



Confederation of Indian Industry



CII Institute
of Logistics

Supply Chain Network Design in the Era of E-Commerce

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Preface

For decades, strategic network design has addressed a familiar set of questions: **Where should we manufacture? Where should we hold inventory? Which facilities should serve which markets?**

Those questions remain relevant. **But the range of questions that network design needs to address is expanding.**

What happens when demand can emerge rapidly through digital channels? When are customers expecting delivery in days vs hours vs minutes? Should the same product be reaching the customer through a store, marketplace, company website or quick-commerce platform? How does growth extend into new markets while infrastructure, tariffs and supply conditions continue to evolve?

These perspectives raise a broader question for supply-chain leaders:

Is my network, designed around today's assumptions, equipped for the diverse range of conditions the business might face tomorrow?

The tools available to explore these questions are evolving as well. Advances in optimization, digital twins and AI create new possibilities for how network choices can be modelled, tested and revisited.

This paper examines these prominent themes rising around **Supply Chain Network Design in the Era of E-Commerce:**

1. **Why does the e-commerce era change network economics?**
2. **How is the service promise encoded in the supply-chain network?**
3. **How has the network objective function expanded?**
4. **Why does a more connected India require a more granular network?**
5. **How does omnichannel change the unit of network design?**
6. **How can AI move network design from episodic to adaptive?**
7. **Why should networks be designed for scenarios rather than one forecast?**
8. **What capabilities are required across the ecosystem?**
9. **How can supply-chain leaders move towards network decisions within three to six months?**



Executive summary

India's commerce environment is changing, creating new considerations for strategic supply-chain network design.

Digital commerce is becoming materially larger. India's e-commerce industry, valued at approximately US\$125 billion in 2024, is projected to reach approximately US\$345 billion by 2030.¹ The composition of online commerce is also changing. According to CareEdge Ratings, quick-commerce gross order value in India more than doubled to approximately ₹64,000 crore in FY25 and is projected to reach approximately ₹2 lakh crore by FY28.²

These shifts are reshaping the nature of demand that supply chains need to serve. Digital discovery can influence demand more quickly, online commerce is extending across a wider set of Indian markets, and orders can become more fragmented. Faster and more differentiated customer promises also place new requirements on inventory placement, capacity and the physical network.

The network-design problem is becoming more multi-dimensional.

Cost remains fundamental, while **growth, service, inventory, resilience, sustainability and optionality** can also influence strategic network choices. India's geographic diversity and evolving infrastructure add further considerations, while omnichannel requires companies to support different fulfilment models across stores, e-commerce, marketplaces and quick commerce.

The analytical capabilities available to address this complexity are also evolving. **AI, optimization and digital twins** can help companies maintain a more current representation of their network, evaluate alternatives and explore how changing assumptions affect network decisions. This creates an opportunity for strategic network optimization to become more adaptive, with models and assumptions refreshed as business conditions change.

Uncertainty remains central to these decisions. Demand, channels, service expectations, supply conditions, costs and policy can evolve differently from current forecasts. Network optimization can therefore consider **multiple plausible scenarios**, helping companies understand which choices remain attractive as conditions change and when a network decision may need to be revisited.

For supply-chain leaders, this capability can be built progressively around material network questions. A focused **three-to-six-month first cycle** can establish the fact base, create a baseline network model, evaluate priority alternatives and develop a foundation that can be reused for subsequent network decisions.

This paper explores how strategic network optimization can evolve in this environment, and the capabilities organizations can build to support more adaptive network decisions.

01

Why the e-commerce era changes network economics

India's retail environment has changed materially over the past decade. Online commerce has expanded the reach of brands beyond traditional store-led distribution, while quick commerce has introduced much shorter fulfilment expectations. At the same time, digital channels have changed how customers discover products, evaluate alternatives and complete purchases.

Digital channels are changing where customers buy, how demand is created and how quickly it can appear. Product discovery and purchase journeys increasingly extend across digital channels, including social media, creator content, reviews and online recommendations. IAMAI's Internet in India 2024 research identified approximately 55 million social-media shoppers, equivalent to nearly one in six online shoppers.³ A demand signal generated through these channels may emerge faster than traditional planning and replenishment cycles are designed to respond to.

Digital commerce is becoming materially larger

India's e-commerce industry was valued at approximately US\$125 billion in 2024 and is projected to reach approximately US\$345 billion by 2030, representing an 18.4% CAGR.¹

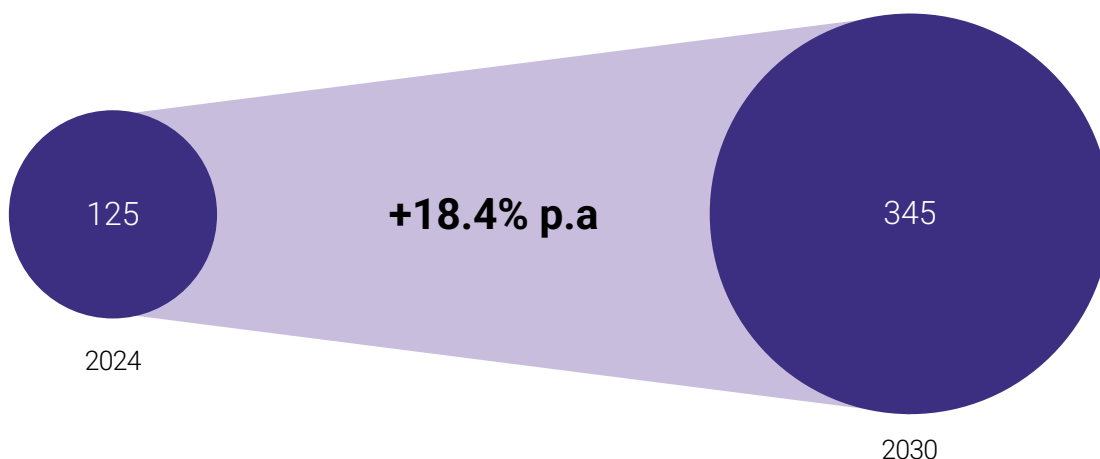
Within this expanding digital market, newer commerce models such as quick commerce are also gaining traction, adding to the range of ways in which consumers access products online.²

As a larger proportion of consumer demand flows through digital channels, companies may need to support a greater number of direct-to-consumer orders across a wider set of locations and service expectations.

Exhibit 1

India's e-commerce ecosystem could approach three times its current size by 2030

USD billion



Source: India Brand Equity Foundation (IBEF), "E-commerce Industry in India," 2026.¹

Younger consumers and digital discovery are changing demand creation

Younger consumers are a significant part of India's digital-commerce market. Gen Z accounts for approximately 40–45% of India's e-retail shoppers and is among the cohorts leading incremental shopper growth.¹ Digital discovery can influence how quickly demand emerges and how widely it spreads. This can shorten the distance between product discovery and purchase and create demand patterns that develop differently from conventional planning assumptions. For network planning, this can make demand signals more dynamic. A product may experience a sudden increase in demand without a corresponding change having appeared in a conventional long-term forecast.

E-commerce is extending beyond the largest cities

The geographic footprint of digital demand is expanding beyond India's largest cities. India had approximately 290–300 million online shoppers in 2025, with Tier-2 and smaller cities contributing around half of incremental e-retail orders.¹ This means that future demand may be distributed across a wider set of markets than the traditional metro-centric retail network was designed to serve. The result is a changing demand landscape:

larger digital demand + faster demand signals + broader geographic reach

Together, these developments may alter the assumptions on which existing network configurations were built.

The e-commerce era may change the scale, velocity and geography of the demand that the network needs to serve.



02 | The service promise is encoded in the supply chain network

Digital commerce has changed where customers buy. Quick commerce demonstrates something deeper: **the customer promise itself can depend on the physical architecture of the network.**

Digital interfaces may make an order appear instantaneous, but fulfilment continues to operate within physical constraints. Products need to be available, picked, packed and moved from a fulfilment location to the customer. As the promised lead time compresses, the amount of distance and processing time available to fulfil an order also reduces.

This may require changes in network density, inventory placement, local capacity, assortment and replenishment. A network designed to fulfil an order within several days can therefore look materially different from one designed to fulfil it within several hours or minutes.⁴

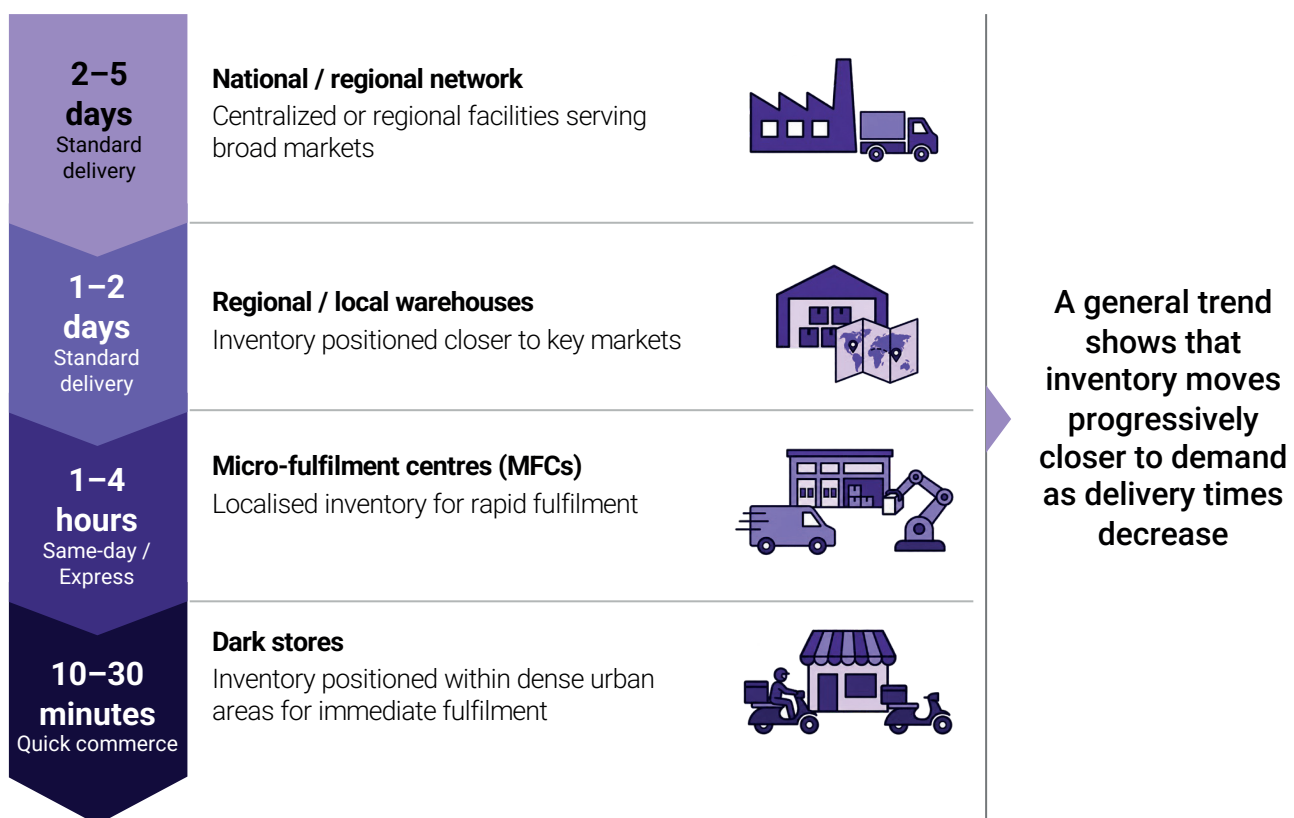
Service speed changes network architecture

Four broad service models illustrate how network requirements can change as lead times compress.

