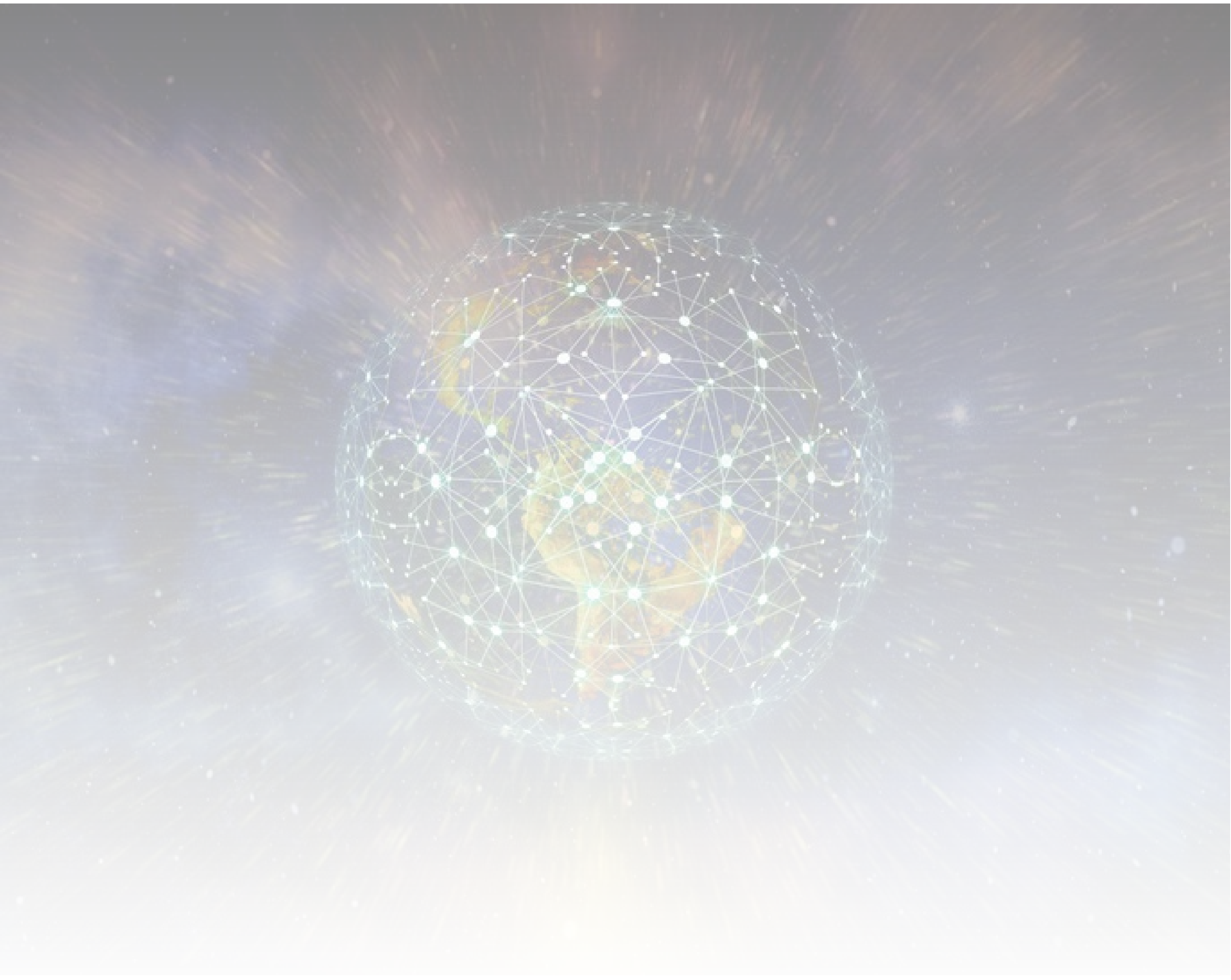
University of St.Gallen
Institute of Technology Management

Formulation and Implementation of Strategy in International Manufacturing Networks

Insights from Research and Practice



Foreword

This publication presents a collection of research findings connected to my doctoral studies investigating international manufacturing networks. At the core was the goal to better understand how strategy-making works in manufacturing networks. What started as a quick summary of my findings has evolved into this whitepaper, exploring key aspects of network strategy formulation and implementation.

Drawing on nearly two years of intensive research and nearly two exploratory years prior to that with leading multinational manufacturers, this work synthesizes insights from over fifty real-world cases spanning diverse industries and network architectures. The research has focused on developing practical frameworks and insights that operations managers can apply when formulating and implementing effective network strategies. The frameworks presented here have been tested and refined through application in the real world. However, since every company, business unit, and network is different, they are not universally applicable. They serve more as inspiration and a first draft rather than a prescriptive how-to guide.

Jointly working with you on various shorter and longer projects has been invaluable for my time at the Institute. I am deeply grateful to the people and their manufacturing organizations who have participated in this research. Their generosity in sharing operational insights, strategic thinking, and experiences has been instrumental in developing actionable guidance that reflects the realities of managing global manufacturing operations. More than that, they have made my time at the Institute of Technology Management at the University of St.Gallen an extraordinary learning experience.

This whitepaper represents an interim result rather than a conclusion. The landscape of international manufacturing continues to evolve with shifting geopolitical conditions, advancing technologies, and changing market demands. Thus, fortunately, my younger colleagues are blessed with new phenomena to investigate and explore. In the meantime, my time at the Institute has come to an end and in early 2026, I will embark on a new journey.

Karl Schalm
Chair of Production Management
Institute of Technology Management
University of St.Gallen

IMN Strategy

How can network managers formulate and implement an international manufacturing network strategy?

1. Executive Summary

International manufacturing networks (IMNs) have become essential to global competitiveness, processing 80% of global trade through interconnected value chains. While these networks offer substantial advantages, including knowledge sharing, capacity mobility, and production reconfiguration, they introduce significant complexity requiring capabilities beyond traditional factory management.

