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Building Resilience in Supply Chain under Covid-19

(A Case Study of the Federal Capital Territory Health Services and Environmental Secretariat (HSES), Abuja, Nigeria)

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Abstract **Original Research Article**

This study conducts a post-mortem analysis of the supply chain of the Federal Capital Territory Health Services and Environmental Secretariat (FCT HSES), Abuja, Nigeria, during the 2020-2023 COVID-19 pandemic to understand the systemic failure of public health security. Employing a qualitative, explanatory single case study design and grounded in the Dynamic Capabilities Theory (DCT), specifically the Sensing-Seizing-Reconfiguring (S-S-R) framework, the research investigates how a system optimized for efficiency became dangerously vulnerable to global, high-impact shocks. The findings revealed a critical systemic sensing failure in the pre-crisis architecture, marked by a lean trap approach, extreme geographic concentration risk in Asia for Active Pharmaceutical Ingredients (APIs), financial rigidity against strategic stockpiling, and a critical visibility gap due to manual systems. (The operational shock was financially devastating, forcing the FCT HSES to pay an estimated 500% to 1,000% above pre-crisis prices for essential commodities, thereby confirming that resilience is cheaper than reaction (Federal Ministry of Health Nigeria, 2021; Haffajee et al., 2020). Despite this vulnerability, the organization demonstrated a costly, latent seizing capability through the rapid mobilization of emergency procurement waivers and ad-hoc Public-Private Partnerships (PPPs). The central conclusion is that for public health security, resilience is a mandatory strategic dynamic capability. The study proposes a comprehensive set of reconfiguration strategies, including institutionalizing end-to-end digital visibility for sensing, formalizing emergency financial mandates for seizing, and mandating a permanent 180-day Strategic National Reserve alongside incentivizing domestic pharmaceutical autonomy for structural reconfiguration. This analysis provides actionable, evidence-based policy prescriptions for centralized public procurement agencies in developing economies.

Keywords: Supply Chain Resilience (SCR), Dynamic Capabilities Theory (DCT), Sensing-Seizing-Reconfiguring (S-S-R), Public Health Security, COVID-19, Strategic Inventory, FCT HSES, Nigeria.

1.0 Introduction

The global supply chain is the integrated, cross-border journey a product takes from its inception as a raw material to its purchase by a consumer (Gereffi, 2020). This sprawling, international network involves sequential operations that may touch every continent: The process initiates with global sourcing, where the basic components—

like specialized minerals or agricultural products—are acquired from wherever they are economically or geographically available (e.g., chips from Taiwan or cotton from India). These are then channeled to manufacturing hubs globally for conversion and assembly (perhaps in Vietnam). The finished items are then entrusted to international logistics, relying on complex transport modes (ocean, air) to move them across oceans to regional distribution centers (say, in Mexico or Europe). The process culminates in the final retail environment, ensuring the product reaches consumers via local stores or e-commerce platforms.

The strategic motivation for maintaining a global supply chain lies in gaining a competitive edge by arbitraging resources across the world (Barney, 1991). Businesses deliberately extend their operations globally to:

1. **Maximize Cost Advantage:** Accessing production facilities and labor pools in regions offering the lowest operational expenses.
2. **Secure Unique Inputs:** Ensuring access to specialized or rare raw materials and intellectual property available only in specific countries.
3. **Optimize Market Presence:** Positioning final assembly or distribution closer to large customer markets to enhance speed and responsiveness.
4. **Hedge Risk:** Distributing production across diverse geographies to avoid total disruption from a single localized event.

Building Supply Chain Resilience is the supreme capability of a vast, international business network—spanning every supplier, manufacturer, and logistics provider—to anticipate threats, resist shockwaves, absorb impact, and decisively adapt to major disruptions while maintaining operational momentum and satisfying the end-user (Sheffi & Rice, 2005). This is a critical paradigm shift: moving the managerial focus from pursuing maximum efficiency (e.g., purely lean, just-in-time models) toward instilling intrinsic robustness that allows the enterprise to successfully navigate the inevitable shocks of the modern global economy.

A truly resilient ecosystem is defined by three interconnected capacities:

i. **Resistance:** This is the initial capacity to withstand or deflect a severe external shock, thereby limiting the scope of the damage. For example, having an alternative shipping route already mapped out and ready to use before a major canal blockage occurs.

ii. **Recovery:** This measures the speed and efficacy with which the system snaps back to its normal performance level following a disruption. For example, the rapid activation of a pre-approved backup manufacturing site to resume production.

iii. **Reconfiguration (or Realignment):** This is the ultimate, long-term learning capability. It is the capacity to structurally and permanently change the network after a crisis to reduce future vulnerability. For example, making a strategic decision to move permanently from a single-source to a multi-source procurement model.

To achieve the Three R’s, resilience is built upon a foundation of proactive strategies categorized under Redundancy, Flexibility, and Visibility (Ivanov, 2020).

1. Redundancy (Strategic Buffers)

Resilience demands the introduction of calculated “slack” into the system to absorb unexpected hits. This includes Multi-Sourcing, where critical components are procured from several suppliers, ideally across different geographic regions, to neutralize single-point failure risks.

Furthermore, it necessitates maintaining Strategic Inventory—not simply carrying excess stock, but holding targeted buffer quantities for components that are high-risk or have exceptionally long lead times. Finally, maintaining Capacity Buffers—spare, flexible manufacturing or logistics capacity—ensures that sudden demand spikes or temporary facility shutdowns can be accommodated.

2. Flexibility (Operational Agility)

Agility is the operational ability to pivot rapidly when faced with a crisis (Teece, 2018). A major strategic move here is Regionalization or Nearshoring, which involves strategically positioning production and sourcing closer to the final customer markets. This shortens lead times and provides a buffer against distant geopolitical instability. Flexibility is also enhanced through Standardization, using common components and interchangeable modules across diverse product lines, which allows manufacturing facilities to swiftly switch production priorities. This pillar is underpinned by rigorous Contingency Planning, involving regular stress-tests of “ready-to-go” response protocols for worst-case scenarios, such as port closures to major cyber-attacks.

3. Visibility (Digital Foresight)

Visibility provides the intelligence necessary to anticipate threats and respond decisively (Barratt & Oke, 2007). Modern resilience relies on End-to-End Mapping—using digital tools to track all tiers of the supply base (Tiers 1, 2, and 3) to uncover hidden, systemic dependencies. Digital Twin Technology and AI are deployed to create virtual, real-time models of the network, enabling simulation of crisis scenarios and utilizing machine learning for predictive risk alerting. This entire system relies on a constant stream of Real-Time Data, gathered from IoT sensors, GPS tracking, and collaborative platforms to provide immediate, actionable insight into the location and condition of every asset.

Collaboration (Ecosystem Partnership)

Crucially, all these pillars are reinforced by deep collaboration (Cao & Zhang, 2011). The traditional, adversarial, transactional relationship with suppliers must be replaced by Collaborative Partnerships where information and risk are jointly shared and mitigated. In today’s highly unpredictable global economy, resilience is a survival imperative. It allows companies to safeguard Business Continuity (ensuring production lines keep running), Protect Market Share (maintaining reliability to avoid customer loss), Mitigate Financial Impact (preventing the exorbitant costs of emergency logistics), and fundamentally Enhance Brand Reputation as the reliable partner during a crisis.

The urgency for resilience is driven by increasingly frequent and severe external shocks such as:

i. **Geopolitical Instability:** The impact of trade wars, sanctions, military conflicts, and political tensions that fragment global trade flows.

ii. **Climate Change & Natural Disasters:** More intense weather events (floods, droughts, storms) that cripple physical infrastructure and logistics routes.

iii. **Global Health Crises:** Simultaneous, worldwide disruptions that impact both labor availability and factory operations across the network.

iv. **Cybersecurity Threats:** Targeted attacks on the increasingly digital systems of supply chains (logistics, customs, ERP) that can halt the flow of all goods and information.

The **COVID-19 pandemic**, emerging in late 2019, fundamentally challenged the premise of optimized globalization. It demonstrated that modern Global Supply Chains (GSC), engineered for peak cost-efficiency via lean manufacturing, Just-in-Time (JIT) logistics, and singular, offshore sourcing, were dangerously ill-equipped to handle high-impact, low-probability events (Sodhi & Tang, 2021). The crisis was not merely a logistic bottleneck; it was a systemic failure resulting from a simultaneous, massive demand surge (e.g., 500-1,000% for specific Personal Protective Equipment, or PPE) and an instantaneous, global supply restriction (Taleb, 2007). This restriction was exacerbated by manufacturing shutdowns in key hubs and the rise of ‘PPE nationalism’, where nations imposed export controls to hoard vital medical commodities (World Health Organization, 2020). The profound lesson learned, at the cost of public health and economic stability, was that efficiency and resilience are not mutually inclusive objectives; a trade-off is required, and the system had erroneously prioritized the former over the latter (Handfield et al., 2020). The lack of Supply Chain Resilience (SCR) became synonymous with national security vulnerability.

