National Electrical Manufacturers Association

Supply Chain Resilience Playbook

Building Infrastructure Sector

July, 2023

BCG

Playbooks

Integrating Resilience

Sector Overview

Playbooks Overview

A. Near-term Recovery

B. Network Design

C. Sourcing Strategy

D. Inventory & Planning

E. Flexible Engineering

BCG and NEMA are partnering together to provide actionable insights for NEMA members to make their supply chains more resilient

Context

NEMA members have been dealing with multiple "perfect storms" in their supply chains over the past few years

As a result, NEMA is prioritizing supply chain resiliency as one of its three 2022/2023 campaigns

Campaign and BCG partnership goals are to:

- Identify potential future risks that require policy/advocacy focus
- Provide members with a resiliency playbook they can leverage independent of policy outcomes

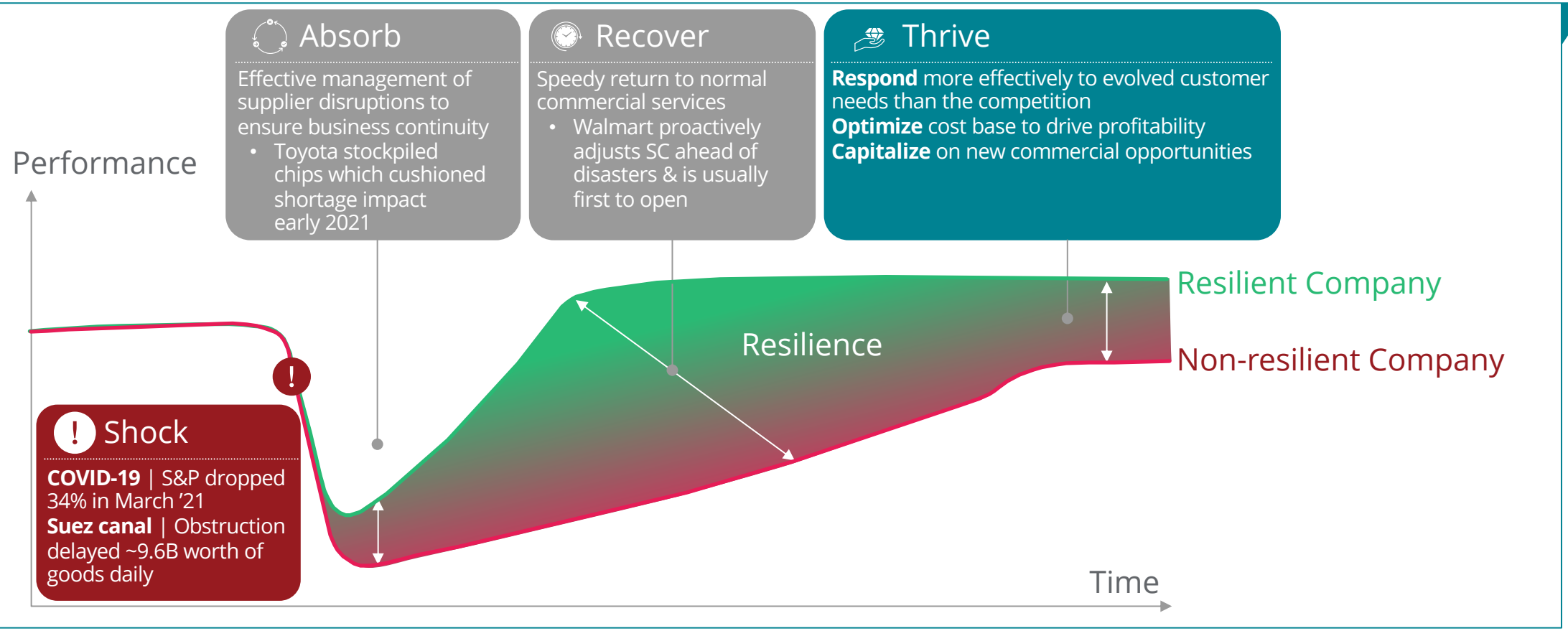
8-week sprint

Member companies will participate in an e-survey (all members) and 1:1 focused interviews (for select members) alongside input from BCG's global experts to deliver:

- Bill of Materials (BOM) of the Future
- BOM Risk Assessment & Priorities
- Supply Chain Capability Assessment scorecard
- Resiliency Playbook for Immediate Action

What is Supply Chain Resilience?

Capacity to absorb stress, recover critical functionality, and thrive in altered circumstances



Source: BCG Henderson Institute Analysis

Multiple risk categories are impacting NEMA member supply chains, driving need for greater resilience

Supplier Operational risks
Single-sourcing, on-time performance, lead times

Supplier Financial risks
Insolvency, commodity price disruption, market imbalance

Geographic risks
Global trade dynamics, conflict, climate change regulations etc.

Industry risks
ForEx volatility, macroeconomic policy, product regulations etc.

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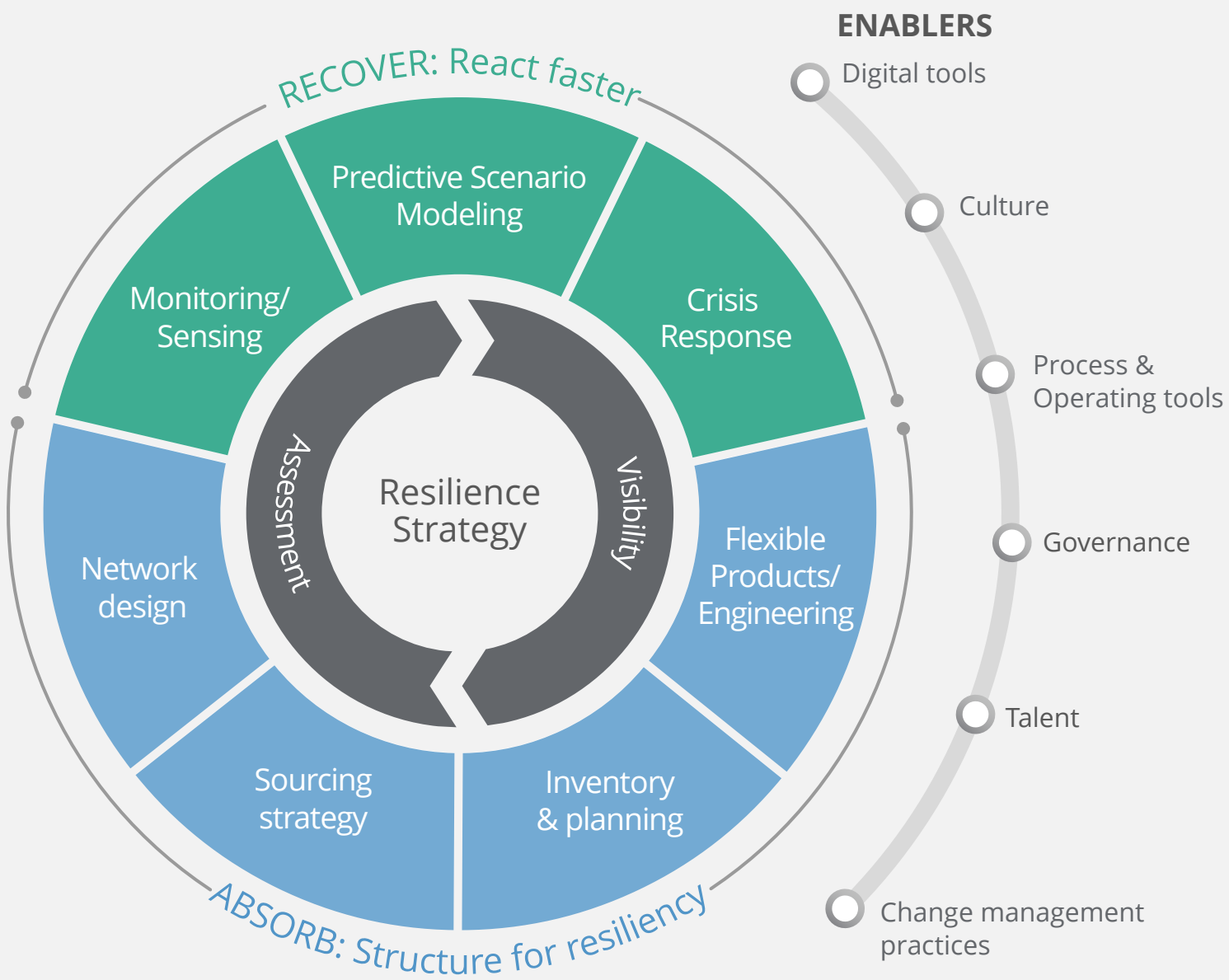
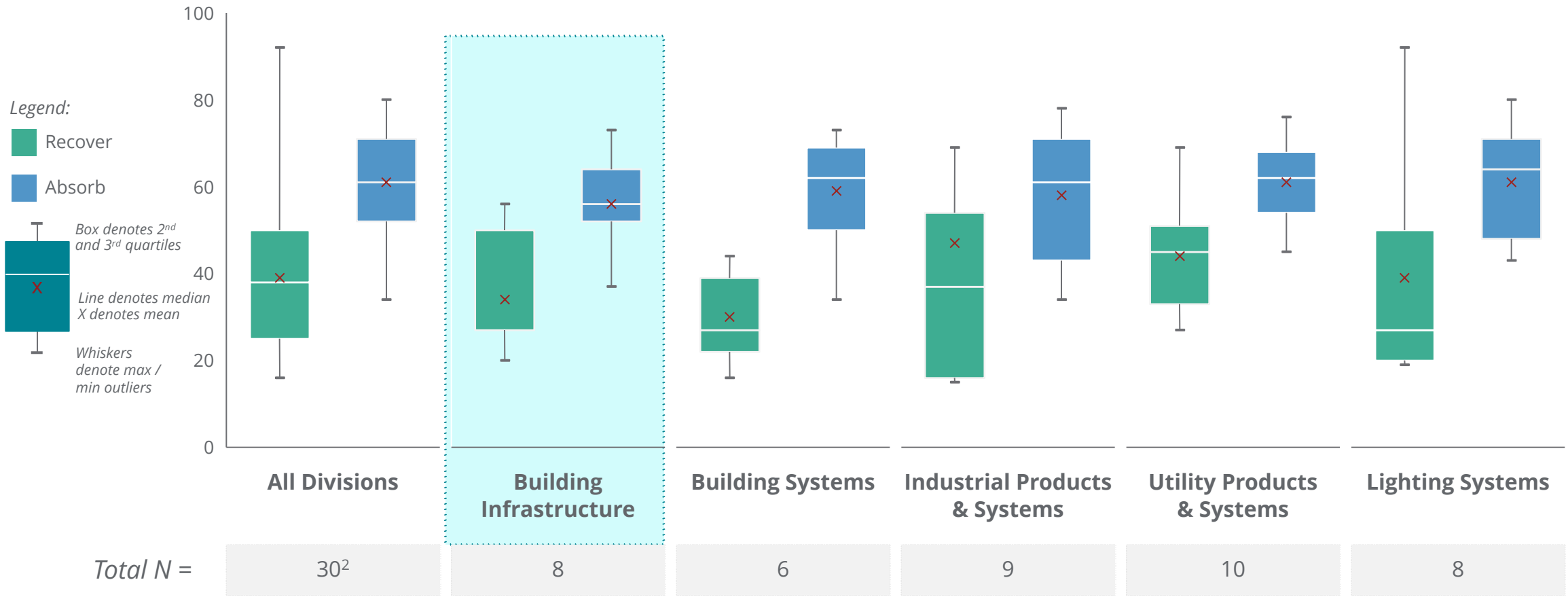
Tackling resilience holistically requires building proactive and reactive capabilities as well as strategic enablers



