From efficient to effective modern combat logistics

Modern warfare requires modern logistics practices built on incremental changes and data-driven solutions.

ARTICLE • 7-MIN READ • Deloitte Center for Government Insights

Wartime demand for food, medical supplies, and essential military hardware, like circuit boards or munitions, would require navigating significant logistics challenges. It would involve surges in demand for products, requiring new sources of supply and global production. It would also require tracking billions of items through data-driven technologies, like radio-frequency identification tags, to better align inventory with demand. It's also probable that wartime demands could lead to workforce shortages and the need to produce new products and services quickly. In a war with a peer adversary, logistics and maintenance activities would also be prone to attack by cyber and other more traditional military means.[1] None of these assumptions would be trivial logistical tests, to say the least.

However, these challenges are not completely unprecedented. Setting aside adversary disruption, commercial food, health care, and technology companies dealt with each logistics challenge described above during the COVID-19 pandemic.[2] While enemy attacks on logistics would be a driving factor influencing how militaries might adjust to these challenges, recent lessons from commercial companies suggest dealing with wartime demand for supplies likely doesn't require entirely new or monolithic

solutions. Additionally, improving logistics practices before a conflict can improve wartime resilience as well.[3]

The Future of Warfighting

Read more from Deloitte Center for Government Insights' The Future of Warfighting collection

Digital technologies are changing warfare, similar to how they have changed modern supply chains, maintenance, and logistics practices. Today's hyperconnected digital world has changed the character of warfare in part by extending its reach and increasing its speed. Missiles travel farther and faster, while cyber and information capabilities have, in some ways, reduced the significance of distance.

These new features of warfare can give a military a significant advantage. While much of today's digital battlefields will enable greater speed and reach, distance and geography still matter—people and supplies can't be delivered over fiber optic cables, nor can factories be moved or duplicated quickly. Ultimately, the latent value of speed and reach in warfare only matters if a military can produce and deliver required military capabilities and supplies despite logistical disruptions.

To better optimize their operations, militaries need to develop practices predicated on the following:

- Better integration with industry, allies, and partners.
- Build logistics practices around data and wargame.
- Develop talent accustomed to addressing disrupted logistics.

Factors driving change in military logistics

1. More ways to attack and disrupt the production, transportation, and distribution of military supplies (e.g., cyber, mis- and disinformation, electronic warfare, and advanced munitions).

2. Digital tools, like those that compose a digital thread, automation, AI, and data analysis can allow for more resilient, predictive, and responsive logistics systems.

3. Mutual supply needs among allies can provide opportunities to share and distribute production and transportation resources.

