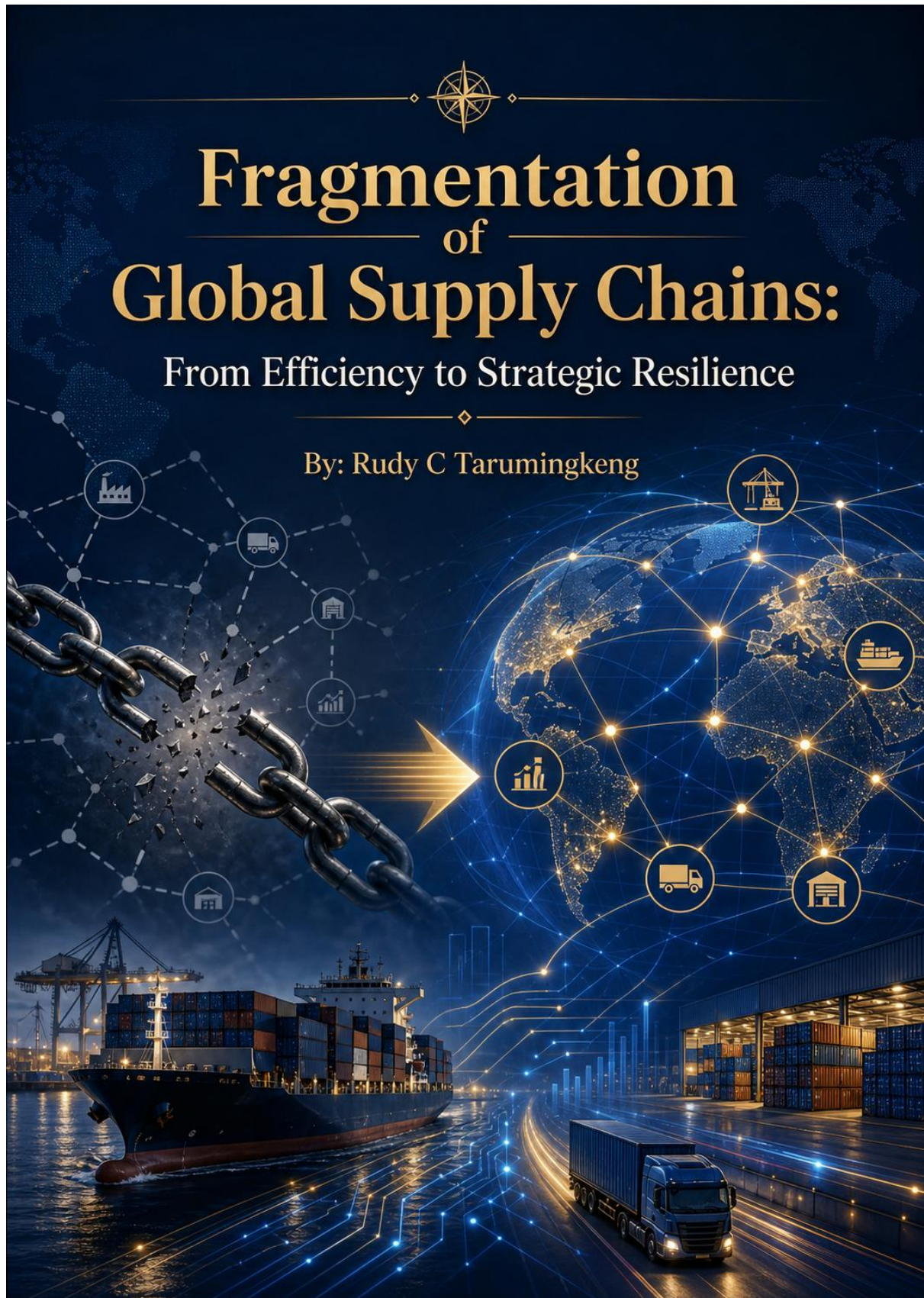




*Rudy C Tarumingkeng: Fragmentation of Global Supply Chains - From
Efficiency to Strategic Resilience*

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FRAGMENTATION OF GLOBAL SUPPLY CHAINS: FROM EFFICIENCY TO STRATEGIC RESILIENCE