NEMA Divisions | The Building Infrastructure division is in line with NEMA

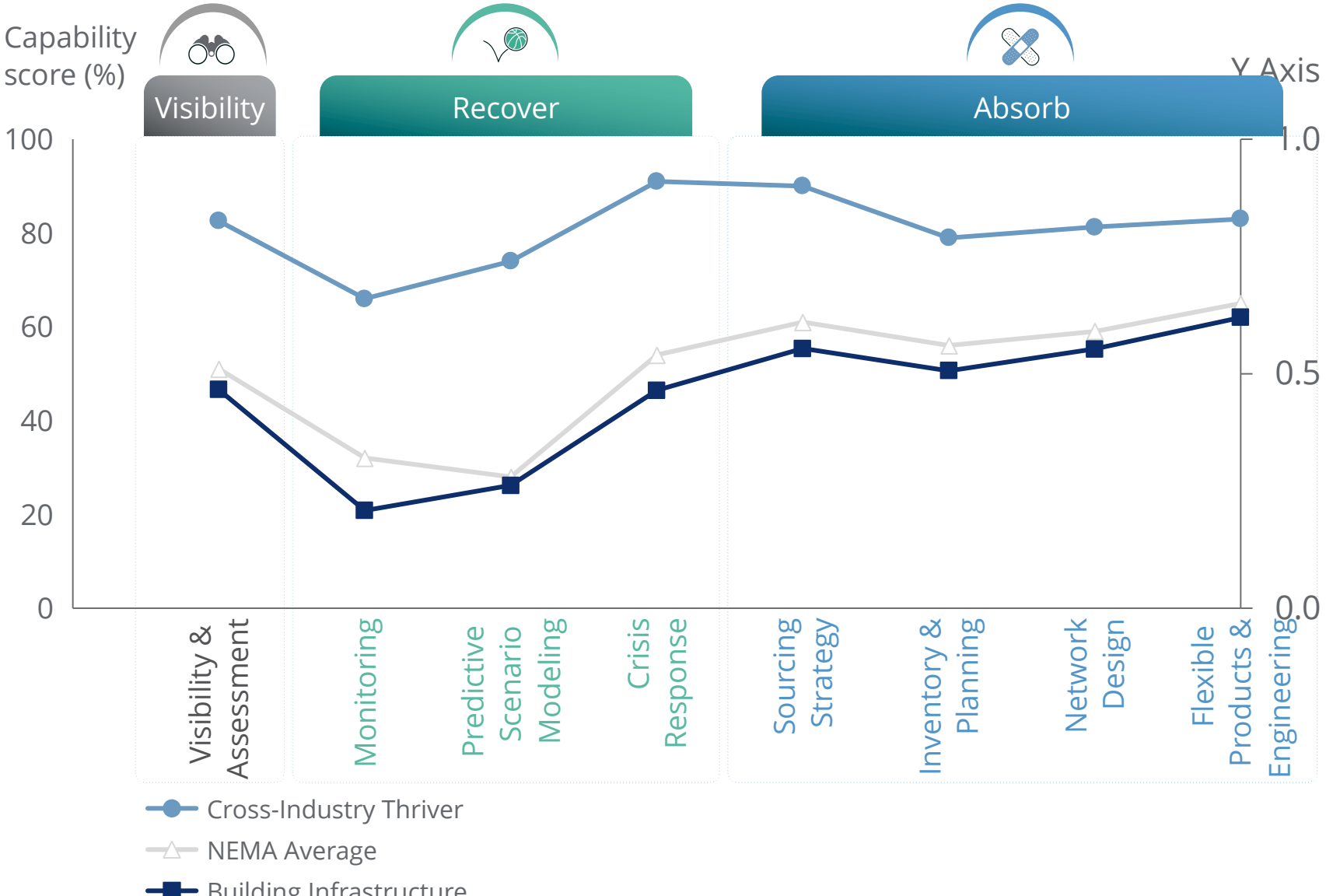
Breakdown of resiliency scores by divisions[1]



Source: NEMA Supply Chain Resiliency survey conducted in February 2023 with n=30

1. Divisions with N < 5 not included
2. Total will not add as multiple members operate in multiple divisions

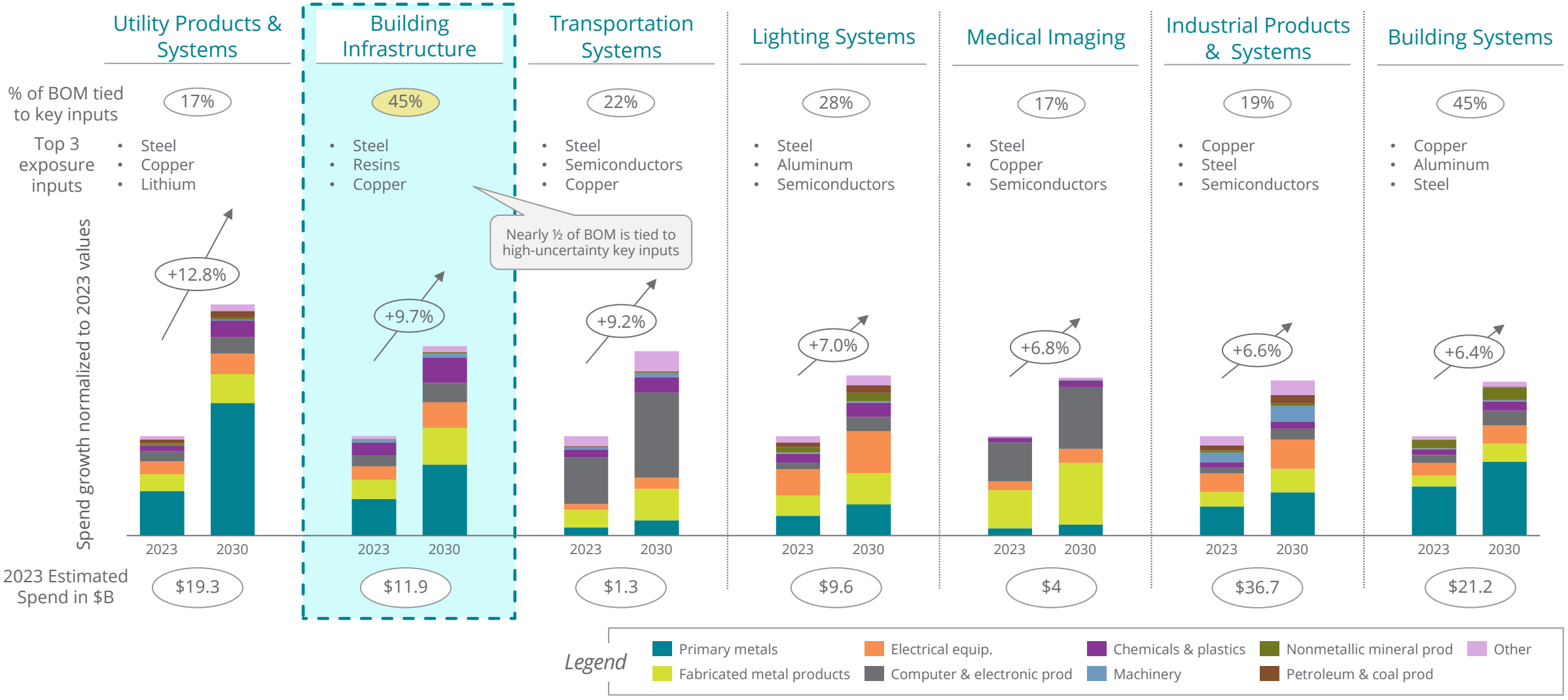
Sector Deep Dive | Building Infrastructure



Sector broadly aligned with NEMA but below bechmarks

- **Visibility & Assessment:**
  Similar opportunity to close gap as other NEMA members
- **Recover**
  Biggest opportunity in Monitoring
- **Absorb**
  Sourcing Strategy largest gap to benchmarks

The Building Infrastructure Division's BOM will grow higher than GDP and at the second fastest rate vs NEMA members



Source: U.S. Bureau of Economic Analysis (BEA) input/output (I/O) tables; Census 2016 Annual Survey of Manufactures; NEMA data on product mix by segment; BCG Analysis

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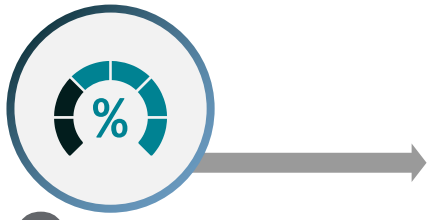
Implementing a structured step by step process will help build high priority capabilities and embed resiliency across the organization



0 Assess

Initial Assessment

Benchmark vs. peers

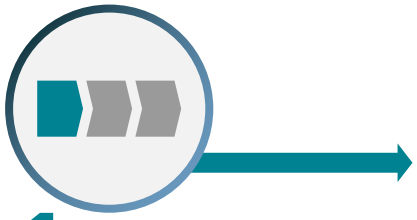
Resilience Maturity Score

Flag weakest and critical areas

Identify risks to operations

Assess resilience of your company

2 weeks



1 Roadmap

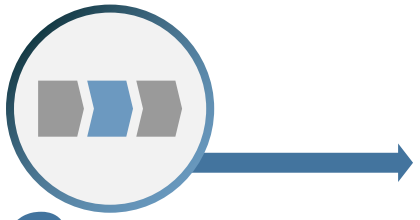
Identify and prioritize quick wins for capability ramp-up

Align leadership, set up governance and resilience tracking system

Understand capability gaps and design transformation journey

Build an integrated resilience roadmap

~2-6 weeks



2 Embed

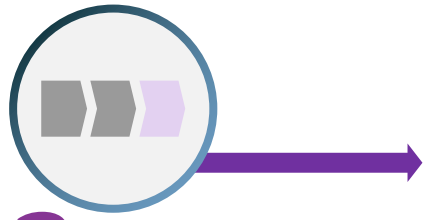
Implement visibility tools for risk monitoring in core company processes

Launch small number of key initiatives and track results

Incorporate robust change management approach to enable smooth transformation

Embed resilience in critical areas

6 months



3 Expand

Integrate monitoring / predictive scenario modeling across operations and supply chain (including tier 2+)

Continue to implement resilience initiatives

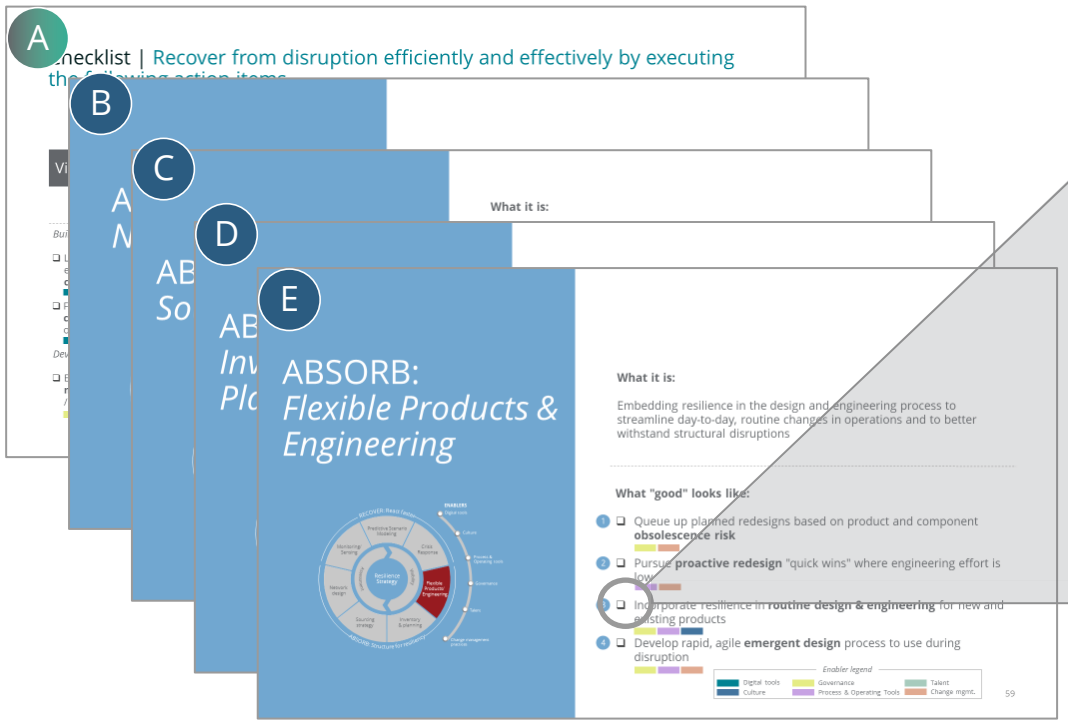
Implement more structural changes for a resilient business and operating model

