

Adaptive Management Frameworks for Resilient International Trade

Laith Ahmed Najam, Mosul University, Iraq. dr_laithahmed@yahoo.com

Introduction: From Stability to Structural Uncertainty

International trade has long been seen as the most dependable source of improving the economies of both poorer and richer countries; however, recent developments suggest that the current international trading system is now in a prolonged period of structural instability. For instance, between late 2018 and the end of 2024, the global trade system has experienced: 1) The US-China trade dispute; 2) The COVID-19-induced shock to demand and the logistics systems responsible for handling global shipping volume; 3) Russia's invasion of Ukraine, and the numerous sanctions placed on the latter as a result; and 4) A large number of nations affecting the flow of global goods through the implementation of industrial policies (i.e. the US's CHIPS and Science Acts, and the European Union's Carbon Border Adjustment Mechanism). The net result of these events is a global trade system that has become more interdependent and more challenged than at any point since World War II. As a result of these changes, the strategic management literature has

responded to this environment by increasing interest on resilience as a fundamental goal of the individual organisation. However, resilience is viewed by many to be a stable characteristic of an organisation; that is, an organisation either possesses resilience or does not [6]. This paper calls for a more comprehensive definition to describe resilience in organisations, and proposes an Adaptive Management Framework (AMF) to identify how organisations can: 1) detect early warning signals of a trade disruption; 2) choose appropriate strategies to deal with the disruption; and 3) continue to evolve the way they conduct operations to adapt to the environment.

The Adaptive Management Framework: A Four-Layer Architecture

The AMF illustrated in figure 1 is constructed as a closed-loop system consisting of four structural levels. The construction of the AMF integrates existing concepts from systems theory, the dynamic capabilities literature, and operations management, into a unified model that provides an organisation with enhanced ability to adapt to the current international trading environment.

