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An Integrated Operational Framework for National Champion Industrial Policy

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ABSTRACT

This paper argues that national champion strategies succeed not through firm-level support alone, but through alignment across industrial ecosystems, technological hierarchies, and spatial-industrial coordination. It develops the Ecosystem–Stack–Symbiosis (ESS) framework as a system-level sequencing logic linking institutions, capabilities, ecosystem formation, stack positioning, industrial symbiosis, and competitive selection.

Drawing on comparative illustrative cases, the paper shows that industrial outcomes depend less on isolated firm support than on alignment across institutional, technological, and industrial systems. Misalignment across these dimensions generates predictable failure patterns, while coordinated sequencing improves the likelihood of globally competitive firm emergence.

The paper contributes in three ways. First, it synthesizes fragmented literatures on industrial policy, innovation systems, techno-industrial competition, and industrial symbiosis into an integrated analytical framework. Second, it develops a functional sequencing logic explaining how national and industry champions emerge from broader industrial systems. Third, it proposes a stage-contingent governance architecture emphasizing competition, conditionality, transparency, and sunset discipline.

The ESS framework is intended as a theory-building and diagnostic architecture rather than a fully validated predictive model. Its principal contribution lies in providing a structured foundation for future comparative and empirical analysis of industrial transformation.

Keywords: National Champions, Industrial Policy, Ecosystem–Stack–Symbiosis (ESS) Framework, Industrial Ecosystems, Industrial Symbiosis, Innovation Systems

INTRODUCTION

Industrial policy and national champion strategies have re-emerged as central components of economic strategy in both advanced and developing economies. Governments increasingly seek to develop globally competitive firms in strategic sectors such as semiconductors, renewable energy, artificial intelligence, telecommunications, and advanced manufacturing. Yet the historical record is mixed: while some national champion strategies have produced internationally competitive firms, others have generated inefficient incumbents, fiscal burdens, and protected monopolies with weak innovative capacity. This variation raises a central question: why do similar policy instruments—subsidies, protection, directed credit, and procurement support—produce sharply divergent outcomes?

Existing literature suggests that firm-level support alone cannot explain success. Competitive firms are typically embedded in broader systems of suppliers, infrastructure, finance, research institutions, skilled labour, and technological capabilities. In this context, national champions are better understood not as isolated recipients of state support, but as anchor firms within wider industrial systems. As competition increasingly occurs across industrial ecosystems, technological architectures, and global production networks, industrial policy must be understood less as firm selection and more as system construction.

This paper develops the Ecosystem–Stack–Symbiosis (ESS) framework to explain how national and industry champions emerge under these conditions. The framework synthesizes three strands of literature that are usually treated separately: industrial ecosystems, techno-industrial stack structures, and industrial symbiosis. It argues that competitive firms emerge when institutional capacity, firm capabilities, technological positioning, and spatial-industrial coordination are aligned through a functional sequencing logic.

The paper adopts a restrictive definition of a national champion as a large corporation—private or state-owned—that receives deliberate, preferential government support to achieve a dominant position in its home market. Such support may include subsidies, directed credit, procurement advantages, tax incentives, and trade protection. National champions are therefore policy-enabled rather than purely market-selected. This definition distinguishes them from industry champions, which achieve dominance through competitive performance without preferential protection, and from large firms, which simply attain scale without deliberate state engineering.

The central argument is that national champions do not arise solely from firm support. They emerge when governments build the institutional, technological, and industrial conditions that enable capable firms to be competitively selected and scaled. The ESS framework, therefore, reconceptualizes industrial policy as a stage-based process of capability building, ecosystem formation, stack positioning, and competitive discipline. Its contribution is threefold. First, it synthesizes fragmented literatures on industrial policy, innovation systems, and technological competition into a unified framework. Second, it develops a functional sequencing logic for the formation of national champion. Third, it proposes a stage-contingent governance architecture centered on competition, conditionality, and sunset discipline.

This paper is primarily theory-building and framework-development in orientation rather than a causal identification exercise. Its objective is not to statistically validate the ESS framework but to develop an integrated analytical architecture that synthesizes fragmented strands of industrial policy literature into a coherent explanatory model. The comparative cases used in later sections, therefore, serve illustrative and diagnostic purposes rather than formal empirical tests of causality.

The paper proceeds as follows. Section 2 reviews the literature and identifies the analytical gap. Section 3 develops the ESS framework. Section 4 identifies the main determinants of success and failure in national champion policy. Section 5 applies the framework to selected comparative cases. Section 6 outlines operational and governance implications. The final section concludes by integrating the paper's contribution with its policy implications.

LITERATURE REVIEW

National Champions, Industrial Policy, and Industrial Systems

National Champions and the Limits of Firm-Centric Explanations

The literature on national champions begins from a deceptively simple proposition: governments can accelerate industrialization by supporting large domestic firms. The "*national champions route*" formalizes this logic, arguing that scale, protection, and preferential access to finance enable firms to overcome latecomer disadvantages and compete globally (Kumar & Steenkamp, 2013). Historical cases—from Airbus to Samsung—are frequently cited as validation.

Yet this firm-centric perspective is internally inconsistent. While it explains how firms acquire scale, it does not explain why similar policies often produce inefficient incumbents rather than globally competitive firms. The late industrialization literature directly challenges any unconditional reading of the national champion model. Alice Amsden shows that state support succeeds only when tied to strict performance discipline, particularly export targets (Amsden, 2001). Ha-Joon Chang, by contrast, emphasizes the historical ubiquity of protection and intervention, but is less explicit about the institutional conditions required to discipline firms (Chang, 2002).