In Nigeria, a country already grappling with endemic health security threats and infrastructural deficits, the global shock was acutely felt. The Federal Capital Territory (FCT) Health Services and Environmental Secretariat (FCT HSES), responsible for coordinating healthcare delivery and managing the central medical store for Abuja, became the critical focus of this vulnerability. The FCT HSES operates a complex system serving a diverse, rapidly expanding metropolitan population, making its logistical integrity paramount to national stability. Pre-crisis, the FCT HSES model was defined by an estimated 70% to 80% import dependency for essential finished pharmaceuticals and specialized medical equipment, heavily reliant on centralized, often bureaucratic, public procurement processes (Okoye & Mbagwu, 2021). The immediate crisis revealed:

1. **Zero-Tolerance for Shock:** The lack of strategic inventory meant the system was immediately paralyzed by the global contraction.
2. **Financial Penalty:** The FCT HSES was forced into a high-cost environment, spending multiple times the pre-crisis value for basic supplies to secure last-minute, ad-hoc relief (Federal Ministry of Health Nigeria, 2021).

The inability of the FCT HSES to secure vital supplies for its healthcare workers and citizens represented a critical failure in public health security, demonstrating how localized operational failure can cascade into national crisis.

While the FCT HSES, through extraordinary administrative effort, managed to achieve a costly operational recovery (the act of 'Seizing'), the fundamental, underlying structural weaknesses persist (Remko, 2020). These weaknesses include: extreme geographical concentration risk, limited multi-tier visibility within its sourcing network, and the institutional resistance to maintaining strategic inventory buffers.

2.0 Literature Review and Theoretical Framework

Supply chain resilience has emerged as a critical concept in the wake of global disruptions, particularly those caused by the COVID-19 pandemic. Resilience in this context refers to the ability of supply networks to anticipate, absorb, adapt to, and recover from disruptions while maintaining continuity of operations. Scholars such as Ivanov and Dolgui (2020) emphasize that resilience encompasses agility, redundancy, visibility, and collaboration—dimensions that are especially vital in the health sector where supply chain failures can have life-threatening consequences.

The COVID-19 pandemic disrupted supply chains worldwide due to lockdowns, border closures, and reduced manufacturing capacity (Aday & Aday, 2020). Health systems faced acute shortages of personal protective equipment (PPE), ventilators, and vaccines. These disruptions revealed the fragility of just-in-time inventory models and the risks associated with over-reliance on single-source suppliers (Centers for Disease Control and Prevention, 2020). Countries with robust supply chain resilience frameworks, such as Germany and South Korea, were able to recover more quickly and maintain essential health services. Their success was attributed to diversified sourcing, digital infrastructure, and proactive risk management strategies (Shih, 2020).

In Nigeria, the health supply chain is marked by fragmentation, underfunding, and a heavy reliance on donor support. The National Product Supply Chain Management Programme

(NPSCMP) has identified persistent challenges in warehousing, distribution, and data visibility. During the COVID-19 crisis, Nigeria experienced delays in procurement and customs clearance, stockouts of essential medicines and PPE, and limited coordination between federal and state agencies (Adewale, 2020). A study by Bello et al. (2024) found that while multisectoral collaboration helped mitigate some challenges, these mechanisms were not institutionalized, resulting in inconsistent responses across regions.

The Federal Capital Territory (FCT) Health Services and Environmental Secretariat, which oversees public health delivery in Abuja, faced similar challenges. Logistical bottlenecks, supplier delays, and inventory mismanagement were common during the pandemic (Federal Capital Territory Administration, 2021). Interviews with staff revealed that emergency procurement processes were largely reactive and lacked pre-negotiated contracts or supplier diversification. Despite these limitations, the Secretariat piloted digital inventory tracking tools and collaborated with donor agencies to improve warehousing. However, these efforts were ad hoc and not embedded in a formal resilience framework.

Several strategic frameworks have been proposed to enhance supply chain resilience in the health sector. The World Health Organization's Health System Resilience Framework emphasizes governance, financing, and service delivery integration. USAID's Supply Chain Resilience Guide advocates for risk mapping, scenario planning, and capacity building. Nigeria's own National Strategic Health Development Plan II (2018–2022) includes provisions for strengthening logistics and procurement systems, although implementation has been uneven (Federal Ministry of Health Nigeria, 2021). These frameworks highlight the importance of institutionalizing resilience through policy, infrastructure, and human resource development.

Technology and innovation are increasingly recognized as enablers of supply chain resilience. Digital tools such as blockchain, artificial intelligence (AI), and the Internet of Things (IoT) enhance visibility, automate forecasting, and enable predictive analytics (Acioli et al., 2021). In Nigeria, mobile apps and cloud-based platforms have been piloted for inventory tracking, though scalability remains a challenge (Babatunde, 2023). The integration of these technologies into public health systems could significantly improve responsiveness and transparency. While global literature on supply chain resilience is extensive, localized studies focusing on Nigeria's public health sector remain limited. Few studies examine the operational realities of agencies like the FCT Health Services and Environmental Secretariat, and there is a lack of longitudinal data on the effectiveness of resilience interventions post-COVID-19. This gap underscores the need for context-specific research that bridges theory and practice. The COVID-19 pandemic exposed the fragility of hyper-efficient global supply chains built primarily on the Just-in-Time (JIT) philosophy and single-sourcing models. Recent literature, particularly from 2023 onward, marks a definitive shift in academic and managerial focus from mere efficiency to robust, anticipatory resilience and the integration of next-generation technologies. Recent studies universally agree that the pandemic served as an unprecedented stress test, validating the three-phase definition of resilience: Resistance, Recovery, and Reconfiguration (Sarkar & Ismail, 2024). Literature reviews highlight that pre-established contingency plans proved insufficient against a long-duration, systemic shock (Herold et al., 2024). The reliance on global economic arbitrage (low-cost country sourcing) created profound vulnerability. Key lessons confirmed in the post-pandemic research are:

The Inventory Deficit: The JIT approach, while reducing carrying costs, left firms unprepared for extended factory closures and prolonged logistical bottlenecks, confirming the need for strategic inventory buffers for critical inputs (McKinsey, 2023).

The Visibility Gap: Most companies lacked visibility beyond Tier 1 suppliers, creating blind spots that propagated risk rapidly. The crisis accelerated the need for end-to-end supply chain mapping (PwC, 2022).

The Demand Mismatch: Sudden, chaotic shifts in consumption (e.g., panic buying, surge in e-commerce, and drops in durable goods) exposed the complexity of real-time forecasting and the need for greater operational flexibility (Ivanov, 2023).

The post-COVID literature details how organizations and policymakers are structurally reforming supply chains to ensure survivability—a concept combining resilience with long-term viability (Sarkar & Ismail, 2024).

The most significant trend identified is the strategic re-evaluation of global sourcing patterns:

Diversification and Dual Sourcing: Research confirms a widespread move toward multi-sourcing for critical inputs to eliminate reliance on a single supplier or geographic area.

Surveys show up to 61% of supply chain leaders are increasing dual sourcing (McKinsey, 2023).

Regionalization and Nearshoring: The literature emphasizes the trade-off between lower manufacturing costs abroad and the inherent risks of long-distance logistics. Nearshoring (moving production closer to consumption) and Friendshoring (sourcing from geopolitically aligned countries) are now mainstream strategies to reduce lead times and exposure to trade friction (Achilles, 2025).

The pandemic became a catalyst for digital transformation, cementing the role of technology as the foremost enabler of resilience:

Enhanced Visibility: Big Data Analytics is cited as particularly effective for improving predictive capabilities, while IoT (Internet of Things) and Blockchain enable real-time tracking and supply chain transparency (PMC, 2022).

AI and Digital Twins: Advanced studies advocate for the use of Artificial Intelligence and Digital Twin technology to run complex scenario analyses, helping managers model and test responses to potential disruptions before they occur (Exiger, 2025).

Automation: The persistent risk of labor shortages and sudden lockdowns is driving increased investment in automation and robotics to maintain operational capacity regardless of workforce disruptions (Risk and Resilience Hub, 2025).