The St.Gallen Network Management Model

This systems theory-based framework emphasizes four interconnected elements: *global production strategy* (translating customer requirements into network capabilities), *network configuration* (determining location and structure of activities), *network coordination* (linking and supporting actitivites), and *fit* (achieving alignment between the network and its environment, among components, and within decisions).

A Five-Phase Strategy Process

An Effective network strategy follows a systematic procedure with five phases. *Assess* gathers business, market, and operational intelligence. *Design* translates insights into actionable configurations through scenario planning. *Align* synchronizes with corporate strategy and financial planning. *Deploy* transforms strategy into projects with defined KPIs and materializes results in the sites. *Operate* sustains improvements through governance and risk management.

Network Capabilities Framework

Successful IMN strategies focus on developing network-wide capabilities. These global capabilities can fall into two categories. *Operation capabilities* directly affect the value stream: structural and infrastructural inputs, operational and organizational synergy, flexibility, market access, and institutional environment advantages. *Orchestration capabilities* enable coordination: network management, knowledge generation, and market expansion. They together serve as direction-giving for the network and underlying decisions.

Six Strategic Phenotypes

The analysis of real-world networks identified six successful capability configurations. The *Downstream Differentiator* (large dispersed networks prioritizing market access and flexibility), the *Stable Synergist* (emphasizing economies of scale in stable environments), the *Stability Seeker* (leveraging institutional advantages for high-tech products), the *Flexible Forager* (combining input access with high flexibility), the *Upstream Utilizer* (focusing on input exploitation with proactive orchestration), and the *Pioneer* (emerging networks with high growth potential). Most successful networks exhibit no more than two core capabilities, revealing critical trade-offs between coordination and configuration.

Key Imperatives

To maximize IMN performance, managers should establish a dedicated network operating model with clear governance structures and coordination mechanisms. This approach requires implementing a comprehensive strategy process that spans from business strategy through to site-level execution, engaging stakeholders across marketing, controlling, logistics, and supply chain. Further, managers should actively explore future network scenarios while maintaining close alignment with corporate initiatives and financial planning. By investing in dedicated network management resources, they will significantly improve the crisis response capabilities and strategy execution. Most importantly, managers need to focus on developing network-wide capabilities that deliver competitive advantage. For that business requirements and product characteristics like value density or transportability must align seamlessly with the overall network strategy.

2. History and Status Quo of International Manufacturing Networks

"Management of an integrated global factory network is a challenge that manufacturing managers will be facing with increasing frequency. They need all the valuable lessons that they have learned about improving the operations inside individual factories and their supply chains but must also learn new ways of transferring knowledge between factories and crafting strategic charters for each factory in the network. "
Ferdows, 1997

Global trade has evolved from single factory operations to international manufacturing networks. These networks offer great potential but come at the cost of increased complexity. As a consequence, they require a distinct management approach.

Globalization of International Trade

Technological advancements, such as the railroad, modern container ships, and planes, accelerated the globalization of international trade in three waves. Beginning in the 1850s, firms mostly globalized by establishing sales locations and exporting from their home country. In the second wave, between 1930 and the 1980s, multinational firms established independent production locations abroad. They used their power and expertise generated in their home country to conquer new markets by acquiring existing local companies or founding new production sites.

The Rise of Manufacturing Networks

Starting in the 1980s, firms began connecting their independent sites into collaborative networks. As a consequence, investments between countries expedited. Foreign direct investments surged in the 1990s and have fluctuated since, with geopolitical and economic conditions (Figure 1). These investments made the transition from single sites to global networks possible.

Today, 80% of global trade is processed in global value chains, largely managed by international manufacturing networks (IMNs). Thus, they contribute significantly to global output and trade flows. As a consequence, for most firms and industries, global operations are a necessity rather than an option.

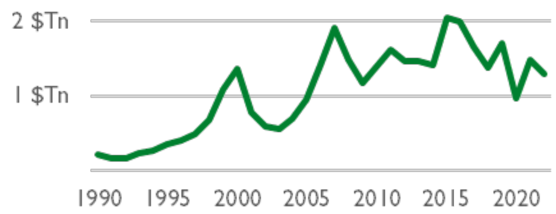


Figure 1: Global foreign direct investment flows

More Than the Sum of Its Parts

An IMN can be defined as a coordinated aggregation of intra-firm plants or factories located in different places. As such, it provides several advantages that go beyond single-site operations. Sites of the network can share knowledge about the ramp-up of new products or the deployment of new production technology. Standardizing IT systems or processes enables the mobility of capacities to adapt to dynamic environments. During periods of heightened trade barriers, such as recent tariff escalations, firms with networks can reconfigure production locations and value-chain steps to maintain competitiveness. These Opportunities come at the cost of increased complexity and interdependencies. Their management is a demanding task and, naturally, requires capabilities beyond traditional factory management.

3. Network Management and Strategy

Network management involves decisions across a wide array of categories, which must be aligned with corporate strategy and deliver improved production capabilities.

Network Management

An effective network management pursues consistency between its capabilities and policies and the desired competitive advantage. Competitive advantage arises from aligning the manufacturing and network strategy with corporate goals and the competitive environment. Policies are represented in choices made in different decision categories. Capabilities materialize themselves in the configuration and coordination of the network and are the result of strategic network initiatives.

Manufacturing Strategy

A network strategy is central to leveraging the network as a competitive advantage. Externally, manufacturing strategy requires alignment of production capabilities with market demands and corporate strategy. Internally, it acts as a guiding principle, aligning diverse plans and policies toward common objectives. Strategies may apply to the entire corporation, individual business units or partial subnetworks, depending on organizational structure. The manufacturing strategy, as a functional strategy, must align horizontally with other functions to ensure company-wide coherent decision patterns.