This reveals a first-order tension: is state support sufficient, or is discipline the binding constraint? The national-champion literature identifies the instruments of support but under-specifies the systemic conditions under which those instruments yield competitive outcomes rather than rent-seeking equilibria.

Industrial Policy: Market Failure vs. Market Shaping

Industrial policy theory provides a broader justification for intervention but introduces a second tension. The dominant framework—market failure correction—argues that governments intervene to address coordination failures, knowledge spillovers, and capital constraints (Hausmann & Rodrik, 2003; Rodrik, 2004). In this view, policy is reactive: it fixes inefficiencies in otherwise functioning markets.

However, this perspective is increasingly challenged. Mariana Mazzucato argues that the state is not merely corrective but constitutive, actively shaping technological trajectories and creating new markets (Mazzucato, 2013). This shifts the analytical focus from fixing failures to directing structural transformation.

The tension is consequential. If policy is primarily corrective, then firm-level interventions may suffice. If policy is market-shaping, then outcomes depend on system-wide coordination across technologies, institutions, and actors. Traditional industrial policy theory provides limited guidance on how such coordination is achieved in practice.

Institutions vs. Systems: The Developmental State Debate

The developmental state literature resolves part of this problem by emphasizing institutional capacity and discipline. Peter Evans' concept of *embedded autonomy* highlights the need for bureaucracies that are both insulated from capture and deeply connected to industry (Evans, 1995). Empirical studies of East Asia reinforce the importance of export discipline, performance monitoring, and coherent policy sequencing (Amsden, 2001; Wade, 1990).

However, this literature introduces another limitation. While it explains how states discipline firms, it does not fully explain how technological and industrial systems are structured. Institutional capacity alone cannot account for why some countries successfully enter high-value technological domains while others remain locked in low-value segments.

Thus, a second tension emerges: are institutions sufficient to explain industrial success, or do outcomes depend on deeper technological and systemic structures?

Global Value Chains and the Constraints of Integration

The global value chain (GVC) literature shifts attention from national systems to transnational production networks. Gary Gereffi and colleagues show that firms operate within hierarchically organized chains in which upgrading opportunities depend on positional advantages and governance structures (Gereffi et al., 2005).

This perspective challenges both national champion and developmental state approaches. If value creation is distributed across global networks, then national policies aimed at building fully integrated champions may be misaligned with the realities of fragmented production.

Yet GVC theory has its own limitations: it explains how firms upgrade within existing structures, but not how countries reshape those structures or build new technological capabilities. It is analytically strong on constraints but weaker on transformation.

Critiques and Conditionality of National Champion Policies

A substantial body of literature highlights the risks associated with national champion strategies. Industrial concentration has been linked to increased corruption and rent-seeking (Ades & Di Tella, 1997), while critics argue that such policies may function as disguised protectionism (Hemphill & White, 2013).

Empirical evidence suggests that outcomes depend critically on institutional quality and governance structures. Without performance discipline, time-bound support, and exposure to competition, national champion policies tend to produce inefficient firms with limited global competitiveness (Falck et al., 2011).

Accordingly, the literature converges on a conditional conclusion: national champion strategies succeed only under specific institutional and competitive conditions. However, it remains less clear how these conditions interact within broader industrial systems.

Ecosystems, Stacks, and Symbiosis

Recent advances in industrial analysis shift the unit of inquiry from firms and sectors to systems of interdependent capabilities. The innovation systems literature provides the foundational framework for this shift. Bengt-Åke Lundvall and Richard Nelson conceptualize innovation as a systemic process involving interactions among firms, universities, and public institutions, emphasizing learning, coordination, and institutional complementarities (Lundvall, 1992; Nelson, 1993). Extending this perspective, Franco Malerba highlights how sectoral systems of innovation vary across industries depending on technological regimes, demand conditions, and institutional structures (Malerba, 2002).

However, this literature largely treats industrial systems as relational networks, under-specifying hierarchical technological dependencies. Not all components of an industrial system are equal; control over specific technological layers—such as semiconductors, operating systems, or energy infrastructure—confers disproportionate strategic advantage. This creates a critical analytical tension: innovation systems explain interaction but not hierarchy, while emerging stack perspectives explain hierarchy but under-specify governance and coordination.

Recent work on techno-industrial architectures addresses this gap by conceptualizing production systems as layered “stacks.” Kamiya (2026) develops the notion of a techno-electric stack, linking energy systems, critical materials, digital infrastructure, and industrial production into an integrated hierarchy. Within such systems, competitive advantage derives not from dominance in a single sector, but from strategic positioning across interdependent technological layers.

At the spatial level, industrial symbiosis and cluster-based approaches provide complementary micro-foundations for system efficiency. Empirical studies such as Sellitto et al. (2025) show that eco-industrial networks—characterized by resource sharing, co-location, and knowledge exchange—generate cost efficiencies, innovation spillovers, and resilience. These dynamics reinforce the importance of spatial coordination and network density in shaping industrial performance.

Policy-oriented research further operationalizes these insights. The Organization for Economic Co-operation and Development *Science, Technology and Innovation Outlook* conceptualizes competitiveness as emerging from industrial ecosystems composed of firms, suppliers, research institutions, finance, infrastructure, and skills systems (OECD, 2025). From this perspective, firm performance is contingent on the depth and coordination of the surrounding ecosystem, shifting the focus of industrial policy from firm-level support to system-level capability building.