Expand resilience in all parts of the company

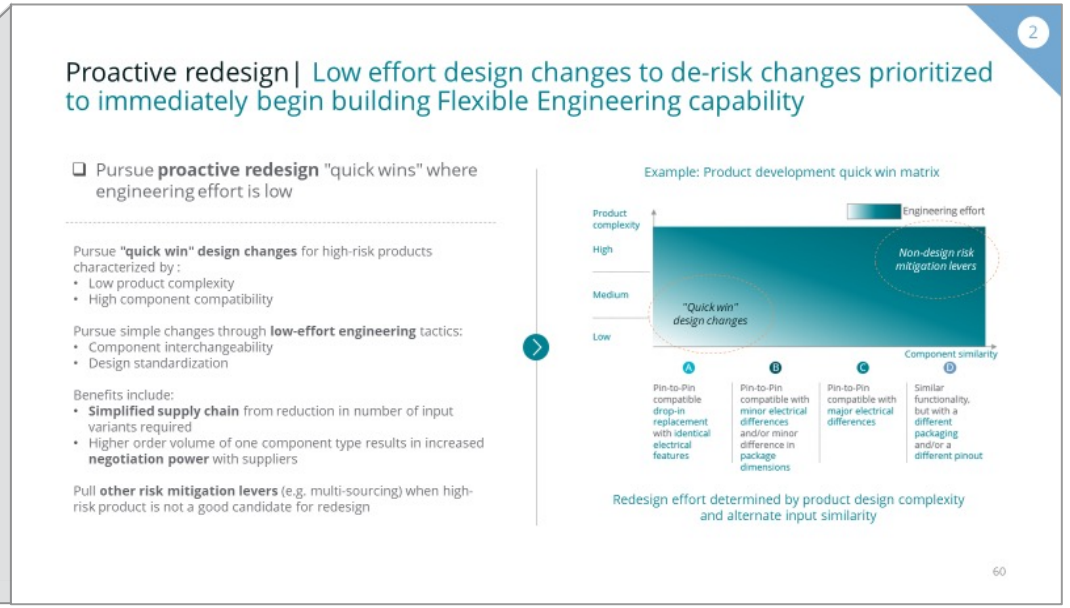
1–2 years

Overview | Five playbooks to action the resilience improvement strategies

Five "playbooks" with checklists outlining best-in-class supply chain resilience strategies…



…With detail pages and example vignettes explaining how to approach each strategy



A

Checklist | Recover from disruption efficiently and effectively by executing the following action items

Recover faster

Visibility & assessment	Monitoring / Sensing	Predictive Scenario Modeling	Crisis Response

❑ Invest in a **control tower** to integrate legacy data, external data, and AI/ML for end-to-end supply chain analysis and management

Build visibility across your network:

❑ Leverage internal data and existing tools to develop view of **current-state supply chain**

❑ Fill in gaps in **extended supply chain** visibility with external data or AI

Develop assessment mechanism:

❑ Establish **key operational metrics** to quantify potential risk / exposure and prioritize action

Monitor for disruption:

❑ Build out **threat intelligence** capabilities to proactively track industry-level, company-specific, and macro-level developments

❑ Set up integrated **alert system** to flag risks as they arise and deploy appropriate early response resources

Predict impact of risks:

❑ Determine likely **scenarios** and potential **levers** for both short-term action and long-term mitigation (e.g., alternative sources, inventory allocation)

❑ Invest in a **digital twin** to model scenarios, quantify impact of disruption, and evaluate options for response

Respond effectively to crises:

❑ Set up cross-functional **Crisis Response Center** with a dedicated team and dynamic playbooks to react to crisis scenarios

❑ Embed an **after-action mechanism** reinforcing continuous improvement in resilience with every crisis

Enabler legend

Digital tools · Culture · Governance · Process & Operating Tools · Talent · Change mgmt.

Checklist | Develop supply chain resilience capabilities by executing the following action items to absorb shocks with minimized impact to operations

Structure to Absorb

B Network design

Optimize your network:

- ❑ Consider **re/near-shoring** part of footprint for optimized stability and cost
- ❑ Optimize **manufacturing** plant and **DC/Warehouse footprint**
- ❑ Optimize **logistics network**
- ❑ Increase manufacturing productivity via **OEE**[1] metrics
- ❑ Leverage **flexible manufacturing** to improve resiliency (e.g., 3D printing)

C Sourcing strategy

Transform your strategy:

- ❑ Strengthen strategic **sourcing governance** (decision-making) to balance cost and risk
- ❑ Identify critical components to prioritize for **alternate sourcing** (e.g., multi-sourcing or bringing in-house)
- ❑ Review (and if needed, renegotiate) **contractual agreements** to bolster supply certainty
- ❑ Prioritize suppliers for development of **strategic partnerships** to ensure continuity of supply

D Inventory & planning

Develop capabilities:

- ❑ Evaluate use of strategic **inventory buffers** for most critical inputs
- ❑ Embed resilience-oriented analysis in regular **IBP/SIOP/S&OP** business cycles
- ❑ Invest in **planning tool** with inventory visibility and analytical demand targets
- ❑ Invest in **production scheduling tool** to minimize impact of disruptions when they arise

E Flexible engineering

Build flexibility into design:

- ❑ Queue up planned redesigns based on product and component **obsolescence risk**
- ❑ Pursue **proactive redesign** "quick wins" where engineering effort is low
- ❑ Incorporate resilience in **routine design & engineering** for new and existing products
- ❑ Develop rapid, agile **emergent design** process to use during disruption

1. OEE = Overall Equipment Effectiveness; 2. SIOP = Sales, inventory and operations planning, also known as S&OP (Sales & Operations Planning); 3. VAVE: Value-added value engineering

Enabler legend

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Control Tower | Control Tower helps organizations monitor the full supply chain in one centralized location, increasing agility and performance

Key enablers: Digital | Process

- ❑ Invest in a **control tower** to integrate legacy data, external data, and AI/ML for end-to-end supply chain analysis and management

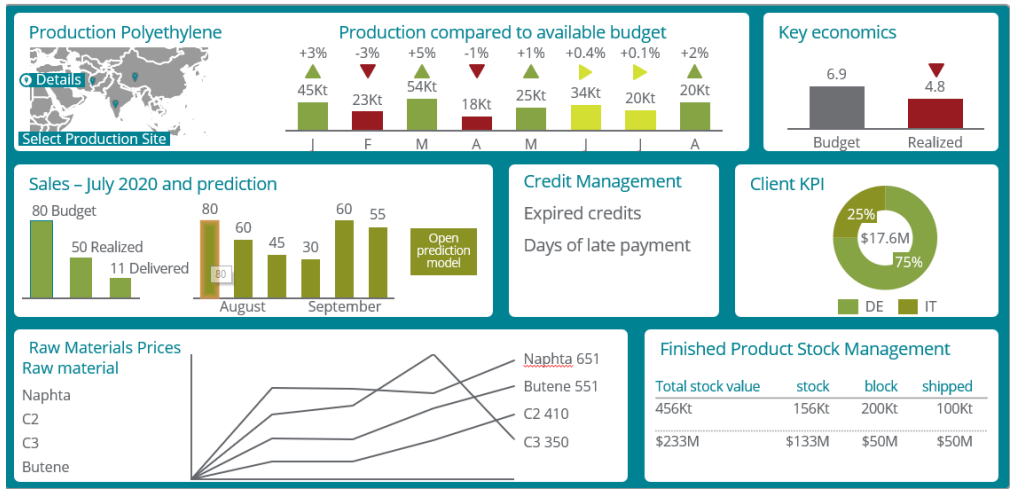
Connect disparate data sources in a control tower dashboard, using API integrations and/or pulls directly from data lake (in-house or via integrator, e.g. Snowflake)

Customize control tower functionality in line with company objectives (e.g. priority capability development)
- Select from set of pre-existing modules from established vendors (e.g. SAP, o9 Solutions, Blue Yonder)
- Apply fully modular design in case of in-house build

"Best-in class" control towers includes **embedded functionality** across multiple modules:
- Visibility
- Key metric tracking
- Threat intelligence
- Alert systems
- Scenario development
- Scenario modeling (via digital twin)
- Crisis response automation + decision support
- After-action report for continuous improvement

Functionality detailed across other capabilities in "Recover" playbook

Example control tower dashboard



Companies deploying SC control towers typically see:

1. 30% Fewer delayed deliveries
2. 10% Revenue increase
3. 10% Reduced logistics costs
4. 15% Service level increase

Example | End-to-end (E2E) control tower for a multinational manufacturer

Context

COVID-19 caused **limited disruption** on the manufacturer's supply chain (SC), but the impact was not fully averted. Manufacturer wanted to implement **more best in class measures** to soften potential SC disruptions in the future.

One of the initiatives to build supply chain resilience was to develop an **E2E SC Risk Management Control Tower** (CTRL TWR), including a Scenario Modeling Tool as a Minimum Viable Product (MVP).

The CTRL TWR was designed to **ensure "line of sight"** to how (practically) the manufacturer could better **sense** potentially disruptive (external) signals earlier and convert the signals into **quantifiable, actionable risks** that could be mitigated through the existing S&OP cadence.

Highlights

On the 'front end' of the CTRL TWR, an **external environment monitoring system** is stood up, using three 'lenses' to retrieve signals of potential risks to the supply chain. Based on a set of **threshold values** for different **Key Risk Indicators** (KRI) an iterative process ensures that **only risks of a certain size** get added to the risk register for potential further **scenario modeling** with the Scenario Modeling tool. Once evaluated the potential impact of these risks will enter the existing S&OP cadence

1. **KRI selection conducted**: Selected from tool, list of best-in-class risk indicators, ensuring comprehensive overview, frequent updates and sound geographical coverage
2. **Risk identification methodology**: Used comprehensive framework for quantifying SC risk in combination with "the art of the possible"
3. **Dashboard**: Combining multiple internal and external KRIs ensures a comprehensive overview

Key Takeaways

Established SC risk management process with dedicated resourcing and tools

Increased ability to **react** to disruptive events through:

1. Better ability to anticipate/"predict" disruptive events
2. Better ability to make informed and early decisions through simulation of impact of the event itself and countermeasures
3. Increased preparedness in the supply chain to quickly adapt

Retrospectively, it was assessed that the specific COVID-19 SC disruption could have been **a lot less costly** if the control tower had been in place:

- ~2 weeks faster anticipation time
- ~3-4 weeks faster recovery speed

... resulting in improved EBIT impact of ~$15M

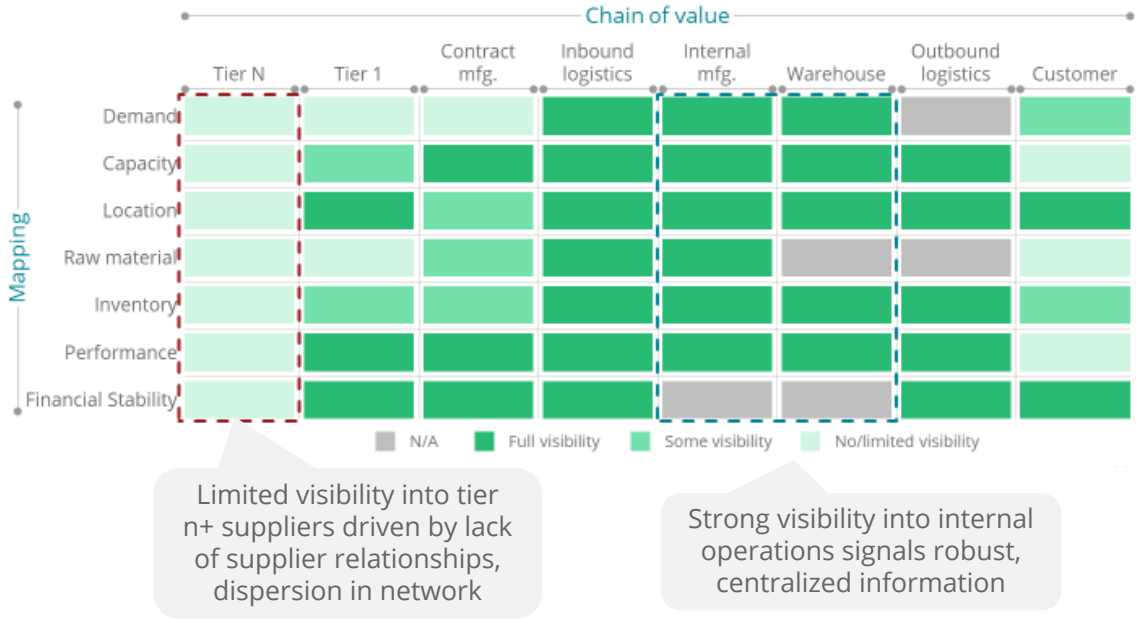
Current-state Supply Chain| Develop supply chain visibility by assessing existing internal data to determine current-state and flag gaps in visibility

Key enablers
Digital | Process

❑ Leverage internal data and existing tools to develop view of **current-state supply chain**