Fragmentasi Rantai Pasok Global: Dari Efisiensi ke Ketahanan Strategis

Abstract

Global supply chains were once celebrated primarily as instruments of efficiency. Firms distributed production across countries to minimize costs, exploit comparative advantages, accelerate specialization, and serve global markets at scale. This efficiency-centered model generated remarkable gains in productivity, affordability, and industrial development. Yet the shocks of the twenty-first century—financial crises, pandemics, geopolitical rivalry, trade wars, cyber risks, climate disruption, commodity insecurity, and technological competition—have revealed the fragility of highly optimized global value chains. The emerging era is not simply one of “deglobalization,” but of selective reconfiguration. Supply chains are becoming more regional, more security-sensitive, more digitally monitored, and more strategically diversified. This paper analyzes the transition from efficiency-driven globalization toward strategic resilience. It argues that the central managerial and policy challenge is not to abandon global integration, but to redesign it. Excessive reshoring or protectionist relocation may reduce welfare and weaken resilience; OECD analysis warns that relocation scenarios could reduce global trade by more than 18 percent and global real GDP by more than 5 percent, without

consistently improving stability. ([OECD](#)) At the same time, pure reliance on lowest-cost sourcing is no longer adequate. Strategic resilience requires diversified suppliers, digital visibility, buffer capacity, institutional trust, regional preparedness, sustainability standards, and renewed multilateral cooperation. For emerging economies, including Indonesia, the fragmentation of global supply chains creates both risks and opportunities: exclusion from advanced networks is possible, but new openings may emerge through critical minerals, green manufacturing, digital trade, food systems, logistics, and regional industrial upgrading.

Keywords: *global supply chains, global value chains, fragmentation, resilience, reshoring, friend-shoring, strategic management, trade policy, risk management, Indonesia*

Fragmentation of Global Supply Chains: From Efficiency to Strategic Resilience

1. Introduction

Global supply chains are among the most important institutional architectures of the modern economy. They connect raw materials, components, finance, knowledge, logistics, technology, and final markets across multiple jurisdictions. A smartphone may contain minerals from Africa, chips designed in the United States, components manufactured in East Asia, software developed globally, assembly in China or Vietnam, and final consumers in Europe, India, Indonesia, or Latin America. The World Bank describes global value chains as systems in which a single finished product often results from manufacturing and assembly in multiple countries, with value added at each step. Participation in such chains can

provide developing countries access to investment, technology, growth, and employment. ([World Bank](#))

For several decades, the dominant logic of supply-chain design was efficiency. Firms pursued lower labor costs, scale economies, tax optimization, just-in-time inventory, lean production, outsourcing, offshoring, and supplier specialization. The guiding question was: *Where can each activity be performed at the lowest total cost while maintaining acceptable quality?* This model contributed to lower prices, greater product variety, industrial upgrading in selected developing economies, and the expansion of multinational production networks.

However, the global context has changed. The COVID-19 pandemic exposed shortages of medical equipment, semiconductors, pharmaceuticals, shipping capacity, and critical inputs. The Russia–Ukraine war disrupted energy, fertilizer, wheat, and logistics markets. Strategic rivalry between major powers has produced export controls, technology restrictions, investment screening, sanctions, and industrial policies. Climate change has increased the frequency of floods, droughts, wildfires, and port disruptions. Cyberattacks and digital dependence have added new layers of vulnerability. Trade policy uncertainty has also increased: the WTO noted in 2025 that rising tariffs, policy uncertainty, regional conflicts, and geopolitical tensions had contributed to a volatile and unpredictable global trade landscape.

Yet the evidence does not support a simplistic narrative of total deglobalization. Global trade has remained surprisingly resilient. UNCTAD reported that world trade reached a record level of about US\$33 trillion in 2024, up 3.7 percent from 2023, although it also warned that geopolitical tensions, policy changes, and trade imbalances were creating new risks. ([UN Trade and Development \(UNCTAD\)](#)) Likewise, OECD nowcasting suggests limited changes in global value chain integration in 2023–2024, with the domestic value-added share in exports rising only marginally from about 77 percent in 2022 to 77.6 percent in 2024. ([OECD](#)) The world is

therefore not witnessing the death of globalization, but its strategic reconfiguration.

This paper examines the fragmentation of global supply chains as a transition from an efficiency paradigm toward a strategic resilience paradigm. The central argument is that resilience should not be confused with isolation. A resilient supply chain is not necessarily domestic, closed, or self-sufficient. Rather, it is one that can anticipate, absorb, adapt to, and recover from disruption while sustaining essential functions. The most effective strategy is not autarky, but intelligent interdependence.