Decision Categories

Synchronizing and aligning a wide array of decisions requires a structured approach to decisions. For that, those can be broadly classified into two dimensions: structural elements, mostly influencing network configuration, and infrastructural elements, shaping operational mechanisms and coordination. Generally, seven key categories are considered within manufacturing strategy: process, capacity, facilities, vertical integration, organization and workforce, quality systems, and planning and control systems. The pattern of decisions in these categories retrospectively constitutes the manufacturing strategy. To guide decisions on configuration and coordination of the network and align these with the day-to-day work, most managers rely on tools and frameworks.

Plant Role Models

To simplify and align site-level decisions in all seven categories, the concept of plant roles has emerged. This framework positions sites within a strategic matrix defined by two (or more) dimensions. Initial models included site competence and strategic site reason. Strategic site reason consists of access to low-cost production, access to skills and knowledge, and proximity to markets, while competence levels range from low to high, resulting in six distinct roles. Recent developments emphasize the company-specific nature of plant roles, requiring customization aligned with the IMN's strategic direction. Consequently, plant roles have evolved as a key instrument for network management and strategy implementation.

Strategy Implementation

Strategy implementation, defined as translating strategy into action, is challenging due to multidimensional and often conflicting objectives. Far from mechanistic, implementation is dynamic and iterative, involving complex HQ-plant interactions. Modern views distinguish intended from realized strategies, emphasizing a dual process: top-down cascading of goals and bottom-up adaptation through frontline insights. Balancing these approaches is critical. For that, in many firms, strategic initiatives are set up. Those are proactive undertakings that aim to improve or develop capabilities. Consequently, they link strategy formulation with tangible realization. To lay the foundation of network management and to structure the strategic process, a management framework is imperative.

The St.Gallen Network Management Model

The Model

The St.Gallen Network Management Model (Figure 2) approaches IMNs from a systems theory perspective with a contingency approach, i.e., the network must be analyzed holistically, and the environment of the network must be considered. The four core elements are global production strategy, network configuration, network coordination, and fit. The network analysis starts with understanding the business strategy and its implications. Then, the four network dimensions are considered. Finally, the network approach is broken down into individual site strategies.

Global Production Strategy

The global production strategy ensures the connection to the "outside world" and defines how the network aims to be more than the sum of its parts. It includes two elements:

The externally-facing production priorities help to translate customer requirements into target parameters for the network using an order qualifier/order winner logic. Network Capabilities are the internally-facing strategic guidelines for the network that result from the global configuration and coordination of the network.

Network Configuration

The configuration of a network describes the location, geographic dispersion, and structure of value chain activities in the multi-plant network with its corresponding sites.

Network Coordination

The coordination of a network describes the linking, integrating, managing, and organizing of globally distributed activities in the network or between sites to achieve the firm's strategic objectives.

Fit

Network managers must achieve fit on three levels to achieve satisfactory performance. First, fit must be achieved between the network and its environment. Second, fit must be achieved between the three parts (strategy, configuration, and coordination) of the network. Third, fit must also be considered between decisions in each network part.

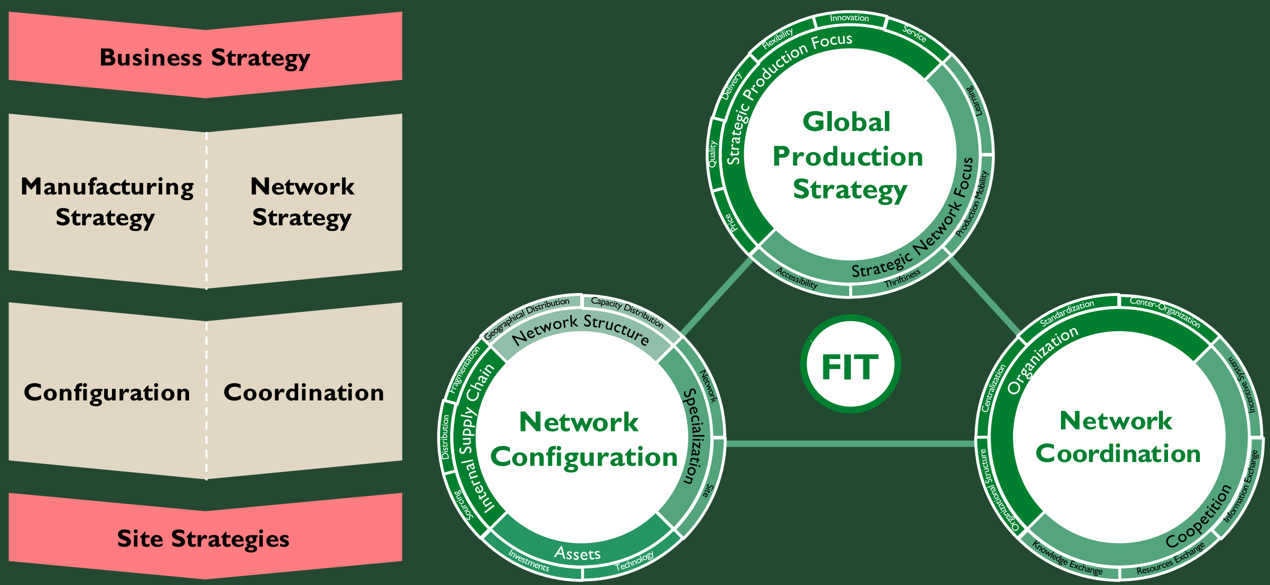


Figure 2: The St.Gallen Network Management Model

4. Strategy Process

Formulating and implementing a network strategy is a highly complex process requiring different departments to work together. Following a systematic procedure of phases secures success. Sustaining advantages gained by network improvement projects is based on a network operating model fit to one's organizational structure and business model.

