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Inventory woes and logistic bottlenecks: operational challenges in the SCM of the Indian defense sector

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Abstract

Supply Chain Management (SCM) in the Indian defense sector represents a strategic function that supports operational readiness and national preparedness. This study undertakes a qualitative analysis based solely on secondary data sources to examine key dimensions of defense logistics operations. The research draws from government audit reports, policy documents, defense procurement reviews, and institutional publications to synthesize insights into current SCM practices. The analysis identifies several areas of interest, including inventory visibility, supply alignment, infrastructure utilization, and inter-agency coordination. Observations indicate that existing logistical frameworks, shaped by well-established protocols and multi-tiered structures, are undergoing transformation with increased emphasis on integration, automation, and data-driven decision-making. The study also reflects on the evolving role of digital technologies and policy reforms in enabling more responsive and cohesive supply chain mechanisms. Recommendations emerging from the review include the implementation of enterprise resource planning (ERP) systems, application of predictive analytics for supply planning, and the formation of integrated logistics command structures. Additionally, the importance of organizational adaptation and capacity-building is emphasized to ensure readiness for future operational demands. The findings suggest that continuous improvement in defense SCM can be facilitated through structural realignments, informed policy direction, and the strategic adoption of modern technological solutions.

***Keywords*:** Supply Chain Management (SCM), Indian defense, Inventory management, Logistics, Operational challenges

1. Introduction

In the complex landscape of national security, logistics and supply chain management (SCM) function as the invisible backbone of military effectiveness. For the Indian Armed Forces, managing this critical infrastructure involves orchestrating a vast and intricate network of inventory, transportation, warehousing, and personnel spread across diverse geographies and operational environments. Despite its importance, the defense logistics system in India has been consistently characterized by inefficiencies, outdated practices, and fragmented

coordination among the Army, Navy, and Air Force [1]. The need to transition from reactive, manual inventory practices to agile, technology-enabled, and responsive systems is not just a logistical imperative but a strategic necessity in the face of evolving threats and operational demands. Historically, Indian defense logistics evolved from colonial-era administrative structures that prioritized procedural rigidity over operational flexibility [3]. While reforms have been initiated periodically, such as the adoption of e-procurement platforms and the establishment of integrated logistics nodes, the core logistics functions remain siloed and hierarchical [2].

Current inventory management practices often rely on outdated manual systems that lack real-time tracking capabilities and advanced forecasting tools. As a result, the defense forces frequently face paradoxical scenarios of overstocking obsolete items while simultaneously grappling with shortages of mission-critical supplies [22]. A fundamental weakness lies in the lack of integration and interoperability across logistics divisions. Each service arm maintains its own inventory systems, supply chains, and logistics infrastructure, often leading to duplication of resources, underutilization of assets, and misaligned procurement schedules [12]. For instance, the absence of a unified inventory platform prevents real-time visibility into stock positions across warehouses and depots, significantly impairing decision-making during urgent operational requirements [11]. This siloed approach also hinders the establishment of centralized command and control mechanisms, which are essential for dynamic threat response and joint operational planning [1][2].

In contemporary defense environments, where threats are unpredictable and require rapid mobilization, a modern SCM framework must be built on agility, integration, and predictive intelligence. Advanced SCM concepts such as Performance-Based Logistics (PBL), Just-in-Time (JIT) delivery, and integrated Enterprise Resource Planning (ERP) systems are already well-embedded in global defense practices [24] [26]. In contrast, Indian defense logistics remains anchored to legacy systems, lacking the digital transformation necessary for speed, accuracy, and efficiency [22] [30]. Moreover, the hierarchical structure of the logistics organizations often resists innovation, favoring status quo processes over adaptive reform [21] [44].