Exhibit 2

As the service promise compresses, the network moves closer to demand

Faster service requires inventory to be positioned closer to demand, with a corresponding change in network design



Source: Framework developed for this paper, informed by published research on e-commerce and omnichannel distribution-network design.⁴

Longer delivery windows provide greater flexibility to pool inventory across fewer locations and consolidate transportation. As the service window becomes shorter, inventory may need to be positioned closer to customers, with sufficient local capacity and the appropriate assortment available when the order arrives.⁴

The network-design question therefore changes from:

Where should a warehouse be located?

to:

How close does inventory need to be to demand for a particular service promise to remain economically viable?

The customer promise creates an economic trade-off

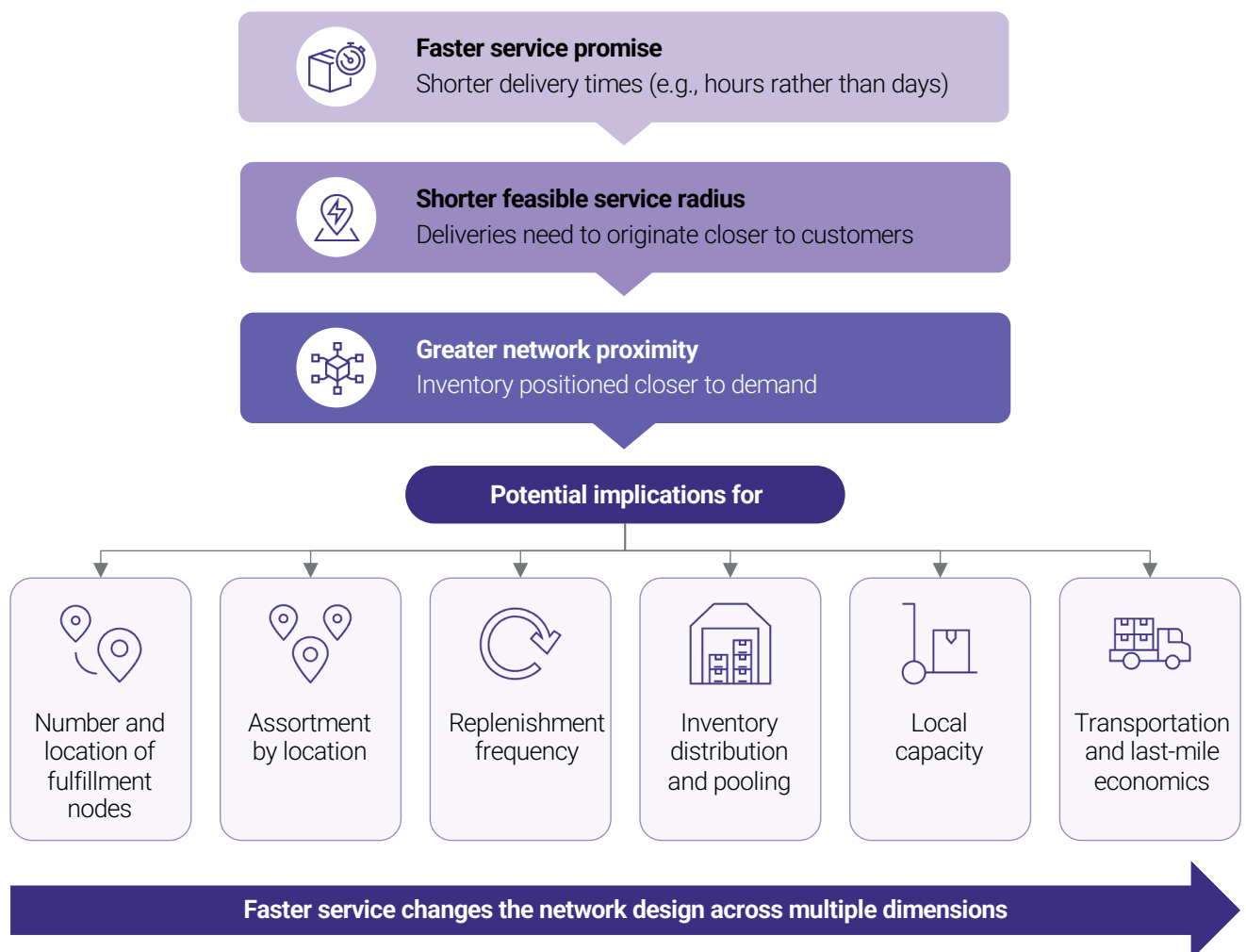
Faster service can influence several parts of the network simultaneously. Moving inventory closer to customers may reduce the distance between the fulfilment node and the final destination. At the same time, distributing inventory across additional locations can reduce some of the pooling benefits available in a more centralized network.

The network may therefore face a series of interconnected trade-offs:

Exhibit 3

From faster service to network design implications

A faster service promise reduces the feasible service radius, requiring greater network proximity and leading to several network design implications



**The relevant optimization question becomes:
What network configuration can support the
chosen customer promise at an economically
viable cost and inventory position?**

The commercial service promise and the physical network required to deliver it therefore need to be considered together. India's quick-commerce network provides a visible example of how faster service expectations can translate into physical network expansion.

The combined dark-store footprint of leading quick-commerce chains increased from approximately **3,405 locations in May 2025 to 5,026** in May 2026, an increase of approximately **48% in one year.**⁵

of dark stores across leading quick-commerce platforms increased by ~48% in 1 year period between May 2025 to May 2026

Exhibit 4

Rapid fulfilment is being supported by greater network scale

Number of dark stores across leading quick-commerce platforms increased by ~48% in 1 year period between May 2025 to May 2026



Source: Equirus Securities, quick-commerce sector analysis, 2026.⁵

Network scale needs to be considered alongside dark-store productivity and local demand density. Emkay Global estimates that a dark store may require approximately 1,300 orders per day to break even in a Tier 1 city, compared with approximately 800 orders per day in a Tier 2 city, reflecting differences in the underlying cost and demand environment.⁶ This illustrates an important network-design principle:

A customer promise that is economically viable at one level of demand density may require a different network configuration or service promise in another market.

The physical network determines where a given customer promise can be offered economically.

03 | The objective function has expanded in the network context

Network optimization has traditionally focused heavily on minimizing the combined cost of manufacturing, transportation, warehousing and inventory while meeting defined service requirements. Cost remains fundamental, while strategic network decisions increasingly need to consider multiple business objectives simultaneously.

A strategic network decision can influence **business growth, service, landed cost, inventory, resilience, sustainability and optionality**. Gartner's network-design research similarly describes the need for long-term, fit-for-purpose networks that balance objectives beyond cost.⁷

Network optimization therefore needs to make the trade-offs between these objectives visible alongside cost.

The network increasingly supports multiple business objectives

Business growth

The physical network can influence where and how a company grows.

Relevant questions may include:

- Which markets should the company enter?
- Which channels should it serve?
- Where could new capacity be required?
- Which markets may become viable if the network changes?

Service

Service requirements translate commercial choices into network constraints.

Relevant questions include:

- What lead time should be offered?
- Which customers or channels require differentiated service?
- How much inventory may need to sit closer to demand?

Service becomes one of several objectives that need to be balanced within the network decision.

Landed cost

Landed-cost evaluation can incorporate manufacturing, sourcing, transportation, warehousing, duties, tariffs and handling. The relevant question is therefore the **total landed cost associated with alternative network configurations**.

Inventory

Increasing the number of fulfilment locations may improve proximity and service while potentially increasing inventory requirements.

Network optimization therefore needs to consider:

- Where inventory pooling creates value;
- Where localization may be justified; and
- How inventory requirements change as the footprint changes.

Resilience

A network that performs efficiently under normal conditions may behave differently when a supplier, plant, port or transportation corridor becomes constrained.

Network design may therefore consider:

- Concentration of manufacturing;
- Supplier dependence;
- Alternate sourcing possibilities;
- Capacity flexibility; and
- Exposure to critical nodes and corridors.

Sustainability

Facility location, sourcing, transportation mode and distance travelled can influence the environmental footprint of the network. Network alternatives can therefore be evaluated for sustainability alongside cost and service.

Optionality

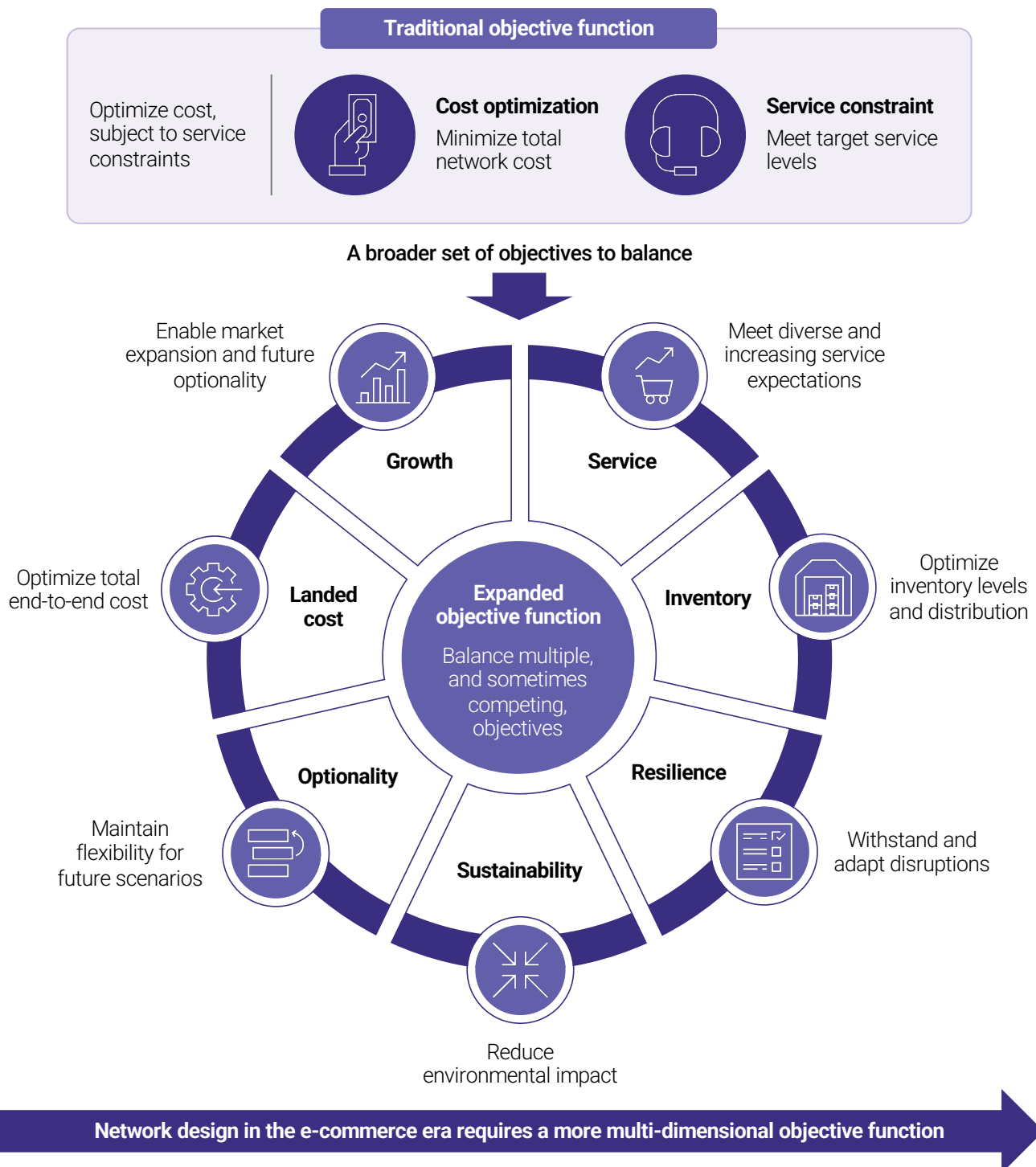
Network decisions are often made before the future is fully known. Optionality reflects the ability of the network to preserve viable choices if demand, channel, supply or regulatory conditions develop differently from current expectations.