Taken together, these literatures converge on a common insight: industrial competitiveness is systemic, technologically hierarchical, and network-dependent. However, the literature remains analytically fragmented. Innovation systems research emphasizes interaction but under-specifies technological hierarchy; stack approaches explain strategic control points but devote less attention to governance and coordination; and industrial symbiosis research explains spatial spillovers without fully accounting for national industrial strategy. The ESS framework integrates these dimensions into a unified analytical structure.

Research Gap and Analytical Positioning

Existing literature provides partial but incomplete explanations of industrial transformation.

Table 1: Literature Gaps and Analytical Positioning

Literature	Main Strength	Key Limitation for National Champion Policy
Traditional national champion theory	Explains state support and scale	Too firm-centric; weak on ecosystems
Developmental state literature	Explains state capacity and discipline	Limited treatment of technological architectures
Industrial policy literature	Identifies market failures and coordination needs	Often lacks system-level integration
Ecosystem literature	Explains relational embeddedness and networks	Weak on hierarchy and strategic prioritization
Techno-electric stack literature	Explains technological control points	Weak on governance and spatial coordination
Industrial symbiosis literature	Explains spillovers and clustering	Weak on firm emergence and national strategy

This fragmentation motivates the need for an integrated framework.

Accordingly, this paper proposes the **Ecosystem–Stack–Symbiosis (ESS) framework**, which synthesizes these perspectives into a unified analytical structure. The ESS framework integrates institutional capacity, firm capabilities, industrial ecosystems, technological hierarchies, and spatial-industrial dynamics to explain how national and industry champions emerge within coordinated systems rather than through isolated firm-level support.

ANALYTICAL FRAMEWORK: THE ESS FRAMEWORK

The Ecosystem–Stack–Symbiosis (ESS) Framework provides a system-level explanation of how national champions emerge. It reconceptualizes industrial policy from firm-level intervention to system construction, where competitive firms arise from aligned institutional, technological, and network conditions.

The ESS framework is not intended as a universal model applicable across all contexts. Its effectiveness depends upon several enabling conditions, including minimum administrative capability, opportunities for technological learning, ecosystem depth, and sufficient domestic or export-market scale. Very weak institutional environments may lack the governance capacity required for effective implementation, suggesting that institutional reform itself may need to precede industrial policy interventions.

Conceptual Overview

The ESS framework integrates three complementary dimensions:

- Ecosystems: Institutional and economic networks linking firms, suppliers, finance, infrastructure, skills, and research systems
- Stacks: Layered technological systems (e.g., energy, semiconductors, AI, manufacturing) where competitive advantage depends on control of key nodes
- Symbiosis: Spatial and networked industrial organization, including clusters, co-location, and inter-firm collaboration

Within the ESS framework, stack positioning refers to the strategic location of firms and economies within layered technological systems where control over specific nodes generates disproportionate competitive

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advantage. Competitive selection refers to the process through which market competition, export exposure, and performance discipline determine which firms successfully scale within ecosystems. Symbiotic coordination refers to network relationships among firms and institutions that generate spillovers, learning effects, and collective efficiency gains.

These dimensions shift the focus of industrial policy:

From *supporting firms* → to *structuring systems in which firms compete and emerge*

National champions are therefore system outcomes, not policy inputs.

Functional Sequencing Logic

The ESS framework operates through a stage-based causal sequence:

Institutions → Capabilities → Ecosystem → Stack → Symbiosis → Selection → Champions

Each stage performs a distinct function:

- Institutions: Establish governance, discipline, and coordination
- Capabilities: Enable firm-level learning and technological absorption
- Ecosystem: Builds the broader production and innovation environment
- Stack: Positions the economy within strategic technological layers
- Symbiosis: Generates spillovers through clustering and networks
- Selection: Applies competitive discipline (especially export exposure)
- Champions: Emergent firms achieving global competitiveness

The sequencing is critical: misordering produces predictable failure modes (e.g., premature firm support → rent-seeking; weak ecosystems → stranded investments).

The ESS framework is not a rigid chronological model. It represents a functional sequencing logic rather than a strictly temporal progression. Institutional capacity and capability formation operate as prerequisite conditions. Ecosystem formation, stack positioning, and symbiotic clustering function as mutually reinforcing system-building processes, rather than discrete stages. Competitive selection mechanisms determine which firms emerge as national or industry champions within this system. Thus, the framework combines hierarchical dependencies with iterative feedback loops, rather than a linear policy sequence.