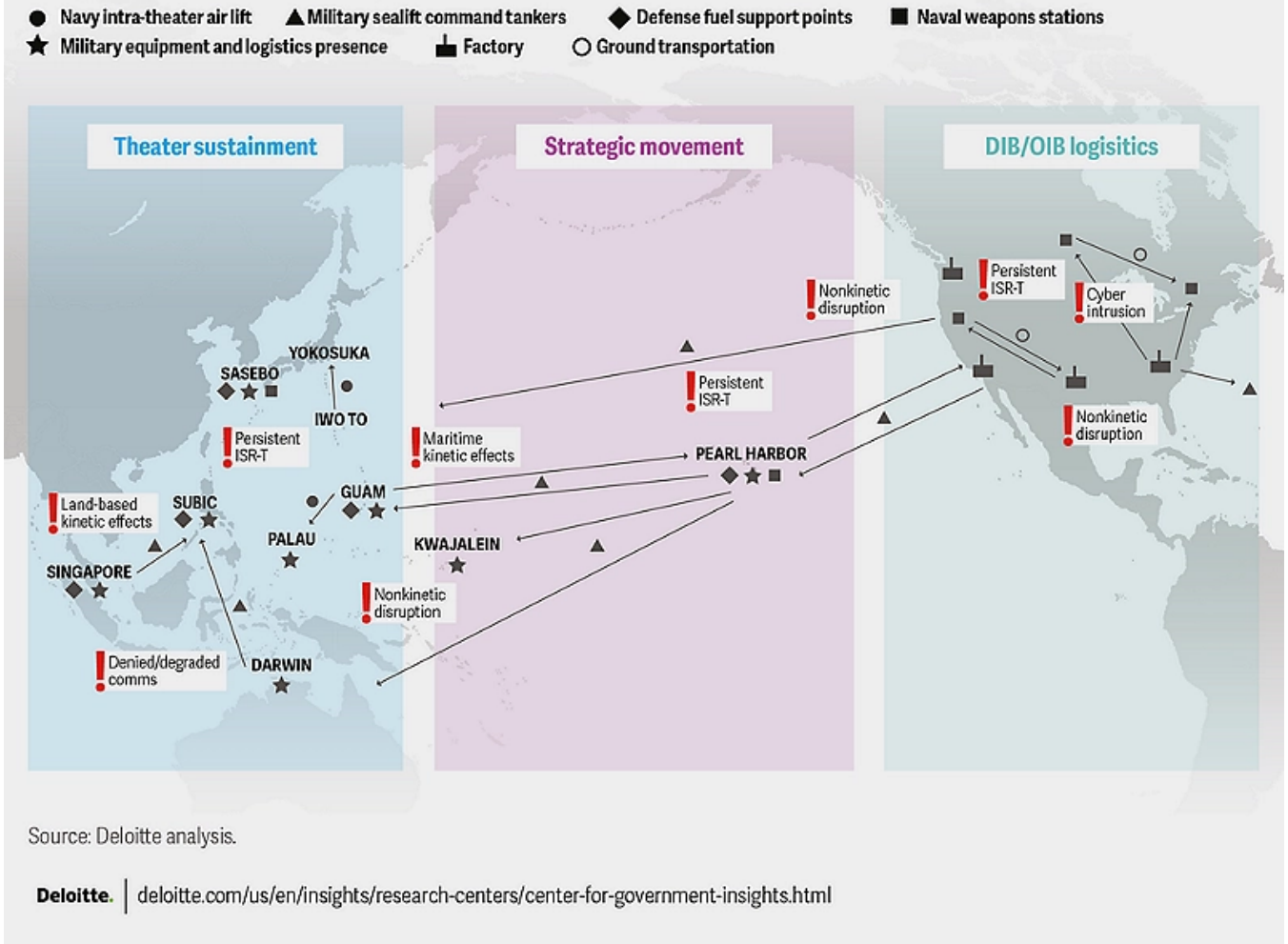
The need for effective logistics

Logistics is the life support of combat. Without the ability to supply troops and maintain equipment, it's doubtful a military could sustain combat operations. In a peer fight, success may depend on which side can most effectively deprive their adversary of resupplying and maintaining forces beyond the initial outbreak of hostilities. Moreover, the longer a war between peers persists, the more costly it becomes for all sides. Consequently, it's likely that in a war with a peer, the aggressor would try to win through quick, decisive actions that, among other objectives, would target logistics hubs and routes.[4]

Deterring such a fight, therefore, can require developing a logistics system that makes an adversary question their ability to starve its opposing force of supplies and maintenance. Figure 1 details a hypothetical scenario where logistics is contested from origin to destination. If a peer aggressor isn't confident that they can quickly and decisively win the conflict, they may question whether the war is worth the cost. Developing a deterrent logistics system during peacetime is crucial to enable better response and readiness in a crisis or competition. This way, the military can be prepared to respond in any situation.

Figure 1

Hypothetical contested logistics scenario



Source: Deloitte analysis.

Deloitte. | deloitte.com/us/en/insights/research-centers/center-for-government-insights.html

Exposing logistic vulnerabilities

After decades of changes predicated on cost savings and time efficiencies, commercial and military supply and logistics practices may not be that difficult to disrupt during a war with a peer.

The pandemic exposed the fragility of commercial practices that produce and move materials and products. Although militaries have their own logistics capabilities, there is overlap with the private sector in areas such as railways, airports, seaports, and the increasing significance of commercial technologies in modern warfare. Additionally, using automated inventory algorithms that prioritize inventory choices based on logistical normality rather than risk is an important industry practice that intersects with military operations.[5] A war with a peer will likely require mobilizing the nation

to respond, somewhat like the national responses to the pandemic. To be sure, militaries can make their own decisions to shore up logistics, but dependence on industry for many essential capabilities and resources will persist (and they should).