- Create a **central view** from disparate data sources (ERPs, planning systems) to take stock of your existing **visibility** into …
  - Internal network (DCs, plants)
  - Upstream (suppliers, as many tiers as available)
  - Downstream (logistics providers, customers)
- Flag major **gaps** in **existing visibility** and prioritize unknowns based on revenue at risk

Example current-state view of visibility across the value chain deliverable



Visibility varies across different parts of the supply chain depending on distance from information

Extended Supply Chain | Extend visibility across full SC by integrating external data to map multiple tiers of suppliers and downstream network

Key enablers

Digital | Process

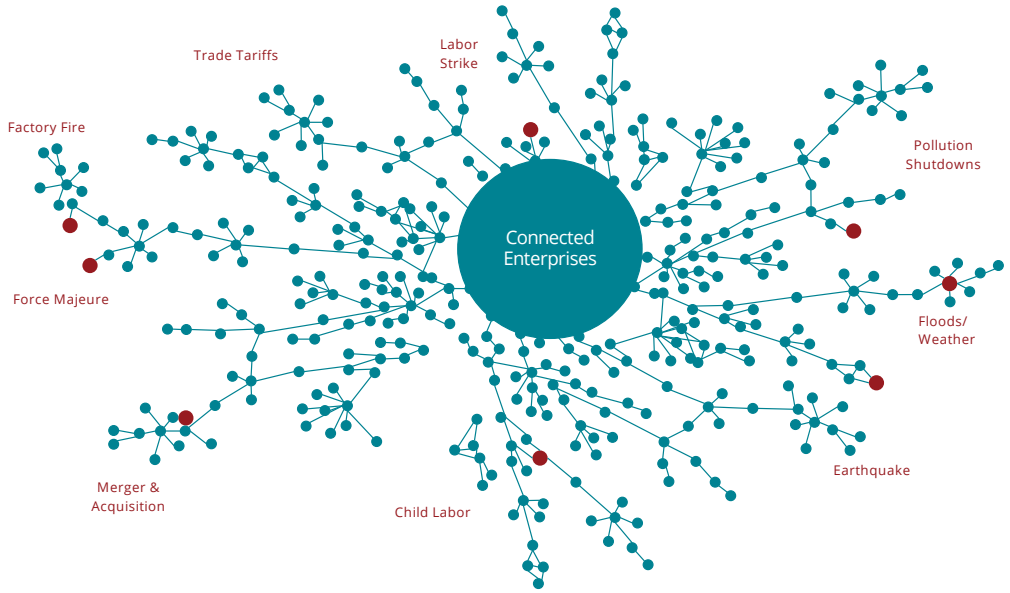
❑ Fill in gaps in **extended supply chain** visibility with external data or AI

Map full **upstream** and **downstream** network, estimating lowest tiers with advanced analytics by investing in…

- Internal / third party resources to build a **custom tool**, pulling together extended SC data sourced from vendors / partners
- A SC mapping vendor **estimating network** via **AI** (e.g. Resilinc to map tier n+ suppliers based on known tier 1 operations)

Prioritize **biggest risks** to manufacturing and operations maintenance for proactive mitigation (e.g., identify alternative sources if critical tier 2 suppliers found to source inputs from same tier 3)

Example extended SC network mapping deliverable



Within complex supply chain networks, shocks can have major consequences as disruptions flow up the network

Key Operational Metrics | Develop specific metrics to assess resiliency capabilities in current-state operations and track progress of risk mitigation

Key enablers: Governance | Process | Change

❑ Establish **key operational metrics** to quantify potential risk exposure and prioritize action on an ongoing basis

Ensure SC **resilience angle** is incorporated into **traditional** SC **metrics** and regular **business planning**

Goal is to attribute what share of SC performance shortfalls is tied to mitigatable factors

Example metrics include:

- **Inventory volume** tied to **high volatility inputs** (e.g., lithium)
- Share of **revenue** associated with **single-sourced components**
- Days of **delayed service** tied to specific **logistics providers**
- Days of **production delays** tied to **shortages** (incl. labor)

At regular **cadence** (e.g., monthly or quarterly), **track metrics** against company **performance goals** to assess **success** of **mitigation levers** and degree of resilience

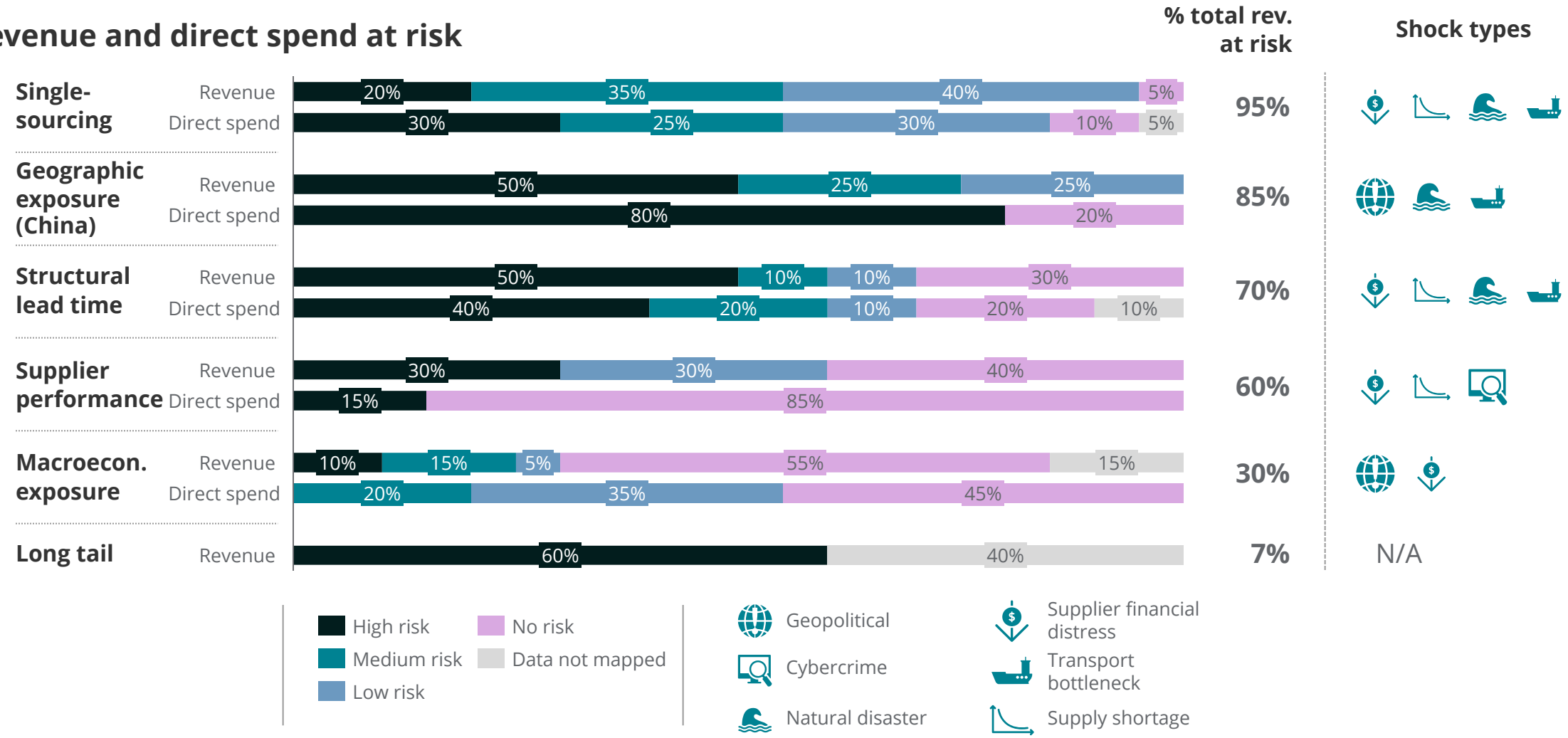
Example KPI dashboard

	KPI	Apr	May	Jun	Target
Financial	1. Revenue at risk (%)	2%	9%	13%	10%
	2. Profit at risk (%)	4%	21%	27%	5%
Customer	3. Distribution coverage (%)	70%	61%	48%	80%
	4. Service level (%)	87%	67%	54%	90%
	5. Stock availability at POS (%)	84%	78%	64%	95%
Process	6. Total stock days (days)	54	50	38	60.0
	7. Sales forecasting accuracy (%)	78%	72%	58%	90%

Key operational metrics provide immediate view of risk-driven performance changes

Key Operational Metrics Example | Resilience-oriented assessment KPIs indicate share of revenue and spend associated with major risk categories

Revenue and direct spend at risk



Example | Manufacturing organization mitigated supply chain risks via E2E visibility

Context

The organization developed **detection modules** to systematically identify **potential risks** in supply chain

Detection modules consist of **supplier evaluations**, **self-assessments**, and **on-site inspections**

Highlights

The organization implemented **interconnected** controlling mechanisms:

- Corporate responsibility self-assessments
- Supplier audits
- External sustainability audits
- Declarable substances verification
- Responsible mineral sourcing

Key Takeaways

The implementation of an interconnected controlling mechanism has provided:

- End-to-end visibility on supply chain
- Early identification of supply chain bottlenecks
- Accelerated risk mitigation / response

Threat Intelligence| Robust monitoring requires ability to track events that can have adverse SC impacts

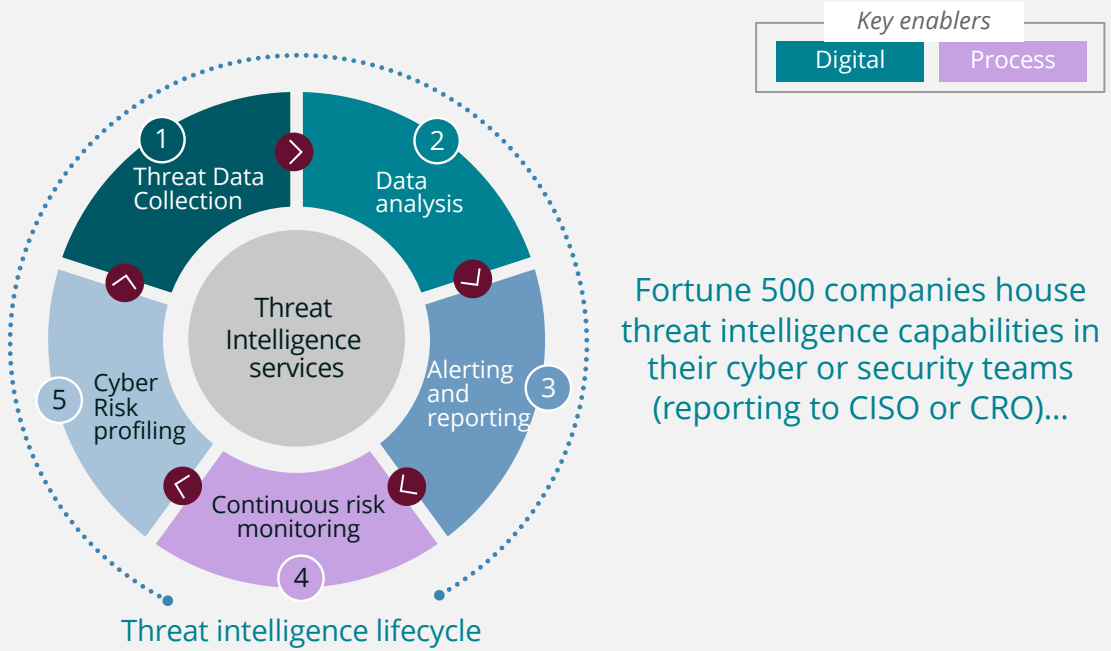
- Build out **threat intelligence** capabilities to proactively track industry-level, company-specific, and macro-level developments

Monitor open-source intelligence (local news, fringe social media, chat rooms, deep dark web) using key word tracking for relevant facilities, suppliers, third-parties, inputs, political entities, and geographies

Identify **events with potential to impact operations** such as:

- Labor strikes
- Supplier insolvency or plant closures
- Extreme weather events
- Ransomware and other cyberthreats
- Geopolitical crises (e.g. threatened shipping lanes)
- Macro-economic conditions (e.g. bank insolvency)

Integrate data feeds into control tower for best-in-class single point of analysis and decision support



Threat intelligence lifecycle

Fortune 500 companies house threat intelligence capabilities in their cyber or security teams (reporting to CISO or CRO)...