Core Components of the ESS Framework

Figure 1. The Ecosystem–Stack–Symbiosis (ESS) Framework

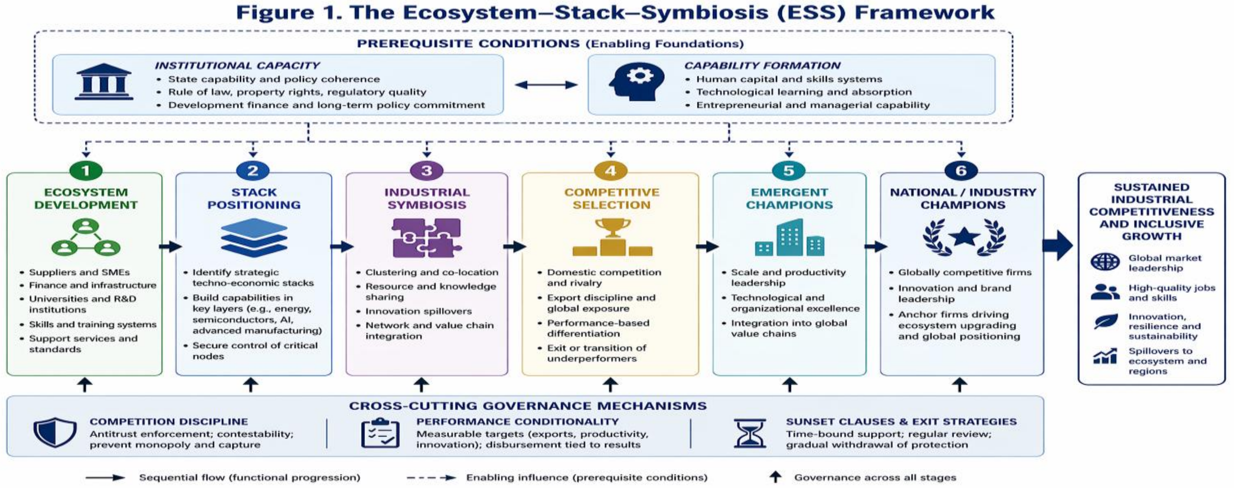

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Figure 1 illustrates the ESS framework as an integrated system of institutional sequencing, technological positioning, and industrial coordination. Institutional capacity and capability formation operate as foundational conditions enabling ecosystem construction, strategic stack positioning, and industrial symbiosis. Competitive selection mechanisms then determine which firms successfully scale into national or industry champions. Governance mechanisms—including competition discipline, conditionality, transparency, and sunset clauses—operate across all stages to reduce capture and dependence on subsidy. The framework is not strictly linear. Feedback loops exist across stages: successful firms deepen supplier ecosystems, strengthen innovation capacity, and reinforce technological specialization over time.

Ecosystem Foundations

Drawing on the OECD (2025), industrial competitiveness depends on dense, coordinated ecosystems. Policy must target system-wide bottlenecks—skills, logistics, finance, and innovation—rather than isolated firms.

Stack Targeting

Building on Kamiya (2026), competition occurs across interdependent technological layers. Industrial policy should prioritize strategic stack positions rather than discrete sectors.

Symbiotic Networks

As shown by Sellitto et al. (2025), clusters and industrial symbiosis generate spillovers, efficiency, and innovation. Anchor firms emerge from these networks rather than being administratively constructed.

Propositions

The ESS framework advances four core propositions:

1. **System Primacy**

   Industrial outcomes are determined by system alignment, not firm-level support.

2. **Sequential Dependence**

   Each stage conditions the next; mis-sequencing reduces effectiveness.

3. **Emergent Champions**

   National champions arise from structured competition within ecosystems.

4. **Stack-Based Competition**

   Long-term advantage depends on positioning within technological systems, not sectors.

DETERMINANTS OF SUCCESS AND FAILURE IN NATIONAL CHAMPION POLICY

The literature reviewed above identifies a recurring set of conditions that shape whether industrial policy produces globally competitive firms or protected inefficiency. Within the ESS framework, these conditions operate not as isolated variables but as interdependent system determinants. Success depends on the alignment of institutional quality, firm capabilities, policy design, competition, political incentives, and integration across ecosystems and technological stacks.

Institutional Quality and Governance Capacity (Ecosystem Governance)

Institutional capacity is the foundational condition for effective industrial policy. States must be able to coordinate finance, skills, infrastructure, trade, and regulatory systems while maintaining sufficient autonomy to resist capture. Where bureaucratic capacity is weak, industrial policy tends to degenerate into patronage and rent allocation rather than productive transformation.

ESS link: Institutional quality forms the governance backbone of ecosystem construction and policy discipline.

Firm Capabilities and Learning Capacity (Preconditions for Emergence)

Firm size alone is not a reliable predictor of competitiveness. What matters is firms' ability to learn, absorb technology, upgrade organizational capabilities, and compete under pressure. Dynamic capabilities are therefore a precondition for successful scaling. Support for firms without learning capacity is unlikely to yield globally competitive outcomes.

ESS link: Capabilities determine which firms can effectively operate within ecosystems and ascend strategic stack positions.

Support Design and Performance Discipline (Discipline Mechanism)

The design of state support is as important as its scale. Successful interventions are conditional, time-bound, and linked to measurable performance outcomes such as exports, productivity growth, and technological upgrading. Unconditional and open-ended support weakens discipline and creates dependency.

ESS link: Support design functions as a cross-cutting discipline mechanism across all stages of the framework.

Domestic Competition and Contestability (Ecosystem Dynamics)

Traditional national champion strategies often prioritize scale through concentration. However, evidence suggests that structured rivalry, rather than monopoly, is more conducive to innovation and efficiency. Competitive domestic environments force firms to upgrade before global expansion, while contestability prevents incumbents from becoming complacent.

ESS link: Competition sustains dynamic evolution within ecosystems and improves selection quality.

Political Incentives (System Coherence)

Industrial policy succeeds where political incentives align with productivity, upgrading, and export performance. It fails where support is driven primarily by patronage, short-term politics, or protection of politically connected incumbents. Regime type alone is not decisive; what matters is whether governance structures reward performance and discipline failure.

ESS link: Political alignment determines whether ecosystem and stack development remain productivity-oriented or become politically distorted.