Optionality can be evaluated by identifying where additional flexibility has value and where future network reconfiguration could become difficult or expensive.

Exhibit 5

The network objective function therefore becomes multi-dimensional

In addition to cost and service, a broader set of objectives can influence network design in the e-commerce era



Source: Framework developed for this paper, informed by Gartner's research on changing supply-chain network-design priorities.^{7,8}

Different businesses may assign different priorities depending on their strategy. A value retailer may place greater emphasis on landed cost. A rapid-delivery business may place greater weight on service. A manufacturer with concentrated global supply may place greater value on resilience and optionality. Network optimization can make these priorities and their associated trade-offs visible.

Resilience has also become a material consideration in network economics. McKinsey estimates that companies can experience disruptions lasting **one to two months approximately every 3.7 years**. For consumer-goods companies, the cumulative financial fallout of supply-chain shocks over a decade could equal approximately **30% of one year's EBITDA**.⁹

Gartner's 2024 survey of **437 supply-chain leaders** found that **73% of companies had added or removed production locations during the preceding two years**, with risk management considerations overtaking cost and efficiency as the leading drivers of network changes.⁸

Network choices involve trade-offs

The objectives above do not always move in the same direction.

For example:

More fulfilment locations may increase reach and improve service, while potentially increasing inventory requirements.

Localized sourcing may improve responsiveness and reduce some forms of supply exposure, while potentially involving different sourcing economics.

Concentrating manufacturing or procurement in fewer locations may create scale and cost advantages, while potentially increasing exposure to disruption at those locations.

Lower-carbon transportation choices may involve trade-offs in lead time, cost or network configuration depending on the mode and route selected.

Network optimization can quantify these trade-offs so that decision makers understand **what is gained, what is given up and which objectives matter most for the business**.



04 | Connected India requires a more granular network

India's digital-commerce opportunity increasingly extends beyond its largest metropolitan markets. The growing contribution of Tier-2 and smaller cities to India's online shopper base is broadening the geographic footprint that e-commerce networks need to serve.¹

This geographic expansion creates different network requirements across markets. Demand density, category mix, infrastructure, service feasibility and cost-to-serve can differ substantially across markets. A network designed around a small number of large metropolitan demand centres may therefore not provide the appropriate service and economics for a broader set of cities and towns.

The strategic network question becomes:

How much of each market should the network serve, at what service level, with which assortment and from which inventory pool?

India's consumers do not form one homogeneous demand market

Expanding geographic reach can require different network propositions across markets. Category demand can vary across locations as regional preferences, climate, income and local consumption patterns influence what customers buy. A city with sufficient aggregate demand may justify local inventory for one category but not another. Similarly, a market may support faster service for high-velocity products while long-tail inventory remains economically better positioned at a regional or national node.

The relevant unit of geographic analysis may therefore need to move from:

country → region → city

toward:

market cluster × category × service requirement

The economics of serving different markets should therefore be evaluated at sufficient granularity before deciding where inventory and capacity should sit

National coverage is not a binary variable

Network coverage can be evaluated across more dimensions than whether a market or pin code is technically serviceable.

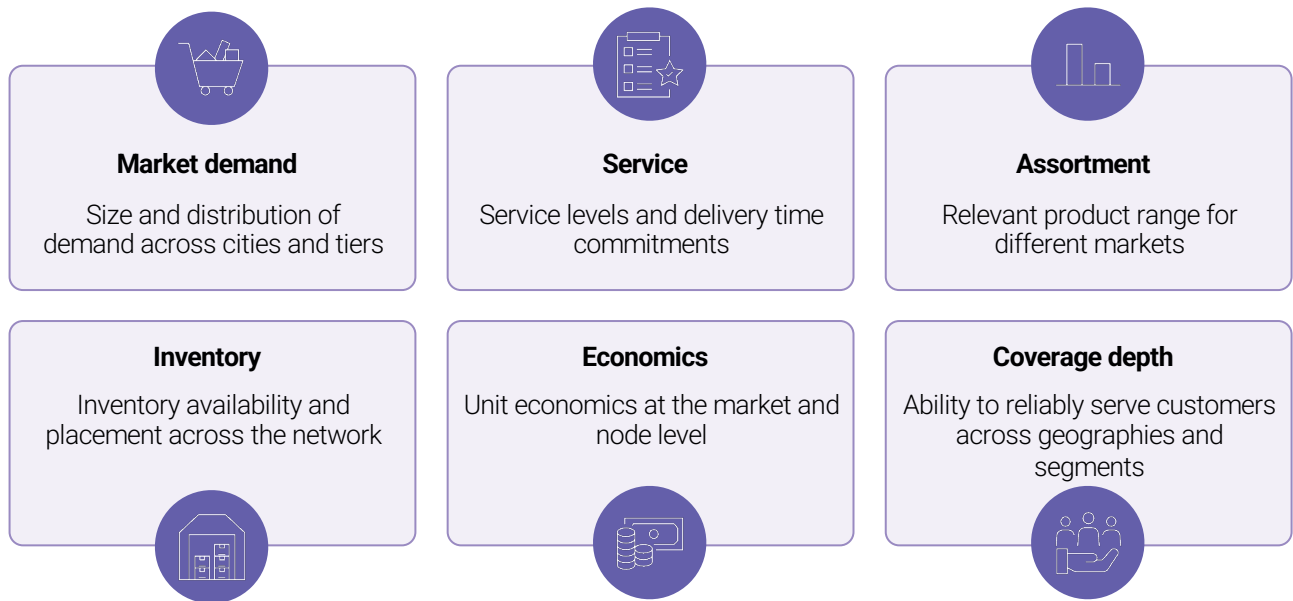
A market may be:

- reachable within several days but not economically viable for next-day delivery;
- serviceable with a selected assortment but not the complete national catalogue;
- attractive for selected high-velocity categories but not for long-tail inventory;
- economical from a regional node but not from a hyperlocal location; or
- easy to serve through forward logistics but expensive when returns are included.

Coverage can therefore be evaluated across several dimensions.

What service + assortment + inventory model is economically viable for this market?

National coverage can be evaluated as depth rather than reach alone



Source: Framework developed for this paper

This reframes the network question from:

“Do we cover this market?”

to:

“What service, assortment and inventory proposition should the network support in this market?”

It also allows investment to be phased. Markets where demand density or infrastructure does not currently support faster service may continue to be served through regional or national inventory until their economics change.

Inventory localization should be selective

As geographic demand becomes more distributed, network design needs to determine which inventory benefits from being positioned closer to the customer and which inventory benefits from remaining pooled.

Centralization can provide greater inventory pooling, particularly where demand is long-tail or unpredictable.

Localization can reduce distance to demand and support faster service where order density is sufficient.

The appropriate answer may differ by SKU, category and market cluster. Centralization is preferred when demand is unpredictable, products are standardized, and inventory pooling outweighs speed. Localization is helpful when demand is predictable and proximity improves service, transportation economics, assortment, or availability.

The resulting architecture may combine larger national or regional inventory pools with selected forward locations carrying narrower, higher-velocity assortments.

This allows the network to balance **inventory pooling with market responsiveness**, rather than choosing between complete centralization and complete localization.

The optimization question becomes:

Which inventory should be localized, in which markets, and at what point does the service or transportation benefit justify the additional inventory and facility complexity?

A service promise that is attractive in a dense metropolitan cluster may require a different inventory strategy in a smaller city.

Infrastructure is changing the feasible network

Network economics are also shaped by the infrastructure available to serve demand. India's physical and digital logistics infrastructure is also evolving, potentially changing which locations and transportation corridors are economically attractive.

The **PM GatiShakti National Master Plan**, launched in 2021, is intended to improve multimodal connectivity and first- and last-mile linkages through integrated infrastructure planning.¹⁰

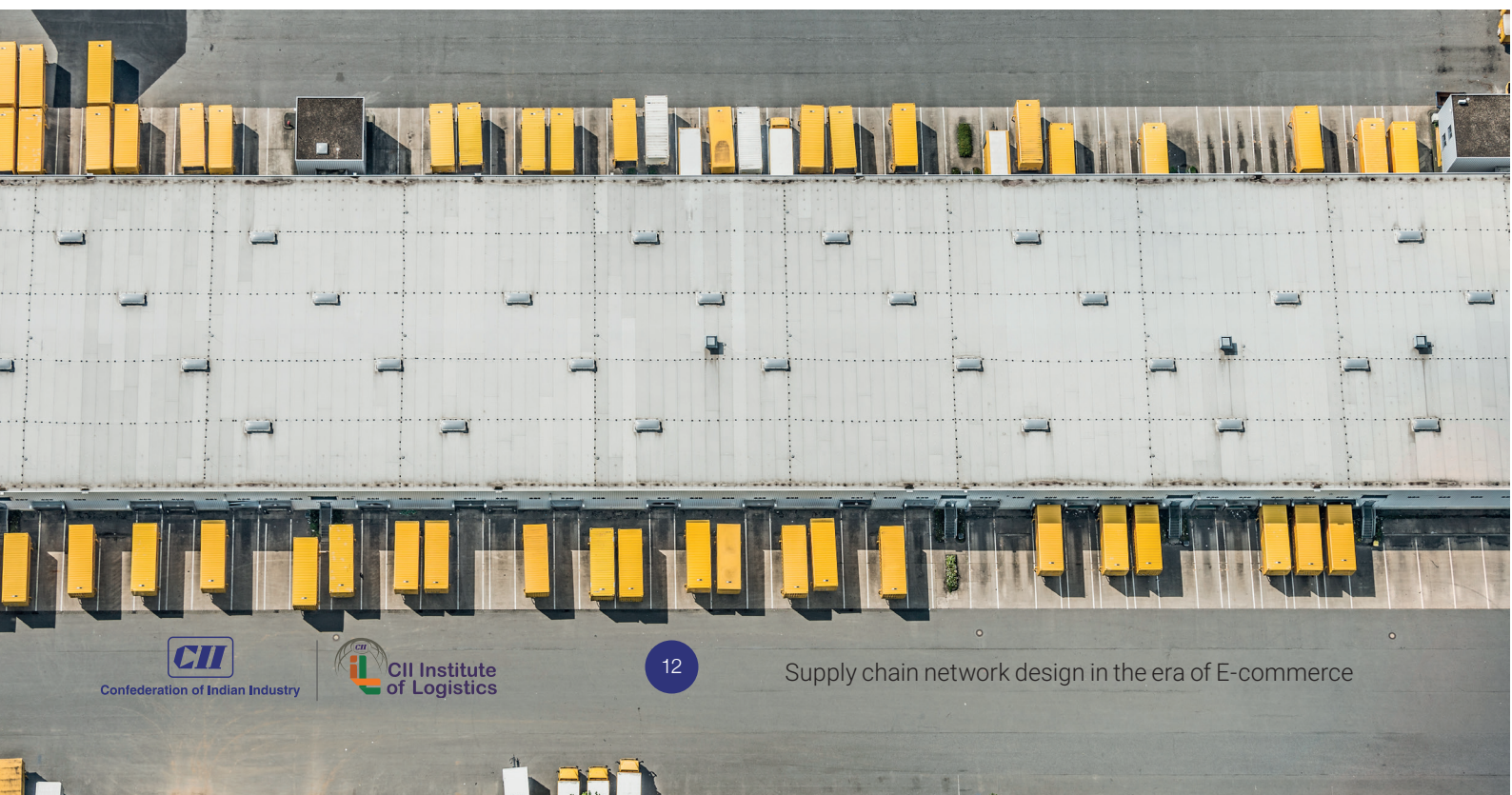
The National Logistics Policy, launched in 2022, complements this through initiatives focused on logistics services, processes, technology adoption and integrated planning.¹¹

Digital logistics infrastructure is developing alongside the physical network. Initiatives such as the **Unified Logistics Interface Platform (ULIP)** connect logistics-related digital systems, while the **Logistics Data Bank (LDB)** provides visibility into container movements across parts of India's EXIM logistics system.¹¹

These developments matter to network optimization because infrastructure can change the relative economics of locations.