The Network Strategy Process

The network strategy process generally resembles traditionally (corporate) strategy processes. However, the complexity of the network, interdependencies between sites and decisions, agency problems between HQ and sites, and subtle or delayed results of actions make the network process unique. Generally, to structure the process, four major aspects are considered: point of entry, participation, project and process management, and the procedure. Additionally, the temporal perspective of strategy formulation and implementation defines when which activities are taking place.

Point of Entry

Strategy formulation can be triggered through ordinary or extraordinary events. Ordinary events include regular cycles, such as annual or multi-year strategy reviews, minor updates to higher-level strategies, and routine checks for misalignment. Extraordinary events arise either within operations, such as weak demand or changes in labor costs, tariffs, or exchange rates, or outside operations, including shifts in corporate strategy, management changes, restructuring projects, or poor company performance. These events often necessitate immediate or significant updates to the network strategy.

Participation

Participation in the network strategy process varies across firms and depends on organizational structure and scope. In the assess phase, network management leads the analysis of strategic context, supported by top management, product management, sales, and cross-functional expert teams. It should be noted that what constitutes network management differs from firm to firm. It can be a department or a single person regularly working on the network. In other cases, the network management is a loosely aggregated group of (project) managers, who work on network topics with a mandate from the (top) management. The design phase is driven by network management and cross-functional teams, with involvement from top management (COO or executive board) and, in larger projects, regional or divisional heads; site managers typically act as informants. The align phase involves network management, finance, and strategic managers, with additional departments engaged when initiatives intersect with major projects such as IT rollouts. During the deploy phase, network management oversees implementation, while sites and, in decentralized structures, regional management play a central role. Finally, the operate phase focuses on sustaining improvements and coordinating daily operations, primarily involving network and site management.

Project and Process Management

Project and process management of network strategy varies across firms, influenced by the allocation of tasks between the deploy and operate phases. Two time-frames shape the process: annual strategy cycles for incremental updates and multi-year cycles (typically three to five years) for major revisions, with extraordinary events potentially triggering deviations. While the first year emphasizes assessment and design, later cycles focus on deployment, adaptation, and global rollout of initiatives. The network operating model remains relatively stable, defining governance structures and meeting routines, and its sophistication reflects network management maturity. Resource allocation is critical: firms with dedicated network teams and standardized tools manage deployment more effectively, whereas organizations relying on ad-hoc staff positions often struggle due to competing priorities and limited capacity. Well-structured teams enhance efficiency, flexibility, and the institutionalization of routines for continuous improvement.

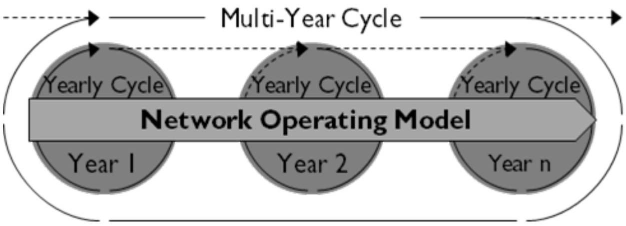


Figure 3: Strategy Cycle and Network Operating Model

Procedure

The network strategy process comprises five phases: assess, design, align, deploy, and operate. Thereby, it extends traditional strategy formulation and implementation due to the complexity of international manufacturing networks.

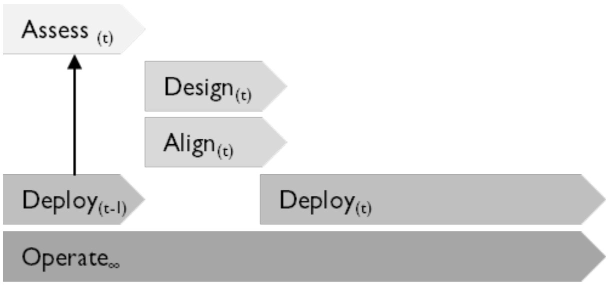


Figure 4: Strategy Formulation and Implementation Procedure

Assess

The assess phase prepares the network strategy cycle by collecting and analyzing relevant information from business, market, and operations. It involves understanding the current business model, financial requirements, customer needs, market projections, and auditing corporate and functional strategies. Additionally, it reviews previous strategic initiatives and operational guidelines to establish a foundation for footprint design and subsequent strategy development. Further, key stakeholders should be involved early to evaluate the playing field of the strategy exercise.

Design

The design phase translates strategic insights from the assess phase into actionable network strategy content. It begins by converting customer and market requirements into network design requirements, using network capabilities as a central framework. Firms ideate strategic options such as footprint configurations, plant roles, and coordination structures, often subdividing the network to reduce complexity and enable clearer product allocation. Scenario planning or variant generation is employed to evaluate multiple configurations under varying external conditions, while risk management has become an integral component of this phase. After ideation, concepts undergo feasibility assessments or business case evaluations, including cost scenario analyses for factors like labor, tariffs, and transportation. Afterward, the most promising concepts are elaborated in more detail. Once a viable option is selected, prioritization and roadmap development organize projects and initiatives into a temporal sequence. Finally, implementation plans detail site-level implications and break down complex strategies into manageable projects, ensuring readiness for deployment.

Align

The align phase runs parallel to design and ensures that the network strategy is synchronized with corporate initiatives, financial planning, and operational requirements. Multiple loops of design and align can arise if initial ideas can not be aligned with the general development trajectory of the firm. Strategic alignment involves integrating company-wide projects, such as innovation or technology transitions. In contrast, financial alignment addresses growth forecasts and capital expenditure plans or budgets for investments in factories, machinery, and IT. Operational alignment focuses on short-term budgeting and defining the network operating model, including logistics, R&D, and cross-unit site coordination.

Deploy

The deploy phase translates network strategy into actionable initiatives and projects. It begins with planning, where strategic concepts are broken down into configurational and coordinational initiatives, site-specific strategies, and associated KPIs. Execution involves project management setup, pilot implementations, and resource allocation, followed by systematic control through KPI reviews and site visits. Continuous adjustments are often required to address unrealized or emergent strategies, ensuring alignment with financial plans and stakeholder expectations.