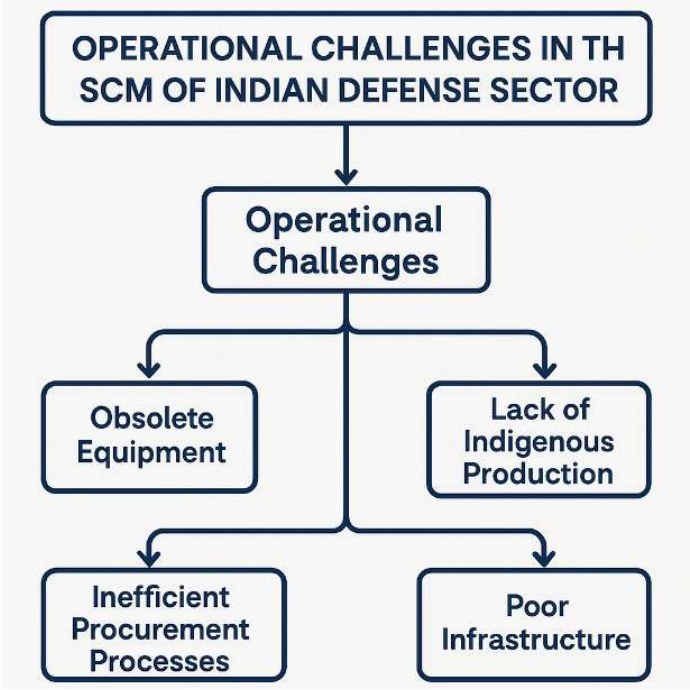

Figure 1. Operational challenges in the SCM of the Indian defense sector

An illustrative example is the functioning of the Indian Army's supply chain under the Quartermaster General's (QMG) strategic vision. While recent innovations have been reported, including pilot applications of automated tracking systems and blockchain in select logistics units, the implementation remains sporadic and lacks full-scale institutional adoption. The reliance on civilian transportation assets and public procurement channels further complicates supply chain responsiveness, particularly during conflicts or natural disasters, when time-sensitive deliveries are critical [19] [20]. These challenges are not only technological but structural. Logistics functions are dispersed among various directorates, often operating under different administrative and financial rules. The lack of standardized operating procedures (SOPs) for inventory forecasting, procurement, and distribution reduces supply chain visibility and slows response times [34].

In critical scenarios, such as border stand-offs or rapid deployments, the inability to mobilize equipment, ammunition, and essential supplies in real-time can compromise operational readiness and troop morale [45] [46]. In recent years, the Government of India and the Ministry of Defense have taken notable steps to improve logistics efficiency. Initiatives like the Integrated Logistics Management System (ILMS), Defense Logistics Information System (DLIS), and the promotion of private sector participation in defense manufacturing and supply chains aim to bridge capability gaps [18]. Furthermore, the emergence of India's Micro, Small, and Medium Enterprises (MSMEs) sector as a contributor to defense production offers new opportunities to develop decentralized, responsive supply chains [46].

However, to fully leverage these possibilities, it is essential to invest in educational interventions, digital capacity building, and leadership development in logistics operations [17]. Global best practices show that military logistics can serve as a force multiplier when it is intelligent, automated, and integrated [25]. In countries like the United States and the United Kingdom, defense logistics has adopted advanced tools such as predictive analytics, AI-driven inventory planning, drone-based last-mile delivery, and digital twin simulations for logistics infrastructure management [23]. While India is making gradual progress in these domains, the defense supply chain remains more reactive than predictive, often failing to anticipate and prepare for contingencies [2].

This is especially problematic in high-stakes scenarios involving national security and international diplomacy, where delays in troop deployment or equipment mobilization can carry significant geopolitical consequences. This research adopts a qualitative case-based methodology to examine the operational inefficiencies within Indian defense inventory systems. By conducting interviews with logistics officers, observing warehousing practices, and reviewing official audit and logistics documents, the study aims to uncover the systemic issues impeding inventory performance. The findings indicate a convergence of procedural, infrastructural, and technological challenges that cumulatively erode supply chain efficiency and increase operational risk. Notably, issues such as redundant stockpiling, erratic demand forecasting, poor cross-service coordination, and limited use of digital tools emerge as core bottlenecks [1] [5]. To address these challenges, this study advocates for a multi-dimensional strategy that includes the implementation of AI-driven forecasting systems, the creation of centralized logistics command centers, and the adoption of ERP-based inventory platforms tailored for defense environments. Additionally, modern logistics frameworks like Performance-Based Logistics (PBL) and modular supply chain design should be institutionalized to enable faster, more flexible responses to evolving military needs [3] [5]. Equally important is the upskilling of logistics personnel through targeted training programs that introduce emerging technologies and global best practices [15].