2. Conceptual Foundations: From Supply Chains to Global Value Chains

A supply chain refers to the sequence of actors, resources, processes, and relationships through which goods or services move from input providers to final consumers. A global supply chain extends this sequence across national borders. A global value chain emphasizes not merely the movement of goods, but the distribution of value creation across activities such as design, research, manufacturing, branding, logistics, marketing, after-sales service, and data analytics.

The global value chain perspective is important because it shows that countries do not simply export products; they participate in tasks. One country may specialize in raw materials, another in intermediate components, another in assembly, and another in intellectual property or branding. This task-based fragmentation of production has altered the meaning of competitiveness. In the old model, competitiveness was often measured by the ability to produce complete goods domestically. In the modern model, competitiveness depends on a country's position within cross-border production networks.

The rise of global value chains was supported by several structural forces: trade liberalization, containerization, information technology, global logistics, foreign direct investment, industrial zones, and the integration of

China, Eastern Europe, Southeast Asia, and other regions into world production. Firms increasingly separated production into modules and located each module where cost, skill, infrastructure, and policy conditions were most favorable.

This system produced four major benefits. First, it reduced production costs and consumer prices. Second, it enabled firms to specialize and scale. Third, it allowed developing economies to enter industrialization through specific tasks rather than complete industrial ecosystems. Fourth, it spread technology, management practices, and export capabilities. The World Bank emphasizes that global value chains can help countries move toward higher-value-added tasks by embedding technology and know-how in agriculture, manufacturing, and services. ([World Bank](#))

However, the same features that made global value chains efficient also made them vulnerable. A highly specialized, lean, geographically dispersed network may function well under stable conditions but fail under stress. A supplier concentration in one region, a port shutdown, a geopolitical sanction, or a sudden demand spike can create cascading disruptions. In systems language, global supply chains became optimized but tightly coupled. When everything works, efficiency is high; when one node fails, the consequences travel rapidly across the network.

3. The Efficiency Paradigm and Its Limits

The efficiency paradigm emerged from the logic of comparative advantage and managerial optimization. Firms sought to minimize cost per unit, reduce inventories, accelerate turnover, and outsource non-core activities. Lean manufacturing and just-in-time systems became symbols of operational excellence. The ideal supply chain was fast, low-cost, inventory-light, and globally optimized.

This paradigm was not irrational. For many industries, it delivered extraordinary results. Automotive firms reduced inventory costs. Electronics

companies coordinated thousands of specialized suppliers. Retailers achieved global sourcing at scale. Consumers benefited from cheaper goods. Developing countries gained manufacturing employment and export revenues.

Yet the efficiency paradigm had hidden assumptions. It assumed that borders would remain relatively open, shipping lanes reliable, financial systems stable, political tensions manageable, and natural disasters localized. It also assumed that markets could quickly correct shortages through price signals. These assumptions proved incomplete.

A supply chain designed only for efficiency often lacks redundancy. It may depend on one supplier, one port, one shipping route, one country, or one technology platform. It may have minimal inventory and limited visibility beyond first-tier suppliers. It may not know where critical second-tier or third-tier components originate. As a result, firms can be surprised by disruptions that occur far upstream.

The pandemic revealed this problem dramatically. Many firms discovered that the supplier they trusted was itself dependent on another supplier in a disrupted region. Hospitals lacked personal protective equipment. Automakers halted production because small semiconductor components were unavailable. Consumers faced delays for appliances, vehicles, medicines, and electronics. What had been celebrated as lean suddenly appeared fragile.

The lesson is not that efficiency is obsolete. Rather, efficiency must be redefined. In a stable world, efficiency means minimizing cost. In a volatile world, efficiency includes the capacity to continue operating under stress. A cheap supply chain that collapses during disruption is not truly efficient; it merely transfers risk into the future. Strategic management must therefore move from static efficiency to dynamic resilience.

4. Drivers of Global Supply Chain Fragmentation

4.1 Geopolitical Rivalry and Strategic Competition

The most visible driver of supply-chain fragmentation is geopolitical rivalry. Trade is no longer viewed only as a source of mutual gain; it is also interpreted through the lens of security, technological power, and strategic dependence. Major economies increasingly ask whether dependence on foreign suppliers creates vulnerabilities in defense, health, food, energy, data, semiconductors, and critical minerals.