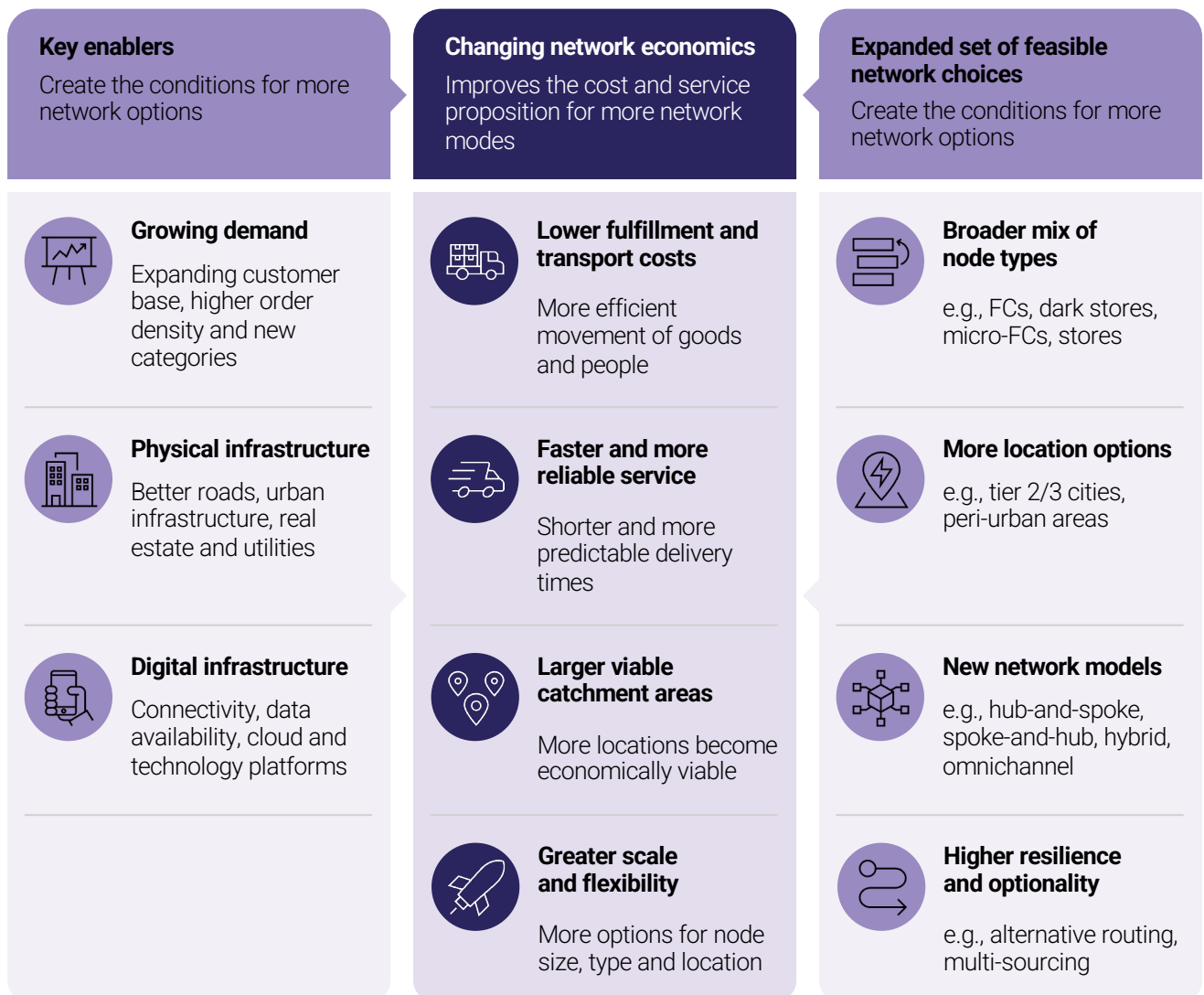
A location that was unattractive in an earlier network study may become more relevant as:

- Transportation connectivity improves;
- Transit times change;
- Supplier ecosystems develop;
- New manufacturing clusters emerge; or
- Market access improves.



Infrastructure development can expand the set of feasible network choices

Improvements in physical and digital infrastructure, alongside growing demand, can change network economics and enable a wider range of viable network configurations



Which locations become viable as infrastructure and demand evolve?

Source: Framework developed for this paper, informed by Government of India logistics initiatives

Which locations become viable as infrastructure and demand evolve?

Source: Framework developed for this paper, informed by Government of India logistics initiatives.^{10,11}

The implication is that strategic network design may need to be revisited as the environment changes. As India's demand and infrastructure develop, the assumptions underlying an earlier network footprint may also change.

05 | Omnichannel changes the unit of network design

Connected India makes network design more granular geographically. Omnichannel introduces another dimension. The same product sold to a customer in the same pin code may carry a different service promise and cost-to-serve depending on whether the order comes through a company's own website, a physical store, a marketplace or a quick-commerce platform.

Each route may involve a different inventory owner, fulfilment location, operating window, service requirement and return path. Research on the transition from multichannel to omnichannel retail similarly highlights the need to coordinate inventory and fulfilment decisions across channels.¹²

Geography therefore remains important, but it may no longer be sufficient as the primary unit of network design.

One way to represent the resulting complexity is:

**Product × Customer segment × Channel ×
Service promise × Fulfilment node**

This changes the strategic network question from **"Which facility serves this market?"** toward **"Which network configuration should support different product-channel-service combinations?"**

Different channels place different requirements on the network

Omnichannel is sometimes understood primarily as the presence of multiple sales channels. **Different channels can place different claims on the same inventory and physical infrastructure.**

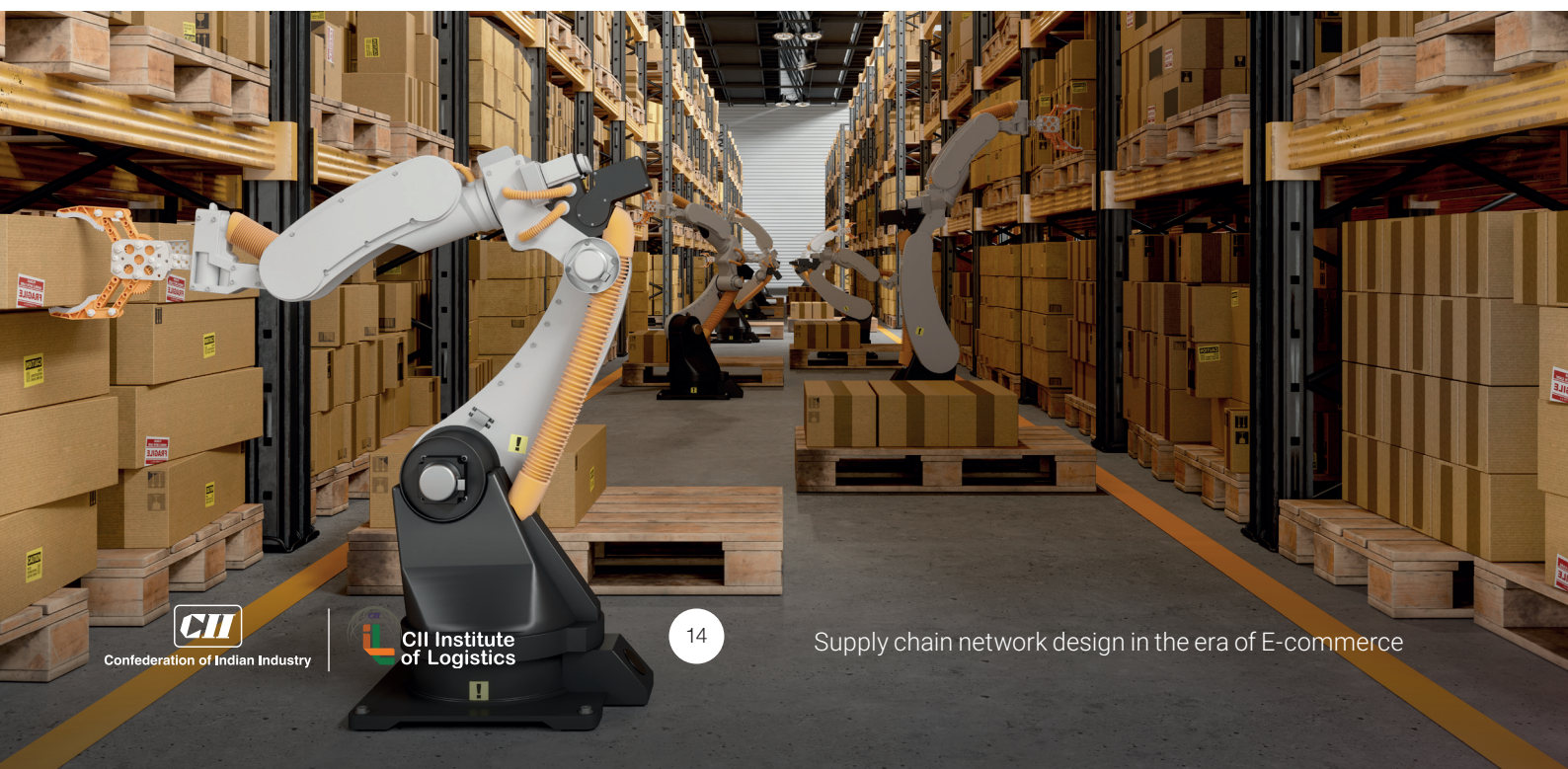
A company website may provide control over assortment and the customer promise.

A physical store may support immediate purchase, pickup or selected e-commerce fulfilment, but operate within fixed hours, labour availability and storage capacity.

A marketplace may expand geographic reach while introducing platform-specific service requirements, inventory arrangements and commercial economics.