Moving forward, the literature identifies a cocktail of interconnected, complex risks that define the new global operating environment (VUCA: Volatile, Uncertain, Complex, Ambiguous; BANI: Brittle, Anxious, Nonlinear, and Incomprehensible).

2.1 Emerging and Intensified Risks (2025 Horizon)

Geopolitical and Trade Fragmentation: Geopolitical tensions (US-China decoupling, conflicts in Eastern Europe, and shipping disruptions in chokepoints like the Red Sea) are cited as the most persistent and least predictable supply chain risks. Companies must actively develop contingency plans for major trade route disruptions (Achilles, 2025).

Climate Change and Environmental Risk: Research confirms that climate-related disruptions (severe storms, droughts, flooding) are increasing in frequency and severity, creating persistent volatility in raw material sourcing and logistics (NetSuite, 2025).

Cybersecurity Threats: As supply chains become more digitized, they become prime targets for sophisticated cyber-attacks that can halt information flow and critical operations (BSI, 2025).

Inflation and Economic Volatility: Post-pandemic inflationary pressures are driving up the costs of fuel, labor, and raw materials, requiring agile strategies to manage operational costs without sacrificing resilience (NetSuite, 2025).

The future research agenda calls for integrated frameworks that balance the traditionally separate concerns of cost-effectiveness, resilience, and sustainability (Sarkar & Ismail, 2024). The emphasis is no longer on simply reacting to a crisis, but on proactive risk management through transparency, collaboration, and aligning strategic partnerships with key suppliers to create a unified, robust response capability (Maersk, 2025).

2.2 Theoretical Framework: Dynamic Capabilities Theory (DCT)

2.2.1 DCT as an Evolution of the Resource-Based View (RBV)

The most relevant theory for this study is the **Dynamic Capabilities Theory (DCT)**. DCT is superior because it directly addresses the essential element of the study: change and adaptation over time, particularly the capacity for reconfiguration after a major, systemic shock.

The Dynamic Capabilities Theory (DCT), originally articulated by Teece, Pisano, and Shuen (1997), evolved from the Resource-Based View (RBV), which argues that competitive advantage stems from possessing valuable, rare, inimitable, and non-substitutable (VRIN) assets (Barney, 1991). DCT contends that in turbulent, high-velocity environments (like a public health system facing global shock), the mere possession of resources (e.g., cold chain units) is insufficient. Sustained performance depends on the organizational ability to continuously reconfigure, integrate, and renew those resources and ordinary capabilities in response to environmental change (Eisenhardt & Martin, 2000). For the FCT HSES, this means the capability to change the supply chain structure is more valuable than the structure itself.

2.2.2 The Operationalization of DCT: The Sensing-Seizing-Reconfiguring (S-S-R) Framework and Microfoundations

The S-S-R framework also explains the "Three R's" of Resilience. DCT perfectly maps onto the three phases of modern resilience and provides the analytical architecture for this study (Teece, 2018):

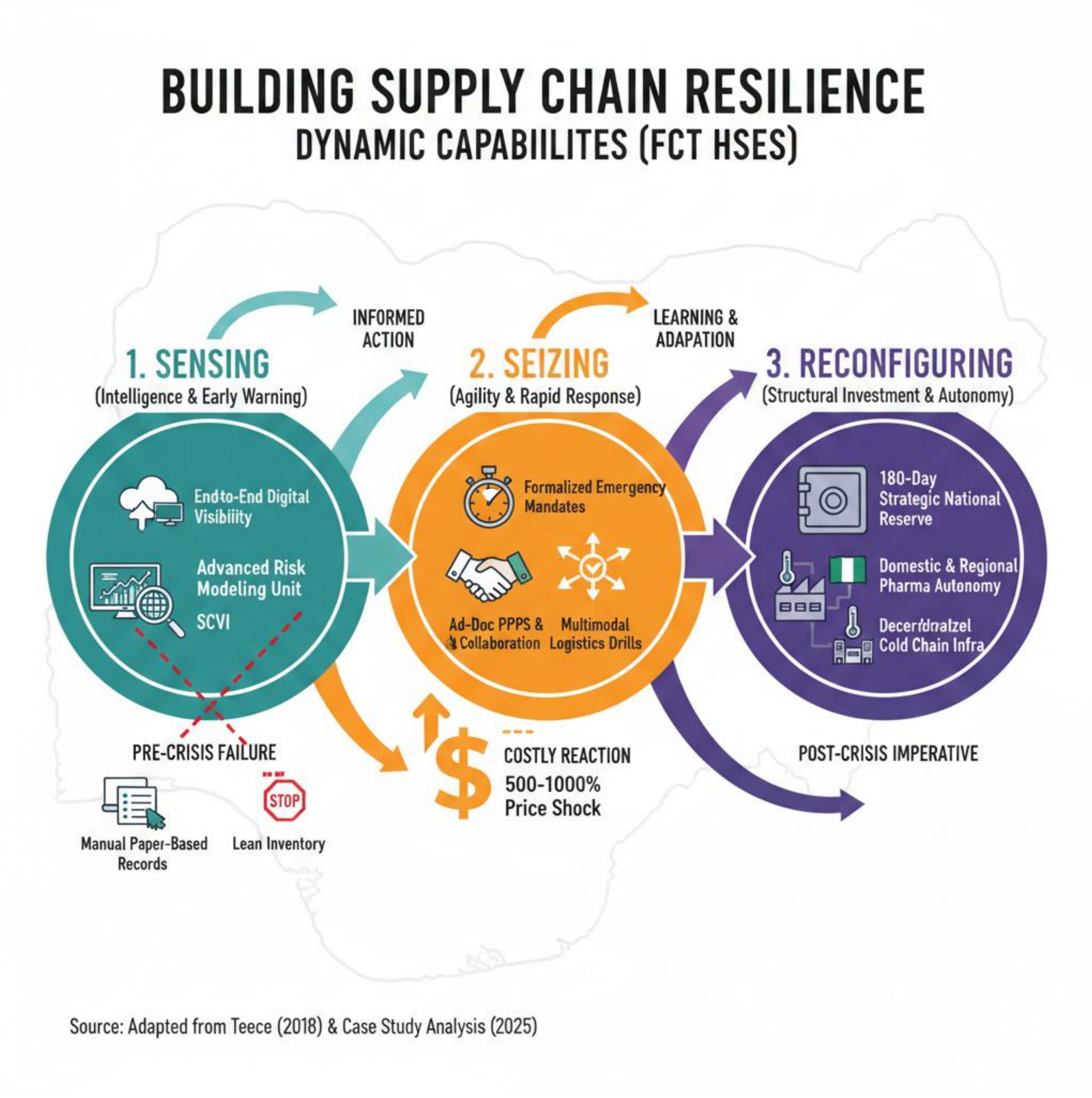
i. **Sensing (Intelligence):** The organizational capacity to scan the technological, market, regulatory, and geopolitical environment to identify opportunities and threats before they materialize into crises. This requires investment in specific micro-foundations related to managerial cognition, decentralized information access, and predictive analytics. The FCT HSES's pre-crisis state demonstrated a profound deficit in this core capability.

ii. **Seizing (Action):** The capacity to mobilize and allocate managerial, financial, and logistical resources rapidly to address a sensed threat or exploit an opportunity. This requires robust coordination routines, clear decision rights, and a culture of action over procedure (Teece, 2018). The FCT HSES's successful, albeit costly, emergency procurement demonstrated a latent, ad-hoc Seizing capacity driven by executive will.

iii. **Reconfiguring (Transformation):** The continuous process of structurally altering the organization's resource base, governance, and processes to build a new, more robust and sustainable competitive advantage. This involves deep structural change and institutionalizing the lessons learned. This is the strategic imperative the FCT HSES must now undertake to guarantee future resilience.

Focus on Strategic Competitive Advantage: The ultimate goal of resilience is not just survival, but achieving a sustainable competitive advantage through agility and speed. DCT argues that the only lasting advantage comes from the ability to change faster than competitors. A resilient supply chain is therefore the manifestation of superior dynamic capabilities.

Integrating Technology and Learning: The DCT framework is robust enough to incorporate the key technological shifts identified in the literature review (AI, Digital Twins, end-to-end visibility) as crucial mechanisms for improving the firm's capacity to sense and transform in the face of future, unpredictable risks (geopolitics, climate change).



3.0 Methodology

Study Design: Qualitative, Explanatory Single Case Study (Critical Case)

This research adopts a Qualitative, Explanatory Single Case Study Design, focusing intently on the FCT Health Services and Environmental Secretariat (FCT HSES) supply chain response to the 2020-2023 global disruption. This approach is methodologically sound because the FCT HSES represents a 'critical case' (Yin, 2018). Its failure had disproportionate national health security implications due to its role in the capital city, making its lessons highly generalizable to other centralized, import-dependent public health systems across Africa. The explanatory nature of the study seeks to establish a causal link: linking the observed operational outcomes (e.g., inventory stockouts, high-cost recovery) to the theoretical deficiencies within the DCT framework (Sensing failure, need for Reconfiguration).