The United States–China rivalry has intensified this trend. Export controls on advanced semiconductors, restrictions on technology transfer, investment screening, sanctions, and debates over data security have encouraged firms to reconsider production footprints. Companies do not necessarily abandon China, but many adopt “China plus one” strategies by adding capacity in Vietnam, India, Mexico, Indonesia, Malaysia, Thailand, or other locations.

The IMF has warned that the economic costs of fragmentation vary widely, from small losses in mild scenarios to losses as high as 7 percent of world GDP in extreme scenarios with limited adjustment capacity. ([IMF](#)) This range is important because it shows that fragmentation is not a single event. It is a spectrum, from modest diversification to severe bloc formation.

4.2 Trade Policy Uncertainty and Protectionism

A second driver is trade policy uncertainty. Tariffs, export bans, local content rules, subsidies, and regulatory restrictions can alter supply-chain decisions. Firms must now calculate not only production costs but also policy risk. If a tariff can suddenly change the economics of sourcing, then managerial decisions must incorporate political forecasting.

The WTO’s 2025 trade monitoring update highlighted the deteriorating outlook for world trade after surges in tariffs and trade policy uncertainty. It reported that WTO economists expected world merchandise trade to decline by 0.2 percent in 2025 under conditions observed in April 2025,

with downside scenarios possibly producing a 1.5 percent decline. Even when forecasts change, the broader point remains: uncertainty itself becomes a cost.

4.3 Pandemic Learning and Health Security

The pandemic did not create supply-chain fragility, but it made fragility visible. Governments recognized that dependence on foreign suppliers for medical masks, ventilators, pharmaceuticals, vaccines, and diagnostic equipment could become a national security issue. Firms learned that just-in-time systems require complementary resilience mechanisms.

Health security introduced a new moral dimension. During crises, countries may restrict exports of essential goods. Such restrictions may be politically understandable, but they can worsen scarcity elsewhere. Thus, resilience cannot be purely national. Public health requires trusted international cooperation, transparent stockpiles, diversified suppliers, and emergency coordination.

4.4 Commodity, Energy, and Critical Mineral Vulnerability

Commodity markets are especially exposed to fragmentation because production is geographically concentrated and substitution is often difficult. An IMF working paper on geoeconomic fragmentation and commodity markets found that fragmentation could cause large price changes and volatility, especially for minerals critical to the clean energy transition and selected agricultural commodities. ([IMF](#)) The same study emphasizes that commodities are vulnerable because production can be highly concentrated, difficult to relocate, hard to substitute, and essential as inputs for manufacturing and key technologies. ([IMF](#))

This issue is central to the energy transition. Electric vehicles, batteries, solar panels, wind turbines, and digital infrastructure require lithium, cobalt, nickel, copper, rare earth elements, and other minerals. Countries with mineral reserves may gain strategic importance, but they also face

governance challenges: environmental protection, downstream industrialization, community rights, and fair distribution of value.

For Indonesia, nickel illustrates the point. Indonesia's mineral resources create opportunities for battery ecosystems, electric vehicles, and green industrialization. But strategic advantage depends on more than extraction. It requires processing capacity, environmental governance, skilled labor, technology transfer, infrastructure, reliable energy, and credible regulation.

4.5 Climate Change and Environmental Disruption

Climate change is another driver of supply-chain risk. Floods can disrupt ports and factories. Droughts can affect agriculture, hydropower, river transport, and semiconductor production. Heat stress can reduce labor productivity. Storms can damage infrastructure. Supply chains designed without climate scenarios may underestimate future disruption.

Climate risk also interacts with regulation. Carbon border adjustment mechanisms, sustainability reporting, deforestation rules, and green procurement standards are reshaping trade access. Firms must now trace emissions, labor practices, land use, and material origins. Fragmentation may therefore be regulatory as well as geopolitical.

4.6 Digital and Technological Fragmentation

Digital systems increasingly govern supply chains. Cloud computing, enterprise resource planning, artificial intelligence, blockchain, Internet of Things sensors, and digital customs systems create visibility and efficiency. But digitalization also introduces new fragmentation. Data localization, cybersecurity rules, platform dependence, AI governance, and incompatible standards can create digital borders.