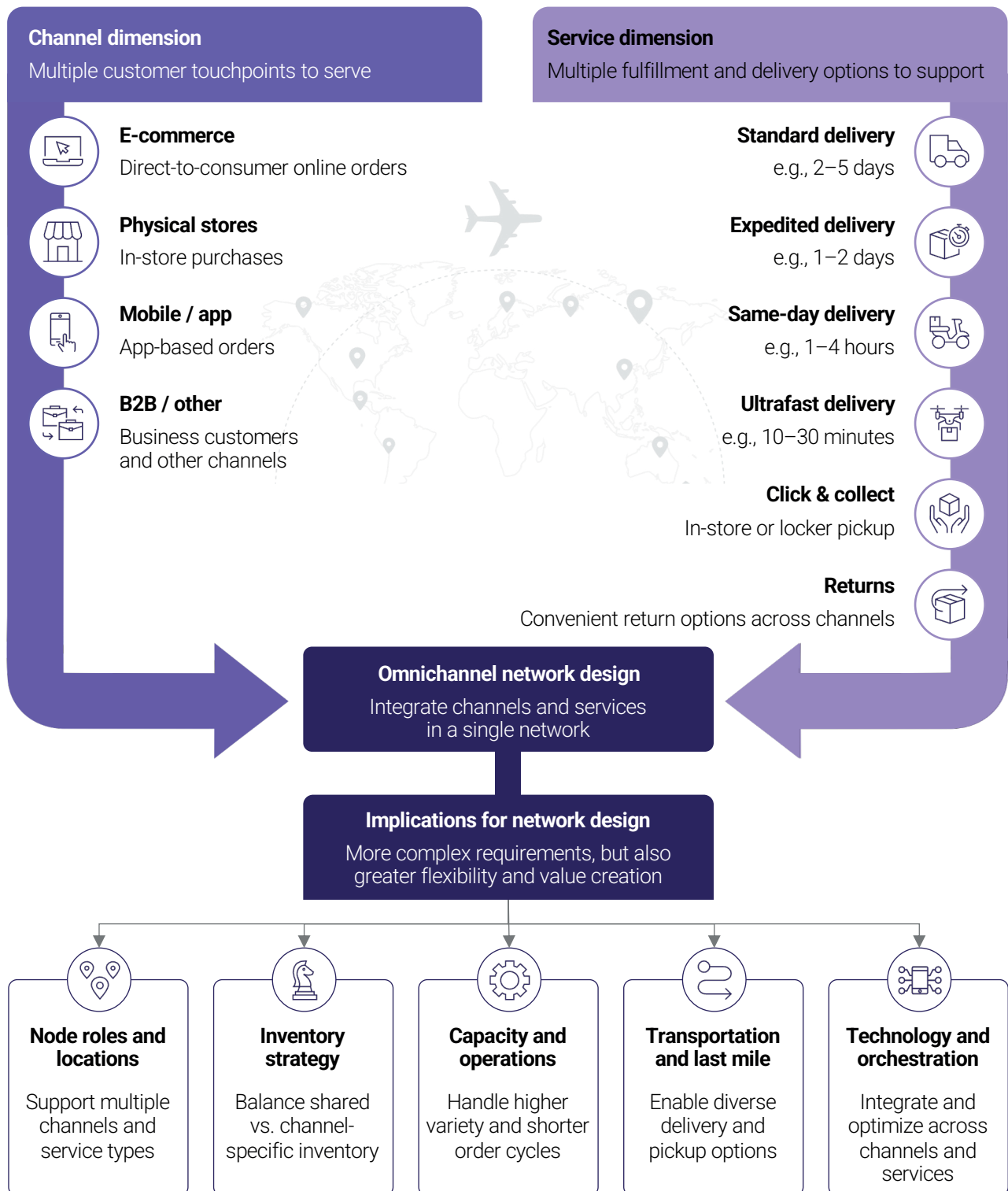
Quick commerce may require selected products to be available much closer to demand, subject to local demand density and replenishment economics.

Strategic network design therefore needs to determine where inventory should sit, which channels can access it, and which nodes are eligible to fulfil demand. Research on omnichannel inventory and fulfilment decisions similarly demonstrates the interdependence between inventory placement and fulfilment choices.¹³



Omnichannel adds channel and service dimensions to network design

The network must be designed to serve multiple channels and service types simultaneously, increasing complexity but also creating new opportunities



Source: Framework developed for this paper, informed by omnichannel fulfillment research.^{12,13}

Two orders for the same product and geography may create different network requirements when the channel or customer promise differs.

Nodes can play multiple roles

Omnichannel can expand the range of roles performed by individual facilities.

Stores can serve customers directly, support click-and-collect, fulfil local orders, and process returns. Regional fulfilment centres can replenish stores, fulfil direct-to-consumer orders, hold marketplace inventory, and provide fallback capacity.

A supplier or manufacturing location may directly fulfil selected bulky or low-velocity products rather

than routing them through every downstream warehouse.

Research on omnichannel fulfilment has documented the expanding role of stores and the integration of store and distribution-centre inventory in serving digital demand.¹⁴

These additional roles can create network optionality while placing new requirements on space, labour, inventory accuracy, packing capability, operating windows and transportation capacity.

Strategic network design can therefore define the portfolio of capabilities available at each node and the constraints under which those capabilities can be used.

Exhibit 9

A network node can represent a portfolio of fulfilment capabilities

Node	Potential roles	Important constraints
 Store	Sell, pickup, selected fulfilment, returns	Space, labour, stock accuracy, operating hours
 Regional FC/DC	Store replenishment, D2C, marketplace, fallback	Capacity, inventory, parcel capability
 Micro-FC / dark store	Rapid local fulfilment	Radius, assortment, density, replenishment
 Supplier / plant	Direct fulfilment for selected products	Lead time, handling, shipment economics
 Return node	Consolidation, inspection, recovery	Processing capacity, disposition economics

Source: Framework developed for this paper, informed by omnichannel distribution research.^{12,14}

The relevant design question is which capabilities create value at which nodes.

Fulfilment segmentation becomes the design principle

Fulfilment segmentation groups demand with similar economics into a manageable set of network treatments.

A combination of **product characteristics, channel requirements, customer promise and market conditions** can determine the appropriate fulfilment model.^{12,15}

A compact, high-velocity product sold through quick commerce in a dense market may justify local inventory. The same product sold through a standard e-commerce channel in a lower-density market may remain better suited to regional fulfilment. Bulky or slow-moving products may remain more centralized where inventory, space and handling economics outweigh the benefit of additional proximity.

This segmentation allows a large number of individual product-channel-market combinations to be translated into a smaller number of strategic fulfilment models.

Exhibit 10

Fulfilment archetypes require different network logics

Fulfilment segment	Illustrative categories	Best-fit node pattern	Primary design priority
 High velocity / compact	Essentials; selected beauty and personal care	Micro-FC or dark store	Proximity, local assortment and replenishment
 Broad / long-tail	General e-commerce assortment	National and regional FCs	Pooling, availability and parcel economics
 Store-assisted	Fashion, beauty and electronics	Store + FC; pickup, fulfilment and returns	Inventory accuracy, store capacity and allocation rules
 Bulky / low velocity	Large appliances and furniture	Supplier-direct or central DC	Cube, handling, damage and scheduled delivery
 Returns-intensive	Fashion, footwear and selected electronics	Store / drop point + return hub	Inspection, disposition and recovery speed

Source: Framework developed for this paper, informed by omnichannel and e-fulfilment research.^{12,15}

For compact fast movers, proximity may protect the customer promise. For long-tail products, pooling may protect availability. For bulky products, centralized inventory may preserve space and handling economics. Returns-intensive products introduce another consideration because the network also needs to recover and reintegrate inventory efficiently.

The strategic question therefore becomes:

Which parts of the portfolio have sufficiently different economics to require a different fulfilment architecture?

The resulting network can provide a portfolio of nodes, capabilities and inventory positions that supports the fulfilment models the business intends to offer.

06 | AI moves network design from episodic to adaptive

Strategic network optimization requires information from multiple parts of the enterprise to be brought together into a consistent representation of the network. Business rules and physical constraints also need to be incorporated before network alternatives can be evaluated.

As business and external conditions change, this analytical foundation needs to be refreshed. The effort involved in maintaining the data, assumptions and model can influence how readily the capability is used for new strategic questions.

AI can connect **enterprise data, machine learning, mathematical optimization, digital twins and agent-based interaction** into a more responsive strategic network-design capability.^{16 17}

Adaptive network intelligence can be built through four connected layers

The emerging capability can be understood through four connected layers.

Layer 1 – Data foundation

The starting point is a reliable representation of the network. This can include demand, products, customers, inventory, suppliers, manufacturing capacity, facilities, transportation lanes and costs. External information such as tariffs, infrastructure developments, freight conditions and supply risks may complement enterprise data depending on the network question.

The usefulness of AI-enabled analysis depends on the quality and accuracy of this underlying foundation.

Layer 2 – AI and machine learning

AI and machine learning can help interpret what is changing in and around the network. Potential applications include:

- **Anomaly detection** across demand, inventory, cost or capacity
- **Signal interpretation** from external developments
- **Data preparation and classification**
- **Pattern recognition** across products, customers and markets
- Natural-language interaction with the network model

For example, a business user may want to understand:

“Which Indian region is approaching the point where next-day fulfilment could justify another warehouse location?”

or:

“Which products are most exposed if a major supplier becomes unavailable?”

AI can help translate such business questions into the analytical inputs required for further evaluation.

Layer 3 – Optimization and the network digital twin

AI can identify patterns and interpret signals, while mathematical optimization evaluates feasible alternatives within the physical and economic constraints of the network. Digital-twin research similarly describes the use of virtual representations to evaluate alternative configurations and understand the impact of changing operating conditions.¹⁶

The optimizer can then evaluate strategic questions such as:

- Where should inventory be positioned?
- Which facilities should serve which markets?
- How should demand be allocated across manufacturing locations?
- Where may additional capacity be required?
- What changes if a node is added, expanded or removed?

Layer 4 – Agent and decision-support layer

An agent can provide an interaction layer between the business question and the underlying analytical capabilities.

For example, a user may ask:

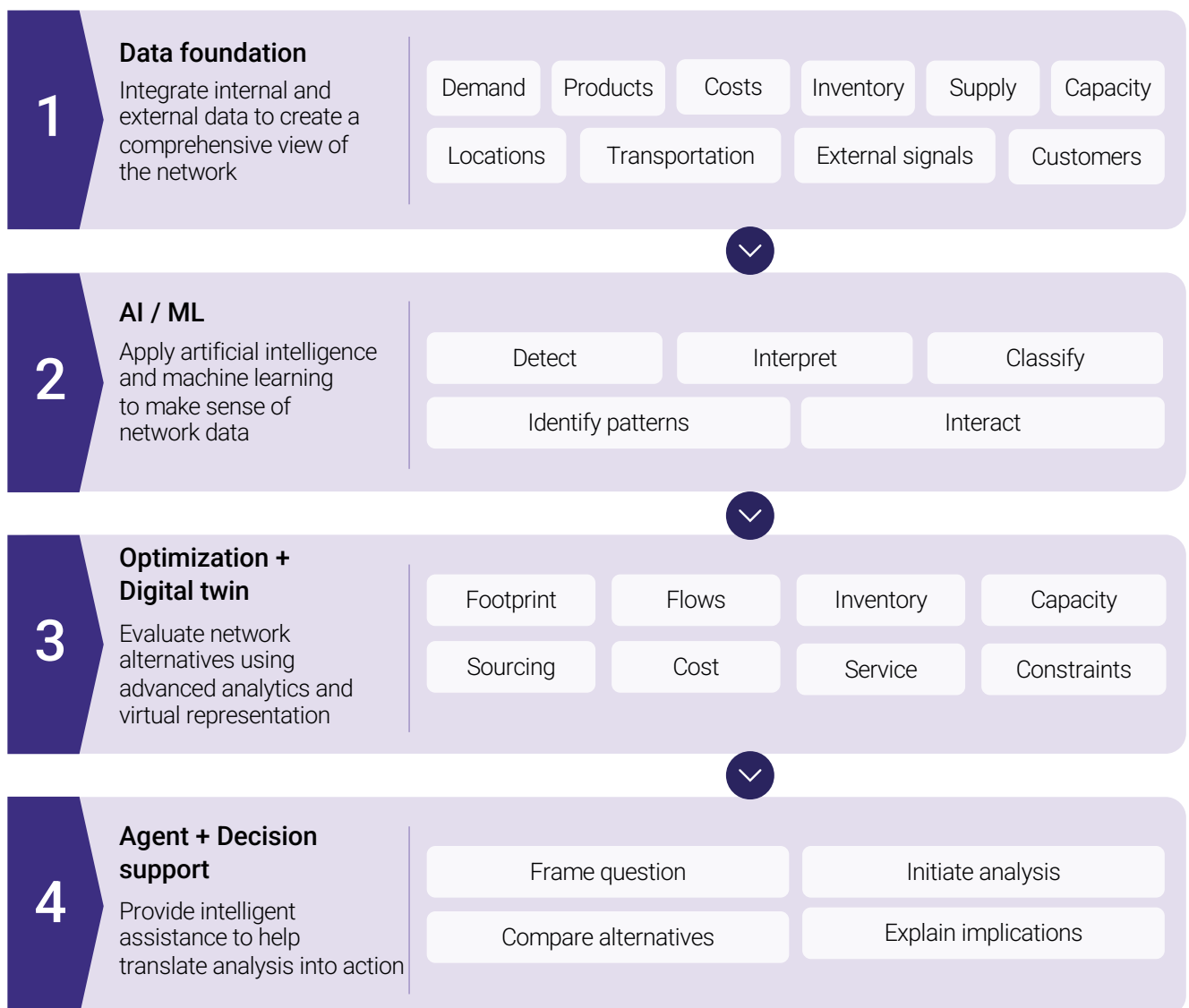
“What happens to our network if quick commerce becomes 20% of sales in our largest markets?”