Operate

The operate phase extends beyond traditional implementation by focusing on sustaining and integrating deployed strategies within the network. Its activities include governance and communication with stakeholders, establishing management infrastructure such as dashboards and global meeting structures, and facilitating knowledge exchange through institutionalized networks and operational excellence programs. Additionally, it encompasses continuous risk management and business continuity planning to address evolving internal and external threats, making this phase highly contingent on network maturity and organizational context. The decisions on how to operate the network constitute the network operating model.

Strategy Timing

An analysis of the temporal perspective of strategy formulation and implementation reveals that for different clusters. The heatmap (Figure 5) illustrates the quarterly intensity of the five strategic phases: assess, design, align, deploy, and operate for each cluster. Cluster 1 (12 firms, 27 sites on average) concentrates assessment in Q2 and Q3, with design and alignment peaking in Q3 and extending into Q4. Deployment and operation remain steady year-round, indicating decentralized execution. Cluster 2 (10 firms, nine sites on average) shows high, continuous activity across all phases and quarters. Design peaks in Q1, while deployment and operation intensify progressively, reflecting a centralized approach. Cluster 3 (5 firms, 37 sites on average) front-loads assessment and design in Q1 and Q2, followed by alignment in Q3. Deployment and operation persist throughout, though deployment dips during planning peaks, suggesting resource constraints. Cluster 4 (5 firms, 10 sites on average) is strongly front-loaded. Assessment and design dominate Q1 and Q2, while deployment spans all quarters. Operation remains low, indicating limited strategic capacity.

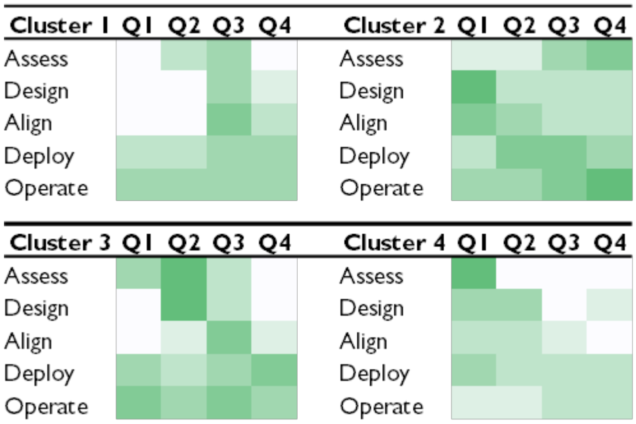


Figure 5: Strategy Timing Heatmap

Larger networks (Clusters 1 and 3) favor concentrated mid-year alignment, while smaller networks (Clusters 2 and 4) adopt continuous or early-year strategies. Timing reflects structural contingencies and resource allocation. Across all networks, deployment peaks in parallel to or directly after the design phase.

Synthesis and Recommendation

Operations managers should establish a network operating model consisting of the necessary tasks to run the network. In parallel, a strategy process for the network from business strategy to the sites should be established (assess, design, align, deploy, and operate). It should include vertical and horizontal strategic coordination and include the right participants for the organization. In terms of project management, depending on the overall organizational structure, a dedicated network management team, rather than relying on ad-hoc resources, can improve reaction time to a crisis and completeness of strategy implementation. Finally, the network strategy needs to fit into the timing of the overall strategy cycle of the company.

5. Strategy Content

IMNs require a distinct strategic approach focused on holistic network design and management. It should emphasize the development of unique, network-wide capabilities rather than solely investing in assets or individuals. These network capabilities, categorized into ones for the operation of the value stream and orchestration, materialize through configuration and coordination.

Strategy Content in IMNs

IMNs differ significantly from the traditional single-factory model, necessitating a distinct strategic approach. Firms must prioritize a holistic design and management of the networks to unlock substantial strategic benefits. Additionally, effective manufacturing strategies rely on unique capabilities rather than only investments into assets and specific individuals. As a consequence, network managers must plan and develop unique, network-wide capabilities.

Network Capabilities

Generally, a capability is composed of a routine, i.e., standard operating procedure, formal and informal process, rules, heuristics, and norms that enables an organization to carry out a particular task proficiently as a normal part of its business. Strategic network capabilities, specifically, are capabilities that result from the global configuration and coordination of the network. They provide a competitive advantage when better executed vis-à-vis their competitors. By assessing and describing the current state of these capabilities, manufacturers can causally explain how the current capabilities contribute to a firm's competitive advantage. By defining and describing the desired state of these network capabilities, manufacturers set the strategic targets for the entire network and its sites.

Hierarchy of Capabilities

State-of-the-art network capabilities can be categorized into two parts: capabilities that directly affect the value stream and configuration, as well as capabilities that affect the coordination. The former are coined *operation capabilities* and consist of structural and infrastructural inputs, operational and organizational synergy, flexibility, market access, and accessing institutional environments. The latter are named *orchestration capabilities* and include network management capabilities, knowledge generation, and market expansion. Their relationship is shown in Figure 6. Operation capabilities work together and are centered around the value stream from inputs, over manufacturing, with a trade-off between synergy and flexibility, to market access. This stream is characterized by a flow of goods. The organizational synergy is connected to the production process. Institutional environment influences the manufacturing-market interface. However, both are not flows of goods, but rather (financial) resources and information.