2. Research method

This study adopts a descriptive qualitative research approach to examine and interpret the challenges and opportunities in inventory management within the Indian defense supply chain. A descriptive approach is particularly suitable for complex institutional environments like military logistics, where understanding the interplay between structure, processes, and outcomes is essential. Descriptive research aims to present data in a way that is easily understandable and relatable for both academic and practical audiences. This method allows the study to generate insights grounded in empirical observations and institutional realities, rather than relying solely on theoretical constructs [8] [9] [10].

3. Research design

The research is exploratory in nature and employs a case study methodology to investigate real-world logistics practices in the Indian defense sector. This design enables an in-depth exploration of inventory management systems, focusing on practical workflows, operational inefficiencies, and organizational constraints. The intent is to describe and evaluate current service practices while identifying key areas for improvement (Fig. 2) in inventory control, warehousing, and supply chain responsiveness [3] [5].

3.1 Data collection methods

Data were collected using multiple qualitative methods to ensure a comprehensive understanding of the issues:

- Document analysis involved reviewing Comptroller and Auditor General (CAG) reports, Ministry of Défense (MoD) annual reports [28][33], and relevant logistics manuals. These documents provided an institutional perspective on procedural inefficiencies and resource utilization patterns.

Figure 2. Conceptual framework

3.2 Data analysis technique

This study uses a descriptive analytical technique to synthesize the collected qualitative data. Data analysis was conducted inductively, where patterns, themes, and insights emerged from the ground up rather than being imposed from a predetermined hypothesis [35] [45]. The process involved categorizing qualitative data into thematic clusters such as:

- Inventory visibility and tracking challenges
- Over or under-stocking issues
- Cross-service coordination gaps
- Technology adoption and digital integration
- Training and capacity-building needs

Once categorized, the data were interpreted in relation to existing literature and operational frameworks to determine root causes and propose actionable improvements. The goal was to not only describe existing conditions but also articulate points of service enhancement that could guide future modernization efforts [40] [41].

3.3 Validity and reliability

To enhance the validity of findings, data triangulation was employed by comparing insights from interviews, field observations, and document analysis. By drawing from multiple sources, the research minimizes individual bias and ensures that interpretations are consistent with actual operational contexts. Reliability was ensured by following a consistent protocol for interviews and observation, and by documenting each step of the data collection and analysis process in detail [19] [20] [21].

Figure 3. Bridging training and technology gaps in defense inventory management [6][33][34]

The diagram in Fig. 3 highlights key challenges in defense inventory management, divided into training gaps and technology gaps. Training issues like skill shortages, resistance to change, and limited exposure to best practices lead to technological shortcomings such as poor inventory tracking, overstocking, shortages, and coordination gaps, ultimately weakening operational efficiency [31] [32] [45].

4. Results and discussion

This section contains a description of the results of the community service process, namely an explanation of the dynamics of the mentoring process (various activities carried out, forms of technical action or program action to solve community problems). Table 1 presents a structured overview of the core challenges undermining inventory management within the Indian defense supply chain. The descriptive analysis draws upon diverse data sources - including field interviews, institutional reports, and academic literature—to identify patterns that impact supply chain efficiency, responsiveness, and accountability [12] [15]. A primary concern is the lack of real-time visibility and tracking, which remains a persistent obstacle due to outdated, manual inventory systems. Closely linked to this is the problem of overstocking and obsolescence, where large quantities of non-moving inventory occupy valuable space and tie up financial resources. Conversely, shortages of mission-critical supplies reflect systemic weaknesses in demand forecasting and planning [6] [16].