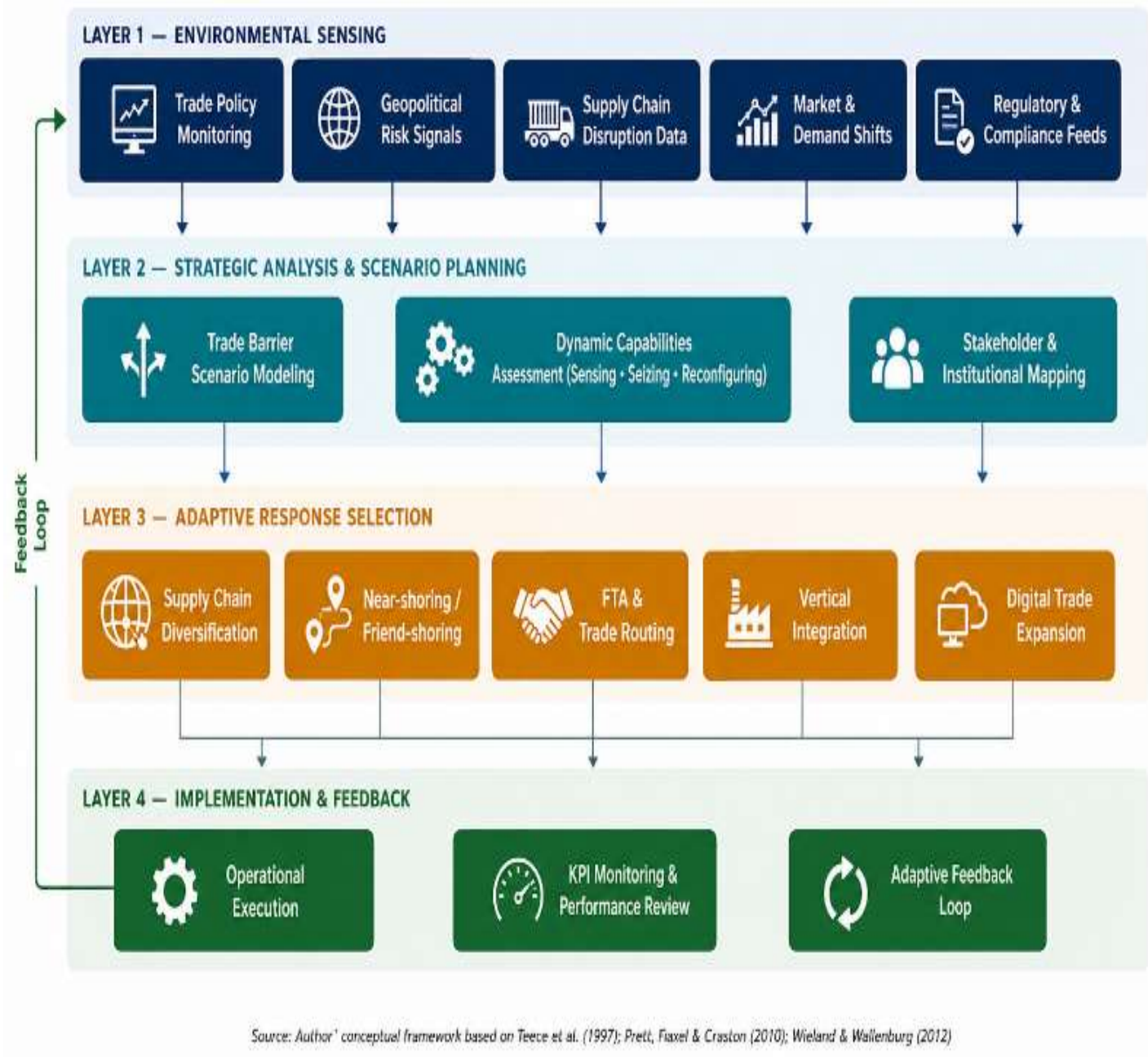


Figure 1: Adaptive management framework architecture for resilient international trade source: authors' conceptual framework based on Teece et al. (1997); Pettit, Fiksel & Croxton (2010); Wieland & Wallenburg (2012) [5][6]

The first level of the AMF is the detection of environmental signals. Specifically, environmental signals consist of current trade policies in real-time, geopolitical risk indicators, global economies affected by supply chain disruptions, current demand in markets (i.e. growth or decrease), and data to confirm compliance with laws and regulations. To have effective trade sensing, companies need intelligence resources such as: government affairs units; trade counsel; and data analytics platforms to interpret the disparate trade policy signals into actionable trade risk alerts. There is empirical research showing that companies that have a formalised trade monitoring function will make supply chain adjustments before tariffs are put into place instead of waiting until they are implemented (Witt et al., 2023).