The agent can help translate the question into the relevant products, markets and assumptions, invoke the appropriate analytical capabilities and explain the resulting cost, service and inventory implications. This can make sophisticated network analysis more accessible through a business-oriented interaction layer.

Exhibit 11

Adaptive network intelligence combines four analytical layers

From data to decisions, the layers work together to turn complex network information into actionable insights



Source: Framework developed for this paper, informed by McKinsey research on digital twins and Gartner research on supply-chain analytics and decision-making platforms.^{16,17}

The network model can become a maintained decision capability

Traditionally, network models were often built for a specific business requirement and point in time. Addressing subsequent network questions could require significant effort to refresh the data, assumptions and model.

A maintained digital representation can incorporate changes in the business and external environment, creating a reusable analytical foundation for subsequent network questions.

Plants, warehouses and major capacity investments remain relatively long-term decisions, while the

intelligence surrounding those decisions can refresh more frequently.

This creates a more responsive analytical cycle:

SENSE - What has changed?

INTERPRET - Which parts of the network could be affected?

MODEL - What alternatives are feasible?

COMPARE - How do those alternatives perform?

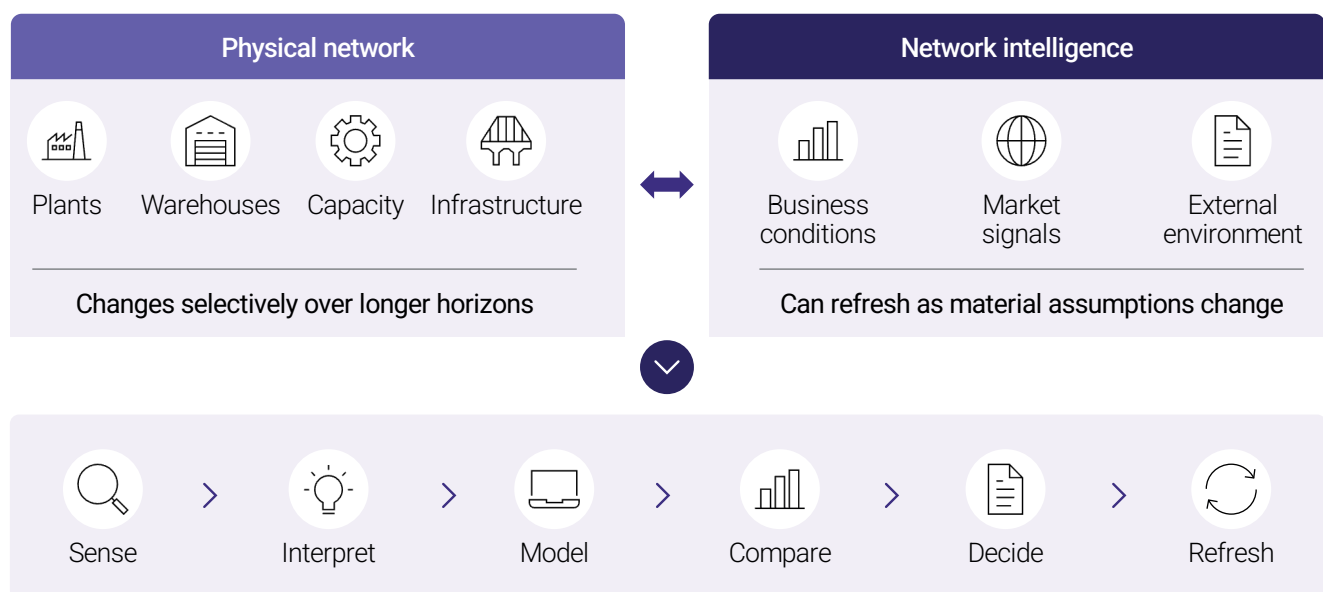
DECIDE - Which trade-offs are relevant?

REFRESH - Which assumptions or network conditions should be updated?

Exhibit 12

Network intelligence can refresh more frequently than the physical network

Analytical insight can be updated regularly, even when physical network changes take longer to implement



Source: Framework developed for this paper, informed by research on digital twins and supply-chain decision intelligence.^{16,17}

Material changes in demand, channels, tariffs, capacity or infrastructure can trigger a fresh evaluation of whether the existing network remains appropriate.

AI strengthens network modelling as decision support

AI can reduce effort in preparing, configuring and analysing network models, allowing modelling teams to spend more time interpreting results and exploring the questions behind them.

Decision support can include deeper interpretation of headline outputs such as cost, inventory and service. Modellers can investigate **why** one network performs differently from another, which assumptions and constraints are driving the result, and how the answer changes when those assumptions move.

Gartner describes GenAI-enabled decision support being used alongside established optimization

engines to summarize scenarios, highlight risks and explain trade-offs in natural language. Gartner research also highlights supply-chain applications where GenAI helps planners explore existing data and derive insights more readily.^{18 19}

AI can also make iterative exploration easier. For example:

What is driving the difference between these network alternatives?

Which assumptions and constraints are materially affecting the result?

What happens if demand shifts to another region?

At what level of demand does another fulfilment location become attractive?

The value is in enabling **faster analysis, deeper interpretation and richer exploration of alternatives.**

07 | Design for scenarios, not for one forecast

Network optimization traditionally starts with a demand forecast. Demand is projected by product and geography over a defined planning horizon. Expected costs, capacity and service requirements are incorporated, and the network is evaluated against these assumptions.

Strategic network decisions can remain in place for several years, while the assumptions behind them may change much sooner. Market growth may shift. Channel mix can evolve. Freight rates and tariffs can change. New capacity or infrastructure may become available. Customer service expectations can move.

Network decisions can therefore be evaluated across multiple plausible conditions, particularly where changes in key assumptions could alter the preferred footprint, capacity or flows.²⁰

One forecast provides one view of the future

A base forecast represents the conditions considered most likely at a particular point in time. It provides an important reference case for network optimization.

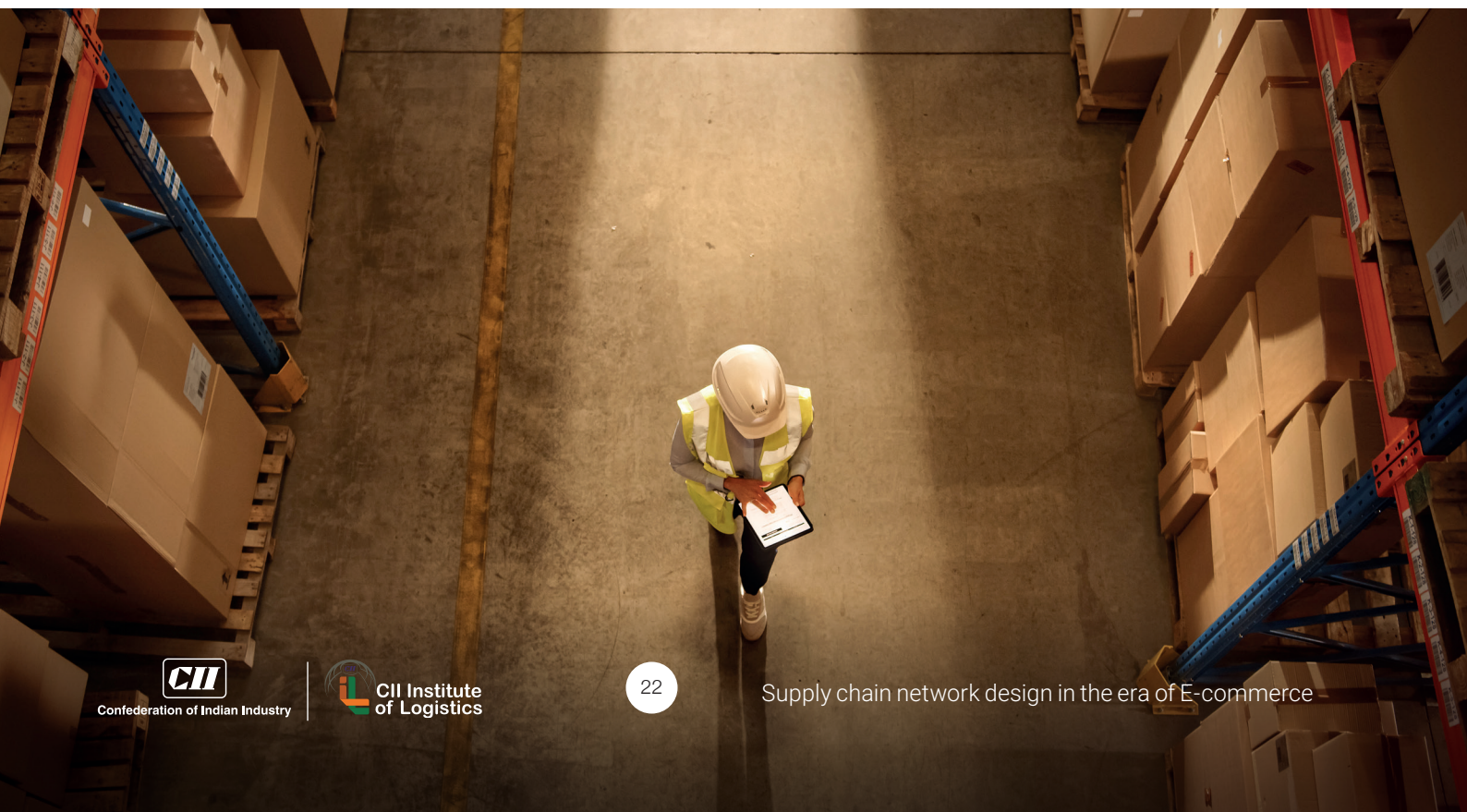
The preferred network can change as the underlying assumptions move. Higher e-commerce growth combined with faster service requirements may increase the attractiveness of local fulfilment capacity. Higher inventory carrying costs may favour greater consolidation. Infrastructure improvements or tariff changes may alter the relative attractiveness of locations and sourcing flows.

The relevant question is therefore:

How sensitive is today's network decision to changes in the assumptions on which it is based?

Scenario analysis helps show whether changes in these assumptions would lead to a different network decision.