Ecosystem–Stack Integration (System Depth)

Competitiveness increasingly depends on how firms are embedded within industrial ecosystems and positioned across strategic technological layers. Firms operating without supplier depth, research linkages, infrastructure, or access to strategic technologies are unlikely to sustain competitiveness, even when protected or subsidized.

ESS link: This is the core integrative condition of the framework, linking ecosystems, stack positioning, and spatial coordination.

Synthesis: ESS Conditions for Success

The ESS framework suggests that national champion policy is most likely to succeed when:

- Institutions are capable and disciplined;
- Firms possess or develop dynamic capabilities;
- Support is conditional and time-bound.
- Competition and contestability are preserved;
- Political incentives reinforce performance, and
- Ecosystem–stack integration is achieved.

Failure emerges when one or more of these conditions are absent. The ESS framework organizes these determinants into a functional sequencing logic, providing the basis for the comparative illustrations that follow.

Transition to the ESS Model

These determinants become analytically meaningful when understood as interacting components within the ESS framework's system-level sequencing logic. The following section illustrates how different configurations of alignment and misalignment shape industrial outcomes across comparative cases.

ILLUSTRATIVE APPLICATIONS OF THE ESS FRAMEWORK

This section derives policy implications from the ESS framework, rather than prescribing a universal policy blueprint. It applies the Ecosystem–Stack–Symbiosis (ESS) Framework to selected country cases to demonstrate its explanatory and diagnostic value across different development pathways. The cases are illustrative applications rather than causal tests, chosen to highlight theoretically distinct configurations of system alignment and misalignment.

Case Selection Logic

The cases are selected for theoretical contrast, not representativeness, enabling comparison across alternative industrialization pathways:

- **South Korea**: Sequential, disciplined champion development under export competition
- **China**: Large-scale ecosystem construction combined with techno-electric stack targeting
- **Germany**: Ecosystem-driven industrial strength without explicit national champion policy
- **France, United Kingdom, Argentina**: Cases of sequencing failure, where support preceded system readiness

Each case is evaluated across six ESS dimensions:

Institutions, firm capabilities, ecosystems, stack positioning, symbiosis, and competitive selection.

South Korea: Disciplined Sequencing and Export-Led Selection

South Korea represents one of the clearest approximations of ESS sequencing. The state initially prioritized institutional capacity and export discipline, and conditioned support for large conglomerates (chaebol) on measurable performance outcomes.

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Between 1965 and 1990, South Korea's exports grew from less than $200 million to over $65 billion, with firms such as Samsung and Hyundai emerging as global competitors. Crucially, access to subsidized credit was tied to export targets, and underperforming firms faced withdrawal of support.

From an ESS perspective:

- **Institutions:** strong bureaucratic coordination and discipline
- **Capabilities:** rapid firm-level learning through export exposure
- **Ecosystem:** dense supplier networks in electronics and automotive sectors
- **Stack:** gradual upgrading from assembly to advanced manufacturing (e.g., semiconductors in the 1980s)
- **Symbiosis:** clustering in industrial zones such as Ulsan

The key insight is that support followed capability formation and was continuously disciplined by global competition, preventing the emergence of protected but inefficient incumbents.

China: Large-Scale Ecosystem and Stack Construction

China represents a different pathway, emphasizing simultaneous ecosystem construction and stack positioning. Since the 2000s, China has invested heavily in strategic sectors such as telecommunications, high-speed rail, and renewable energy.

For example:

- China now accounts for over 70% of global solar panel production,
- Firms like Huawei invested over $20 billion annually in R&D by the early 2020s
- High-speed rail expansion exceeded 40,000 km, creating domestic scale advantages.

From an ESS perspective:

- **Institutions:** strong state coordination with evolving market mechanisms
- **Capabilities:** rapid technological absorption and indigenous innovation
- **Ecosystem:** extensive supplier and research networks
- **Stack:** targeted control of strategic layers (5G, batteries, AI)
- **Symbiosis:** large-scale industrial clusters (e.g., Shenzhen)

Unlike South Korea, China pursued parallel rather than strictly sequential development, but still aligned system components.

Germany: Ecosystem Strength Without Explicit Champions

Germany demonstrates that ESS alignment can emerge without an explicit national champion policy. Its strength lies in coordinated industrial ecosystems, particularly the Mittelstand.

Evidence includes:

- Manufacturing accounts for ~20% of GDP, significantly above OECD averages

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- Germany maintains a persistent trade surplus in high-value manufacturing sectors.
- Strong integration between firms, vocational training systems, and research institutes

From an ESS perspective:

- **Institutions:** strong coordination via industry associations
- **Capabilities:** highly skilled workforce and incremental innovation
- **Ecosystem:** dense SME–large firm linkages
- **Stack:** specialization in advanced manufacturing niches
- **Symbiosis:** regional clusters (e.g., Baden-Württemberg)

The case shows that system-level coordination can substitute for the selection of an explicit champion.

Sequencing Failures: France, United Kingdom, Argentina

Failure cases highlight the diagnostic power of the ESS framework, particularly in identifying mis-sequencing and system misalignment.