For militaries worldwide, the private sector is often an essential part of logistics. However, relying on the private sector can expose national supply chains and logistics to vulnerabilities that can also affect military operations. A vulnerability associated with supply chains and logistics practices optimized for efficiency is that minor disruptions can reverberate across industries and supply lines more easily. When the Suez Canal was blocked by a stuck ship, the logistics repercussions were felt around the world and cost tens of billions of dollars and weeks of delays.[6] Similarly, when labor shortages slowed semiconductor production, numerous industries felt the consequences to the tune of approximately US$240 billion in a single calendar year (2021) in the United States alone.[7]

The disruptions from the pandemic or shipping accidents were unforeseen and resulted in considerable global ramifications. Given the fragility of many supply chains and logistics practices, the concerted effort to disrupt them during a war with a peer would likely result in greater disorder for industry and military logistics alike.

The pandemic has led governments to adopt innovative methods for developing and delivering resources. In the United States, Operation Warp Speed was the program coordinated by the United States Department of Health and Human Services and the Department of Defense to expedite the development and delivery of vaccines. This initiative involved producing a variety of vaccines, earlier ramp-up of production by vaccine companies, and faster data collection compared to standard vaccine development procedures.[8]

While Operation Warp Speed shows that there are alternative ways of producing and delivering critical items, military logistics face some unique challenges. For example, defense industrial capacity has shrunk in recent years (as noted in the companion article, *Out with the defense industrial base, in with the defense industrial network*). Due to a focus on cost savings, the military has shifted many of its supply sources

offshore. As a result, many suppliers and parts of the industrial base only have enough capacity to meet the demand during peacetime, with little flexibility to rapidly increase production during times of crisis or warfare.[9]

Fragile commercial practices combined with limited military capacity to surge production may leave many militaries vulnerable to wartime disruptions. Sophisticated cyber and electronic warfare attacks reserved for the high stakes of warfare, striking logistics and maintenance facilities through air or maritime military operations, dis- and misinformation campaigns designed to impede workforces, and other means are likely to be persistent wartime threats capable of exploiting existing supply chain, logistics, and maintenance fragility. Blunting the consequences of military attacks on logistics requires thinking differently about logistics.

The shift to resilient logistics practices

If supply chain and logistics fragility is caused by emphasizing efficiency, then shifting practices toward effectiveness can offer a solution. More effective practices would ideally prioritize resilience over cost-effectiveness and speed, and industries, governments, and militaries are already taking steps to develop more robust and effective approaches.

In the United States, the effort to modernize military logistics is underway. Joint warfare concepts describe the challenges of operating in "contested logistics" environments, and the US Army has created modernization teams to develop new logistics capabilities, and US military leaders are championing new logistics practices in public statements.[10] These efforts are predicated on assumptions that logistics will be critical and a target in theater and at home.[11] The solutions involve various elements, like a better use of data, anticipating requirements more quickly, building relationships with global sources of supply, and better integrating logistics capabilities.[12]

Similarly, Australia's Department of Defence outlined in its National Defence: Defence Strategic Review 2023 that "optimal Defence logistics network must be resilient

through disaggregated and dispersed mutually supporting nodes that enhance redundancy and survivability."[13] The document also notes the importance of integration at the national and global levels to access the "full range of logistics ... effects required by defence," and to meet maintenance, manufacturing, and storage needs.[14]

India is also heavily investing in the coproduction of defense capabilities with friendly countries, which provides inherent advantages in building resilience through distributed production for both acquisition and sustainment. For example, the M777 Ultra-Light Howitzer is in service with the United States, Canada, Australia, and now India. The Indian Army's procurement of Howitzer also includes private sector integration through shared industry assembly of the equipment in India.[15] Similarly, the multirole C-295 aircraft used by the Indian Air Force is being manufactured in India through collaboration between industry partners.[16] Aircraft engines are also part of coproduction efforts between the United States and industry partners.[17]

