ARTIFICIAL INTELLIGENCE AS FORCE ENHANCER IN AIR FORCE LOGISTICS

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Introduction

April 13, 2025 witnessed the signing of agreement between India and Germany to enhance the cooperation in the sphere of Artificial Intelligence (AI), Quantum Technology and green hydrogen with a focus on innovation-driven growth and sustainable development.[1] The utilisation of AI in ensuring a smooth and timely last-mile delivery can be a force multiplier in the science and art of logistics supply chain, amidst challenges related to the complexities faced by even the highly experienced logistics planners in the logistics ecosystem.[2] This development drives home the point regarding the significance of AI in logistics management in the times to come. In fact, the AI helps in improving the supply chain processes by simplifying technology and enhancing the team experiences.[3]

A Gurgaon-based well-known logistics company Delhivery is leveraging technology like predictive analytics and automation and Generative Artificial Intelligence (GenAI) to meet the growing customer demands in this sector.[4] All these facts bring home a point regarding the logistics, undoubtedly remaining the backbone of effective operations in peace as well as conflict situations, whether it is the question of delivering goods inter-theatre or across continents, thereby ensuring that the soldiers get what and when they need it most during operations. Over the past decade or so, artificial intelligence (AI) has started gaining firm ground in logistics operations ultimately impacting and reshaping the modern-day battlefield in a big way. More than just streamlining the supply chains, the AI, when operated in conjunction with automation in Indian Air Force (IAF) logistics,

can act as a definite force enhancer, potentially transforming the planning, execution and adaptation of logistics practices.

Covering activities from predicting the inventory needs before the user can even raise the demand, to physically routing the supply transport vehicles to and from the zones of operations, AI has a definite potential to make logistics smarter, more agile and more robust.

> **AI can process humongous quantities of data within seconds, identify the patterns that humans might perhaps miss at times and recommend optimal decisions based on these patterns. When paired with automation, i.e. the machines, vehicles and software that can act based on AI's insights, we can get a system that's not only smarter but is also incredibly agile and scalable.**

AI as a Force Enhancer

The first and foremost question here is as to how is AI a "force enhancer" in logistics? In the context of air operations, it encompasses all the support mechanisms that enhance the punch of the IAF armour, taking into account factors like Air-to-Air Refueling (AAR), aircraft mounted weapon systems, guided weapons, greater surveillance capabilities and self-protection suites, to name a significant few, that augment the effectiveness of the aerial platforms in the role that it is mandated to perform. In logistics, the AI also has capability to amplify human capacity and enhance the efficacy of the decision-making. Contrary to a popular myth, the AI doesn't replace people, but it can explain in greater detail as to what they can actually do. AI has the capability to process humongous quantum of data within seconds, identify the patterns that the humans might perhaps miss at times and recommend optimal decisions based thereupon. When paired with automation i.e. the machines, vehicles and software that can act based on AI's insights, we can get a system that's not only smarter but is also incredibly agile and scalable.

To amplify the point, while a traditional supply chain might take days to react to a disruption, an AI-enabled Supply Chain can effectively replan, reschedule and reroute the shipments and reorganise the assets, besides readjusting the schedules in near real time. It becomes even more pronounced when we consider the speed and precision being the significant hallmarks of everyday logistics amidst a high-pressure wartime environment.

Scope of AI in Peacetime Logistics Operations

Logistics is all about efficiency, accuracy, speed and customer satisfaction. The private businesses and the armed forces use logistics to timely obtain and send the spares, food, fuel and the operational units where they need to go, safely and on time.

In this regard, the AI can potentially impact the process in the following areas: -

- **Smarter Inventory Management**:   Imagine a logistics section with prior information as to what all items will be in demand in the coming months. AI-driven demand forecasting Enterprise Resource Platform (ERP), e.g. Integrated Logistics Management on Line System (IMMOLS) in case of the IAF, can use historical consumption data, planned flying effort, past lead time fluctuations in the supply chain and use it in near real time predicting the future requirements with an uncanny accuracy. Accurate material planning through IMMOLS in conjunction with AI can potentially minimise the waste, avoids stockouts and save the organisation a lot of public money.

- **Transportation Routes Optimisatio:**   Transporting the stores from one location to another is a lot more complex of an exercise than it sounds. In this, the AI can help by analysing the real-time traffic data, enroute weather patterns and associated terrain conditions to identify and ascertain the fastest, safest and the most fuel-efficient route. This becomes crucial especially in ensuring the last-mile delivery by getting stocks from the designated sources of supply and sending them to the doorstep of the user utilising the service aircraft or the service transport, achieving the economies of time and fuel.

- **Warehouse Automation:** Imagine a logistics warehouse today where we may likely find robots zipping around, scanning barcodes and stacking items on storage racks. Utilised thus, these won't just be the cool gadgets but the mechanisms effectively powered by AI that guide them where to go and precisely what to do. For example, the robots can be programmed and trained to pick, pack, and sort the items 24/7. The AI systems backing these robots can potentially evolve and improve over time, helping the organisation cutting the storage and inventory handling costs, boost the logistics efficiency with accuracy and lower error rates. This can be extremely useful in respect of managing, especially the holding of op-critical aircraft spares on Aircraft-on-Ground, i.e. AOG demand.

