 2023), including those designed for identifying the level of available resources, alternative power supply concepts (Rheinmetall Electronics GmbH, 2025) and innovative acclimate cooling systems (Casem, 2024), integrated in the fighting equipment, enhances the lethality, survivability and also mobility and sustainability for the human warrior (Thales, 2025). Additionally, the robotic assistance exoskeleton, another soldier augmentation technology, might produce a great revolution in terms of mobility and the possibility for any soldier to hold sufficient quantities of provisions and ammunition in order to survive and be more lethal in any contingency (Keller, 2024).

5. Conclusion

The analyzed literature, as well as the study of past operations, provides the foundation and necessary insights to understand the benefits of precision logistics, offering the possibility to find answers to the former research question. It highlights the need to develop additional, accurate, and resilient capabilities to support precision in the logistic domain. With respect to the latter research question, two operational characteristics can be considered as potential enablers of

advantages in precision logistics: the speed of the logistic response and informational accuracy.

Regarding the speed of the response provided by logistical capabilities, modern transportation means can now reach their destination faster than in the past. However, the conclusion of this paper focuses on more than that: it emphasizes the innovative elements that shorten supply chains, create flexibility by reducing consumption, and promote the use of alternative sources as well as of those available within the area of operations. The integration of such capabilities into logistic activities might bring operational advantages by supporting force mobility, sustainability and, as a consequence, the success of the ongoing operations.

At the same time, regardless of how fast logistical capabilities might respond, access to real-time, accurate, reliable, processable, and relevant information is essential to supporting decision-making processes. Furthermore, in order to be both precise and on time, predictive information is required, translated in identifying needs before they arise. Additionally, the tools that provide such information must be capable of integrating the necessary details to ensure movement visibility, both for equipment and for transported materials, down to the smallest detail. In this respect, asset visibility, using the existing coding systems, the RFID technology, or image

fragmentation, represents an indispensable dimension of precision logistics. Therefore, ensuring its resilience and accuracy is a matter of ongoing interest, which should be addressed by future research.

The issue referring to the command and control system within the field of precision logistics is another element whose development requires digitalization and also integration of artificial intelligence tools. The large volume of information needed to ensure logistics precision can be effectively managed and transformed into concrete operational advantages, provided data is processed automatically and decision points are offered the adequate attention. Furthermore, artificial intelligence can be trained to suggest possible courses of action to support the decision-making process.

To conclude, the large range of complex requirements needed to obtain precision in military logistics involves significant efforts that could be made through inter-institutional cooperation, including with the civilian companies, as well as through multinational collaboration, to ensure interoperability. However, the analysis conducted in this study reveals that employing precision logistics capabilities in military operations could also leave room for errors. Therefore, a balanced approach is advisable in establishing the right level of stocks for the fighting forces and the usage of precision logistics tools, in accordance with the operational context.

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