Table 2: Comparative ESS Diagnosis of Failure Cases

Case	Institutions	Capabilities	Ecosystem	Stack Positioning	Symbiosis	Selection	Outcome
French Computers (Plan Calcul)	Misaligned	Weak	Underdeveloped	Mis-targeted	Limited	Absent	Failure
UK Car Industry	Weak	Eroding	Fragmented	Stagnant	Weak	Distorted	Collapse
Argentina SOEs	Unstable	Absent	Dismantled	Absent	None	Absent	Insolvency

France (Plan Calcul)

- Heavy investment in computing without a competitive ecosystem
- Limited global market penetration despite state backing

United Kingdom (Automotive, 1970s–80s)

- Declining productivity and global competitiveness
- Fragmented supply chains and weak industrial coordination
- Repeated state support without sustained performance discipline

Argentina (State-Owned Enterprises)

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- Persistent protection without export discipline
- High fiscal costs and low productivity

Cross-Case Insight

Across all failure cases:

- Capabilities were underdeveloped before support.
- Ecosystems were weak or fragmented.
- Selection mechanisms were absent or politicized.

The consistent pattern is that support without system alignment produces inefficiency rather than competitiveness.

Table 3 summarizes the comparative cases across ESS dimensions, illustrating how differences in institutional quality, ecosystem depth, stack positioning, and competitive selection shape divergent industrial outcomes.

Table 3. Comparative Illustration of the ESS Framework Across Cases

Case	Institutions	Capabilities	Ecosystem	Stack Positioning	Symbiosis	Selection Discipline	Outcome
South Korea	Strong, disciplined developmental state	Rapid firm learning under export pressure	Dense supplier and industrial networks	Progressive upgrading into electronics and semiconductors	Strong clustering in industrial zones	High, especially export discipline	Successful emergence of global champions
China	Strong state coordination with evolving market mechanisms	Fast technological absorption and scaling	Extensive supplier, research, and infrastructure networks	Strategic targeting of 5G, batteries, AI, renewables	Strong regional clustering, especially Shenzhen and coastal hubs	Mixed but significant, increasingly global	High success in multiple strategic sectors
Germany	Strong institutional coordination and vocational systems	High incremental innovation capacity	Deep SME–large firm integration	Strong specialization in advanced industrial niches	Robust regional clusters	Strong market discipline	Industry champions without explicit champion policy
France (Plan Calcul)	State-led but insufficiently adaptive	Weak commercial capability development	Underdeveloped support ecosystem	Mis-targeted positioning	Limited cluster depth	Weak	Failure
UK Cars	Weak coordination and declining industrial discipline	Eroding capabilities	Fragmented supply chains	Stagnant technological positioning	Weak clustering effects	Distorted by repeated support	Collapse
Argentina SOEs	Politically unstable and weakly disciplined	Limited technological learning	Weak and fragmented industrial ecosystem	Minimal strategic positioning	Weak inter-firm coordination	Low competitive discipline	Persistent inefficiency and fiscal dependency

Analytical Synthesis

The case evidence reinforces three core ESS insights:

1. **Sequencing determines outcomes**

   Successful cases follow system-first, firm-later trajectories; failures reverse this order.

2. **Selection is indispensable**

   Competitive discipline—especially export exposure—is the mechanism through which systems produce globally competitive firms.

3. **System alignment is multiplicative.**

   Weakness in any ESS dimension—institutions, capabilities, ecosystems, stack positioning, or symbiosis—undermines overall performance**.**

OPERATIONALIZING THE ESS FRAMEWORK

The ESS framework implies a shift from firm-centric intervention to system-centric industrial policy. Its practical value lies not in prescribing a universal template, but in identifying the functional conditions under which national champion strategies are more likely to succeed.

The ESS framework should not be interpreted as requiring simultaneous implementation of all components. Industrial transformation typically occurs under conditions of resource scarcity, administrative constraints, and political trade-offs. Consequently, policymakers should prioritize interventions according to existing capabilities and development stages rather than attempting comprehensive system construction from the outset.

Core Policy Implications

First, industrial policy should be ecosystem-wide rather than firm-specific. Governments should invest in supplier networks, SME upgrading, skills systems, research institutions, infrastructure, finance, and innovation platforms. This reduces the risk of capture while broadening the pool of capabilities from which competitive firms can emerge.

Second, policy should target strategic technological layers rather than broad sector labels. In practice, this means identifying critical nodes—such as semiconductors, batteries, AI, digital infrastructure, and advanced manufacturing systems—where domestic capability-building can yield a durable advantage.

Third, governments should promote industrial symbiosis and cluster formation. Geographic clustering, eco-industrial parks, technology centres, and coordination platforms improve knowledge exchange, resource efficiency, and innovation spillovers.

Fourth, support for large firms should remain conditional, temporary, and performance-based.

Fifth, competition and contestability must be preserved. National champions should emerge from rivalry and disciplined selection rather than from monopoly protection.

Functional Sequencing and Policy Prioritization

The ESS framework operates through a functional sequencing logic in which institutional capacity and firm learning precede large-scale ecosystem and champion support. The central policy implication is that industrial transformation depends less on selecting firms ex ante than on constructing the institutional and technological conditions under which competitive firms can emerge.

Misalignment produces predictable failures. Premature firm protection encourages rent-seeking; ecosystem investment without absorptive capacity generates underutilized assets; and weak competition undermines effective selection. The sequencing problem is therefore fundamentally one of institutional coordination and timing of capabilities rather than subsidy scale alone.

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Stage-Based Policy Architecture

Stage 1: Institutional Capacity Building

Governments strengthen bureaucratic capability, development finance, competition policy, and skills systems.

Stage 2: Capability Formation

The policy focuses on technology transfer, training, and firm learning, expanding the pool of viable firms rather than prematurely selecting champions.

Stage 3: Ecosystem Construction and Stack Targeting

Public investment supports supplier development, R&D systems, infrastructure, clusters, and strategic entry into technological layers and global value chains.