- **Predictive Maintenance:** In the event of a delivery transport or conveyor belt breaking down, the entire logistics chain is thrown off the track. In this sphere, the AI can save the situation by flagging potential issues before they become big problems. Using automated sensors and AI, the logistics storekeeper can monitor the equipment's health in real time. If the system detects abnormal vibrations or temperature spikes, it can alert the maintenance teams or even schedule the repairs automatically. This approach, known as predictive maintenance with AI, can keep the operations running smoothly.

- **Supply Chain Risk Mitigation:** A prudent logistics officer should never lose sight of supply chain disruptions arising out of natural disasters, strikes, global pandemics and nowadays due to regional conflicts, geopolitical rivalries or sometimes targeted sanctions by certain countries. In this regard, the AI can help the organisation in efficiently tackling these scenarios and sustain more resilient supply chains, besides identifying and creating the alternative supply lines. In this regard, we can have the example of operations in the civil logistics companies during COVID-19, wherein the AI-powered logistics systems enabled faster reallocation of resources, giving these companies an edge in chaotic times. The IAF can use the AI in similar fashion to enhance the supply chain effectiveness.

Scope of AI-Enabled Logistics during Operations

In the conflict zones, logistics operations become even more critical and complicated, wherein the supplies are to be delivered to the designated consignees, many times located in the most inhospitable terrains, by conducting the supply chain operations in the most unfavourable conditions, often with limited resources and against tight timelines. The AI under these circumstances can potentially enhance the effectiveness of the wartime logistics in the following ways: -

- **Facilitating Real-Time Tactics Oriented Logistics Planning:** In combat, a few minutes can make a life-or-death difference. AI can potentially help the military logistics managers in processing the battlefield data instantly, offering live updates on supply status, squadron movements, and impending threat perception. For example, if a Sqn convoy moving by road encounters resistance or gets stuck, AI can immediately suggest alternate routes or trigger automated drones to deliver supplies instead giving time to the convoys in recovering from the situation. That kind of rapid response would certainly save time and keep the missions on track.

- **Complementing Autonomous Vehicles and Drones:** Autonomous supply vehicles, e.g. self-driving trucks or self-operated autonomous drones, can be tested and deployed to augment the military logistics operations. These AI-controlled systems can deliver food, ammunition, or medical supplies without putting the air warrior or civilian Mechanical Transport Drivers (MTDs) at risk. The autonomous drones can effectively facilitate the inter and intra-theatre movement of fighting resources especially in the remotely located contested zones. These drones can use AI for navigation, obstacle

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avoidance and even terrain recognition. In respect of the Transportable Radar Units (TRUs), Mobile Observation Flights (MOFs), Garud Commandoes and other mobile Air Force units operating in remote locations amidst grossly inhospitable terrains, the AI-enabled robotic mules may be useful by carrying heavy equipment efficiently, navigating through rough terrains.

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- **Enabling Predictive Logistics and Operational Readiness:** AI doesn't just help in real-time management but can proactively anticipate the requirements based on mission plans. By analysing the op-locations, movement plans and battlefield scenarios, the AI can predict what kind of supply chain difficulties are likely to be faced and when. This type of predictive logistics, with the help of AI, can ensure that the operational units never run low on essentials like fuel, food, critical spares or ammunition. And when the missions are required to be diverted to the other theatre of operations, like in the eventuality of a two-front op-scenario as successfully practised during Exercise Gaganshakti on more than one occasion, the supply chain using the AI can swiftly and efficiently shift from one theatre of operations to the other.

- ·**Supporting Cybersecurity and Digital Warfare:** Wartime logistics nowadays necessitates protecting digital systems as much as the physical ones. Supply chains are potential prime targets for cyberattacks, especially concerning national security. AI can play a key role in monitoring the military networks, identifying unusual activity patterns and accordingly responding to the cyber threats in real time. These systems learn from previous attacks to craft the defences and even predict the potential threats, giving the organisation a major tactical advantage.

- **Making Simulations and War Gaming more Effective:** Before launching the actual operations, the commanders can run simulations or "war games" to test the efficacy of the Standard Operating Procedures (SOPs) and Contingency plans. In this context, the AI can potentially enhance the efficiency and effectiveness by simulating countless variables ranging from effects of weather changes to the damage likely to be inflicted by the enemy tactics, and all that at a scale and speed that the humans can't match. These AI-powered simulations can effectively help the military leaders in preparing for contingencies and make better decisions when

the real conflict unfolds.

Comparing AI Enabled Logistics in Peace and Wartime

To put it across plainly, though the basic philosophy in both the scenarios is broadly similar, the stakes are entirely different. We can see as to how AI can work differently in peace and wartime logistics scenarios (Table 1).