Example threat intelligence vendors

digital shadows_
CROWDSTRIKE
Recorded Future
ZEROFOX
FLASHPOINT
INTEL471

...with self-generated data feeds or curated data provided by specialty threat intelligence SaaS vendors

Proactive Alerts | While monitoring supply chain deviations, organizations should incorporate proactive alerts, enabling rapid response

Key enablers

Digital | Process

❑ Set up integrated **alert system** to flag risks as they arise and deploy appropriate early response resources

Enable real-time alerts to notify appropriate stakeholders of SC risks and deviations while in **early stages and easier to mitigate**

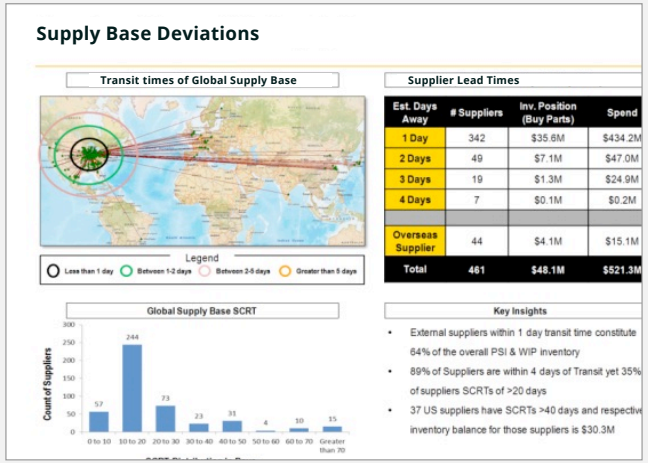
Outline appropriate **alert escalation guidelines** based on nature of deviation and scale of operations (or revenue) at risk (e.g. notify only analyst responsible for control tower, include full crisis response center, escalate to VP of SC, escalate to CEO)

Integrate alert system with automatic **incident response** and/or operations recovery activities (e.g. contacting staff potentially impacted by a facility fire or earthquake in their geography)

Consider embedding alerting capability in…

- The **control tower dashboard** directly – best-in class approach
- A separate **SC tracking** mechanism (e.g. E2open)
- A company-wide **critical event management system** (e.g. Everbridge, Dataminr)

Example alert systems for supply chain crises and risks



Supply chain network deviation alerts

Analyze risks early, before they become full-scale crises

Example | Manufacturer leveraged Control Tower to merge supplier data & increase visibility in gaps

Context

Global manufacturer needed an **integrated, end-to-end** platform to have visibility into **supplier inventory**, leveraging existing API

Previous state:

- Separate **excel templates** for select suppliers
- **Limited forecast data** for tier 1 suppliers only
- **Disparate** supplier communications systems

Highlights

Manufacturer implemented the following solutions:

- Built a **"Clear-to-build MVP"** of a control tower leveraging existing software
- **Aggregated** supplier communications into one platform
- Enabled mechanism for **rapid review of deviations**, prioritization, and risk identification

Key Takeaways

The control tower provided:

- Visibility on critical part supply gaps at various levels of granularity
- Streamlined supplier data
- Proactive mitigation to identify interdependencies and address risks across teams

Scenario & Lever Generation | Develop list of likely disruption scenarios and potential mitigation levers to model, evaluate, and prioritize

Key enablers
Process | Change

❑ Determine likely **scenarios** and potential **levers** for both short-term action and long-term mitigation

Outline a set of potential **disruption scenarios** by identifying parts of SC network with greatest **risk exposure** from external events and operational deviations (e.g., inputs single-sourced in China)

Assess potential mitigation levers for **short-term action**...
- **Identify alternate options** for inputs, product designs, logistics, etc. by assessing feasibility (e.g., inventory allocation, production capacity management)
- **Prioritize levers** by focusing available resources on pain points for maximum impact in the short-term

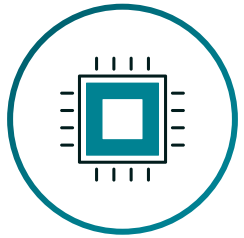
And **long-term mitigation**...
- Analyze **current capability map** vs. **capabilities necessary** to tackle likely scenario
- Develop **business cases** for investing in capability development

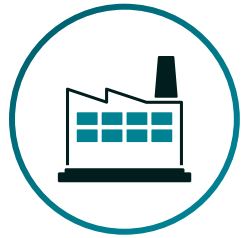
Examples of long-term mitigation levers

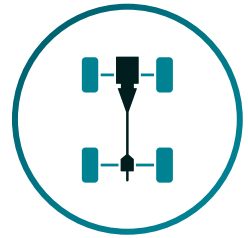
Volume forecast & optimal SKU allocation

Supply Risk Sensing and Monitoring

Supplier Communications


SKU analysis and prioritization for production and distribution


Plant optimization and labor management


Adjusting product offering and configurations

Invest in Digital Twin| Use Digital Twin to model pre-determined scenarios and mitigation levers, quantifying magnitude of impact to prioritize action

Key enablers

Digital | Process | Change

❑ Invest in a **digital twin** to model scenarios, quantify impact of disruption, and evaluate options for response

Simulate **asset performance** and enable comprehensive **scenario modeling** with a digital twin, a virtual replica of a complex supply chain including physical layout, business processes, and relevant parties including suppliers and logistics providers

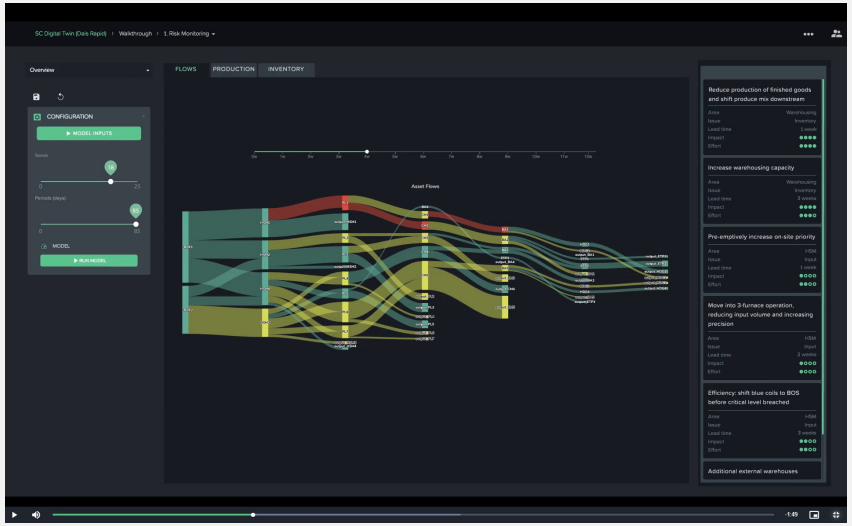
Deploy digital twin in a modular fashion across **multiple use cases**, including:

- Real-time impact modeling (supply uncertainty, service levels, revenue capture, etc.) for short-term crisis decision-making
- Long-term crisis response contingency plan development
- AI risk prediction
- Buffer stock optimization

Advantages include:

- **Enables E2E supply chain management:** Shifting from siloed / static process to forward-looking, systemic decision-making
- **Models end-to-end flows:** Including facility capacity, throughput, service levels, and supply constraints
- **Leverages full visibility and best-in-class digital offering:** Enabling effective decision-making through advanced technologies (e.g., AI, Simulation, Cloud)

Illustration of digital twin risk mapping across supply chain



Three key value levers from using digital twins

1. Increase SC Resilience through **anticipatory risk management**
2. Capture **direct value** via E2E SC Control
3. Drive **sustainability** in E2E supply chain and operations

Example | Manufacturer leveraged Digital Twin to anticipate and manage risks in E2E supply chain

Context

- Global industrial goods player with **complex supply chain** (especially in procurement) and **limited transparency**
- Interdependencies and complex planning resulted in **excess inventory buffer, high costs**, and **sub-optimal buying** strategy
- Experienced substantial **delivery risks** and **long lead times** from suppliers to sites, and **lacked smart alerts** for quick reaction

Highlights

Industrial goods player executed the following:

- Implemented **E2E Supply Chain Digital Twin** as virtual replica of the full supply chain
- Enabled **dynamic transparency** & **optimized** E2E supply chain for operations resilience, bottom line performance, & CO_2 footprint

Key Takeaways

The digital twin enabled the player to…

- Anticipate and manage risks by **simulating disruption** and **automating decision-making**

Leading to…

- Early risk identification, months in advance
- Data-driven, optimized buying
- Operational cost optimization
- Carbon footprint reduction

Set up CRC | Best-in-class Crisis Response requires proper infrastructure through a designated Crisis Response Center and dynamic playbooks

Key enablers

Governance | Culture | Talent

❑ Set up cross-functional **Crisis Response Center** with a dedicated team and dynamic playbooks to react to crisis scenarios

Set up structure:

- Leverage **RACI matrix** to specify **team** and **leadership** structure to ensure stakeholder buy-in
- Authorize **expedited decision-making** and **appropriate spend thresholds** to maximize agility amid crisis
- Coordinate **meetings** to ensure executive visibility, set priorities, manage trade-offs and address roadblocks

Build dynamic playbooks:

- Evaluate modeled scenarios and mitigation levers by conducting **trade-off analysis** (financial and operational) to determine best possible plan
- Build in **alternatives** to ensure playbook is **flexible** for various disruptions (e.g., incl. multiple emergency logistics providers)
- Prepare **action checklist** and cascade decisions throughout organization

Prepare communications plan:

- Drive **accountability** / transparency for internal organization
- Facilitate discussions with critical **suppliers** and **logistics providers** to maximize engagement

Example CRC meeting cadence with key stakeholders

	Objectives	Attendees	Timing
CRC standup	• Determine and execute short-term solution • Evaluate crisis and short-term mitigation impact • Follow-up on plan vs. execution gaps	• Crisis Response Center (CRC) complete team	• Week 1: 2x per day • Weeks 2-4: Daily • Weeks 5-12: 2x per month
Leadership meeting	• Deliver plan, provide direction/oversight, help remove roadblocks • Assist shaping overall direction and decision-making process • Help set priorities and manage trade offs • Highlight recurring issues to drive decision making	• CRC team • Pertinent heads of departments: Supply, Logistics, Procurement, Marketing, Sales	• 2x per month
Townhall	• Communicate context and action plan to create transparency • Provide synthesis to leadership with cross-functional insights • Facilitate Q&A to keep general communication flow	• CRC team • Functional leaders: Supply, Logistics, Procurement, Marketing, Sales, PR, HR	• Week 3
Communications Workshop	• Design, execute and monitor communication strategy to suppliers, customers and consumers • Develop and cascade communications protocols (e.g., scripts) • Setup communication frequency towards external stakeholders	• Procurement and Sales core negotiators and current liaisons with critical suppliers and clients • Public relations and marketing experts on consumer communication	• Week 7
After-action report Workshop	• Build and deliver after-action report suitable to tackle next crisis • Adjust after-action report draft to fit processes, capabilities and resources • Drive flexibility in current processes (e.g., S&OP)	• *Champion* team to face future crises	• Week 11

Proper governance enables swift decision-making and cross-functional collaboration

After-action| After crisis response is executed, assemble CRC to debrief and identify key learnings for continuous improvement

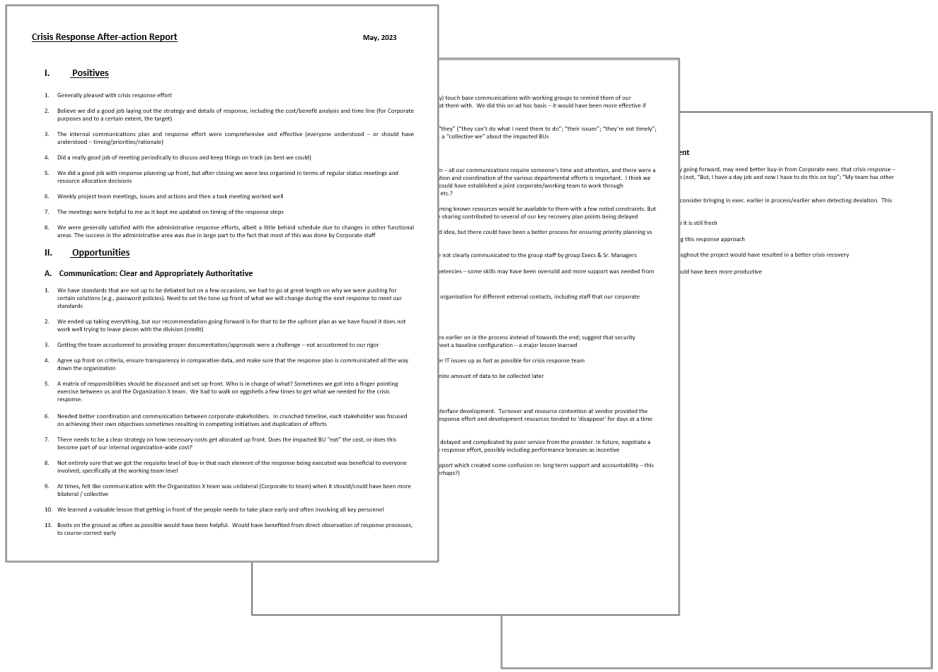
Key enablers

Governance | Change | Culture

❑ Embed an **after-action mechanism** reinforcing continuous improvement in resilience with every crisis