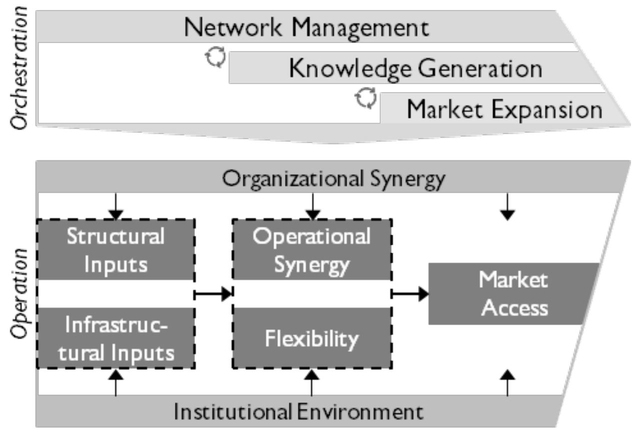


Figure 6: Network Capabilities Framework

Network Operation Capabilities

Operation capabilities include accessing structural and infrastructural inputs, achieving operational and organizational synergy, achieving flexibility, market access, and accessing institutional environments. The sub-components are described in the following.

Structural inputs include accessing of best cost labor, as well as sourcing with low-cost and sourcing with high quality or high tech. All inputs are more short-term in nature and affect the daily operation planning. Infrastructural inputs include accessing skilled labor, accessing production and location factors, low-capital costs, and technologies. They connect and directly empower the creation of goods based on structural inputs. They are not part of the daily operations planning and require a larger planning horizon. Furthermore, they are more closely related to CapEx. *Infrastructural inputs* are more immobile than structural inputs, which can to a higher degree be sent between sites. Together, structural and infrastructural inputs form the input factors of the operation. *Flexibility* includes the mobility of products, processes, resources, personnel, volumes, and orders, as well as sourcing with short lead times. Capabilities in the flexibility category allow the network to react to changes in requirements with little penalty in time or cost. Mobility builds on standards in the network to allow for a swift transfer between sites. Sourcing with short lead times supports flexibility by allowing for a quick gathering of the externally dependent resources for changed orders. *Operational Synergy* consists of economies of scale and economies of scope. It deals with efficiency in the direct area of the sites. They are generally built on allocation rules in the network and therefore require a pooling of the same or similar products in a site. Operational Synergy can require trade-offs with flexibility or other capabilities in terms of dispersion and order allocation or multiplant strategy. *Market Access* includes accessing markets and customers as well as reducing transportation costs. Market access requires a great dispersion of sites and might contradict the target locations required for sourcing or input factors. *Institutional Environment* includes adhering to or overcoming trade restrictions, reducing tariffs, exploiting a beneficial political environment or exchange rates, exploiting made-in labels, other image factors, or local content requirements, or exploiting tax benefits or subsidies. The relevance of the individual capabilities depends strongly on the context. Most are more downstream-facing as they are relevant from the customer's point of view. *Organizational Synergy* includes integrating or co-locating functions as well as reducing overhead redundancies. It deals with efficiency in the indirect area of sites. The overall concept of centralizing or decentralizing functions such as purchasing, quality, R&D, etc., enables or disables organizational synergy.

Network Orchestration Capabilities

Orchestration capabilities include network management capabilities, knowledge generation, and market expansion. The sub-components are described in the following. *Market Expansion* includes developing new markets and customers, and developing new or adapting existing products to local markets. It is tied to expanding the business, sales strategy, and product portfolio. Here, investments in dispersion need to be valued against the risks of a sub-optimal network in case of non-realization of market success. *Knowledge Generation* includes engaging and understanding customers, generating information, and generating knowledge. In the case of customers or competitors, this includes external information and knowledge. For internal knowledge, it means collecting successful practices in production, investments, organizational setups, or technology. It can be facilitated via the flow of people or information in databases. *Network management* includes risk management, sharing or distributing knowledge, achieving ease of network management, reducing network complexity, sustainability and distributing technologies. These tasks influence other capabilities are are closely tied to the network management philosophy as well as the organizational setup of the network management.

Synthesis and Recommendation

Managers must adopt a holistic approach to network design and governance. First, the strategy should emphasize the development of network-wide capabilities rather than isolated investments in assets or personnel. Second, capability development requires long-term planning, particularly for infrastructural inputs and organizational synergy, which are less mobile and more capital-intensive. Finally, orchestration capabilities should be leveraged to reduce complexity, foster knowledge sharing, and support market expansion, ensuring that the network remains adaptive and competitive in dynamic global environments.

6. Strategy Phenotypes

Managers must strategically plan their network by investing in capabilities. To get guidance on which capability combinations function under which contingencies and how trade-offs work in real companies, six phenotypes were analyzed. Key contingencies were the order decoupling point, firm size, and industry.

Capability Configurations

When deciding which capabilities to invest in, managers are faced with nearly endless possibilities. Additionally, contingency factors as industry, number of employees, order decoupling point, or number of sites increase the difficulty of this decision. Consequently, managers are in need of proactive guidance for defining their network strategy. Based on 42 real-world cases, six successful configurations or phenotypes of network capabilities were identified. For each type, a rectangular figure (Figure 7 - Figure 12) indicates the capability profile. Hues of green show the degree to which the capability is present in each type; white fields represent the absence of ambiguity. Deep dive cases were analyzed to understand contingencies.

Type A: Downstream Differentiator

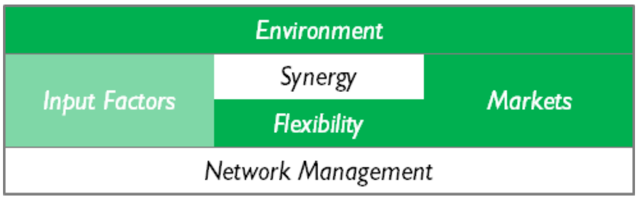


Figure 7: Capability Configuration for the Downstream Differentiator

The Downstream Differentiator is characterized by a strong downstream orientation, prioritizing market access, institutional advantages, and flexibility, while lacking network and organizational synergies. Networks in this group disperse sites to reduce transportation costs and exploit favorable institutional conditions such as tariff reductions and political stability, typically locating in high-wage, market-proximate countries. Flexibility is achieved through product and volume mobility, supported by coordination measures, whereas synergies are limited due to geographic dispersion and the need for redundant overhead functions across sites. Contingency variables indicate large, highly dispersed networks averaging over 30 sites, significant employee counts (5,000 - 20,000), high revenues, and an order decoupling point between make-to-order and engineer-to-order, reflecting strong customization. Deep dive cases analyzed belong to the machinery industry, where complex product architectures and frequent changeovers constrain operational synergies. This configuration exhibits the highest growth among all types, suggesting a link between downstream focus, market dispersion, and expansion dynamics.