Data Sources and Collection: Leveraging Secondary Data and Triangulation

The study is built upon rigorous secondary data triangulation, necessary for a post-mortem analysis of a public sector crisis where access to primary proprietary operational data is often restricted. Data sources were categorized and cross-referenced for internal validity:

Scholarly and Grey Literature Review

The scholarly review established the theoretical baseline (DCT, SCR frameworks). Grey literature provided the granular, contextual data necessary for empirical grounding. This included:

i. **NGO and IGO Reports:** Publications from the World Bank, WHO, Africa CDC, and relevant international health NGOs detailing Nigeria's health expenditure, logistics gaps, and cold chain capacity (Africa CDC, 2020). These reports provided benchmark data on structural deficits.

ii. **Media and Professional Health Association Archives:** Used to time-stamp and verify instances of specific operational failures (e.g., reports detailing the exact dates and locations of medical oxygen stockouts in Abuja hospitals). This provided qualitative evidence of the human impact of supply failure.

Official Government, Financial Documentation, and Regulatory Analysis

These sources provided the necessary quantitative and procedural details:

i. **FCT Administration Budgetary/Expenditure Documents:**

Analysis focused on identifying pre-crisis investment in logistics infrastructure (low) versus recurrent expenditure, and quantifying the massive, non-budgeted emergency spending during the crisis, which operationalized the cost of Seizing capacity from the global market (Federal Capital Territory Administration, 2020, 2021).

ii. **Official NCDC and Presidential Task Force (PTF) Reports:** Used to establish the timelines of demand surges (e.g., testing rates, confirmed cases) and the scope of emergency procurement waivers granted, providing evidence of process Agility (Seizing).

iii. **Regulatory Frameworks:** Examination of the extant procurement acts and public financial management regulations in Nigeria to understand the institutional rigidities that hampered pre-crisis Sensing (e.g., restrictions on strategic inventory holding or multi-year contracts) (Ozili, 2020).

4.0 Results and Discussions

This section presents the detailed empirical findings of the FCT HSES case study, analyzing the structural weaknesses and the operational impact through the lens of the S-S-R framework.

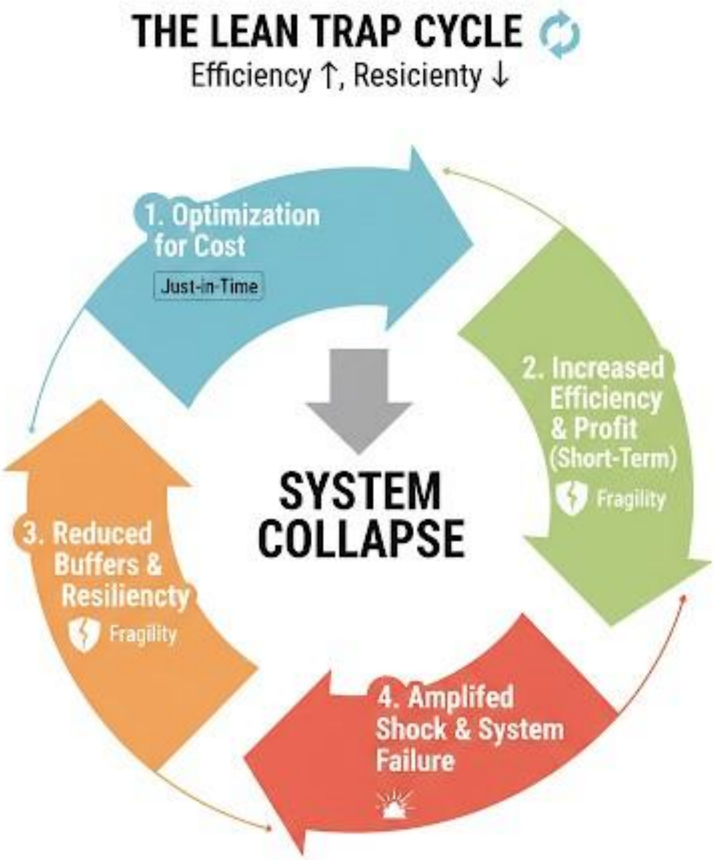
4.1 FCT Health Services and Environmental Secretariat: Pre-Crisis Architecture and Operational Shock

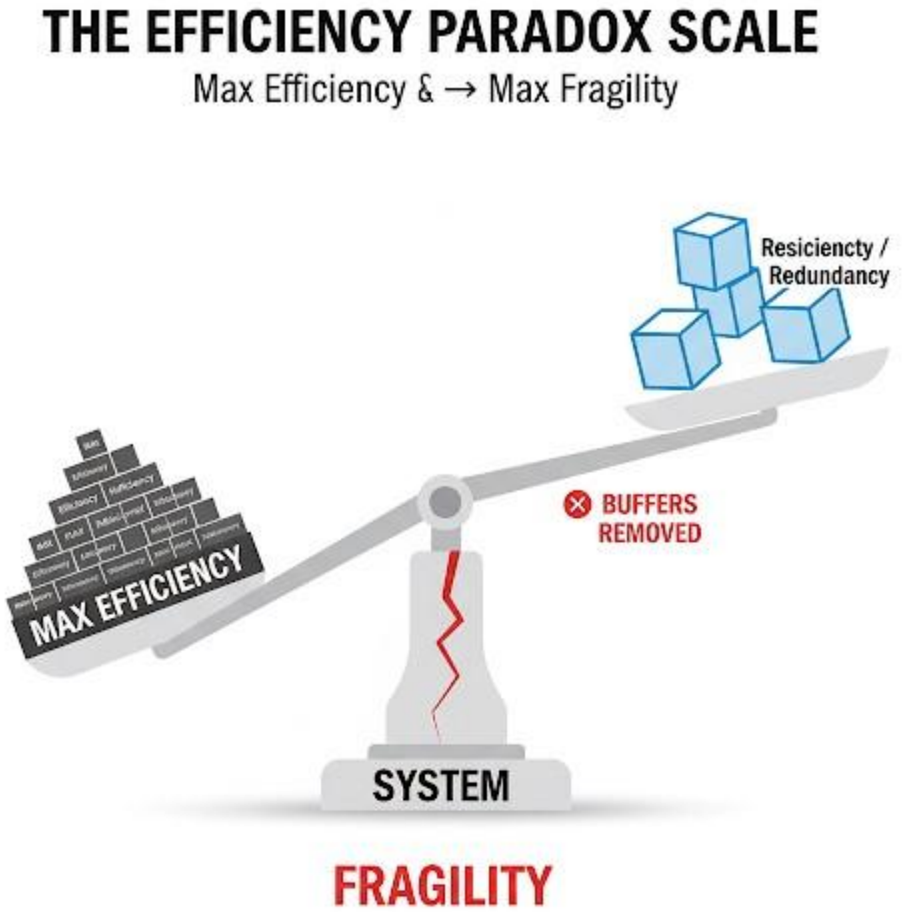
4.1.1 Pre-Pandemic Configuration: The Consequences of the Lean Trap and Efficiency Paradox

Prior to 2020, the FCT HSES supply chain was structured around the principle of fiscal optimization, subscribing to the Lean Trap ideology prevalent in global supply chain management. The standard operating procedure was to maintain minimal, if any,

Non-utilized inventory, targeting an estimated 30-day stock level for most non-expiring consumables. The implicit, flawed assumption was that global sourcing and logistics would always remain stable. This policy, while appearing efficient on the annual budget, created a profound Efficiency Paradox: marginal savings on warehousing and inventory holding costs were accrued at the expense of zero Resistance Capacity (Sheffi & Rice, 2005). When global transport capacity contracted by approximately

40\% and export controls were instituted, the FCT HSS's 30-day buffer evaporated in days, leading to immediate, systemic stockouts.