The future supply chain is therefore both physical and digital. A disruption may occur in a port, a chip factory, a shipping route, a data center, or a software system. Strategic resilience must integrate cyber resilience, data governance, and technological sovereignty.

5. Fragmentation Is Not the Same as Deglobalization

It is tempting to describe current trends as deglobalization. However, the empirical reality is more complex. Trade remains substantial. Services trade is expanding. Digital trade is growing. Many firms are diversifying rather than fully reshoring. OECD evidence suggests limited widespread reshoring in 2023–2024 and indicates that many firms have focused on reconfiguring supply chains through supplier diversification and inventory strengthening rather than systematically relocating production home. ([OECD](#))

Fragmentation should therefore be understood as selective, uneven, and sector-specific. Some sectors—such as semiconductors, defense, pharmaceuticals, critical minerals, batteries, food, and energy—are more likely to be treated as strategic. Other sectors may remain globally integrated because cost structures and market demands still favor international specialization.

There are at least five forms of reconfiguration.

First, **reshoring** refers to bringing production back to the home country. This may be politically attractive but expensive and not always feasible.

Second, **nearshoring** means relocating production closer to final markets. For example, firms serving North America may increase production in Mexico; firms serving Europe may expand capacity in Eastern Europe, Turkey, or North Africa.

Third, **friend-shoring** means sourcing from countries considered politically trusted or aligned. This reduces some geopolitical risks but may create exclusion, inefficiency, and bloc formation.

Fourth, **China plus one** strategies maintain Chinese operations while adding alternative production sites. This is diversification rather than exit.

Fifth, **multi-sourcing and inventory buffering** retain global networks but reduce dependence on single suppliers and ultra-lean inventory.

The key managerial question is not whether to globalize or deglobalize, but how to balance cost, resilience, flexibility, security, sustainability, and market access.

6. The Cost of Excessive Relocalization

A major danger in the current debate is the belief that domestic production automatically means resilience. Domestic production can reduce some external risks, but it can also create new vulnerabilities. A country that produces everything domestically may still suffer from natural disasters, labor shortages, energy shocks, cyberattacks, or domestic policy failures. If all production is concentrated at home, local disruptions become more dangerous.

OECD analysis warns that relocalizing supply chains could reduce global trade by more than 18 percent and global real GDP by more than 5 percent, yet such measures do not consistently improve resilience; in more than half of modeled economies, GDP volatility increased. ([OECD](#)) This finding is crucial. It challenges the simplistic assumption that shorter supply chains are always safer.

The OECD also emphasizes that resilience is better achieved through agile, adaptable, and aligned supply chains, supported by trade facilitation, digital readiness, services, and international cooperation rather than isolation. ([OECD](#)) In other words, resilience is a capability, not merely a location.

Excessive relocalization can produce several negative effects. It may raise production costs and consumer prices. It may reduce competition and innovation. It may exclude developing countries from global opportunities. It may duplicate inefficient capacity. It may intensify geopolitical blocs. It may also reduce the ability of firms to access specialized suppliers that cannot be easily replicated domestically.

This does not mean that governments should ignore strategic vulnerabilities. Some redundancy in essential goods is justified. But the policy goal should be selective resilience, not blanket protectionism.

7. Strategic Resilience: A New Management Paradigm

Strategic resilience is the capacity of a supply chain to continue performing essential functions under disruption, adapt to changing conditions, and transform when necessary. It combines risk management, organizational learning, technological visibility, supplier relationships, and institutional coordination.

A strategic resilience paradigm has several core principles.

7.1 Visibility Beyond Tier-One Suppliers

Many firms know their direct suppliers but lack visibility into lower-tier networks. A company may purchase from a supplier in one country, unaware that a critical subcomponent comes from a politically unstable region or climate-exposed facility. Resilience requires mapping upstream dependencies, identifying bottlenecks, and monitoring risk signals.

Digital tools can help. AI-based risk dashboards, satellite data, supplier databases, customs data, blockchain traceability, and IoT sensors can improve transparency. However, technology alone is insufficient. Firms also need governance structures that translate information into decisions.

7.2 Diversification Without Chaos

Diversification reduces dependence on single suppliers or countries. But excessive diversification can increase complexity and reduce quality control. The goal is not to multiply suppliers randomly, but to design intelligent redundancy. Critical components may require dual sourcing, while non-critical components may remain optimized for cost.