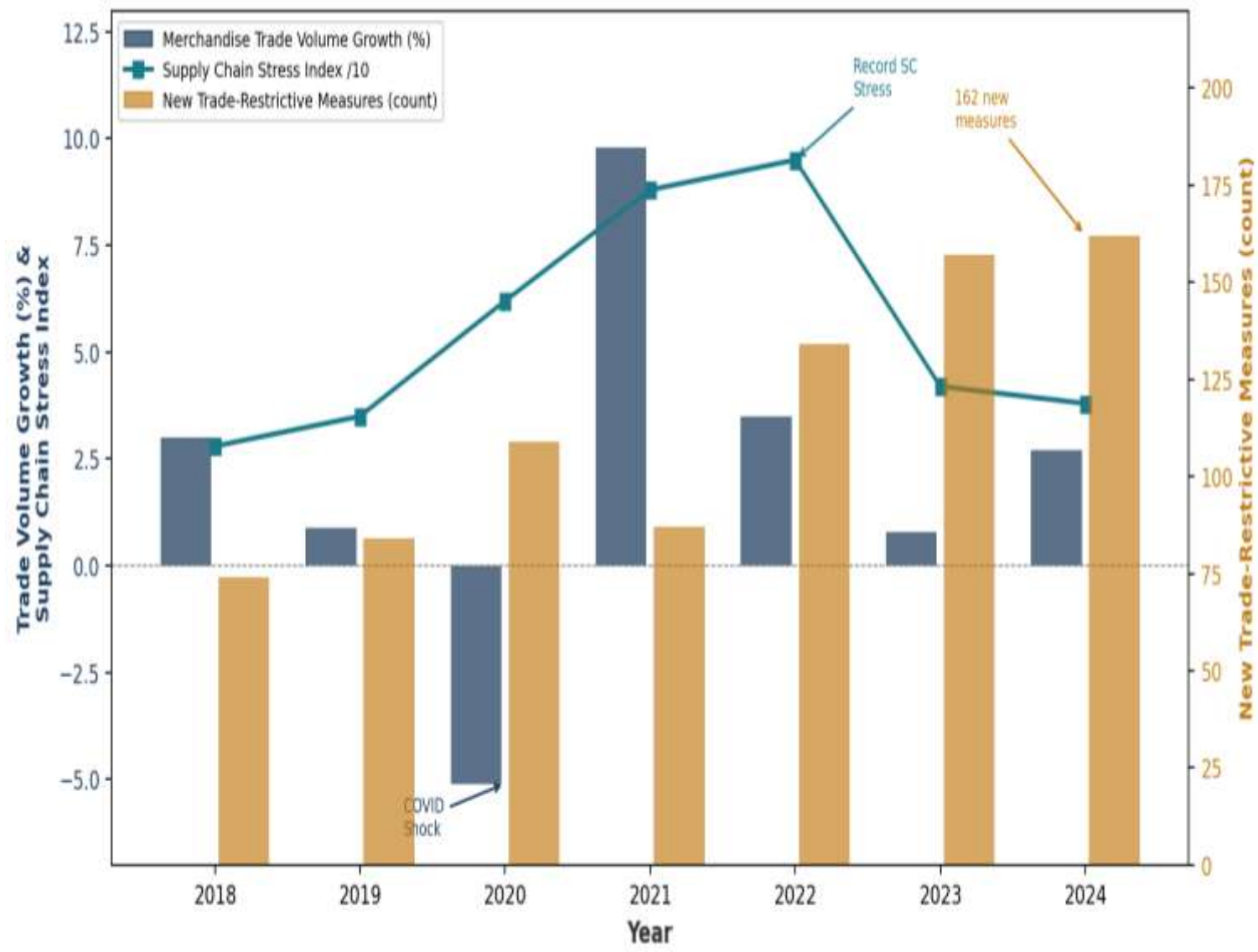
Layer 2 (Trade Strategy Analysis/Scenario Planning) is where we use the outputs from Layer 1 to create structured evaluations of the output data. This includes: modelling trade barrier scenarios (constructing plausible tariff scenarios such as optimistic, base case, and pessimistic); assessing your dynamic capabilities to audit or determine your firm's ability to use the multiple strategic functions of sensing, seizing, and reconfiguring; and mapping your key stakeholders and institutions so that you understand the political or regulatory context in which you are doing business [3].

Layer 3 (Adaptive Response Selection) is the decision-making layer where we will leverage the six strategic levers discussed in Section 4 above. It is important to view the selection of responses as a continuous portfolio to be continually updated based on the scenario outputs received from Layer 2. Companies that have modular supply chain architecture and a pre-qualified list of alternative vendors can implement their response switches in a significantly shorter time compared to companies that have a rigid, integrated supply chain.

Layer 4 (Implementation & Feedback) completes the loop in our framework. The use of KPIs to monitor landed cost variance, supplier concentration, lead time volatility, and trade compliance exceptions will create the feedback loop into Layer 1 to help the framework self-correct and adjust. This feedback feature is what makes this framework truly adaptive rather than merely a static strategic plan.

Empirical Evidence: Volatility, Disruption, and Policy Proliferation

Three separate time-series indicators depicting the state of the trade resilience challenge are shown on figure 2, each having come from each of the independent, international data providers that together create a composite measure of this trade resilience challenge—is a measure of change over time—will be provided with each indicator.