- Document key learnings to understand crisis's **root causes**, track **metrics** to monitor recovery, and determine **new tools** and **processes** to leverage in future
- Assemble CRC team to debrief **response**, discuss **outcomes / challenges,** and assess **opportunity areas** to inform future efforts such as:
  - Process adjustments (e,g., S&OP)
  - Scenario planning assessment, prioritization of mitigation levers and trade-offs
  - Supplier and customer communications protocols
  - Approval process and meeting cadence
  - Input and alignment from internal stakeholders: procurement, logistics, operations, finance, marketing, commercial
- Publish **after-action report** with key learnings and recommended improvements

Example after-action report



Crisis Response After-action Report — May, 2023

I. Positives

1. Generally pleased with crisis response effort
2. Believe we did a good job laying out the strategy and details of response, including the cost/benefit analysis and time line (for Corporate purposes and to a certain extent, the target)
3. The internal communications plan and response effort were comprehensive and effective (everyone understood – or should have understood – timing/priorities/rationale)
4. Did a really good job of meeting periodically to discuss and keep things on track (as best we could)
5. We did a good job with response planning up front, but after closing we were less organized in terms of regular status meetings and resource allocation decisions
6. Weekly project team meetings, issues and actions and then a task meeting worked well
7. The meetings were helpful to me as it kept me updated on timing of the response steps
8. We were generally satisfied with the administrative response efforts, albeit a little behind schedule due to changes in other functional areas. The success in the administrative area was due in large part to the fact that most of this was done by Corporate staff

II. Opportunities

A. Communication: Clear and Appropriately Authoritative

1. We have standards that are not up to be debated but on a few occasions, we had to go at great length on why we were pushing for certain solutions (e.g., password policies). Need to set the tone up front of what we will change during the next response to meet our standards
2. We ended up taking everything, but our recommendation going forward is for that to be the upfront plan as we have found it does not work well trying to leave pieces with the division (credit)
3. Getting the team accustomed to providing proper documentation/approvals were a challenge – not accustomed to our rigor
4. Agree up front on criteria, ensure transparency in comparative data, and make sure that the response plan is communicated all the way down the organization
5. A matrix of responsibilities should be discussed and set up front. Who is in charge of what? Sometimes we get into a finger pointing exercise between us and the Organization X team. We had to walk on eggshells a few times to get what we needed for the crisis response.
6. Needed better coordination and communication between corporate stakeholders. In crunched timeline, each stakeholder was focused on achieving their own objectives sometimes resulting in competing initiatives and duplication of efforts
7. There needs to be a clear strategy on how necessary costs get allocated up front. Does the impacted BU "eat" the cost, or does this become part of our internal organization-wide cost?
8. Not entirely sure that we got the requisite level of buy-in that each element of the response being executed was beneficial to everyone involved, specifically at the working team level
9. At times, felt like communication with the Organization X team was unilateral (Corporate to team) when it should/could have been more bilateral / collective
10. We learned a valuable lesson that getting in front of the people needs to take place early and often involving all key personnel
11. Boots on the ground as often as possible would have been helpful. Would have benefited from direct observation of response processes, to course-correct early

Given report outlined 8 positives to continue doing and 5 macro-opportunity areas with ~50 specific learnings to consider in next crisis

Example | Setup Crisis Response Center to coordinate OEM response to input shortage

Context

Leading manufacturer facing **severe production losses** caused by reduced supply of semiconductor components from providers

Industry experiencing **semiconductor supply shortages**, with constraints expected to fully abate in several years. Multiple factors causing this shortage:

- **High demand** for semiconductor-based products on the back of covid-19 recovery and new technology deployment (5G network roll-out)
- **Industrial supply capacity** captured by consumer electronics manufacturers after initial dip in consumer demand due to Covid-19
- **Limited additional production capacity** and **long lead time** to bring additional new capacity online

Initial company response **lacked** a strong executive mandate, structure, and cross-functional coordination given the scale of shortages

Highlights

Setup of a cross-functional response unit (Crisis Response Center)

- Providing transparency to latest shortages and ensure visibility
- Monitoring progress and driving accountability across time horizons: short-term (e.g., turning-off availability of selected options) and mid-term response (e.g., redesign of parts)

Developed tools to support response

- Centralized database, acting as single source of truth, compiling all parts shortage with relevant data (quantity, date, mitigations in progress), available to all group members
- New process and visuals to facilitate identification of critical shortages and support reporting
- Redesigned S&OP process to engage the executive team – providing transparency to risks in the mid-term horizon and proactively frame key trade-offs/ drive decision making

Key Takeaways

Stood up cross-functional crisis response, enabling:

Improved **transparency** to issues, root cause and impact of each individual shortage

Developed **prioritization process** to address shortages in a consistent manner

Developed **structured response plan** spanning multiple time horizons and kicked off mitigation activity

Provided **visibility** to key supply chain **bottlenecks** and developed analysis/ supporting materials for executive-level negotiations with suppliers

~10% of volume de-risked

Playbooks

Integrating Resilience

Sector Overview

Playbooks Overview

A. Near-term Recovery

B. Network Design

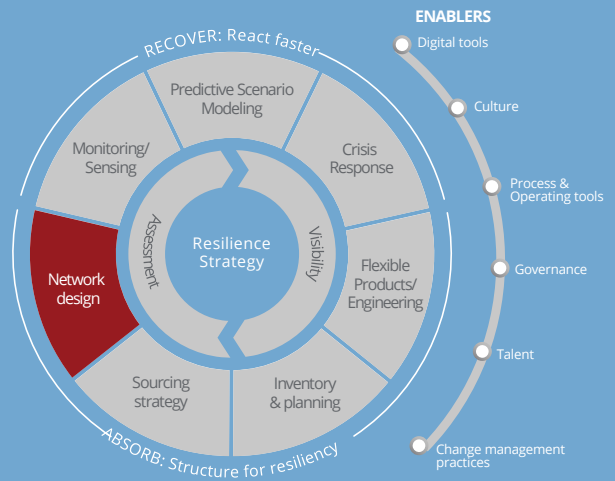
C. Sourcing Strategy

D. Inventory and Planning

E. Flexible Engineering

B

ABSORB: *Network Design*



What it is:

Network of all **site locations** and **flows** across multiple tiers of the supply chain

Ability to identify **single points of failure** and evaluate scenarios to strengthen network against disruption

---

What "good" looks like:

1. ❑ Consider **re/near-shoring** part of footprint for optimized stability and cost
2. ❑ Optimize **manufacturing** plant and **DC/Warehouse footprint**
3. ❑ Optimize **logistics network**
4. ❑ Increase manufacturing productivity via **OEE**[1] metrics
5. ❑ Leverage **flexible manufacturing** to improve resiliency (e.g., 3D printing)

Enabler legend

Digital tools · Culture · Governance · Process & Operating Tools · Talent · Change mgmt.

Re/Near-shoring | Develop criteria to evaluate decision to re/near-shore, balancing stability and cost

Key enablers: Digital | Process | Change | Talent

❑ Consider **re/near-shoring** part of footprint for optimized stability and cost

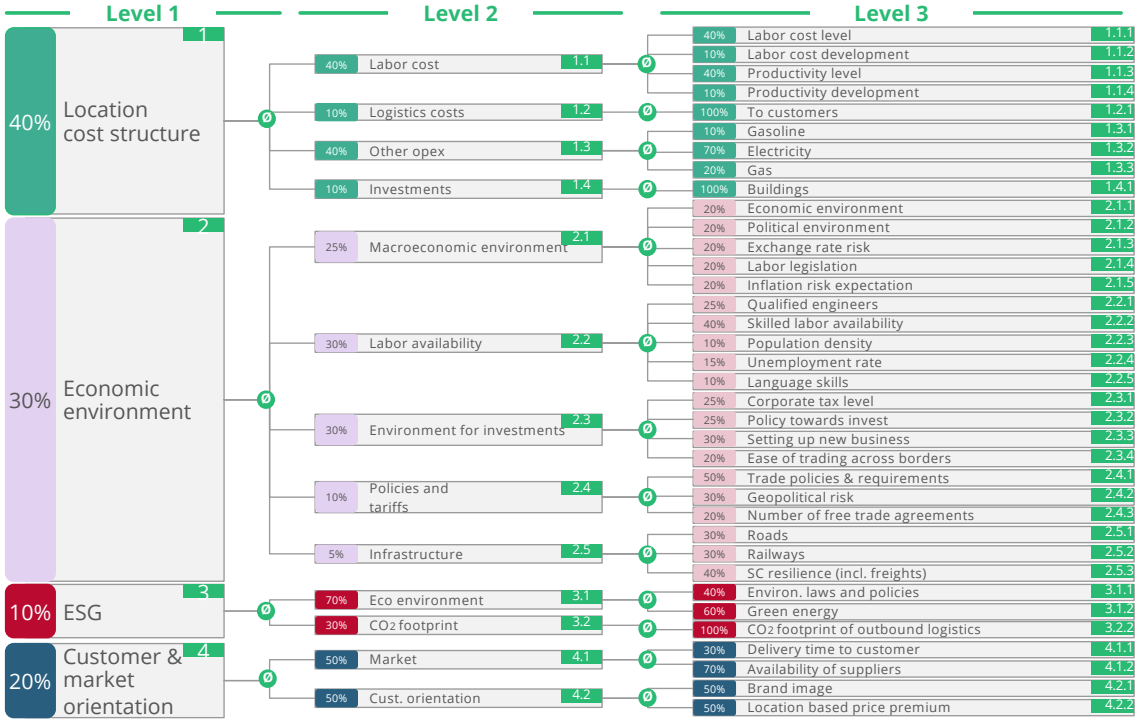
Develop financial and strategic criteria to assess potential re/near-shoring decisions as a resilience lever, with appropriately weighted scoring for criteria impacting stability and cost

Consider quantitative/financial criteria:
Location cost structure
- **One-time investments** for plant, refurbishments and production machine set-up
- **Reoccurring costs** to run operations and up- or downsides depending on productivity/quality levels

Consider qualitative/strategic criteria:
Economic environment
- **Macroeconomic outlook** of the assessed country/region with availability of resources and investment climate
- Feasibility to operate production facility in potential location based on **socio-economic climate** and risk factors
- Impact of trade policies and government incentives on **trade flows**

Operational environment
- Accessibility and security of logistics network for raw material supply and finished goods (to warehouses, customers)
- **Quality** and **delivery time** of material and component supply

Example strategic criteria to be considered



Develop weighting and scoring across different criteria and perform resilience analysis to evaluate re/nearshoring decision

Manuf./Dist. Footprint | Optimize manufacturing and distribution footprint by balancing cost and resilience

Key enablers

Digital | Process | Change

❑ Optimize **manufacturing** plant and **DC/Warehouse footprint**

Assess manufacturing and distribution footprint to identify optimization opportunities