Supplier diversification should be based on risk segmentation. Firms should classify inputs by criticality, substitutability, lead time, geographic concentration, and strategic sensitivity. High-criticality, low-substitutability items require special resilience planning.

7.3 Strategic Inventory and Buffer Capacity

Lean inventory remains useful, but zero-buffer systems are dangerous for critical inputs. Strategic inventory does not mean returning to wasteful stockpiling; it means holding carefully calculated buffers for items whose shortage would stop operations. Governments may also maintain strategic reserves for food, energy, medicine, and emergency materials.

7.4 Modularity and Product Redesign

Product architecture affects resilience. If a product depends on one rare component, it is vulnerable. Modular design allows substitution, repair, and flexible sourcing. Engineers and supply-chain managers must collaborate early in product development to reduce dependence on fragile inputs.

7.5 Relational Governance and Trust

Supply chains are not merely contracts; they are relationships. In disruption, trusted suppliers may prioritize firms with long-term partnerships. Relational governance can improve information sharing, joint problem solving, and coordinated investment. Trust becomes an asset.

7.6 Scenario Planning and Stress Testing

Firms should conduct regular stress tests: What happens if a major port closes? If a supplier country faces sanctions? If shipping costs triple? If a cyberattack disables logistics software? If climate events disrupt agricultural inputs? Scenario planning helps organizations move from reactive crisis management to anticipatory strategy.

7.7 Sustainability as Resilience

Environmental and social sustainability are often treated as separate from resilience, but they are connected. A supply chain that destroys ecosystems, exploits labor, or ignores community rights creates long-term instability. Sustainable sourcing, circular economy practices, energy efficiency, and responsible mineral governance reduce future risk.

8. Case Narratives

8.1 Semiconductors: The Strategic Core of Digital Civilization

Semiconductors are the nervous system of the digital economy. They are embedded in smartphones, cars, medical devices, military systems, energy grids, artificial intelligence, and industrial automation. The semiconductor shortage during and after the pandemic showed how a small component can affect large industries. Automakers lost production capacity not because they lacked steel or labor, but because chips were unavailable.

Semiconductor supply chains are highly specialized. Design, lithography equipment, fabrication, packaging, chemicals, and testing are distributed across different countries. No single country can easily replicate the full ecosystem. This makes semiconductors a classic example of strategic interdependence. Attempts to nationalize the entire chain would be extremely costly, but dependence on a small number of nodes is risky.

A resilience strategy in semiconductors therefore requires diversification, trusted partnerships, strategic investment, talent development, and technology cooperation. It also requires realism: resilience cannot be built overnight.

8.2 Food and Fertilizer: The Human Dimension of Supply Chains

Food supply chains are not merely commercial systems; they are human security systems. The Russia–Ukraine war disrupted wheat, sunflower oil, fertilizer, energy, and shipping routes. Countries dependent on imported

grain or fertilizer experienced price pressures. For low-income households, food inflation can become a social and political crisis.

Food supply-chain resilience requires domestic production capacity, regional trade, storage systems, logistics infrastructure, farmer support, climate adaptation, and transparent market governance. It also requires avoiding harmful export restrictions that worsen global scarcity. For Indonesia, food resilience is especially important because the country is an archipelago with varied logistics challenges, climate exposure, and regional disparities.

8.3 Critical Minerals and the Green Transition

The global energy transition depends on mineral supply chains. Nickel, lithium, cobalt, copper, and rare earth elements are essential for batteries, electric vehicles, renewable energy, and digital infrastructure. Yet mineral production and processing are concentrated in specific countries. The IMF has warned that critical minerals and selected agricultural commodities are among the most vulnerable markets under fragmentation scenarios. ([IMF](#))

Indonesia has an important position because of nickel. The country can move from raw material exporter to value-added industrial actor by developing refining, battery materials, electric vehicles, recycling, and green industrial parks. But this opportunity must be managed carefully. Without strong environmental governance, downstreaming can create ecological damage. Without technology transfer, Indonesia may remain dependent on foreign capital and expertise. Without skilled human resources, value added may be limited.

Thus, the strategic question is not only how to participate in global supply chains, but how to upgrade within them.