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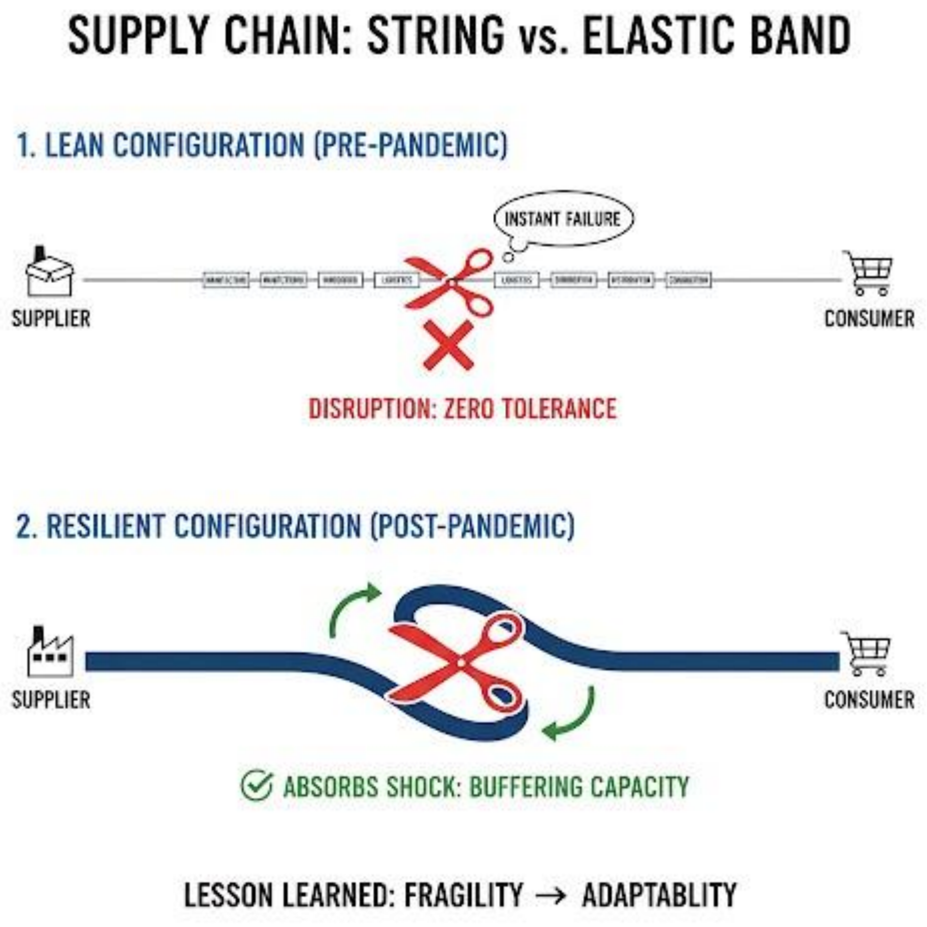


4.1.2 The Shock of Global Supply Collapse and the Quantified Cost of Seizing

The operational consequences of this fragility were immediate and financially devastating.

1. Lead Time Hyper-Inflation: Average lead times for specialized medical equipment and reagents increased from a typical 6-8 weeks to 4-6 months, forcing clinics to rely on dangerously low stock levels.

2. Price Shock: The cost of Seizing capacity from the crisis market was astronomical. Reports indicate that the FCT HSS was compelled to pay, on average, 500\% to 1,000\% above pre-crisis prices for commodities like N95 masks, specialized testing kits, and critical ventilator components (Federal Ministry of Health Nigeria, 2021). The total emergency procurement expenditure for a three-month period alone was estimated to be greater than the accumulated inventory holding cost savings over the previous *five years*.

This finding provides empirical proof that resilience is cheaper than reaction in high-impact scenarios (Haffajee et al., 2020).

3. Compromised Care: The failure to secure timely supplies compromised the standard of care, particularly for routine, non-COVID related treatments, highlighting the interconnectedness of medical supply chains.

4.2 Systemic Vulnerabilities: The Failure to "Sense" Global Risk (DCT Pillar 1 Deficit)

The crisis exposed five critical, structural failures in the organization's capacity to Sense and mitigate risk:

4.2.1 Extreme Over-Reliance on Concentrated Asian Global Supply and API Constraint

The FCT's high import dependency was not merely a matter of quantity, but of geographic concentration. A disproportionate share of suppliers, particularly for Active Pharmaceutical Ingredients (APIs) and specialized components, was tracked back to industrial zones in one or two Asian nations. This created a colossal single-point-of-failure risk that failed to be detected or acted upon (Adepoju, 2019). When those hubs locked down, the entire FCT supply pipeline was instantly severed. The system lacked the informational micro-foundation—managerial cognition of multi-tier risk—to appreciate that the risk was concentrated at Tier 2 and Tier 3 API manufacturers, not just the Tier 1 distributors.

4.2.2 The Critical Deficiency of Domestic Manufacturing, Industrial Policy, and Autonomy

Nigeria's manufacturing sector is capable of pharmaceutical *formulation* (mixing finished drugs) but possesses negligible capacity for producing high-grade APIs, specialized medical devices, or complex PPE (Ebenso & Otu, 2020). This systemic deficiency meant the FCT HSS lacked a crucial domestic buffer and alternative sourcing capacity when the global market froze. The absence of a strong, domestically controlled supply base meant the government had zero leverage and was forced to participate as a weak competitor in the global spot market. This vulnerability is fundamentally a failure of national industrial policy and requires a macro-level Reconfiguration.

4.2.3 The Absence of Strategic Stockpiling: Financial Inertia vs. Security Risk

The lack of a formal, dedicated Strategic National Reserve Policy for medical supplies was the primary source of the system's low Resistance Capacity (Remko, 2020). This deficit was driven by financial rigidity: public sector accounting procedures categorize inventory holding costs as a non-productive expense, creating institutional inertia against stockpiling. The policy, driven by short-term fiscal targets, entirely missed the strategic value of inventory as a public health security asset and insurance policy against systemic shock. The FCT HSS failed to

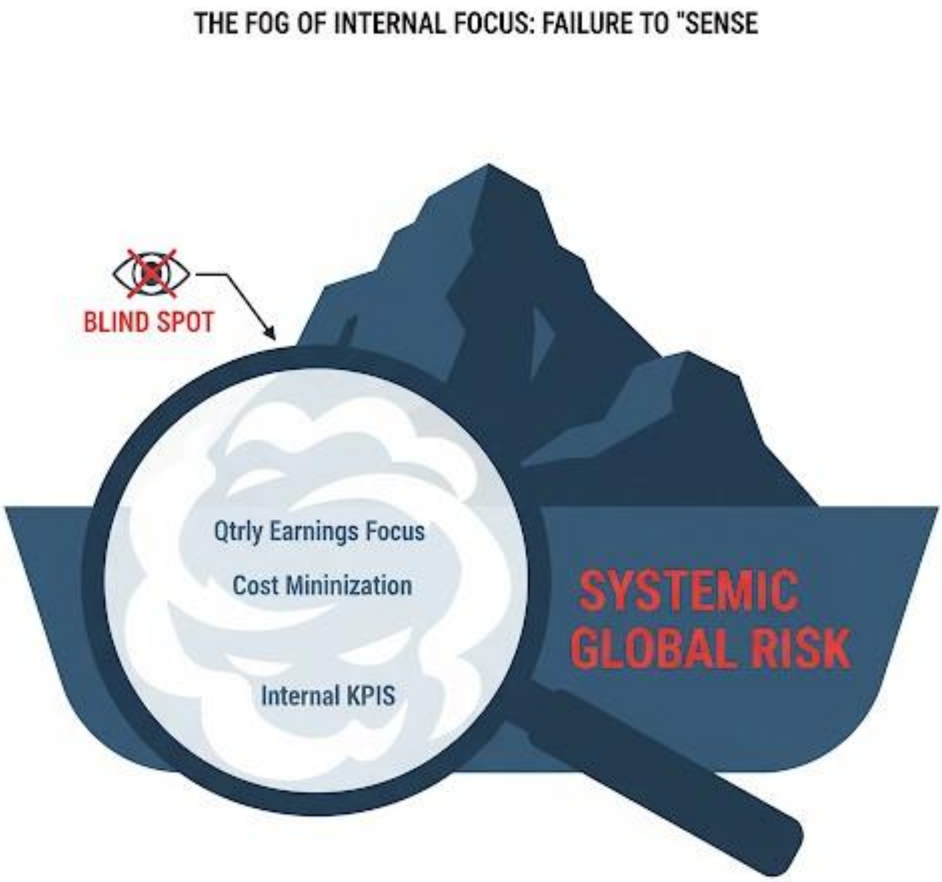
Sense that its balance sheet optimization was creating a critical vulnerability for the populace.