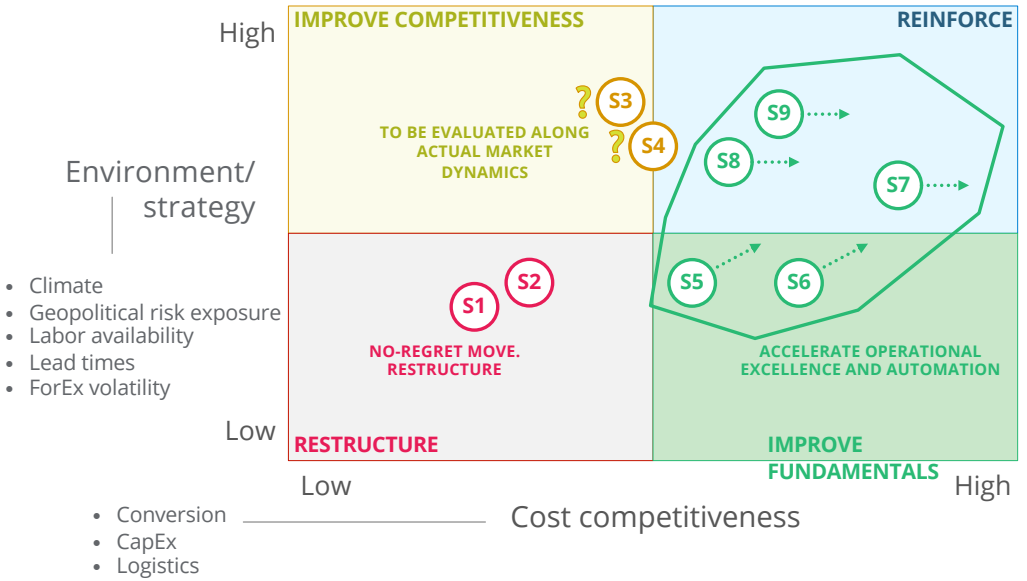
Develop evaluative criteria to identify potential target plants/warehouses:

- **Risk** or exposure to potential disruption as a result of geopolitical tensions, natural disasters, labor shortages, policy, etc.
- **Cost** to run site and how it compares to others in network
- **Criticality** of site to serve set of customers

Implement measures to optimize for resilience:

- **Product redundancy, manufacturing capacity, and scale balancing** across sites (including setting up new plants)
- **Regionalization and diversification** of footprint as resilience lever
- **Relocation** to less risky or more advantageous site
- **Closure** of risky, costly, non-critical sites
- **Plant/Warehouse redesign** to enhance scheduling flexibility (e.g., automation)
- **Adjust footprint size** (e.g., set up new plants or consolidate sites) to appropriately balance risks
- **Outsource** to trusted partners to mitigate risk of own production in risky environments

Example site positioning showing actions to be prioritized



Identify potential targets based on internally-developed criteria and ranking of different sites in network

Logistics Network | Optimize logistics network as a resilience lever

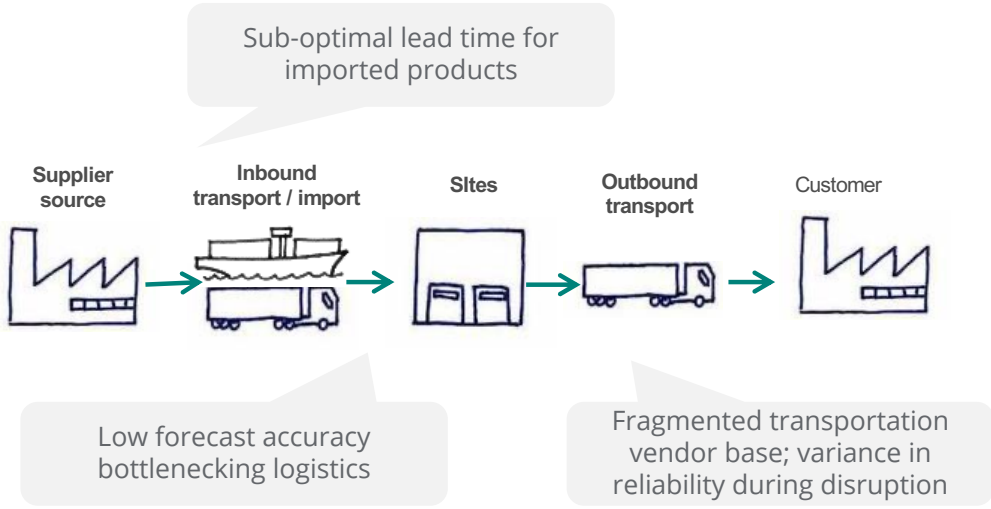
Key enablers: Digital | Process | Change

❑ Optimize **logistics network**

Organize your logistics network to maximize resilience objectives (e.g., delivery mechanisms via multiple transportation modes, how often inbound/outbound deliveries take place, etc.)

- Prioritize ability to reroute flows and build redundancy into logistics operation
- Invest in resilient and reliable modes of transportation
- Assess riskiness of logistics network and consider in-house solutions vs 3PL
- Consider strategic partnerships with logistics providers to get service priority in the event of disruptions

Example pain points addressed by logistics network optimization



Consider manufacturing and distribution footprint, transportation availability and capacity constraints, border crossings, etc.

Overall Equipment Effectiveness | Introduce OEE to optimize manufacturing productivity and be better equipped to absorb shocks

Key enablers

Digital | Process | Change | Governance

❑ Increase manufacturing productivity via **OEE**[1] metrics

OEE can help identify and eliminate sources of loss in production equipment and prioritize improvement drivers to maximize process throughput

OEE deployment can address a range of site challenges, including:

- **Capacity constraint** - need to fit additional volume into an existing asset base
- **Supply shortage** – need to "catch up" on production plan by increasing throughput to provide higher customer service

...through a variety of levers:

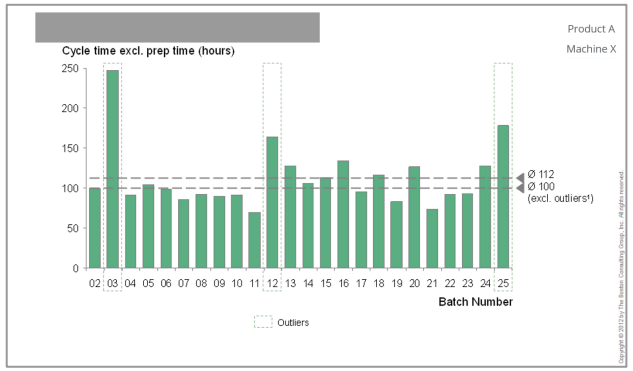
Driving better quality outcomes

- Reduces rejects and deviations by standardizing fix, restart, and replenish activities and operator care

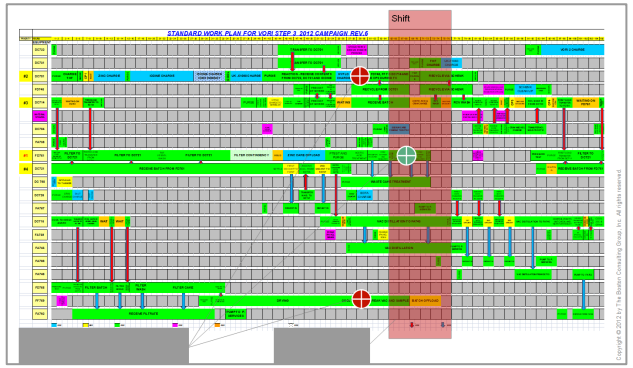
Ensuring more reliable customer supply

- Improves supply reliability by reducing changeover and throughput volatility from standardization
- Improves site flow through recurring schedule for select high volume, low volatility SKUs
- More throughput released

Example analyses for OEE improvement



Cycle time variability analysis



Select metrics and monitor progress over time

OEE value is realized through flexibility provided by freed up capacity and its utilization in the event of supply/manufacturing challenges

1. OEE = Overall Equipment Effectiveness

Flexible Manufacturing | Leverage flexible manufacturing techniques to make production process nimbler and more resilient

Key enablers: Digital | Process | Change | Governance

❑ Leverage **flexible manufacturing** to improve resiliency (e.g., 3D printing)

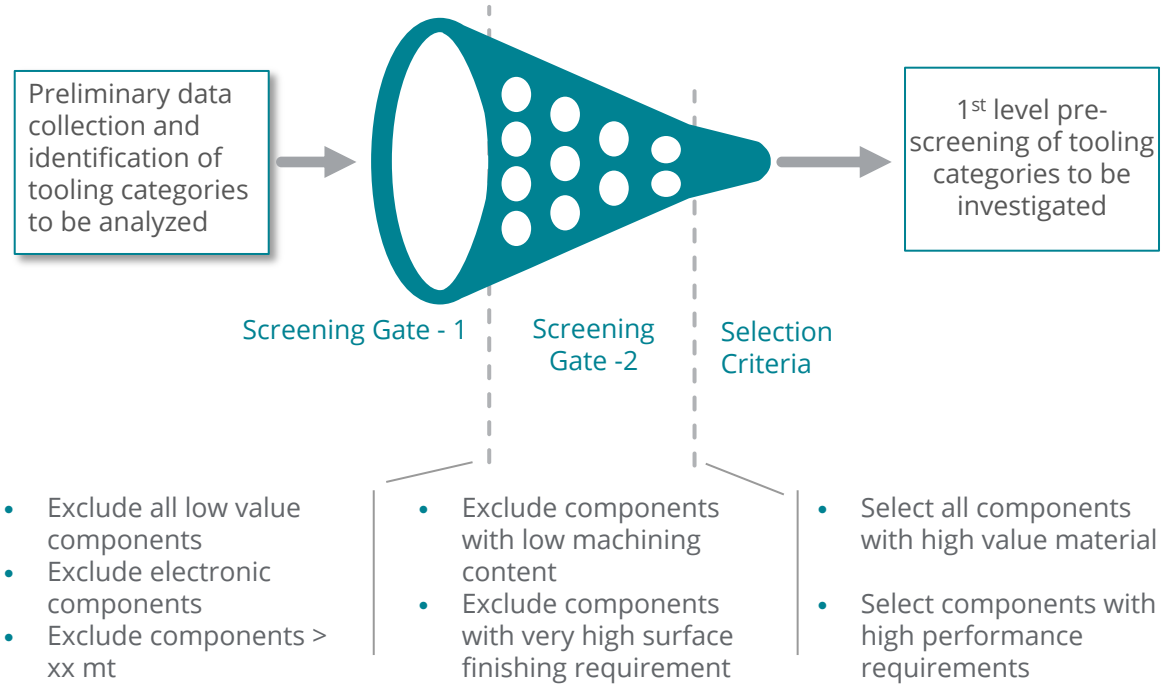
Leverage flexible manufacturing to build nimbler, more resilient and cost-effective response to supply/demand fluctuations and disruptions

Ensure your sites are able to incorporate elements of flexible manufacturing (e.g., sufficient space, trained staff)

Benefits include:

- Make use of **available resources** (incl. inventory & labor during shortages)
- Maintain some throughput amid equipment downtime
- Accelerated **prototyping**, agile testing, and validation to support **emergent design** process
- Manufacturing cost & lead time reduction and flexibility
- Decrease time from design stage to finished goods stage, with integration of R&D and manufacturing functions
- Small series development and production capabilities: Segment-of-One
- Component's robustness, modularity, and weight reduction

Example sample prioritization of components for 3D printing



Develop selection criteria for to identify components as potential candidates for flexible manufacturing techniques

Example | Distribution network optimization and redesign for global MedTech player

Context

Global MedTech player faces **sustained demand growth** of >20% year-over-year until 2025

Distribution network with challenges:

- **Fragmented footprint** with limited supply-demand-fit (also driven by significant M&A activities)
- **Limited** historical focus on **efficiency** (e.g., dropship rate in some regions of >80%, mostly via air freight)

Highlights

- **Baselined current distribution network** and performance (demand centers-of-gravity, logistical flows, current footprint), leveraging Alteryx and Tableau
- **Modeled** distribution network for data-driven objectivity and fact-based decision making
- Developed and evaluated **footprint scenarios**, and provided clear, objective recommendation based on modeling results
- Identified **key implementation milestones** and success factors, and developed implementation roadmap

Key Takeaways

Resilience transformation executed the following:

- **Better customer service**: ~80% of demands within 1,000km of DCs
- **Improved resilience**: Dedicated DCs and backups for key markets
- **Increased cost efficiency**: ~12-15% productivity opportunity
- **Reduced CO2 emissions**: ~30% reduction of freight CO2 emissions

Playbooks

Integrating Resilience

Sector Overview

Playbooks Overview

A. Near-term Recovery

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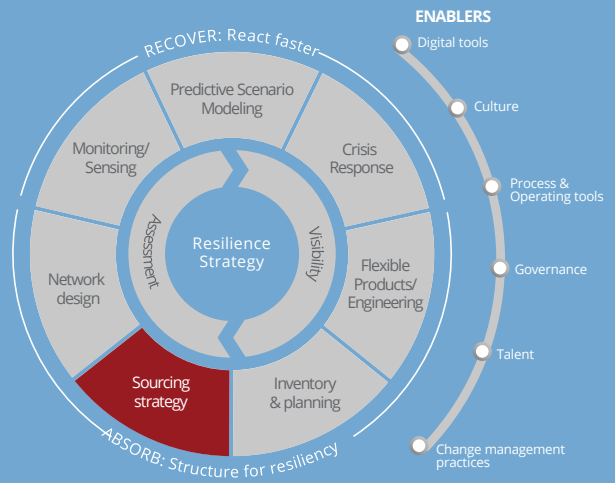
C. Sourcing Strategy

D. Inventory and Planning

E. Flexible Engineering

C

ABSORB: *Sourcing Strategy*



What it is:

Resilience-driven **strategic sourcing** consists of tiered multi-sourcing strategies for different sub-categories, prioritized by risk level, with well-defined recovery strategies for single-sourced items across the full BOM

Strategic sourcing will increase **on-time performance**, **reduce lead times**, and eventually lead to **lower costs** (with less emergency spending, e.g., air-freight)

What "good" looks like:

1. ❑ Strengthen strategic **sourcing governance** (decision-making) to balance cost and risk
2. ❑ Identify critical components to prioritize for **alternate sourcing** (e.g., multi-sourcing or bringing in-house)
3. ❑ Review (and if needed, renegotiate) **contractual agreements** to bolster supply certainty
4. ❑ Prioritize suppliers for development of **strategic partnerships** to ensure continuity of supply

Enabler legend

Digital tools	Governance	Talent
Culture	Process & Operating Tools	Change mgmt.