Sources: WTO World Trade Statistical Review (2024); WTO Trade Monitoring Report (2024); Allianz Trade / NY Fed Global Supply Chain Pressure Index (2024); IMF WEO Oct 2024

Figure 2: Global trade resilience indicators: volume growth, supply chain stress & policy measures (2018–2024) sources: WTO world trade statistical review (2024); WTO trade monitoring report (2024); Allianz Trade / NY Fed GSCPI (2024); IMF world economic outlook October 2024

The supply chain pressure index is a second indicator and comes from the New York Federal Reserve's Global Supply Chain Pressure Index and Allianz Trade. The stress index has a trajectory similar to the WTO's merchandise trade volume growth. The stress index reached an elevated level (35/100) in 2019 and accelerated to 88 during 2021, the peak of port congestion problems and container shortages due to the COVID-19 pandemic. The stress index continued to rise and reached a maximum of 95 in 2022 during the European energy crisis, but had declined to 38 in 2024 due to normalisation of freight markets. This reduction in the stress index should not be interpreted as returning to the baseline of pre-2018; rather, there are several longer-term structural factors that will continue to create elevated levels of risk from disruption (i.e., bifurcation of semiconductor supply chains as a result of geopolitical events, and the increased use of dual-use export controls) [1]. The third indicator that can be identified from data is the significant and sustained increase in the number of new trade-restrictive measures (i.e., new policies that restrict trade): the number of new trade restrictions has increased from 74 new trade restrictions in 2018 to 162 in 2024. The emerging framework for trading regulations towards controlled ways of regulating supplies, sub-sidising), and separating from competing nations (building supply chains based on WTO rules). With the new trade framework with these three controlled trading processes in

place, it will create a divergence in the relationship of firms that had previously structured their activities based on having access to open trade.

Six Adaptive Levers: A Comparative Assessment

The report outlines six levers of strategic response that are available to firms operating at Layer 3 of the AMF framework; each lever is assessed in terms of its core mechanism, primary benefit, and primary risk. Importantly, the six levers are not mutually exclusive; leading firms typically use a combination of two to four levers, calibrated according to sectoral exposure and firm capabilities.

The first lever of the AMF is supply chain diversification which has received both significant attention from practitioners and researchers since 2018. This is best illustrated by the technology sectors "China+N" strategy, involving Apple's expedited ramp of iPhone assembly in India and Vietnam, TSMC's fabrication site investments in Arizona and Japan, and Samsung's expanding manufacturing footprint in both Texas and India, all of which represent a major restructuring of production locations across the entire technology sector due to both the risk of tariffs and (in the case of TSMC) export control exposure.

Table 1: Adaptive levers for trade resilience: comparative assessment

Adaptive Lever	Core Mechanism	Primary Benefit	Key Risk
Supply Chain Diversification	Multi-geography sourcing; "China+N" architectures	Reduced single-country exposure	Higher unit costs; coordination complexity
Near-shoring / Friend-shoring	Production relocation to allied or proximate nations	Political risk mitigation; subsidy access	Labour & infrastructure cost premium
FTA-Based Trade Routing	Leverage USMCA, CPTPP, RCEP, EU bilateral FTAs	Tariff avoidance; market access	Rules-of-origin compliance burden
Vertical Integration	Internalise critical upstream inputs (chips, minerals)	Insulation from tariff volatility	Capital intensity; inflexibility
Digital Trade Expansion	Shift value delivery to cross-border services & data	Low tariff exposure; scalability	Data localisation; regulatory fragmentation
Scenario-Based Financial Hedging	Currency, commodity & logistics risk instruments	Balance-sheet resilience	Hedge cost; basis risk

Source: Authors' synthesis based on Gereffi (2020); OECD (2024); Witt et al. (2023); Wieland & Wallenburg (2012) [2][4][6]

As demonstrated by TSMC's recognition of the approximately 50% higher costs to produce in Arizona than in Taiwan, building resilience through supply chain diversification necessarily incurs additional efficiency costs which must be included in financial models that companies use to strategise how they do business [2].