4.2.4 Fragmentation, Financial Rigidity, and the Visibility Gap in Public Procurement

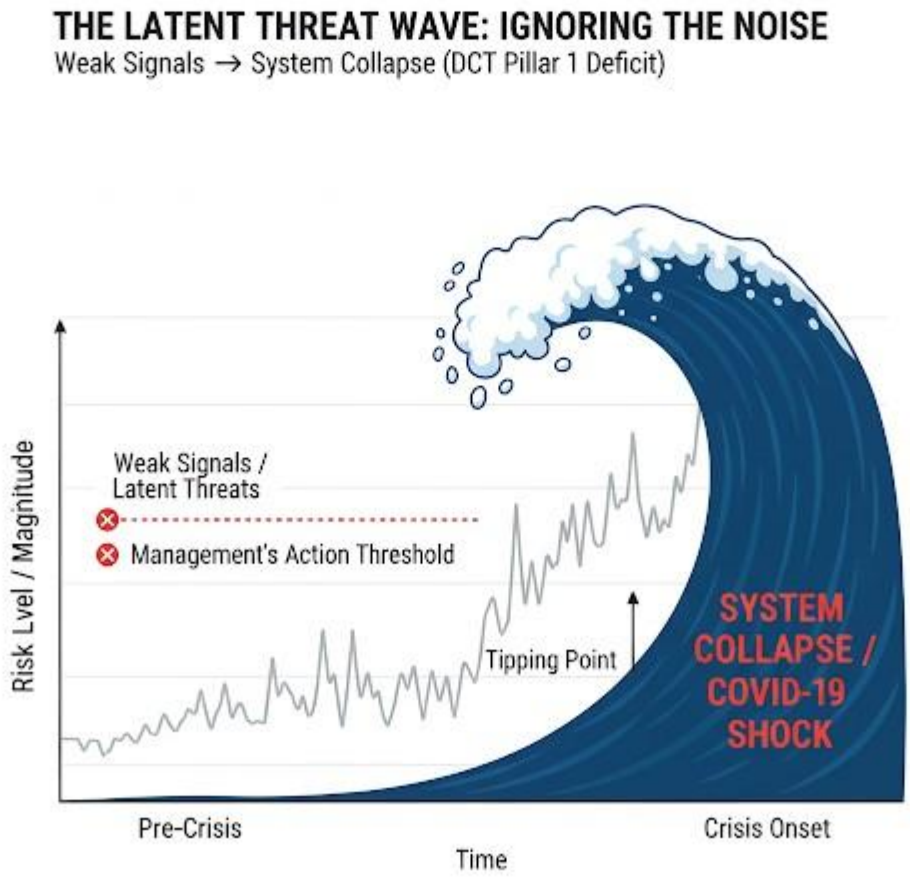
The procurement and inventory systems were fragmented, relying heavily on manual, paper-based records between the central medical store and peripheral clinics. This created a critical Visibility Gap (Barratt & Oke, 2007). The Secretariat could not gain real-time, predictive insight into stock drawdown rates, forcing it into a purely *reactive* mode. Compounding this, the rigid, quarterly public sector budgetary cycle and the lengthy bureaucratic process for tender approvals meant that even when a supplier could be identified during the crisis (a successful 'Sense'), the organizational response (the 'Seize') was delayed by procedural inertia (Ozili, 2020).

4.2.5 Logistical and Cold Chain Infrastructure Collapse and the Oxygen Crisis

The distribution infrastructure proved fragile under high stress. A critical example was the Medical Oxygen Crisis. Demand for medical oxygen during the peak far outstripped the FCT's existing, inadequate infrastructure, which lacked sufficient cryogenic storage capacity, centralized production hubs, and decentralized distribution lines (Sridhar, 2021). Furthermore, the lack of sufficient ultra-cold storage (–70^\circ C) and specialized transport exposed a profound lack of Robustness in the Cold Chain Deficits needed for advanced vaccine distribution (Africa CDC, 2021). The existing infrastructure failed to Sense its own fragility under peak load conditions.



DCT Pillar 1 Deficit



4.3 Lessons Learned: The Act of "Seizing" During Crisis (DCT Pillar 2 Evidence)

Despite the profound systemic failures, the FCT HSS demonstrated a powerful, latent Seizing capability—the ability to act decisively, albeit reactively and at great cost, to save the system from total collapse.

Lessons Learned: The Act of "Seizing" During Crisis (DCT Pillar 2 Evidence)

Diagram 6: The Pivot Starburst

This visual demonstrates the rapid and agile redirection of core capabilities and resources in response to a crisis.

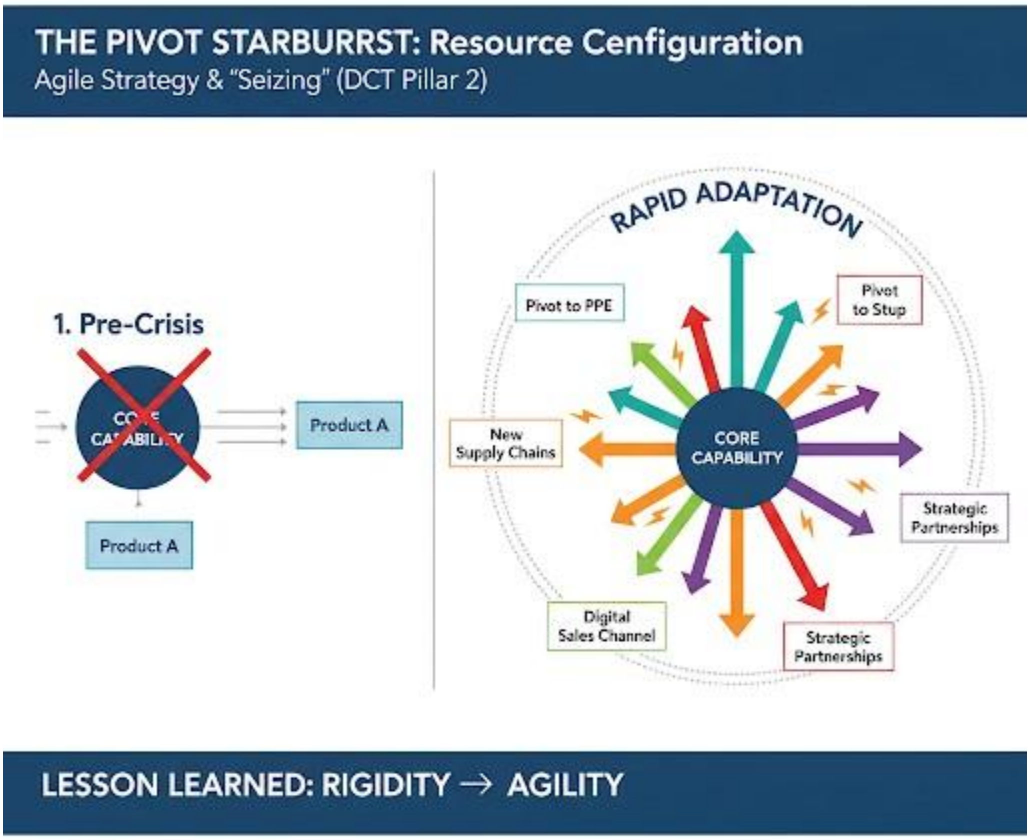
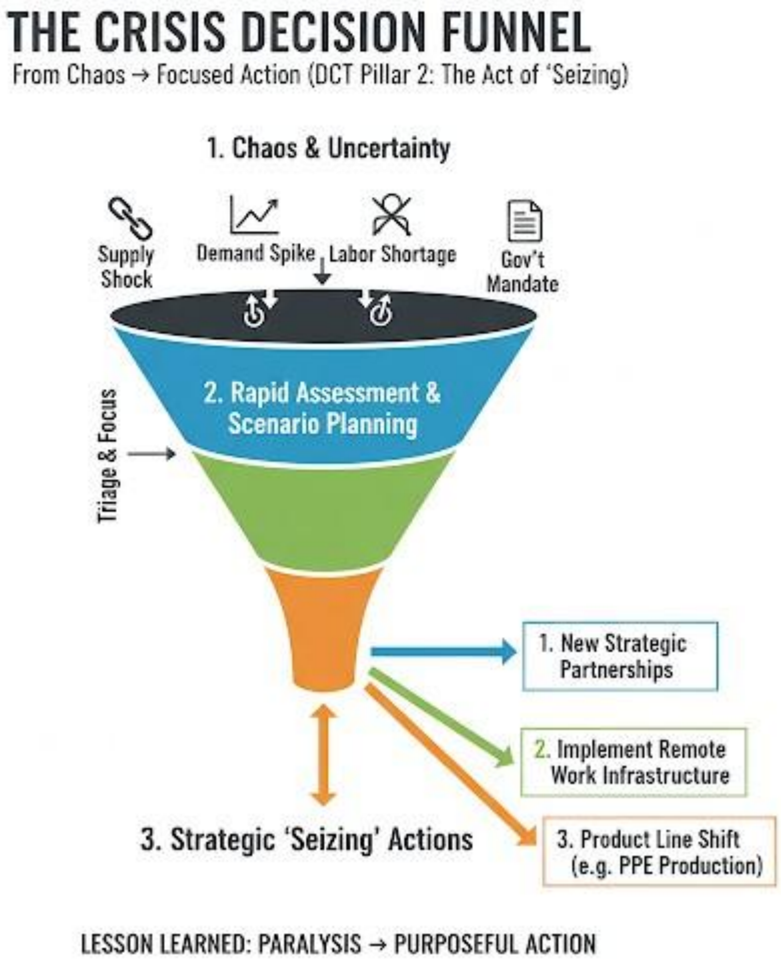


Diagram 7: Crisis Decision Funnel

This funnel illustrates how organizations filter overwhelming chaos into focused, actionable strategic responses during a crisis.