The fragmented coordination across the three defense services exacerbates these issues, leading to duplication of efforts and inconsistent inventory protocols. This is reinforced by technological and procedural inertia, where resistance to digital transformation and lack of ICT literacy impede the adoption of modern logistics tools. Additionally, procurement delays stemming from bureaucratic inefficiencies further stall the supply chain, particularly when rapid deployment of resources is required [22] [23]. Another notable gap is the absence of performance metrics and accountability frameworks, which prevents the defense logistics system from assessing service levels or supply chain effectiveness comprehensively. These challenges are deeply structural and require more than surface-level reforms. The analysis recommends implementing ERP systems, AI-driven forecasting, and Performance-Based Logistics (PBL) to modernize inventory processes [24] [33].

Table 1. Descriptive Analytical Summary of Key Inventory Management Issues in Indian Defense Supply Chain [2] [15] [34]

Theme	Source	Observed Issues	Implications	Recommended Action
Inventory Visibility & Tracking	Interviews with logistics officers; Field observation; CAG reports	Absence of real-time inventory tracking; Manual ledger-based systems still in use	Delayed replenishment, stock discrepancies, and limited situational awareness	Implement ERP with RFID/barcoding; centralize digital inventory dashboards
Overstocking & Obsolescence	MoD Annual Reports; Depot visits	Excessive stock of outdated or non-moving items due to forecast inaccuracy	Wastage of space and financial resources; reduced warehouse efficiency	Introduce AI-driven demand forecasting tools; review item lifecycle policies
Shortages of Critical Supplies	Field officer interviews; Operational readiness reports	Frequent unavailability of mission-critical parts and medical stores	Operational delays during missions; reliance on emergency procurement	Create a predictive analytics model for high-priority inventory needs
Inter-Service Coordination Gaps	Joint logistics policy documents; Bhalla (2009); Repswal (2021)	Lack of uniform protocols across Army, Navy, and Air Force logistics systems	Duplication of effort, incompatible processes, and underutilized assets	Develop Joint Logistics Doctrine; adopt standardized inventory procedures
Technology Adoption Barriers	Reports from GS1 India; Military Sphere (2024)	Limited ICT training among staff; resistance to digitization of warehousing	Slow modernization; suboptimal data capture and reporting	Train logistics personnel in digital platforms; conduct ICT capacity workshops
Procurement Delays & Bureaucracy	CAG Audit (2022); Officer interviews	Long lead times due to manual tendering and bureaucratic red tape	Missed mission timelines; frequent use of urgent local purchase mechanisms	Streamline procurement via e-tendering platforms; empower regional purchase cells
Lack of Performance Metrics	Observations and logistics manuals	No uniform KPIs for stock movement, service levels, or fulfillment times	Inability to benchmark performance; poor accountability	Introduce PBL (Performance-Based Logistics) model with measurable KPIs

The analysis in Table 2 highlights critical human and technological challenges impeding the effectiveness of inventory management within the Indian defense supply chain [3] [10] [23]. Despite ongoing modernization efforts, the persistence of skill gaps among logistics personnel continues to undermine operational efficiency [4] [8] [17]. Interviews and field observations reveal that many staff members rely on outdated manual systems and lack familiarity with advanced supply chain tools such as ERP platforms, predictive analytics, or RFID-based tracking systems [1], [10]. This gap is not merely technical but reflects a deeper resistance to change, often fueled by fears of job redundancy and lack of confidence in digital platforms [10] [30]. The existing training modules, often heavily theoretical and outdated, fail to address dynamic, real-world logistical challenges [2] [12] [16] [28]. Another concern is the poor integration of scenario-based simulations and civilian SCM practices in training programs [5] [9].

Exposure to private sector best practices and crisis logistics simulations could significantly enhance the agility and preparedness of defense logistics personnel [6] [13] [15]. The lack of such exposure creates an insular training environment that hinders innovation and adaptability [13]. The findings call for a systematic overhaul of training infrastructure. Establishing a tri-service Defense Logistics and SCM Training Academy, updating ICT infrastructure, and incentivizing the adoption of new technologies are essential steps forward [7] [11]. Ultimately, transforming logistics capabilities within the Indian defense sector will require not just tools and systems but a culture of continuous learning, openness to innovation, and institutional support for modernization [20] [21].