Table 1: AI in Peace and Wartime Logistics Scenarios

Logistics Function	In Peacetime	In Wartime
Inventory Forecasting	Based on consumer demand and consumption patterns	Based on mission objectives and formation movements
Route Optimisation	Focuses on traffic and cost efficiency	Prioritises speed, safety and enemy threat avoidance
Warehouse Automation	Designed for speed and economies of scale	Designed for mobility, adaptability and secured dispersal of assets
Predictive Maintenance	Reduces downtime and extends equipment life	Ensures op readiness and mission-critical reliability
Cybersecurity	Prevents data theft or service disruption	Protects mission-critical networks and battlefield communication
Autonomous Delivery	Efficient last-mile delivery and warehouse operations	Expeditious deliveries in hostile conditions and in remote locations

Source: Table by the author.

Challenges Inherent in the AI-Driven Logistics

AI has massive potential to impact the logistics operations significantly, but it's not all that smooth sailing. Some challenges that may come with the discipline of AI in logistics are: -

- **Concerns of Data Security and Privacy:** AI systems rely on massive amounts of data. If that highly sensitive data gets somehow leaked or made available to the enemy by any chance in wartime, the consequences can be disastrous. The government and the IAF have strong cybersecurity protocols in place to protect these systems and they need to be adhered to continuously and updated constantly.

- **Myth of Job Displacement:** As automation ramps up, a myth emerges about humans losing jobs. However, while new technology creates new roles, there is a need for reskilling and multitasking to ensure that the workforce is not left behind.

- **Bias and Algorithmic Mistakes:** AI systems are only as good as the data they're trained on. If that data is biased, the decisions made by AI can also be biased. This is especially dangerous in wartime scenarios, where wrong decisions can impact lives.

- **Ethical and Legal Issues:** Who is responsible when an autonomous drone makes a bad call? As AI becomes more autonomous, ethical and legal questions will need clear answers, especially when used in military operations.

Prospects of using AI in Air Force Logistics

Looking ahead, we can safely say that the AI can become pivotal in logistics operations in the IAF and there is a lot that we can expect from the AI in the context of operational logistics: -

- **Hyper-Automation:** Interconnected IMMOLS and AI can efficiently handle more advanced logistics processes, from procurement to delivery or from womb to tomb.

- **Artificial Intelligence (AI) + Internet of Things (IoT) & Internet of Military Things (IoMT) Integration:** Sensors and smart devices may feed real-time data into AI systems, creating even more responsive logistics supply chains.

- **Collaborative AI:** The most desirable situation would involve humans and AI working side-by-side, with AI offering recommendations while humans making the final decisions .

- **Global Defence Applications:** With the accelerating pace of Atmnirbharta in the country due to the enhanced focus of the government, we may expect better utilisation of the national talent amidst increasing international collaborations on AI logistics systems for peacekeeping and joint military operations.

Final thoughts

The logistics is increasingly mission-critical, whether it's the question of delivering spares or moving a squadron to its op location, having supplied it what it needs. To augment it, the AI, when amalgamated with automation, has great potential to become a forerunner of revolutionising the logistics in unparalleled ways. While in peacetime, the AI can boost logistics efficiency, reduce waste and enhance customer satisfaction, in wartime, it has the potential to become an inevitable operational lifeline by virtue of its capabilities of predicting future needs, securing data and finally enhancing the punch of the armour.

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But we should bear in mind that this powerful tool also needs to be associated with a sense of responsibility. As we lean more on AI, we must stay vigilant about the ethical, legal and human concerns inherent in this. If handled right, AI can actually amplify the human ingenuity by becoming one of the most valuable force enhancers for the discipline of logistics.

Notes:

[1] "India, Germany to Deepen Cooperation in AI, Quantum Tech: Minister," *The Economic Times*, April 14, 2025, https://manufacturing.economictimes.indiatimes.com/news/industry/india-germany-to-deepen-cooperation-in-ai-quantum-tech-minister/120268233. Accessed on May 4, 2025.

[2] Dhruvil Sanghvi, "How AI is Shaping the Future of Last-Mile Logistics," *The Economic Times*, April 11, 2025, https://cio.economictimes.indiatimes.com/news/artificial-intelligence/how-ai-is-shaping-the-future-of-last-mile-logistics/120154208. Accessed on May 4, 2025.

[3] Cem Dilmegani and Sila Ermut, "Top 15 Logistics AI Use Cases & Examples in 2025," *AI Multiple Research*, April 29, 2025, https://research.aimultiple.com/logistics-ai/. Accessed on May 4, 2025.

[4] Sohini Bagchi, "AI, Automation, and Data Intelligence Drive our Focus this Year: Delhivery's Parashar," TechCircle, April 28, 2025, https://www.techcircle.in/2025/04/28/ai-automation-and-data-intelligence-drive-our-focus-this-year-delhivery-s-parashar. Accessed on May 4, 2025.