Type B: Stable Synergist

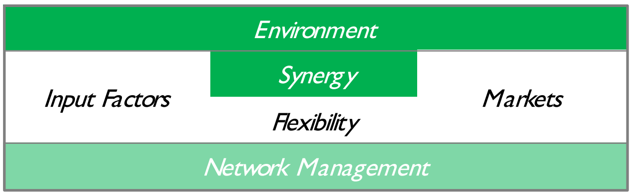


Figure 8: Capability Configuration for the Stable Synergist

The Stable Synergist emphasizes network synergy and institutional stability while lacking flexibility and input factor dependencies. Its core logic centers on achieving economies of scale and scope through centralized engineering, co-location of overhead functions, and integration across sites. A stable institutional environment, characterized by predictable politics, economics, tax regimes, and opportunities for tariff circumvention or subsidies, further supports this model. Market access is not a defining feature, and sourcing advantages are irrelevant, reflecting a focus on internal efficiency rather than external dispersion. Contingency variables reveal networks averaging about 25 sites, high employee counts, and substantial revenues, with an order decoupling point at make-to-stock, enabling standardized, high-volume production. Deep dive case examples include manufacturers of electrical components and low-tech fluid handling parts, illustrating how product simplicity and scale align with centralized orchestration and synergy-driven strategies.

Type C: Stability Seeker

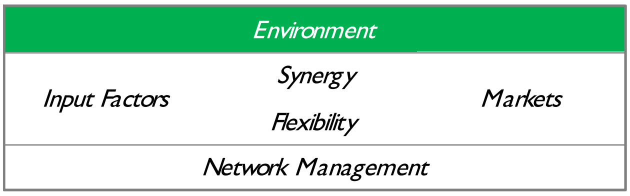


Figure 9: Capability Configuration for the Stability Seeker

The stability seeker is defined by a single dominant condition: leveraging the institutional environment. Networks in this group excel at exploiting trade agreements, tariff reductions, favorable exchange rates, tax benefits, subsidies, and image factors such as "made-in" labels. Success depends on aligning product and production strategies with these institutional advantages. Deep dive cases examples include manufacturers of high-tech, high-value-added products, such as e-mobility components, automation technology, and advanced electrical parts, produced in historically grown networks averaging about 10 sites. These networks operate between assemble-to-order and make-to-order, generating high turnover with relatively low personnel, reflecting strong value creation. Their dispersion is shaped by legacy rather than greenfield optimization, emphasizing institutional benefits over operational or market synergies. This configuration illustrates how stability-driven strategies favor technologically complex products and exploit regulatory and fiscal environments for competitive advantage.

Type D: Flexible Forager

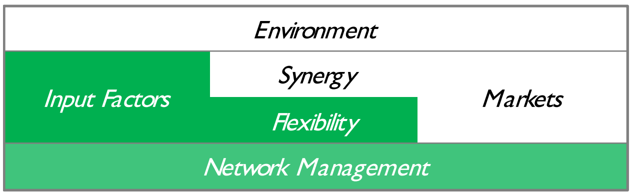


Figure 10: Capability Configuration for the Flexible Forager

The flexible forager combines strong input factor access with high flexibility, while institutional advantages are peripheral. Networks in this group prioritize best-cost sourcing and skilled labor, technologies, and location factors, complemented by short lead-time sourcing. Flexibility is achieved through mobility of products, volumes, and personnel, supported by coordination and, in some cases, network management. Synergies are limited, reflecting a structure optimized for adaptability rather than integration. Contingency variables show smaller networks averaging 10 sites, lower turnover, and fewer employees, with an order decoupling point between make-to-stock and assemble-to-order, enabling standardized production with late-stage customization. Case examples include chemical, medical device, and machinery manufacturers, all requiring rapid adjustments to demand or product mix. This configuration exhibits the lowest operating margin, suggesting a potential trade-off between flexibility and profitability, warranting further research.

Type E: Upstream Utilizer

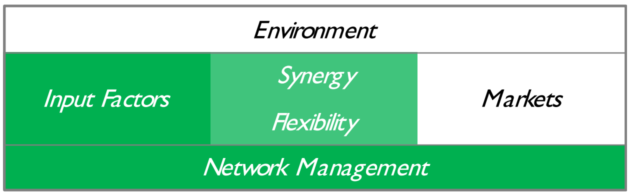


Figure 11: Capability Configuration for the Upstream Utilizer

This configuration combines strong exploitation of input factors with proactive network orchestration, while institutional advantages are absent and market access is peripheral. Networks in this group emphasize sourcing best-cost labor, low-cost supply, and high-quality suppliers, complemented by orchestration mechanisms such as risk management, knowledge sharing, and complexity reduction. This active management approach offsets the lack of institutional stability, enabling operations in more volatile environments. Contingency variables indicate networks averaging 10.5 sites, with an order decoupling point between make-to-stock and assemble-to-order, reflecting standardized production and minimal customer-specific adaptation. Growth is the lowest among configurations, likely due to limited market development and upstream focus. Case examples include process automation and medical device manufacturers producing high-value, small products in large volumes, leveraging input efficiency and orchestration rather than market proximity. This configuration illustrates a trade-off between institutional reliance and managerial control as a source of competitive advantage.