Stage 4: Conditional Champion Support

Only after capabilities and ecosystems are established should targeted firm support be introduced. Such support should be temporary, transparent, reviewable, and tied to performance.

Stage 5: Global Integration and Competitive Consolidation

Firms must compete in export markets, integrate into global value chains, and participate in international innovation systems. International competition acts as the final selection mechanism.

A Simplified Illustrative Application: Battery Manufacturing

The ESS framework may be illustrated through the example of battery manufacturing.

A government seeking to develop a domestic battery champion would not begin by directly subsidizing a single firm. Instead, the ESS framework implies a staged approach. First, institutional capacity would be strengthened through industrial coordination agencies, development finance mechanisms, technical standards, and trade policy alignment. Second, capability formation would focus on engineering skills, technical training, university research, and technology partnerships.

Third, ecosystem construction would support mineral processing, supplier development, logistics infrastructure, electricity reliability, and specialized industrial parks. Fourth, stack positioning would target strategic segments of the battery value chain, such as cathode materials, battery management systems, or grid-storage technologies, rather than attempting immediate dominance across the entire global industry.

Fifth, industrial symbiosis would encourage clustering among battery firms, chemical suppliers, recycling facilities, logistics providers, and research institutions. Only after these conditions are established would direct support for large firms become appropriate.

Competitive selection would then occur through export performance, technological upgrading, cost competitiveness, and integration into global supply chains. Under this approach, national champions emerge from coordinated industrial systems rather than from premature administrative designation.

Governance and Accountability Architecture

Governance must be stage-contingent because policy risks vary across stages.

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Table 4: Stage-Specific Governance Mechanisms

Stage	Primary Risk	Governance Mechanism	Duration
Institutional building	Political capture	Independent reform bodies; legal mandates; external oversight	Long-term
Capability formation	Rent-seeking in selection	Transparent criteria; published decisions; appeals mechanisms	Continuous
Ecosystem construction	Cost overruns; coordination failure	Competitive procurement; independent infrastructure authorities	5–7 years
Champion support	Subsidy dependence	Performance conditionality; independent monitoring; sunset clauses	3–5 years
Global integration	Trade disputes	Compliance monitoring; diplomatic coordination	Ongoing

A key principle is that ecosystem investments require longer horizons than firm-specific support. Infrastructure and ecosystem development generate collective returns over time, while firm support must remain shorter-term to preserve discipline.

Key Governance Insight

Sunset clauses must differ by policy type:

- Ecosystem investments require longer horizons (5–7 years) due to collective returns.
- Firm-level support must be shorter (3–5 years) to enforce discipline and prevent dependency.

Competition and Global Constraints

The ESS framework resolves the tension between scale and competition through coordinated rivalry. Multiple firms should compete within strategic sectors wherever possible; where concentration is unavoidable, contestability, sunset clauses, and antitrust review become essential.

Implementation challenges are likely to be particularly significant in developing economies characterized by weak institutions, limited fiscal space, and fragmented industrial structures. Under such conditions, governments may be unable to pursue simultaneous ecosystem and stack development strategies. A more realistic approach may involve phased capability accumulation through selective entry into narrow technological niches, supplier upgrading, and gradual integration into existing global value chains. Industrial policy in such environments should therefore prioritize institutional strengthening and capability development before attempting large-scale champion strategies.

At the same time, industrial policy operates under global constraints. Late-industrializing economies cannot replicate entire technological stacks at once. Their realistic task is strategic positioning through niche specialization, supplier upgrading, and gradual movement into higher-value layers of global production systems. Trade rules and geopolitical fragmentation further require industrial policy to rely less on blanket protection and more on compatible tools such as R&D support, skills formation, infrastructure investment, and strategic coordination.

LIMITATIONS AND FUTURE RESEARCH

Consistent with its theory-building orientation, the paper prioritizes conceptual integration over causal estimation. This paper has several limitations that point to future research priorities.

First, the framework is primarily theory-building, supported by illustrative case studies rather than systematic empirical testing. The case selection (successful East Asian and European cases, failure cases from Europe and South America) is not representative. Future research should apply the framework to a larger, systematically selected sample, including intermediate outcomes and less-studied regions (e.g., Africa, Latin America, Southeast Asia).

Second, the proposed diagnostic tools (Institutional Readiness Index, Firm Capability Diagnostic) are conceptual. Future research should operationalize them with specific indicators, data sources, and scoring protocols to test the framework's predictive power.

Third, the causal claims require stronger identification. While the case studies are consistent with the framework's sequential logic, they cannot definitively rule out alternative explanations. Industrial outcomes may also reflect factors outside the ESS framework itself, including geopolitical alignment, commodity cycles, macroeconomic stability, trade access conditions, and historical path dependencies. Although the comparative illustrations are broadly consistent with ESS logic, future research should employ process tracing and comparative methods to isolate ESS mechanisms from competing explanations.

Fourth, the framework's scope conditions require specification. Its applicability to very low-income countries, very small economies, or resource-dependent states has not been tested. The Argentine case suggests that very weak institutional environments may render industrial policy infeasible altogether, but the threshold conditions remain unspecified.

Fifth, the framework is static in its current formulation. Future research should develop dynamic versions that incorporate feedback loops, policy-learning mechanisms, and adaptation protocols for external shocks (e.g., technological breakthroughs, geopolitical crises).