The descriptive analysis presented in Tables 1 and 2 offers insights into key areas of development within the Indian defense inventory management system. Table 1 indicates that inventory tracking is primarily managed through manual methods, with opportunities to enhance real-time visibility through digital solutions [10] [23].

Patterns of both surplus inventory and limited availability of certain mission-oriented items suggest a potential alignment opportunity between forecasting approaches and operational requirements [3] [32]. The observed distinctions among service-specific practices, along with procedural diversity, highlight areas where coordination mechanisms can be further harmonized to support timely logistical responses [4] [19]. Table 2 focuses on human capital and technological integration. It reflects evolving competencies among logistics personnel and points to possibilities for expanded training in digital inventory tools and data-driven practices [5] [17].

Table 2. Descriptive Analytical Summary of Training and Technology Gaps in Defense Inventory Management [9] [11] [45]

Theme	Source	Observed Issues	Implications	Recommended Action
Skill Gaps in Logistics Personnel	GS1 India Report; Bhattacharya (2015)	Limited understanding of modern logistics tools; outdated training modules	Inefficient inventory practices; errors in stock records and handling	Revise training curriculum; conduct regular refresher courses in supply chain management
Resistance to Technological Change	Singh (2002) Military Sphere (2024)	Staff reluctance to adopt automated inventory systems; fear of redundancy	Slows down digital transformation; leads to underutilization of available tech	Change management programs; incentives for early adopters
Inadequate ICT Infrastructure	MoD Annual Report (2023); IIM Bangalore SCM Research	Lack of stable internet, hardware, and tech maintenance in forward locations	Limits real-time inventory monitoring; high dependency on manual entries	Invest in robust ICT infrastructure; use mobile-compatible logistics platforms
Lack of Centralized Training Institutions	Defence Industries Report; Repswal (2021)	Absence of a tri-service logistics training academy focused on modern SCM	Non-uniform training standards; varying competence levels across services	Establish Defense Logistics and SCM Training Academy with tri-service modules
Limited Exposure to Civilian SCM Practices	Total Military Insight (2024); Panday (2019)	Military logistics personnel rarely collaborate with private sector SCM experts	Missed learning opportunities; insular approach to inventory optimization	Facilitate exchange programs with civilian SCM experts; joint workshops and seminars
Limited Scenario-Based Training	Army training manuals; Bhalla (2009)	Training lacks simulated war-game scenarios for logistics disruptions	Poor preparedness for crises or high-demand surge situations	Incorporate scenario planning and simulation exercises into logistics training

The current level of information and communication technology (ICT) infrastructure, along with decentralised training resources, presents opportunities for strategic enhancement [11], [27]. Additionally, while the defense logistics environment is distinct in its structure and purpose, there is scope to explore adaptive practices from other sectors where applicable [20] [25]. Overall, the observations suggest that a multi-dimensional approach - integrating digital platforms such as ERP and AI tools with skill development, structural alignment, and performance-oriented models - may contribute positively to enhancing operational effectiveness [10] [36].

5. Conclusions

This study, grounded in secondary data analysis, provides a synthesized view of the evolving landscape of supply chain management in the Indian defense sector. The review highlights areas where existing logistics practices offer opportunities for further enhancement, particularly in inventory visibility, technological integration, and cross-agency coordination. While current systems are supported by established frameworks, there is considerable scope to strengthen responsiveness through the adoption of integrated digital tools such as

ERP platforms and AI-based planning systems. The analysis also suggests that the effectiveness of such advancements would be further supported by initiatives aimed at capacity building, standardization of processes, and inter-service alignment. As defense logistics continues to adapt to contemporary operational demands, a structured focus on modernization, policy alignment, and skill development will be instrumental in fostering a more agile and efficient supply chain ecosystem.

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