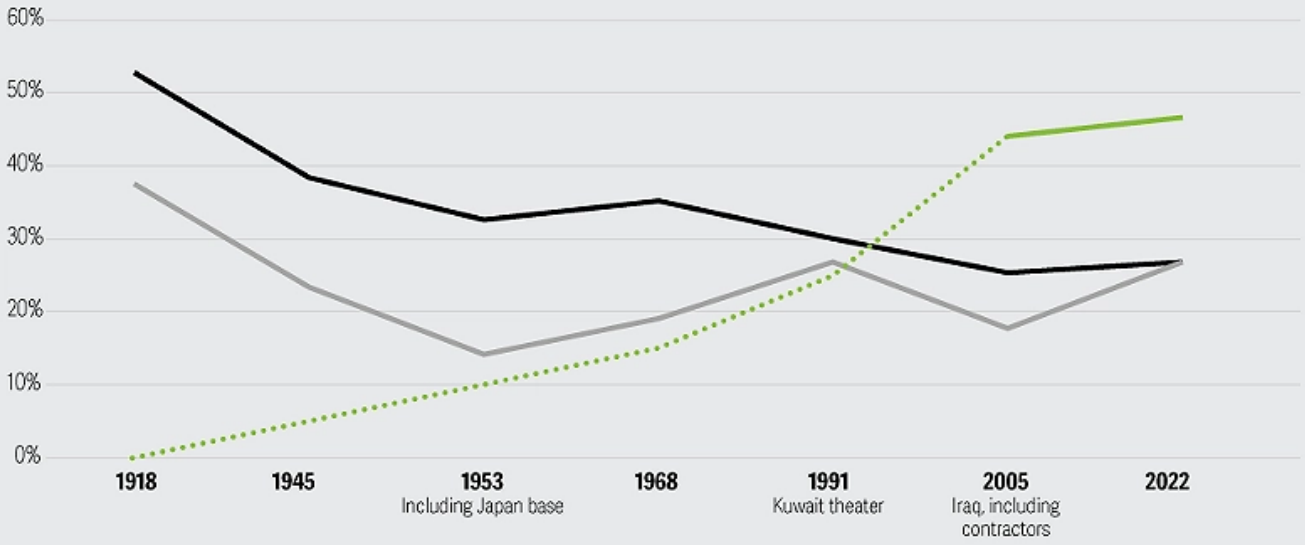
The US-India defense cooperation continues to expand with the implementation of the Logistics Exchange Memorandum of Agreement, Communications, Compatibility and Security Agreement, and the Industrial Security Agreement.[18] These agreements allow for enhanced cooperation based on the exchange of information and data. India is also adopting more digitally defined and integrated logistics practices that offer increased efficiency over older, often industrial-age approaches.[19] India's efforts reflect an appreciation for a logistics system that is globally integrated and cooperative.[20]

The push to modernize sustainment practices, like logistics, isn't unique to the United States, Australia, and India. Militaries recognize the need to adapt logistics practices toward effective, rather than purely efficient, approaches. These approaches have a similar theme: Effective logistics is predicated on reliable information. In today's digital world, reliable information often comes from digital technologies that can produce, collect, understand, and even act on data better than humans. And this makes sense from a military perspective, given the increasingly digital nature of many combat capabilities. Better use of information in logistics can allow for optimization, where issues can be predicted or solved more quickly.

As an example, figure 2 below shows that digital tools are improving the combat effectiveness of troops and reducing the need for excess combat capability (the military personnel in traditional combat roles who aren't being deployed for combat). In other words, digital tools can make combat personnel more effective, potentially reducing the need for more combat troops. So, rather than adding to overhead, investments in digital logistics may be important enablers to help make combat forces effective on an increasingly digital battlefield. This could change the familiar military criticism of 'tooth-to-tail' into a positive 'digital tooth-to-digital tail'.

Figure 2

The military has traded excess combat capacity for increased effectiveness by adding more "digital" capabilities



Source: Deloitte analysis.

Deloitte. | deloitte.com/us/en/insights/research-centers/center-for-government-insights.html

Information sits at the center of effective logistics, from combat capabilities being increasingly digitally defined to understating cyber vulnerabilities or finding the right global partner. The challenge is how to put reliable information at the center of a redefined military logistics enterprise.