Type F: Pioneer

Environment		
Input Factors	*Synergy* *Flexibility*	*Markets*
Network Management		

Figure 12: Capability Configuration for the Pioneer

This configuration represents an outlier with no core conditions, combining the presence of input factors and network orchestration with the absence of market access, flexibility, and synergy, while the institutional environment is irrelevant. These networks appear to be in an early stage of network management maturity, lacking a clear strategic focus. Contingency variables reveal the smallest scale among all configurations - averaging eight sites, the lowest employee count, and the lowest turnover - yet with an order decoupling point between make-to-order and engineer-to-order, indicating highly customized production. Despite limited size and resources, this configuration exhibits one of the highest growth rates, suggesting an emerging trajectory. Case examples include manufacturers of complex machinery and high-tech electronic modules, highlighting the interplay between small network size, customer-specific products, and nascent orchestration capabilities. This configuration underscores the need for further research into growth dynamics and capability development in immature networks.

Synthesis and Recommendation

Based on the identification and analysis of six strategy phenotypes, several managerial implications emerge. First, managers must evaluate trade-offs among capabilities. Types rarely exhibit more than two core capabilities, indicating interdependencies shaped by network dispersion and coordination. Thus, it is critical to determine which capabilities truly add value to the network. Second, coordination-related capabilities (e.g., orchestration, synergy, flexibility) are less affected by site number, whereas configuration-related capabilities (e.g., market access, institutional environment, input factors) often require broader geographic dispersion. Consequently, networks with few sites must integrate multiple capabilities within limited locations, while larger networks should assign clear roles to sites to maintain strategic focus. Third, the analysis of the order decoupling points highlights the need for alignment between product architecture and capability choices: later decoupling favors downstream capabilities, whereas earlier decoupling supports upstream efficiency. Product attributes such as value density and transportability further influence network strategies, reinforcing multi-plant considerations. Managers must therefore thoroughly understand product, production, and operating models before pursuing a network strategy. Finally, configurations facilitate qualitative network planning and benchmarking against competitors or established patterns.

7. Summary

The effective management of international manufacturing networks represents one of the most demanding challenges facing operations managers today. Success requires not only technical expertise but also strategic vision, organizational capability, and the discipline to follow systematic processes. By adopting the frameworks, processes, and insights presented in this work, managers can navigate this complexity and unlock the full potential of their global manufacturing networks.

The Challenge of IMN Management

International manufacturing networks have become the norm rather than the exception in today's global economy. As a consequence, effective network management is no longer optional but essential for competitive success. It requires handling complexity from coordinating geographically dispersed sites, balancing conflicting objectives, and navigating dynamic market conditions while maintaining strategic coherence across the entire network. Thus, a systematic approach that aligns capabilities and policies with the desired competitive advantage is imperative.

A Structured Approach

The St.Gallen Network Management Model provides a holistic approach grounded in systems theory, emphasizing the interconnection between global production strategy, network configuration, network coordination, and fit. This model recognizes that networks must be analyzed as complete systems, considering both internal dynamics and external environmental factors. Critical to success is achieving fit at three levels: between the network and its environment, among the three network components, and within decisions in each component.

A Comprehensive Strategy Process

Formulating and implementing a network strategy requires following a systematic five-phase procedure: assess, design, align, deploy, and operate. Each phase plays a distinct role: Assess establishes the foundation by gathering business, market, and operational intelligence. *Design* translates strategic insights into actionable network configurations and initiatives. Align ensures synchronization with corporate strategy, financial planning, and operational requirements. *Deploy* transforms strategy into concrete projects with defined responsibilities and KPIs. *Operate* sustain improvements through governance structures, knowledge exchange, and continuous risk management.

Building Network Capabilities

Effective network strategies focus on developing unique, network-wide capabilities beyond traditional factory management rather than isolated investments in assets or personnel. These capabilities fall into two hierarchical categories: *Operation capabilities* directly affect the value stream and include accessing structural and infrastructural inputs, achieving operational and organizational synergy, maintaining flexibility, securing market access, and leveraging institutional environments. *Orchestration capabilities* enable effective coordination and include network management capabilities, knowledge generation, and market expansion.

Strategic Phenotypes as Guidance

Analysis of real-world networks revealed six distinct strategy phenotypes, each representing a successful configuration of capabilities under specific contingencies. These phenotypes demonstrate important trade-offs shaped by dispersion, coordination requirements, and product characteristics.

Key Calls to Action for Managers

Establish a Network Operating Model

Establish a dedicated network operating model that defines governance structures, meeting routines, and coordination mechanisms appropriate to your organizational structure and network maturity.

Strategy Process

Implement a structured strategy process that covers all phases from business strategy to site-level execution, including both vertical and horizontal coordination with appropriate stakeholder participation.

Active Network Design

Work actively on possible network scenarios for the future in a creative process to find the optimal setup for the future.

Broad Participating

Involve a broad range of functions from marketing, controlling, process development, manufacturing technology, product management, logistics, and supply chain management.

Early and Frequent Alignment

When designing a new configuration, align the ideas from operations with corporate initiatives and financial planning. Key results or changes in the next years heavily influence how the configuration should or can look.

Network Management Resources

Invest in dedicated network management resources rather than relying on ad-hoc assignments, improving crisis response time and strategy implementation completeness.

Capability Development

Adopt a holistic approach to capability development, focusing on network-wide capabilities that provide a competitive advantage rather than isolated site improvements.

Capability Trade-offs

Understand and manage capability trade-offs by recognizing that coordination-related capabilities scale differently than configuration-related capabilities.

Product Characteristics

Align product characteristics with network strategy by thoroughly understanding your product architecture, value density, transportability, and order decoupling point before pursuing specific capability configurations.

Karl Schalm
Group Coordinator & Postdoc
Institute of Technology Management
Chair of Production Management
University of St.Gallen

Prof. Dr. Thomas Friedli
Director
Institute of Technology Management
Chair of Production Management
University of St.Gallen

University of St.Gallen
Institute of Technology Management