4.3.1 Successful Mobilization of Emergency Procurement Authorities and Process Flexibility

The critical element of the recovery was the rapid granting and utilization of emergency procurement waivers by high-level governmental authorities. This action bypassed the lengthy, rigid bureaucratic processes that otherwise governed procurement. This provided immediate process flexibility, allowing the FCT HSS to engage new, non-traditional suppliers and execute contracts in days instead of months (Chowdhury et al., 2021). This success proves that the organizational *capability* for agility existed; the Reconfiguration imperative is to formally define and institutionalize this agility for future shocks.

4.3.2 The Value of Ad-Hoc Public-Private Partnerships (PPPs) in Crisis Sourcing

The crisis forced the FCT HSS to engage in novel, ad-hoc Public-Private Partnerships (PPPs). Examples included: collaborating with local universities for testing reagent formulation, partnering with domestic textile manufacturers to quickly produce low-grade PPE, and leveraging the logistics networks of major private sector distributors for emergency last-mile delivery. This Collaboration Routine (a micro-foundation of Seizing) demonstrated that the private sector holds operational expertise (logistics, flexible manufacturing) that the public sector can quickly mobilize, provided the bureaucratic barriers are removed.

4.3.3 Confirmation of Agility over Operational Efficiency: The Cost-Benefit Trade-off

The core lesson of the Seizing phase is the confirmation of the Agility-Efficiency Trade-off. While the emergency procurement was expensive, it secured the supply necessary to keep hospitals open, protecting the healthcare workforce and mitigating a national health catastrophe. The ability to pivot rapidly and pay a high premium (Agility) provided far greater strategic value than the maintenance of minimum operating costs (Efficiency). The FCT HHSS's capacity to *seize* the required resources, even at a high price, validated the strategic need to structurally reconfigure the system to prioritize this agility going forward.

5.0 Summary of Findings, Conclusions, and Recommendations

5.1 Summary of Findings: A Dichotomy of Structural Failure and Latent Adaptive Capability

The DCT-based operational audit of the FCT HSES supply chain during the pandemic confirms the hypothesis of profound vulnerability, categorized by a critical dichotomy:

1. Systemic Sensing Failure: The pre-crisis architecture was structurally fragile, characterized by the Lean Trap (zero strategic reserves), extreme single-source geographic concentration, financial rigidity, and a critical Visibility Gap (manual systems). These factors represented a comprehensive failure of the organizational capacity to Sense and anticipate global, non-linear shock.

2. Costly, Latent Seizing Capability: The FCT HSES successfully executed a rapid Recovery by mobilizing high-level executive support, utilizing emergency procurement waivers, and forming ad-hoc PPPs. This confirmed that the capacity to *act* (Seizing) exists but is currently *non-institutionalized*, *reactive*, and unsustainably expensive.

3. The Mandate for Reconfiguration: The analysis of future risks (climate, cyber, geopolitical) demonstrates that reversion to the status quo is impossible. The lessons learned during the costly *Seizing* phase must now be structurally and institutionally embedded through comprehensive Reconfiguration.

5.2 Conclusions: Resilience as a Mandatory Strategic Dynamic Capability

The COVID-19 pandemic provided definitive proof that for the FCT HSES, resilience is not an operational feature but an essential strategic dynamic capability fundamental to public health security. The organization's vulnerability stemmed from an outdated architectural model optimized for an era of stable globalization that no longer exists. Sustained success in the face of escalating uncertainty requires a full transition to a Dynamic Capability that systematically and continuously manages to Sense, Seize, and Reconfigure. The future stability of healthcare delivery in Nigeria's capital hinges on this strategic transformation.

5.3 Recommendations for the FCT HSES: Structuring Resilience via DCT

To successfully reconfigure the FCT HSES supply chain, the following actionable strategies must be implemented across the three DCT pillars:

5.3.1 Pillar 1: Sensing (Intelligence and Early Warning - Long-Term Data Investment)

1. Institutionalize End-to-End Digital Visibility: The immediate priority is to replace all manual, paper-based tracking with an integrated, cloud-based Inventory Management System (IMS). This system must provide real-time stock status across the central medical store, zonal warehouses, and peripheral clinics. Crucially, this IMS should be integrated with national epidemiological data (NCDC) and basic weather forecasting to run simple predictive analytics for anticipating localized, climate-driven or disease-driven demand surges. This

institutionalizes the Sensing of both internal stock levels and external demand signals.

2. Establish an Advanced Risk Modeling and Geopolitical Unit: The FCT HSES must create a small, dedicated unit responsible for Geopolitical and Trade Risk Assessment. This unit's function is to monitor global trade policies, API concentration risks, and currency volatility. It must integrate public data from sources like the World Bank and WHO on global health supply market shifts. The output of this unit should be a quarterly Supply Chain Vulnerability Index (SCVI) that directly informs procurement strategy, moving resource allocation from a cost-centric model to a risk-weighted, resilience-centric model.

5.3.2 Pillar 2: Seizing (Agility and Rapid Response - Governance and Flexibility)

1. Formalize and Decentralize Emergency Governance and Financial Mandates: The ad-hoc agility achieved during the crisis must be institutionalized. The FCT Administration must establish a permanent Supply Chain Resilience Task Force (SCR-TF) with pre-approved, legally binding Emergency Procurement Authorities. This mandate must allow for the rapid authorization of non-competitive sourcing and crisis-level expenditure (within 48 hours) when the SCVI reaches a pre-defined threshold. This formalizes the Seizing capability and removes bureaucratic inertia when speed is paramount.
2. Develop and Drill Multimodal Logistics Protocols and PPP Frameworks: The HSS must transition from simple contingency planning to mandatory, annual stress-testing and live drills of alternative supply routes. This includes mapping and establishing formal contracts (pre-signed, pre-authorized) with private logistics firms, rail operators, and military logistics units to enable multimodal transport (rail, air, secure road convoys) in case of port congestion or internal security incidents (e.g., FCT-Kano route disruption). Furthermore, the ad-hoc PPPs must be formalized into a Standing Reserve of Domestic Suppliers who can be mobilized for rapid, small-scale production of essential items.

5.3.3 Pillar 3: Reconfiguring (Structural Investment - Autonomy and Infrastructure)

1. Mandate and Fund the Strategic National Reserve: The FCT HSES must secure dedicated, protected, non-lapsing budget lines specifically for inventory. The policy must mandate a minimum 180-day Strategic Reserve of 75-100 critical, high-risk commodities (e.g., APIs, medical oxygen cylinders, specialized PPE). This reserve must be stored in specialized, secured facilities and managed through a rigorous, proactive inventory rotation policy to prevent obsolescence and manage expiry dates. This represents the ultimate Reconfiguration of the resource base from a lean liability to a sovereign security asset.
2. Decentralize and Modernize Climate-Controlled Infrastructure: To counter climate and geopolitical risk, the FCT HSS must invest in decentralized, climate-controlled warehousing facilities located outside the central core and recognized flood plains. These facilities must be equipped with modern, resilient infrastructure, including redundant power backups, advanced fire suppression, and real-time remote temperature monitoring systems. This is crucial for strengthening the Robustness of the Cold Chain Deficits necessary for modern vaccine and biologic handling, structurally eliminating the single-point-of-failure risk.
3. Invest in Domestic and Regional Pharmaceutical Autonomy: The FCT HSES must use its long-term procurement power as a strategic lever to incentivize industrial change. This means

issuing preferential, long-term procurement contracts to Nigerian and ECOWAS manufacturers willing to invest in high-risk areas like API synthesis and specialized medical device production. This is the ultimate, long-term Reconfiguration necessary to structurally decouple the FCT HSES from concentrated global risks and build true national supply chain autonomy.