Putting data at the center

The introduction provides examples that demonstrate how commercial companies are familiar with addressing supply chain and logistics disruptions short of direct military assaults. Indeed, in many instances, the digital capabilities and supply chain resilience practices being developed for businesses can help militaries, too. In fact, militaries are looking at industry to understand how to apply commercial leading practices to military logistics.[21]

Many of the tools and methods that underwrite the Fourth Industrial Revolution are central to improving commercial supply chain and logistics resilience.[22] Commercial advances in digital supply networks are one example. The difference between digital supply networks and linear supply chains is that while linear supply chains are fixed, reactive, and hard to change, digital supply networks are connected to a larger ecosystem, intelligent, and nimble. With digital supply networks, responding to and limiting disruptions can be easier because they leverage more information to make educated physical supply chain and logistics choices, like production or transportation. Indeed, digital supply networks can offer great resilience because they offer the means to limit the duration of disruptions.

At the heart of a digital supply network is data.[23] Greater connectivity afforded by a digital supply network comes from integrating existing and new data sets through sensors and visualizations. A digital supply network's intelligence is, in part, a result of advanced analytics and machine learning to empower proactive operations. Whereas the agility of a digital supply network stems from improved decision-making using AI and optimization algorithms. Improvements afforded by digital supply networks come from tools and practices that allow for better use of data.

For example, an American automobile manufacturer used data sets, predictive models, and visualization tools to assess and mitigate supply chain and logistics risks for tens of billions of parts from thousands of suppliers necessary to produce millions of vehicles a year and protect billions of dollars in revenue.[24] More than just diagnosing risk, data can also illuminate alternative sources of supply. Semiconductor production is a good example. Increasing concern over the supply chain concentration of semiconductors has led to calls for greater domestic production. However, market

demand doesn't justify every country producing semiconductors.[25] Consequently, it can become important to use data to understand how to reorganize semiconductor production to account for market demand and risks. Ultimately, predictive logistics can help enable more precise and effective military sustainment.

Combining risk assessments with alternative options requires greater global integration and cooperation. That's because sources of supply are expected to continue to be global, and, as the semiconductor example shows, market forces won't permit each country to create completely insular supply chains. Global integration necessary to complement digital supply networks can require closer integration of manufacturing, too.

While digital supply networks can create more resilient methods for ensuring supplies get to where they are needed with limited disruption, those items should still be turned into a final product through manufacturing. Industries are leveraging smart manufacturing to integrate methods and protocols to empower how products are designed, manufactured, and serviced.[26] Like digital supply networks, data sits at the center of smart manufacturing. Through smart manufacturing, businesses have reported increases in product speed, innovation, reduction in operational costs, faster access to new participants and use cases, and great digital maturity of their organizations.[27]

In one instance, a European car manufacturer leveraged a cloud-based platform supported by machine learning, Internet of Things, and analytics tools to process production information of the machines, plants, and systems across 122 of its facilities in real-time.[28] The use of smart manufacturing technologies allowed the automaker to improve processes, and the platform has since been expanded with plans to connect many more locations and suppliers.[29] Because of its benefits, the use of smart manufacturing techniques is on the rise across the commercial sector.[30]

Maintenance can also be aided by placing data at the center. For example, providing higher-level maintenance, like repairing a ship radar onsite rather than in a country's shipyard, requires knowing what needs fixing, where the resources are to make

repairs, and the means of connecting the two in real-time. It also requires tools, like augmented reality or additive manufacturing, that allow personnel to leverage telemaintenance. Depot facilities connected through data can also mitigate vulnerabilities by helping militaries understand where supplies are and distributing them to minimize the effects of an enemy attack. Advanced manufacturing, which is also predicated on data, can allow militaries to produce more of what they need and when and where they need it.

Smarter logistics practices and tools adopted by the commercial sector can offer some of the solutions militaries require, but not all. After all, military logistics face unique challenges that private logistics don't. Still, both military and industrial logistics practices should be closely integrated, given the importance of commercial technology and services to militaries. Militaries may need to borrow what they can from the private sector while adjusting certain practices to accommodate what is unique about military logistics.