Gartner's 2024 survey of **506 supply-chain leaders** found that only **19% of organizations fully integrated scenario planning into their supply-chain strategies**. Gartner recommends using future-focused "what-if" scenarios to understand the implications of changing conditions.²⁰

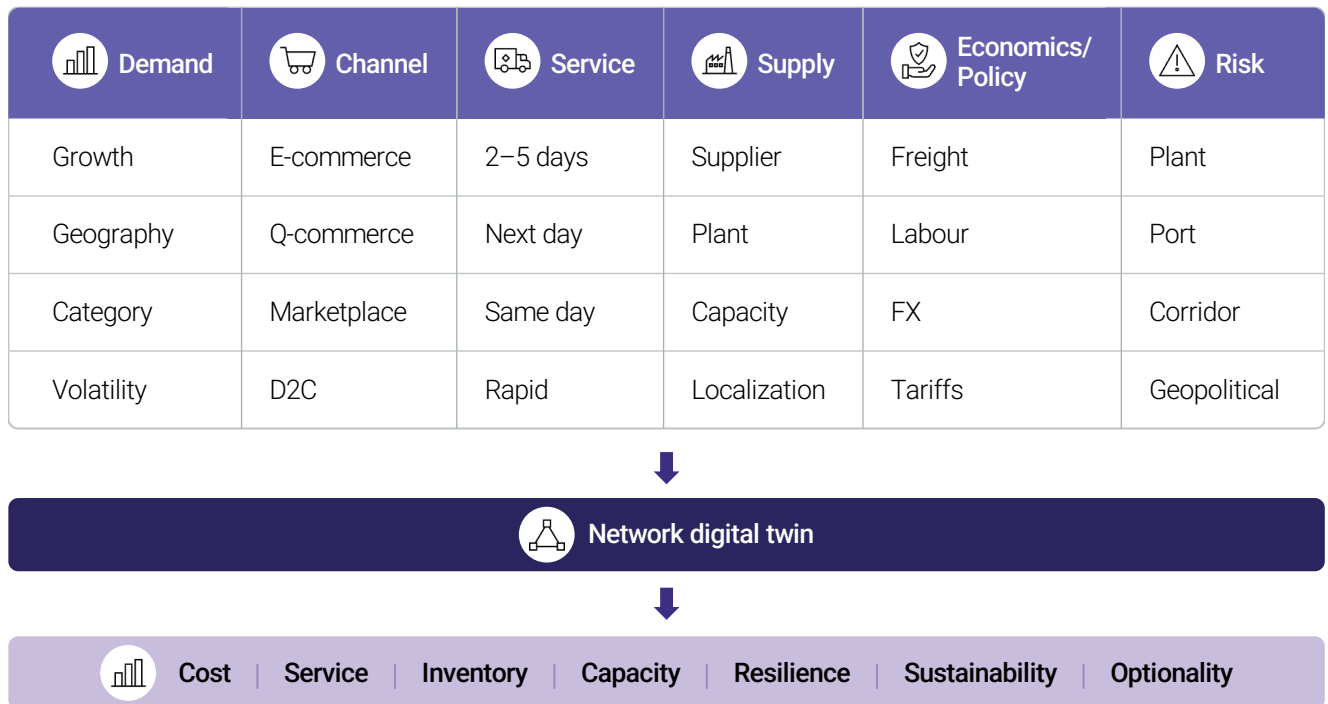


Build a scenario family around the variables that change network economics

A scenario family can be organized around the forces that materially affect network economics.

Exhibit 13

A scenario family connects changing business conditions to network decisions



Source: Framework developed for this paper, informed by Gartner research on supply-chain scenario planning.^{20,21}

Individual variables can also be combined into coherent scenarios.

For example, faster e-commerce growth may occur alongside tighter service expectations and greater regional demand. A margin-pressure environment could combine slower growth with higher freight and inventory costs.

Testing related assumptions together creates coherent views of how several network conditions could evolve simultaneously. A manageable scenario family can therefore focus on the uncertainties most likely to change the network decision.

Evaluate robustness and identify trigger points

Scenario analysis allows alternative network configurations to be compared across several plausible conditions.

A configuration that performs best under the base forecast may become less attractive when demand, service, cost, supply or policy assumptions change.

Robustness measures how well a network configuration performs across the range of futures relevant to the business.

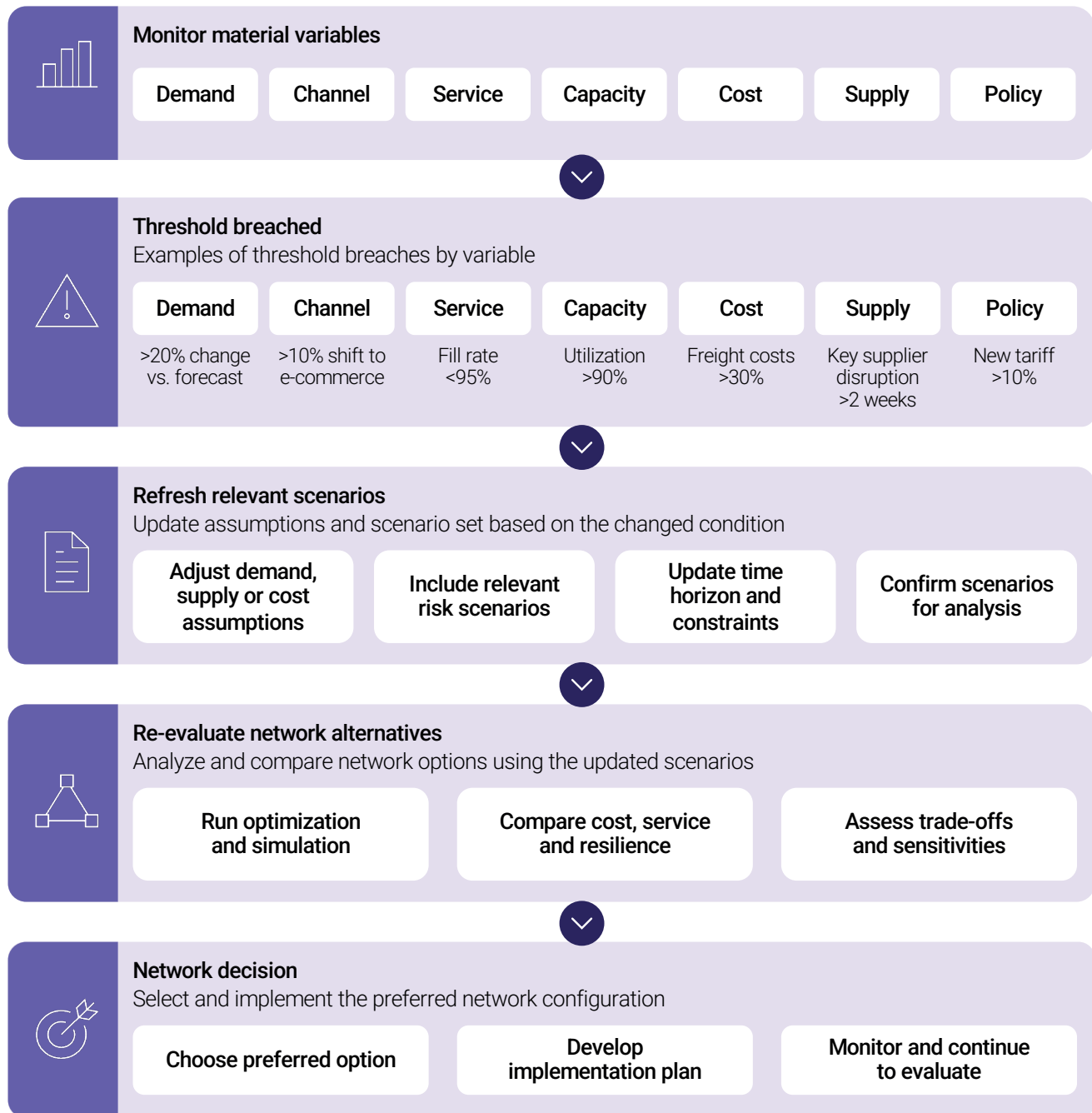
A network with flexibility across sourcing, capacity or inventory locations may preserve viable choices when conditions evolve.

Scenario analysis can also identify **trigger** points—thresholds at which the preferred network decision changes. These thresholds could relate to demand growth, channel mix, service requirements, capacity utilization, freight costs, tariffs or supply exposure.

The specific thresholds are outputs of the company's network model rather than generic industry benchmarks.

Trigger points connect changing conditions to network re-evaluation

When key variables cross predefined thresholds, scenarios can be refreshed and network alternatives re-evaluated



Source: Framework developed for this paper; Threshold values are indicative, not representative of actual data

Scenario-based network design can therefore provide three forms of decision support:

Preferred configuration — the network that performs well under current assumptions.

Robustness — an understanding of how alternative configurations perform as important assumptions change.

Trigger points — the conditions under which the preferred network decision may need to be reconsidered.

Scenario-based network design shows how uncertainty can affect today's network decision and which changes may warrant its reevaluation.

08 | How to build capability in the ecosystem

The quality and repeatability of network optimization depend on the data, constraints, external intelligence, modelling technology and decision processes surrounding the model. Building a sustained capability therefore requires these elements to develop alongside the optimization model.

Readiness precedes repeatable optimization

Data

The organization needs a reliable representation of the network, supported by clear ownership, common definitions and processes for maintaining the information used by the model.

Demand | Products | Customers | Inventory | Suppliers | Manufacturing | Facilities | Transportation | Costs

Operational constraints

The model needs to reflect how the business actually operates.

Capacity limits | Product-plant eligibility | Minimum production quantities | Storage requirements | Supplier restrictions | Service commitments | Transportation constraints

External intelligence

Network economics are increasingly influenced by information outside enterprise systems.

Tariffs | Regulation | Infrastructure | Market growth | Supplier risk | Freight conditions | Geopolitical events

Modelling & technology

The analytical environment needs to represent the network at the required level of detail and evaluate alternatives across relevant objectives, scenarios and constraints.

Decision process

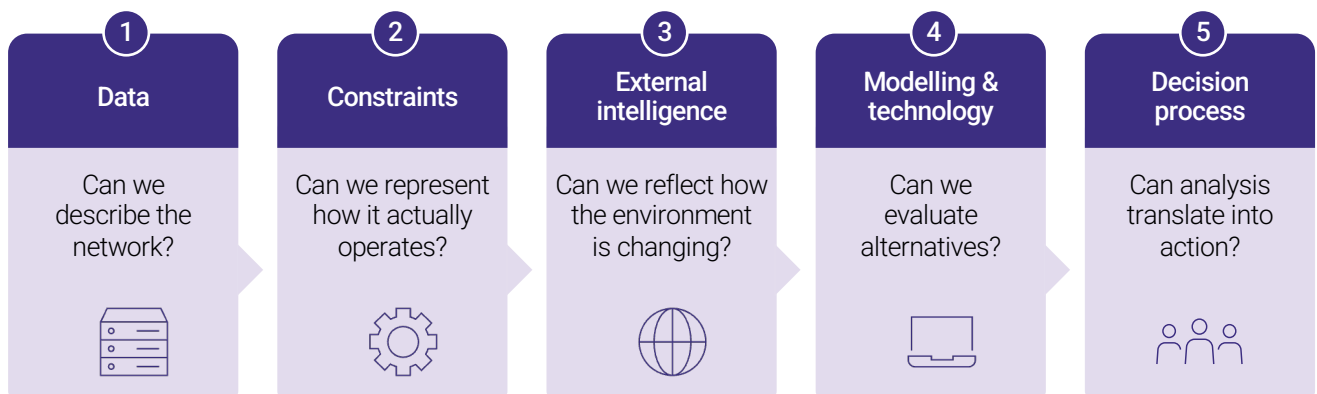
Network recommendations need a clear process for review and interpretation.