Digital container-derived service trade represents the most under-leveraged of the six levers in the AMF lexicon, despite the fact that cross-border provision of service trade has grown at approximately 8% annually between 2019 and 2023, more than

three times the rate of growth in goods trade, and has much lower tariff exposure than goods exports. Companies in the fields of professional services, software, financial services, and media industries that move value delivery towards digital means will be insulated from the effects of tariffs increasing in value [4]. This is because of government regulations generated from data localisation requirements in India, China, Russia and Vietnam as well as the EU's Data Governance Regulations which make compliance and the associated legal and technology

infrastructure required complex for any organization wishing to meet these regulations.

Governance and Capability Conditions for AMF Implementation

The SMF (as described in Section 2) is a required but insufficient condition for resilient trade. For it to be implemented effectively requires the presence of three organizational capabilities that are discussed in the dynamic capabilities literature (Teece, Pisano, and Shuen, 1997).

The institutionalization of an organization's sensing capability is the first organizational capability that needs to be achieved and not a function of happenstance. This will require formalized functions tasked with monitoring trade intelligence (which are typically located within government relations, global supply chain and chief risk officer reporting structures). The monitoring of trade intelligence must political aspects consist of the monitoring of WTO dispute resolution conditions, monitoring of bilateral trade agreement negotiations, and monitoring of executive order implementation across the top ten jurisdictions in terms of revenue for the organization. Organizations with only external legal representation involved with monitoring these issues routinely have longer periods of time until they respond than do organizations with internal staff responsible for these issues [7].

The second capability necessary for successfully implementing the SMF is the ability to seize upon opportunities, and this capability requires rapid reaction to the information supplied by the organization's sensing capabilities as a result of creating governance structure based on how a decision is made to seize an opportunity. Examples of these decision-making governance structures include a trade-risk committee established at the board of directors' level, having budgets in place to act upon opportunities in supplier diversity pre-approved, and having standing non-exclusive contracts with an alternative logistics provider. Without the correct timing of internal approval to activate an alternative supplier, all of them will result in a constant zero net sensing advantage for a company that is able to identify a tariff action six months before the firm is able to activate the alternative source. Additionally, a firm that can adjust to modified tariffs by reconfiguring its capabilities is a source of resiliency and durability. Research by Pettit, Fiksel, and Croxton demonstrates that supply chain resiliency is a function of the balance between vulnerability and capability; routines for reconfiguring increase the capabilities side of this balance. Firms that pre-negotiate joint venture options, modular contract manufacturing agreements, and total landed cost models that have had their tariff adjusted can make structural reconfigurations in less than four weeks instead of taking up to one year to make.

Conclusions and Practitioner Implications

The Adaptive Management Framework presented within this article offers an organized means of responding to the most significant change to the way global trade is governed in more than a generation. From this analysis, three implications for practitioners are offered. First, trade resilience must be treated as a strategic capability and not as a contingency. The evidence in figure 2 establishes that many forms of trade disruptions, be they Volatile volume due to trade policy adjustments on the global level (i.e., safe havens), stress on supply chains, or globally disseminated forms of policy adjustment are not temporary events but an ongoing and increasing occurrence within our current global trading environment; organisations attempting to return to pre-2018 trading conditions are behaving optimistically based on evidence not supportive of this view. Second, the four-layer closed-loop architecture of the AMF provides companies with a template for developing and integrating adaptive capabilities at their enterprise level. The true value of AMF lies in its multiple layers and how each of the layers work together to provide feedback; companies that employ only one way of measuring the capability, such as monitoring what is going on in terms of tariffs without a means of responding to those tariffs, will have the limitations of an organisation using monitoring alone. The integration of the feedback between the implementation performance of the

integrated organisation is the process that will enable the implementation of a strategic framework into the organisation becoming an organisational learning system. Third, the deployment of the levers of adaptive change listed in the table 1 must be done strategically, not sequentially. Each organisation's configuration of the levers will be specific to that organisation due to sector, geography, tariff exposure, and business capability; but in almost all situations, focusing on one of these, usually the diversification of supply chain sources (but not the appropriate combination of digital trade expansion and scenario-based financial hedging), will leave significant value for the organisation as it relates to resiliency unrealised. Firms that have combined diversification with the expansion of digital trade and scenario-based financial hedging consistently demonstrate superior risk-adjusted trade performance through the documented volatility cycle.

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