Moving forward

The military can improve its logistics by taking lessons from commercial practices and collaborating with industry. However, as military logistics has its own distinct characteristics, industry solutions should be customized to meet military needs. To accomplish this, the military should consider:

- **Building new logistics organizations and practices around data:** Militaries have long used data for logistics, but often, the use of data complements older, less data-driven processes. Militaries should put data at the center and build processes and tools around it.

Steps to build a data-centric logistics enterprise:

1. Implement policy changes to help make data more sharable within militaries and between industry or military partners with appropriate protections. Digital supply

networks and smart manufacturing solutions thrive on new and diverse data. Militaries should change policy to be equal data contributors.

2. Collect data in real-time from across the military and logistics enterprise, including factories, depots, ships, and trucks, to gain valuable logistics insights.

3. Adopting data analysis and simulation tools to make sense of data and understand risks (including internal and external sources of disruption), solutions, and the ever-changing logistics ecosystem.

4. Military logistics can often require addressing unique situations that can be hard to program into algorithms. So, part of the unique solution can involve determining where leaders will exercise judgment to impart the *art* of logistics into machine recommendations.

- **Developing logistics talent around new tools and methods:** Militaries excel at training and education, so developing logistics talent based on new processes and tools can draw on familiar training practices. Wargames, simulations, and joint exercises will be necessary to hone skills and identify areas for improvement. These activities should also be expanded beyond militaries to include industry. After all, industry is an important part of effective military logistics.

- **Developing new relationships with industry and military partners by aligning incentives**: The key to aligning incentives with industry is to set the conditions through acquisition processes, and specifically, those conditions should reflect the need to increase interoperability between industry and military logistics practices. To align incentives with allies and military partners, a focus on sharing costs while improving resilience can be persuasive.

For instance, aligning production processes for shared products can mean either partner can help the other produce during times of need without the added costs of installing new manufacturing facilities. Another area where shared incentives could add significant value is reserving industry or defense industrial base capacity,

effectively providing militaries with the ability to surge production. Equally, aligning incentives to diversify suppliers, as the companion article, *Out with the defense industrial base, in with the defense industrial network* discusses, is another area worth considering. Through shared incentives, collaboration can become easier, and so can finding mutually beneficial ways of operating.

Conclusion

Adjusting logistics practices to prevent or win a war requires making important changes across the logistics enterprise. Despite the scale of necessary modifications, progress may not require monolithic solutions. Instead, evolving processes and adopting tools can happen incrementally if they are built around data. Indeed, with data at the center of logistics processes, changes don't need to be seen as a finish line. Instead, it should be viewed as an evolution. Warfare has changed—it's time to change how militaries conduct logistics, too.

Chris Obadal
United States

Jordan Gillis
United States

Adam Routh
United States

Alaric Diniz
India

Abhineet Lekhi
Australia

Endnotes

1. Todd South, "Army logisticians will face 'unprecedented' challenges in future combat," Army Times, October 12, 2021.

   View in Article

2. Sara Silver, "How Kellogg's, Nike, and HP handled 2020 supply chain disruptions," *Financial Management* , January 25, 2021.

   View in Article

3. Alan Estevez, Kelly Marchese, Adam Routh, and Joe Mariani, "The changing character of supply: Rethinking logistics in an era of systems warfare," Modern War Institute, September 6, 2021.

   View in Article

4. Dr. Andrew Krepinevich, Jr., *Protracted great-power war: A preliminary assessment*, Center for a New American Security, February 05, 2020.

   View in Article

5. Bradley Martin, "Military and defense-related supply chains," RAND Corporation, June 22, 2021.

   View in Article

6. Scott Neuman and Jackie Northam, "How a long shutdown of the Suez canal might have roiled the global economy," National Public Radio, March 29, 2021.

   View in Article

7. Juliette Rowsell, "How much has the semiconductor shortage cost?" *Supply Management*, May 5, 2022.

   View in Article

8. US Government Accountability Office, "Operation Warp Speed: Accelerated COVID-19 vaccine development status and efforts to address manufacturing

challenges," February 11, 2021.