This includes clarity on model ownership, assumption ownership, constraint validation, scenario approval and how recommendations are reviewed.

Exhibit 15

Readiness precedes repeatable optimization

Building five foundational elements in sequence enables consistent and scalable network optimization



Source: Framework developed for this paper.

Technology is an enabler of the decision process

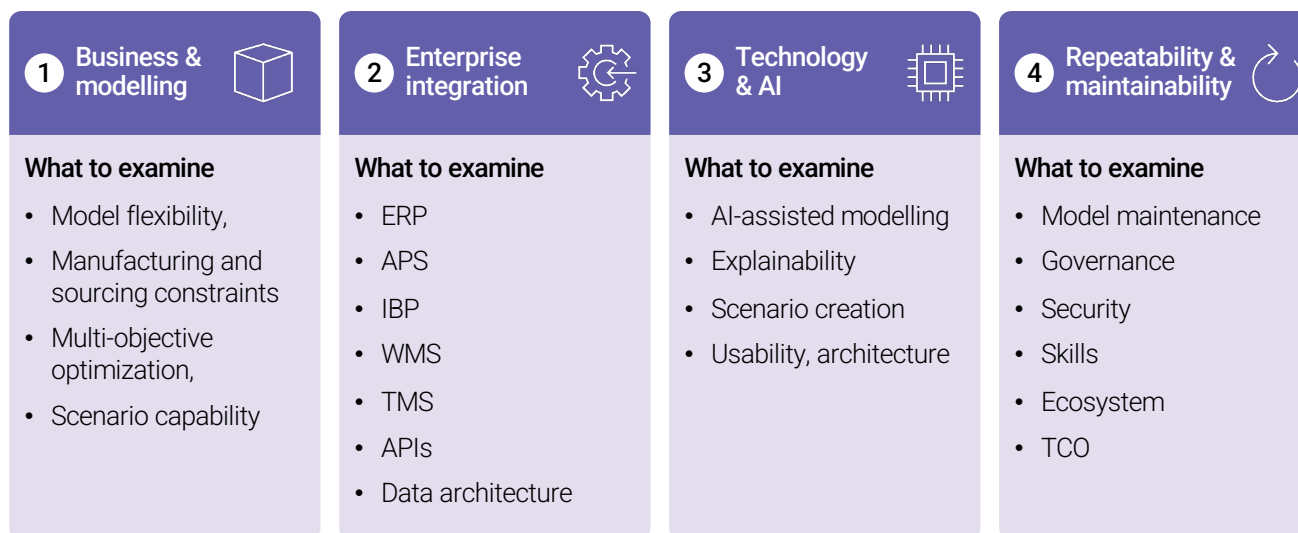
A reusable network-optimization capability requires technology that combines modelling strength with enterprise integration, usability and maintainability.

Integration with ERP, production planning, IBP, WMS, TMS and data platforms becomes important when models are expected to refresh repeatedly.

The platform needs to represent manufacturing and sourcing constraints, multiple objectives and scenarios while supporting data refresh and result interpretation.

Exhibit 16

Network optimization platforms can be evaluated through four lenses



Source: Framework developed for this paper. Gartner's Market Guide for Supply Chain Network Design Tools provides external support for evaluating analytical network-design technologies.²²

A proof of concept can make differences between shortlisted platforms more visible. Shortlisted platforms can be evaluated using the same enterprise data, business question and scenarios. This provides a practical view of modelling effort, flexibility, analytical performance, explainability and the effort required to maintain the capability over time.

Model governance and trust support repeatable use

As network models become more connected to enterprise data and incorporate AI-enabled capabilities, trust in the analytical foundation becomes increasingly important.

Gartner identifies supply-chain data governance as one of the highest-impact technology trends in supply-chain planning. Relevant, accurate and

complete data helps establish trust and encourages adoption of advanced planning capabilities.²³

Gartner also notes that limited transparency into algorithms and lack of trust in data outputs can impede adoption of more autonomous planning technologies.²⁴

Four disciplines can strengthen model trust and repeatability.

Data provenance

Where did the data come from, when was it refreshed and how was it transformed?

Constraint validation

Do the modelled capacities, sourcing rules, service requirements and other constraints still represent how the network operates?

Model versioning

Which assumptions, constraints and logic changed between one model version and another?

Scenario traceability

Which assumptions produced a particular result, and can the analysis be reproduced?

As AI assists with data preparation, scenario creation or interpretation, users need to understand

the analytical basis behind a recommendation and trace material changes in the model.

A repeatable network-optimization capability therefore depends on **confidence in the data, assumptions and model logic surrounding the optimizer.**



09 | A 3–6 month roadmap towards network decisions

The changing network environment creates a practical question for supply-chain leaders: **how can a company move from identifying a network question to a decision-ready analytical capability within three to six months?**

A focused network optimization cycle connects business strategy and customer requirements with a validated fact base, a baseline network model, scenario evaluation and implementation priorities.

Advances in optimization applications, cloud platforms and AI-assisted development can accelerate parts of this journey. A focused first cycle can address a material network question while creating analytical assets that can be reused for subsequent decisions.

Frame the decision and the network question

The starting point is the business decision.

The first step establishes the strategic context, customer requirements, relevant network boundaries and decisions to be supported. This helps determine the scope of the modelling effort and the scenarios that are likely to matter.

Typical questions may include:

- Where should additional manufacturing or distribution capacity be created?
- Which markets should be served through local versus regional inventory?
- How should the network respond to a changing channel mix?
- Which footprint options remain attractive under different demand or supply conditions?
- Where could the existing network face a structural constraint?

Build the fact base and baseline digital twin

A reliable representation of the current network provides the analytical baseline.

Relevant enterprise data is assembled and validated, with information from different systems reconciled across definitions, units, locations and cost structures. Physical flows and operational constraints are then incorporated into the model.

The current network can then be represented through a baseline digital twin that reflects the economics, capacity, flows and service characteristics of the existing footprint.

The baseline can also be reconciled with known business and financial measures to establish confidence in the representation of the current state.

The output is a **validated network fact base and baseline model**.

Define and evaluate priority scenarios

Once the baseline is established, the model can be extended with the structural alternatives relevant to the network question.

These may include:

Footprint – Open, expand, repurpose or close facilities.

Flows – Change market-to-facility or plant-to-market assignments.

Capacity – Add, reduce or relocate capacity.

Sourcing – Introduce alternative suppliers or manufacturing options.

Service – Evaluate alternative customer-service requirements.

Inventory – Test different degrees of pooling and localization.

Each option needs to be represented with the relevant economics, capacity and operating constraints.

The priority alternatives can then be evaluated across multiple dimensions:

The analysis can also explain why alternatives perform differently by identifying the assumptions, constraints and network shifts driving the result.

Scenario families and trigger points can help determine whether the preferred network remains attractive as important assumptions change.

Align on the preferred network and the path forward

Shortlisted configurations can be considered across three practical dimensions.

Impact

What improvement does the alternative create across cost, service, inventory, resilience or other strategic objectives?

Ease of implementation

What changes are required across facilities, flows, suppliers, customers, systems and operating processes?

Investment

What additional capital, capacity or infrastructure is required?

These dimensions help distinguish alternatives that may appear similar in the optimization output but have materially different implementation requirements.

The outcome is a **preferred network configuration and a prioritized set of network initiatives**, together

with the assumptions and conditions supporting those choices.

Trigger points can identify when changes in demand, capacity, channel mix or other variables warrant reevaluating the decision.

Build the capability around the first decision

The first network optimization cycle can establish reusable assets for subsequent decisions.

The baseline digital twin, validated data definitions, constraints and scenario logic can form a reusable analytical foundation. Priority integrations can then be developed around the data and processes that prove most valuable.

Implementation priorities can also be organized across different horizons.

Immediate actions

Changes that can begin with limited structural investment.

Medium-term actions

Capacity, footprint, sourcing or inventory changes requiring additional planning and coordination.

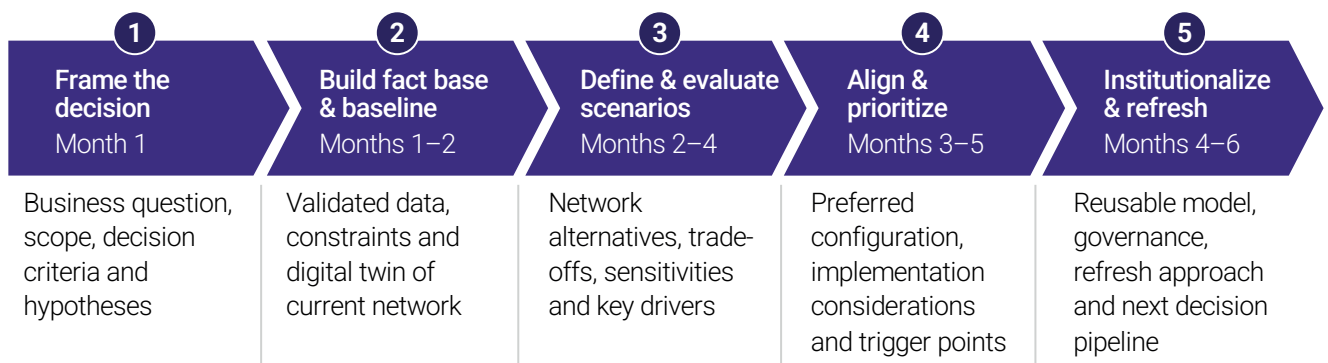
Longer-term actions

Network changes whose timing depends on future demand, infrastructure, investment or other external conditions.

Model ownership, refresh processes and governance can develop alongside these activities to support repeatable use.

Exhibit 17

A focused 3–6 month cycle can move from network question to decision-ready capability



Source: Framework developed for this paper. Timelines are indicative and will vary with network complexity, data readiness and scope.

AI-assisted modelling can support portions of data preparation, model configuration and analysis, potentially shortening parts of the analytical cycle.

The data, model and methodology developed through the exercise can support future network

questions and be refreshed as the strategic or economic context changes.

Over time, this creates a **maintained network decision-support capability** that can respond more readily when the economics of the network change.

Conclusion

Strategic network optimization is becoming a more dynamic problem.

The physical network will continue to involve long-term choices. Manufacturing locations, distribution centres, capacity and infrastructure change over relatively long horizons. The assumptions supporting those choices can move much faster.

Digital commerce is altering where and how demand emerges. Dynamic service expectations are changing the required proximity to customers. Omnichannel introduces different fulfilment requirements across products and channels. Infrastructure, tariffs, supply conditions and market growth influence the relative attractiveness of locations.

These developments expand the scope of network optimization.

A network can be evaluated across **cost, service, inventory, growth, resilience, sustainability and optionality**. Scenario analysis can show which network choices remain attractive as assumptions change. Trigger points can indicate when those assumptions have moved sufficiently to warrant another evaluation.

Technology is also changing how readily this analysis can be performed. A maintained digital representation of the network can provide a common analytical foundation. Optimization can evaluate the

physical and economic choices available. AI can help interpret signals, explore results and explain why alternatives perform differently.

The resulting capability is adaptive because the **intelligence surrounding the network can refresh more frequently than the physical network itself**.

This creates a more current understanding of the network, the assumptions on which it depends and the conditions under which a different configuration may become attractive. Physical changes can remain selective and deliberate, while the analytical capability continues to evolve with the business environment.

For supply-chain leaders, this creates three enduring questions:

- What network configuration best supports the business today?
- How does that answer change across plausible futures?
- What changes in the business environment would cause us to reconsider the decision?

The network itself will continue to evolve over years.

The advantage may increasingly lie in recognizing earlier which changes matter, understanding their implications and having the analytical capability to respond.

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