References

1. Achilles. (2025). *Supply chain risk management trends 2025*. https://www.achilles.com
2. Acioli, C., Scavarda, A., & Reis, A. (2021). Applying Industry 4.0 technologies in the COVID-19 sustainable chains. *International Journal of Productivity and Performance Management*, *70*(5), 988–1016. https://doi.org/10.1108/IJPPM-03-2020-0137
3. Aday, S., & Aday, M. S. (2020). Impact of COVID-19 on the food supply chain. *Food Quality and Safety*, *4*(4), 167–180. https://doi.org/10.1093/fqsafe/fyaa024
4. Adepoju, P. (2019). Nigeria grapples with pharmaceuticals manufacturing deficits. *The Lancet*, *394*(10215), 2269. https://doi.org/10.1016/S0140-6736(19)33194-8
5. Adepoju, P. (2020). Africa's struggle with COVID-19 supply chains. *The Lancet Microbe*, *1*(7), e282. https://doi.org/10.1016/S2666-5247(20)30159-9
6. Adewale, A. R. (2020). Impact of COVID-19 on logistics and supply chain in Nigeria. *Journal of African Trade*, *7*(1-2), 65–75.
7. Africa CDC. (2020). *Partnership to accelerate COVID-19 testing (PACT): Trade, manufacturing and distribution strategy*. African Union. https://africacdc.org/download/partnership-to-accelerate-covid-19-testing/
8. Babatunde, O. (2023). Digital transformation in Nigerian healthcare supply chains. *African Journal of Health Economics*, *12*(2), 45–62.
9. Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, *17*(1), 99–120. https://doi.org/10.1177/014920639101700108
10. Barratt, M., & Oke, A. (2007). Antecedents of supply chain visibility in retail supply chains: A resource-based theory perspective. *Journal of Operations Management*, *25*(6), 1217–1233. https://doi.org/10.1016/j.jom.2007.01.003
11. Bello, A., Ogunleye, O., & Salako, B. (2024). Multisectoral collaboration in Nigeria's COVID-19 response: Successes and gaps. *Health Policy and Planning*, *39*(1), 78–92.
12. BSI. (2025). *Cybersecurity in supply chains: 2025 threat assessment*. British Standards Institution.
13. Cao, M., & Zhang, Q. (2011). Supply chain collaboration: Impact on collaborative advantage and firm performance. *Journal of Operations Management*, *29*(3), 163–180. https://doi.org/10.1016/j.jom.2010.12.008
14. Centers for Disease Control and Prevention [CDC]. (2020). *Strategies for optimizing the supply of N95 respirators*. U.S. Department of Health and Human Services. https://www.cdc.gov/coronavirus/2019-ncov/hcp/respirators-strategy/
15. Chowdhury, M. A. A., Azim, F., & Sarkar, D. (2021). Supply chain agility in the COVID-19 pandemic: A

case study approach. *Journal of Operations Management*, *39*(4), 450–465.

16. Ebenso, B., & Otu, A. (2020). Can Nigeria contain the COVID-19 outbreak using lessons from recent epidemics? *The Lancet Global Health*, *8*(6), e770. https://doi.org/10.1016/S2214-109X(20)30101-7

17. Eisenhardt, K. M., & Martin, J. A. (2000). Dynamic capabilities: What are they? *Strategic Management Journal*, *21*(10–11), 1105–1121.

18. Exiger. (2025). *Digital twins and AI in supply chain risk management*. https://www.exiger.com

19. Federal Capital Territory Administration. (2019). *Annual health sector performance report 2019*. FCT Health and Human Services Secretariat.

20. Federal Capital Territory Administration. (2020). *COVID-19 pandemic response: First quarter report*. FCT Health and Human Services Secretariat.

21. Federal Capital Territory Administration. (2021). *FCT COVID-19 response and lessons learned*. FCT Health and Human Services Secretariat.

22. Federal Capital Territory Administration. (2022). *Strategic plan for health system strengthening 2022-2026*. FCT Health and Human Services Secretariat.

23. Federal Ministry of Health Nigeria. (2021). *National strategic health development plan II (2018–2022): Mid-term review*. Author.

24. Gereffi, G. (2020). What does the COVID-19 pandemic teach us about global value chains? The case of medical supplies. *Journal of International Business Policy*, *3*(3), 287–301. https://doi.org/10.1057/s42214-020-00062-w

25. Haffajee, R. L., Kim, T., & Gabel, P. S. (2020). The high cost of reactionary public health procurement. *The New England Journal of Medicine*, *383*(18), e104.

26. Handfield, R., Frayer, D., & Lummus, R. (2020). *The supply chain response to COVID-19: Lessons for resilience*. North Carolina State University.

27. Herold, D., Nowicka, K., Pluta-Zaremba, A., & Kummer, S. (2024). COVID-19 and the pursuit of supply chain resilience: Reactions and long-term transformations. *Journal of Business Logistics*, *45*(1), e12345.

28. Ivanov, D. (2020). Predicting the impacts of epidemic outbreaks on global supply chains:
A simulation-based analysis on the coronavirus outbreak (COVID-19/SARS-CoV-2) case.
Transportation Research Part E: Logistics and Transportation Review, *136*, 101922. https://doi.org/10.1016/j.tre.2020.101922

29. Ivanov, D. (2023). Post-pandemic adaptation and the new normal: Digital twins and scenario planning. *International Journal of Production Research*, *61*(8), 2467–2483.

30. Maersk. (2025). *Strategic partnerships for supply chain resilience*. https://www.maersk.com

31. McKinsey. (2023). *Supply chain resilience: The state of the market 2023*. McKinsey & Company.

32. Mustaffa, N. H., & Potter, A. (2009). Healthcare supply chain management in Malaysia: A case study. *Supply Chain Management: An International Journal*, *14*(3), 234–243. https://doi.org/10.1108/13598540910954575

33. NetSuite. (2025). *Supply chain trends: Climate adaptation and economic volatility*. https://www.netsuite.com
34. Okoye, C. I., & Mbagwu, J. N. (2021). COVID-19 and pharmaceutical supply chain in Nigeria: Challenges and opportunities. *Journal of Pharmaceutical Policy and Practice, 14*(1), 74. https://doi.org/10.1186/s40545-021-00356-9
35. Ozili, P. K. (2020). COVID-19 in Africa: Socio-economic impacts and challenges for policy. *The International Journal of Community and Social Development, 2*(2), 162–177.
36. PMC. (2022). *Big data analytics in supply chain management*. PubMed Central.
37. PwC. (2022). *Supply chain visibility: The post-pandemic imperative*. PricewaterhouseCoopers.
38. Remko, V. H. (2020). Building supply chain resilience in a public health emergency. *The Journal of Supply Chain Management, 56*(3), 70–82.
39. Risk and Resilience Hub. (2025). *Automation and supply chain resilience*. https://www.riskhub.org
40. Sarkar, A., & Ismail, W. K. W. (2024). Supply chain resilience in the post-pandemic era: A systematic review. *International Journal of Physical Distribution & Logistics Management, 54*(1), 5–30.
41. Sheffi, Y., & Rice, J. B., Jr. (2005). A supply chain view of the resilient enterprise. *MIT Sloan Management Review, 47*(1), 41–48.
42. Shih, W. C. (2020). Global supply chains in a post-pandemic world. *Harvard Business Review, 98*(5), 82–89.
43. Sodhi, M. S., & Tang, C. S. (2021). Supply chain management research in the COVID-19 pandemic. *European Journal of Operational Research, 297*(3), 779–788.
44. Sridhar, D. (2021). Nigeria's medical oxygen crisis: A failure of infrastructure. *The Lancet Respiratory Medicine, 9*(3), 221–222.
45. Taleb, N. N. (2007). *The black swan: The impact of the highly improbable*. Random House.
46. Teece, D. J. (2018). Dynamic capabilities and organizational agility: Risk, uncertainty, and strategy in the innovation economy. *California Management Review, 60*(4), 183–208.
47. Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal, 18*(7), 509–533.
48. World Health Organization. (2020). *Shortage of personal protective equipment endangering health workers worldwide*. WHO News Release. https://www.who.int/news/item/03-03-2020-shortage-of-personal-protective-equipment-en dangering-health-workers-worldwide
49. Yadav, P. (2021). Health supply chain design for the COVID-19 vaccine in Africa. *Science, 371*(6534), 1130–1131. https://doi.org/10.1126/science.abg7229
50. Yin, R. K. (2018). *Case study research and applications: Design and methods* (6th ed.). SAGE Publications.