Operationalization and Future Empirical Testing

A major limitation of system-level industrial policy frameworks is the difficulty of translating conceptual relationships into measurable variables. While the ESS framework is primarily analytical and theory-building in orientation, its components are sufficiently structured to permit future empirical operationalization.

To strengthen analytical tractability, the ESS framework may be operationalized through measurable indicators across its principal dimensions. Institutional readiness may be proxied through indicators such as bureaucratic quality, regulatory effectiveness, and development finance capacity. Capability formation may be assessed using indicators such as R&D intensity, export sophistication, productivity growth, and technological learning. Ecosystem depth may be measured through supplier density, infrastructure quality, research linkages, and logistics performance. Stack positioning may be assessed through participation in strategic technological layers such as semiconductors, batteries, AI infrastructure, and advanced manufacturing systems. Such indicators enable the framework to be transformed into a structured comparative diagnostic tool in the future.

Future research can transform the framework into a comparative diagnostic and evaluative tool by constructing measurable indicators across each ESS dimension. Table 5 provides an illustrative operationalization structure.

Table 5. Illustrative Operationalization of the ESS Framework

ESS Dimension	Core Analytical Question	Illustrative Indicators	Potential Data Sources
Institutions	Can the state coordinate, discipline, and monitor industrial transformation?	Bureaucratic quality; regulatory effectiveness; development finance capacity; export-discipline mechanisms	World Governance Indicators; OECD; national industrial policy agencies

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Capabilities	Do domestic firms possess learning and upgrading capacity?	R&D intensity; patent activity; workforce skills; export sophistication; productivity growth	World Bank; WIPO; UNIDO; firm-level datasets
Ecosystem	Does the industrial environment support competitive scaling?	Supplier density; logistics quality; research institutions; infrastructure reliability; SME integration	World Bank Logistics Performance Index; OECD; national statistics
Stack Positioning	Is the economy positioned within strategic technological layers?	Share of high-value manufacturing; semiconductor participation; battery production; AI infrastructure; renewable-energy integration	UNCTAD; OECD STI Outlook; industry reports
Symbiosis	Are firms embedded within productive industrial networks and clusters?	Cluster density; industrial co-location; inter-firm collaboration; resource-sharing systems	Regional development agencies; industrial cluster databases
Selection Discipline	Are firms exposed to competitive pressure and performance monitoring?	Export exposure; subsidy conditionality; contestability; antitrust enforcement	WTO data; competition authorities; trade databases
Champion Emergence	Have globally competitive firms emerged?	Global market share; export growth; technological leadership; internationalization	Fortune Global 500; Forbes; industry databases

The framework can also support comparative scoring methodologies. Countries or sectors could be evaluated using weighted ESS indicators to identify system strengths, bottlenecks, and sequencing failures. Such an approach would permit:

- Cross-country comparison of industrial policy architectures;
- Sector-specific readiness diagnostics;
- Early identification of ecosystem weaknesses.
- Evaluation of national champion support programs; and
- Comparative analysis of industrial transformation trajectories.

Importantly, the ESS framework does not assume that all dimensions carry equal weight across sectors or development stages. Different industries may require distinct ecosystem configurations and stack priorities. Semiconductor ecosystems, for example, depend heavily on research intensity and supply-chain precision, whereas renewable-energy systems may rely more strongly on infrastructure scale, mineral access, and energy integration.

The framework, therefore, functions as a flexible analytical architecture rather than a rigid universal model.

CONCLUSION

From National Champions to National Champion Systems

This paper has argued that national champion strategies succeed not through firm-level support alone, but through alignment across institutions, capabilities, industrial ecosystems, technological hierarchies, and spatial-industrial coordination. The central implication is that national champions should be understood not as policy-selected inputs, but as system-generated outcomes.

The Ecosystem–Stack–Symbiosis (ESS) framework was developed to explain this process. Its value lies in three contributions. First, it synthesizes fragmented literatures on industrial ecosystems, techno-industrial stacks, and industrial symbiosis into a unified analytical structure. Second, it provides a functional sequencing logic that links institutional capacity, capability formation, ecosystem development, stack positioning, and competitive selection. Third, it introduces a stage-contingent governance architecture in which competition, conditionality, transparency, and sunset discipline act as safeguards against capture and dependency.

The comparative illustrations consistently show that industrial success depends on alignment across institutions, capabilities, ecosystems, technological positioning, and competitive discipline. For policymakers, this shifts the central question from which firm to support to which systems to build. Industrial policy must be ecosystem-based, technologically strategic, and governance-intensive. Premature champion support in weak institutional environments is likely to produce rent-seeking rather than competitiveness. By contrast, when governments build industrial ecosystems, target strategic technological layers, foster industrial symbiosis, and preserve competitive discipline, they improve the probability that globally competitive firms will emerge.

Beyond its conceptual contribution, the ESS framework also provides a foundation for future empirical and policy diagnostics. By operationalizing institutional quality, ecosystem depth, stack positioning, industrial symbiosis, and competitive selection into measurable indicators, future research can transform the framework into a comparative evaluative tool for industrial policy analysis. Such operationalization would enable cross-country comparison, sectoral readiness assessment, and empirical testing of sequencing dynamics across different development contexts. The ESS framework should therefore be interpreted as a diagnostic and heuristic architecture rather than a fully validated predictive model. Its principal contribution lies in integrating previously disconnected strands of literature and providing a structured basis for future empirical evaluation.

The broader implication is that industrial policy in the twenty-first century is increasingly about building national champion systems rather than merely backing national champion firms.

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