View in Article

9. Natasha Bertrand, Oren Liebermann, and Jennifer Hansler, "The United States and NATO grapple with critical ammo shortages for Ukraine," *CNN*, July 18, 2023.

View in Article

10. Bradley Martin and Christopher Pernin, "Professionals talk logistics: Who will fix Pacific lift?" *Breaking Defense*, June 23, 2023; Jen Judson, "US Army forms new modernization team to tackle contested logistics," *DefenseNews*, March 29, 2023; Gen. Charles R. Hamilton, "Delivering predictive and precision sustainment for the joint force," Army.mil, May 2, 2023.

View in Article

11. Frank Wolfe, "Joint warfighting concept assumes 'contested logistics'," *Defense Daily*, October 6, 2020.

View in Article

12. Deployable Training Division of the Joint Staff J7, *Sustainment insights and best practices focus paper (sixth edition)*, The United States Department of Defense, May 2022.

View in Article

13. Australia Government: Defence, *National defence: Defence strategic review 2023*, accessed September 1, 2023.

View in Article

14. Ibid.

View in Article

15. BAE Systems, "Indian army inducts its first M777 Ultra Lightweight Howitzers," November 9, 2018.

View in Article

16. Press Information Bureau of India, "Prime Minister lays foundation stone of C-295 transport aircraft manufacturing facility–country's first in private sector—in Vadodara, Gujarat," press release, October 30, 2022.

View in Article

17. The White House, "Joint statement from the United States and India," joint statement, June 22, 2023.

View in Article

18. US Department of State, "US security cooperation with India," fact sheet, January 20, 2021.

View in Article

19. Centre for Land Warfare Studies, *Revolution in military logistics: Lean, sustainable, reliable supply and maintenance chain*, March 17, 2018.

View in Article

20. Rajeswari Pillai Rajagopalan, "India's military outreach: Military logistics agreements," *The Diplomat*, September 9, 2021.

View in Article

21. Australia Government: Defence, *National defence*; US Department of Defense, *Securing defense-critical supply chains: An action plan developed in response to President Biden's executive order 14017*, February 2022.

View in Article

22. Christina Murata, Nikhil Pant, Sarayu Iyer, Jacob Veitch, and Michael Campbell, *Seizing the Trade 4.0 opportunity: How governments can lead global, digital commerce in Industry 4.0*, Deloitte Insights, December 18, 2020.

View in Article

23. Deloitte, "Digital supply chain strategy: Digital supply networks," accessed September 1, 2023.

View in Article

24. David Simchi-Levi, William Schmidt, Yehua Wei, Peter Yun Zhang, Keith Combs, Yao Ge, Oleg Gusikhin, Michael Sander, and Don Zhang, "Identifying risks and mitigating disruptions in the automotive supply chain," *Interfaces* 45, no. 5 (October 2015): pp. 375–390.

View in Article

25. Deloitte, "Boosting resilience: Working with like-minded partners to orchestrate critical supply chains," accessed September 1, 2023.

View in Article

26. National Institute of Standards and Technology (US Department of Commerce), "Digital Thread for Smart Manufacturing," March 23, 2023.

View in Article

27. Paul Wellener, Ben Dollar, Stephen Laaper, Heather Ashton, and David Beckoff, *Accelerating smart manufacturing: The value of an ecosystem approach*, Deloitte Insights, October 21, 2020.

View in Article

28. Caroline Donnelly, "Volkswagen broadens public cloud commitment by partnering with Amazon Web Services (AWS)," *Computer Weekly*, March 27, 2019.

View in Article

29. Caroline Donnelly, "Volkswagen Group to open up AWS-powered industrial cloud to third-party tech firms," *Computer Weekly*, July 27, 2020.

View in Article

30. Wellener, Dollar, Laaper, Ashton, and Beckoff, *Accelerating smart manufacturing*.

View in Article

Acknowledgments

The authors would like to thank **Rupesh Bhat** and **Kavita Majumdar** of Deloitte Insights for their editorial support and inputs. They would also like to thank **Sonya Vasilieff** for design support.

Cover image by: **Sonya Vasilieff**