9. Implications for Emerging Economies and Indonesia

For emerging economies, supply-chain fragmentation is ambivalent. On one hand, it may create opportunities as multinational firms diversify away from concentrated production locations. Countries with competitive labor, infrastructure, political stability, domestic markets, and industrial policy capacity may attract investment. On the other hand, fragmentation may exclude countries that lack strategic alignment, regulatory credibility, or logistics capacity.

Indonesia has several potential advantages. It has a large domestic market, strategic maritime location, abundant natural resources, growing digital adoption, and a young labor force. It is positioned within ASEAN, which can benefit from regional supply-chain reconfiguration. Indonesia also has resources relevant to batteries, renewable energy, food systems, and maritime logistics.

However, advantages do not automatically become competitiveness. Indonesia must strengthen ports, roads, rail, customs, energy reliability, digital infrastructure, industrial skills, research capacity, legal certainty, and environmental standards. The World Bank notes that countries seeking success in global value chains need coordinated policy across trade, logistics, business services, investment, taxation, innovation, industrial development, standards, ICT, infrastructure, education, labor mobility, and the wider business environment. ([World Bank](#))

For Indonesia, a strategic resilience agenda could include several priorities. First, develop supply-chain intelligence at the national level by mapping critical imports and export dependencies. Second, improve logistics performance across islands. Third, support SMEs so they can meet quality, digital, and sustainability requirements in global value chains. Fourth, invest in vocational education and managerial capability. Fifth, strengthen regional cooperation through ASEAN. Sixth, develop responsible downstreaming in minerals, agriculture, fisheries, and green manufacturing. Seventh, align industrial policy with environmental and social governance.

Indonesia should not interpret fragmentation as a reason to retreat from trade. Instead, it should use the moment to deepen strategic participation.

10. Policy Implications: Re-Globalization Rather Than Isolation

The WTO's World Trade Report 2023 argues that re-globalization—integrating more people, economies, and pressing issues into world trade—offers a more effective response to global challenges than fragmentation. ([World Trade Organization](#)) This concept is important because it reframes the debate. The choice is not between naïve globalization and defensive nationalism. The better choice is reformed globalization: more inclusive, secure, sustainable, and resilient.

Policy should therefore pursue five goals.

First, governments must identify truly strategic sectors. Not every product is a national security issue. Over-securitization can create inefficiency and rent-seeking. Strategic classification should be evidence-based.

Second, governments should promote diversification rather than autarky. Diversified international sourcing can be more resilient than domestic concentration.

Third, trade facilitation matters. Customs modernization, digital documentation, port efficiency, regulatory transparency, and logistics connectivity reduce delays and increase flexibility.

Fourth, international cooperation remains essential. Fragmentation of standards, export controls, and digital regulations can increase costs. Cooperation does not eliminate competition, but it can prevent destructive escalation.

Fifth, resilience policy must include developing countries. If strategic supply chains are built only among rich economies, global inequality may worsen. Inclusive supply-chain restructuring should create pathways for emerging economies to upgrade.

11. Managerial Implications

For managers, the era of supply-chain fragmentation requires new competencies. Procurement can no longer be treated as a narrow cost function. It must become a strategic capability linked to risk management, sustainability, geopolitics, technology, finance, and corporate reputation.

Managers should develop supply-chain risk maps, classify inputs by criticality, monitor geopolitical and climate risks, diversify suppliers, build digital visibility, and create crisis response teams. They should also integrate supply-chain strategy into board-level governance. In many organizations, boards understand finance and markets but not supply-chain architecture. This must change.

Managers must also balance resilience and affordability. Excessive redundancy can destroy competitiveness. Insufficient redundancy can destroy continuity. The art of strategic management lies in choosing where to invest in resilience and where to preserve efficiency.

A useful managerial question is: *Which disruptions would threaten the organization's mission, not merely its margin?* Hospitals, food companies, energy providers, digital infrastructure firms, and public service organizations have resilience responsibilities beyond profit.

12. Ethical and Social Dimensions

Supply-chain fragmentation is not only an economic issue. It is also ethical. When wealthy countries secure supplies by outbidding poorer countries, global inequality may deepen. When critical minerals are extracted without environmental safeguards, the green transition may reproduce ecological injustice. When firms relocate production without protecting workers, communities may suffer.

A resilience paradigm must therefore include justice. Strategic resilience should protect people, not only profits. It should respect labor rights, reduce environmental harm, support local communities, and ensure access to essential goods. The goal is not merely to make corporations more shock-proof, but to make societies more capable of sustaining human dignity under uncertainty.

This ethical dimension is especially relevant for education and management. Future managers must learn that supply chains are human systems. Behind every container are workers, communities, ecosystems, consumers, and institutions. A resilient supply chain is not only technically robust; it is morally responsible.

13. Toward a Framework of Strategic Supply-Chain Resilience

A practical framework for strategic resilience can be organized around seven dimensions:

- 1. Visibility:** Map suppliers beyond tier one and identify hidden dependencies.
- 2. Diversity:** Avoid excessive dependence on one supplier, country, route, or technology.
- 3. Flexibility:** Design products, contracts, and processes that allow rapid substitution.
- 4. Buffering:** Maintain strategic inventory and emergency capacity for critical inputs.
- 5. Digital intelligence:** Use data analytics, AI, and monitoring systems to detect risk early.
- 6. Collaboration:** Build trust among firms, governments, logistics providers, and communities.

7. Sustainability: Integrate climate, labor, and environmental responsibility into supply-chain design.

This framework moves beyond the old binary of efficiency versus resilience. The future requires resilient efficiency: systems that remain competitive under normal conditions and adaptive under stress.

14. Conclusion

The fragmentation of global supply chains marks a major transformation in the world economy. The old model of hyper-efficient, low-cost, globally dispersed production is being reconsidered. Yet the world is not simply returning to national self-sufficiency. Evidence suggests that global value chains remain significant, although firms and governments are reconfiguring them in selective and uneven ways. OECD evidence shows limited widespread reshoring in 2023–2024, while UNCTAD data show that global trade reached record value in 2024 despite mounting risks. ([OECD](#))

The central lesson is that resilience is not isolation. Excessive relocation can reduce trade and GDP without necessarily improving stability. ([OECD](#)) Strategic resilience requires diversification, visibility, digital intelligence, sustainability, institutional trust, and international cooperation. It requires firms to treat supply chains as strategic systems rather than cost-minimizing pipelines. It requires governments to distinguish between genuine security needs and protectionist impulses. It requires emerging economies to upgrade capabilities so they can participate in the next generation of global value chains.

For Indonesia and other developing economies, the current moment is both warning and opportunity. Fragmentation can exclude those who are unprepared, but it can also open space for new industrial roles. Countries that strengthen logistics, skills, governance, digital systems, sustainability, and regional cooperation can move from passive participation to strategic positioning.

The future of global supply chains will not be defined by efficiency alone. It will be defined by the ability to combine efficiency with resilience, competitiveness with responsibility, and national interest with global cooperation. The challenge is not to dismantle interdependence, but to make interdependence wiser, fairer, and more durable.

Glossary

Agility: The ability of a supply chain to respond quickly to disruptions or changes in demand.

Autarky: A condition in which a country attempts to be economically self-sufficient and minimize dependence on international trade.

China Plus One: A business strategy in which firms maintain operations in China while adding production capacity in another country to reduce concentration risk.

Critical Minerals: Minerals essential for strategic industries such as batteries, renewable energy, semiconductors, defense, and digital infrastructure.

Friend-shoring: The relocation or concentration of supply chains among politically trusted or allied countries.

Goeconomic Fragmentation: The division of global economic relations into blocs or restricted networks due to geopolitical, security, or strategic considerations.

Global Supply Chain: A cross-border network of suppliers, manufacturers, logistics providers, distributors, and customers involved in producing and delivering goods or services.

Global Value Chain: A system in which different stages of value creation—design, production, assembly, logistics, marketing, and service—are distributed across countries.

Just-in-Time: An inventory strategy that minimizes stock by receiving inputs only when needed for production.

Nearshoring: Relocating production closer to the final consumer market.

Relocalization: Moving production from foreign locations back to domestic or nearby locations.

Reshoring: Returning previously offshored production activities to the home country.

Resilience: The capacity to anticipate, absorb, adapt to, and recover from disruptions while maintaining essential functions.

Strategic Inventory: Carefully planned reserves of critical inputs used to reduce vulnerability during disruption.

Supply-Chain Visibility: The ability to monitor suppliers, materials, logistics flows, and risks across the supply network.

Trade Policy Uncertainty: Uncertainty caused by possible changes in tariffs, regulations, export restrictions, sanctions, or trade agreements.

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