Sourcing Governance | A best-in-class sourcing strategy drives resiliency in operations, prioritizing supply flexibility in addition to lowest-cost sourcing

Key enablers: Governance | Change

❑ Strengthen strategic **sourcing governance** (decision-making) to balance cost and risk

Embed **risk-oriented** levers in sourcing decision-making:

- Analyze **supply inflows** to generate insights into **key input risks** (e.g., risk categorization matrix of incoming materials)
- For **high-risk categories**, articulate an **explicit plan**: how to mitigate this risk (e.g., require supplier safety stocks) or get explicit approval to accept this risk
- Outline **explicit decision-making frameworks** to delegate or escalate procurement decisions
- Balance appropriately with **traditional, cost-oriented** levers (e.g., systematic supplier review to renegotiate lower costs, bundling / purchase centralization, best-cost-country sourcing)

Ensure **cross-functional** engagement with appropriate **senior stakeholders** in sourcing decision-making:

- Create **executive-level working group** to review risk levels on bi-annual cadence
- Delegate monthly tracking of required actions to **dedicated working team** (e.g., steps to implement contingency plan)

Example bi-annual risk review deliverable

Category	*Risks*	Segment 1	Segment 2	Segment 3	...
Disaster	Natural, infrastructure				
Geopolitical	Regulations/Tariffs/Sanctions				
	Political/Social instability				
Fiscal	Economic downturn				
	Commodity price disruption				
Industry	Supply/demand imbalance				
	Technology shocks				
Structural	Prod. footprint concentration				
	Limited supplier base				
Reputational	Environmental				
	Social				
	Governance				
Financial	Insolvency				
Operational	Quality issues				
	Logistical issues				
	Technological issues				

Transform a traditional sourcing strategy to be resilience-driven by mapping risks to product segments and breaking down by input category

Alternate Sourcing | To reduce potential for supply disruption, consider alternatives to increase redundancy / reduce dependence on risky suppliers

Key enablers
Process | Change

❑ Identify critical components to prioritize for **alternate sourcing** (e.g., multi-sourcing or bringing in-house)

As part of **bi-annual review** process, working team to prioritize riskiest components for alternate sourcing

Alternative sourcing strategies include:
- Identify new supplier
- Balance share of inputs sourced from different suppliers by developing smaller supplier to increase volume provided
- Encourage new player activity in supplier markets
- Access new suppliers via collective buying arrangements
- Acquire supplier
- Build component in-house

In **monthly cadence**, working team to evaluate financial and non-financial criteria, build mitigation plans for prioritized critical components, and execute chosen strategy

Focus mitigation efforts to reduce:
- Dependence on riskier locations and bottleneck channels
- Potential for **Tier n+ single-sourcing** (i.e., your Tier 1 suppliers are using the same source)

Example criteria to use when evaluating alternate sourcing strategies

Financial criteria

Total delivered cost
- What is the total delivered cost impacts including duties and taxes?
- Is there investment capital required at the supplier? If so, what is the ROI?

Working capital
- What is the impact on accounts payable DPO as you shift to an outsourcing model?
- What is the impact on inventory (Raw and Finished Goods)?

Non-financial criteria

Product lifecycle
- Do we have internal capabilities to produce this product already?
- Is the product (or its relevant inputs) still in early stage of lifecycle or reaching obsolescence?

Demand volatility
- What is the impact of cyclical demand on internal plant-fixed cost absorption?
- Is there an opportunity to vary cost by multi-sourcing products with high demand volatility?

Flexibility
- What flex capacity will be available during cyclical peaks?
- How quickly can we expedite during an event?

Contractual Agreements | Establish further protectionary measures to increase supply certainty via advantageous contract inclusions

Key enablers
Change

❑ Review (and if needed, renegotiate) **contractual agreements** to bolster supply certainty

When entering new agreements and during cyclical contract review process, consider the following resilience-building inclusions:

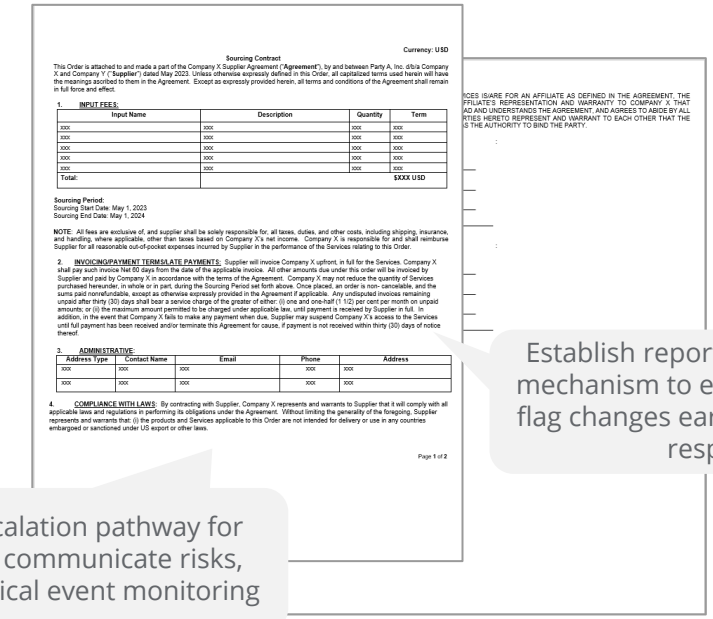
Outline desired supplier resiliency features
- Dedicated **safety stocks** at supplier warehouse
- Access to **2nd source** in case of component shortages
- **Preferred partners** (e.g., logistics providers)
- **Minimum volume commitments** (may require reciprocal volume purchase commitment / exclusivity clause for your organization)

Monitor for compliance
- **Forecast review** (ensure inventory stock matches requirements)
- Regular **reporting cadence** on material availability
- **Timely notification** of critical events (e.g., plant shutdown, risk of insolvency)

Build incentives into contracts
- Penalties system for **poor safety stock management**
- Penalties system for **delivery performance**
- **Cancelation policy** and ramp-down procedure

For high-risk inputs, take care to balance resilience-enhancing terms with discounts in negotiations

Example supplier agreement


Sourcing Contract

Currency: USD

This Order is attached to and made a part of the Company X Supplier Agreement ("**Agreement**"), by and between Party A, Inc. d/b/a Company X and Company Y ("**Supplier**") dated May 2023. Unless otherwise expressly defined in this Order, all capitalized terms used herein will have the meanings ascribed to them in the Agreement. Except as expressly provided herein, all terms and conditions of the Agreement shall remain in full force and effect.

1. **INPUT FEES:**

Input Name	Description	Quantity	Term
xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx
Total:			$XXX USD

Sourcing Period:
Sourcing Start Date: May 1, 2023
Sourcing End Date: May 1, 2024

NOTE: All fees are exclusive of, and supplier shall be solely responsible for, all taxes, duties, and other costs, including shipping, insurance, and handling, where applicable, other than taxes based on Company X's net income. Company X is responsible for and shall reimburse Supplier for all reasonable out-of-pocket expenses incurred by Supplier in the performance of the Services relating to this Order.

2. **INVOICING/PAYMENT TERMS/LATE PAYMENTS:** Supplier will invoice Company X upfront, in full for the Services. Company X shall pay such invoice Net 60 days from the date of the applicable invoice. All other amounts due under this order will be invoiced by Supplier and paid by Company X in accordance with the terms of the Agreement. Company X may not reduce the quantity of Services purchased hereunder, in whole or in part, during the Sourcing Period set forth above. Once placed, an order is non- cancelable, and the sums paid nonrefundable, except as otherwise expressly provided in the Agreement if applicable. Any undisputed invoices remaining unpaid after thirty (30) days shall bear a service charge of the greater of either: (i) one and one-half (1 1/2) per cent per month on unpaid amounts; or (ii) the maximum amount permitted to be charged under applicable law, until payment is received by Supplier in full. In addition, in the event that Company X fails to make any payment when due, Supplier may suspend Company X's access to the Services until full payment has been received and/or terminate this Agreement for cause, if payment is not received within thirty (30) days of notice thereof.

3. **ADMINISTRATIVE:**

Address Type	Contact Name	Email	Phone	Address
xxx	xxx	xxx	xxx	xxx
xxx	xxx	xxx	xxx	xxx

4. **COMPLIANCE WITH LAWS:** By contracting with Supplier, Company X represents and warrants to Supplier that it will comply with all applicable laws and regulations in performing its obligations under the Agreement. Without limiting the generality of the foregoing, Supplier represents and warrants that: (i) the products and Services applicable to this Order are not intended for delivery or use in any countries embargoed or sanctioned under US export or other laws.

Page 1 of 2

Establish reporting cadence and mechanism to ensure service and flag changes early, enabling quick response

Identify escalation pathway for supplier to communicate risks, enabling critical event monitoring

Involve necessary parties in renegotiations to add advantageous inclusions

Strategic Partnerships | Ensure service levels during disruption by investing in supplier relationships through strategic partnerships in advance

Key enablers

Digital | Process | Change

❑ Prioritize suppliers for development of **strategic partnerships** to ensure continuity of supply

Embed resilience considerations in development of relationships with **critical suppliers**, responsible for providing **highest-risk components**

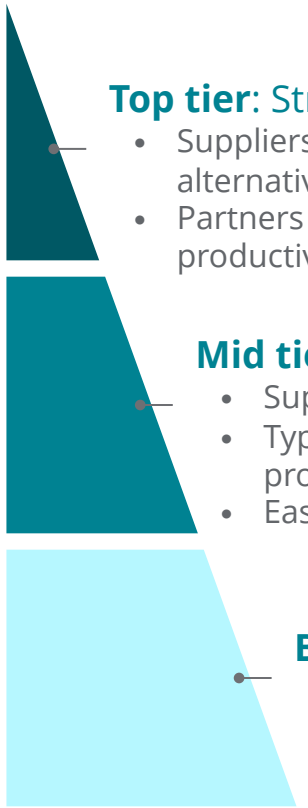
Tailor strategic partnerships to become the supplier's **customer of choice**, to receive…

- **Preferential service** during shortages
- **Early warnings** of emergencies / disruption
- **Collaboration** during emergent redesign process

To develop the partnership…

- Invest more **time** in the relationship
- Increase **transparency** and open information sharing
- Offer **perks** / preferential terms

Example suggested supplier tiering strategy



Top tier: Strategic / Targeted Partners

- Suppliers that provide higher-risk inputs, especially if few alternative players (independent of spending)
- Partners for sharing detailed R&D/Product Dev. information; productivity partnership; modified contracting approach

Mid tier: Major Partners

- Suppliers that provide lower-risk components
- Typically, will be large spend suppliers, but non-proprietary and non-critical
- Easy to move business

Bottom tier: Routine Suppliers

- Suppliers that provide lower-risk components
- Non-critical; manage through simple contracts or PO's
- Source continuously as appropriate

Example | Re-balancing of China-related spend for an equipment manufacturer

Context

Company was a **European materials handling equipment manufacturer** with global supply chain & operations reach and +200m€ of sourcing from China, including e.g. castings, switches and motors

Amid the 2021-2022 zero-covid policy and internal turbulence in China, the manufacturer wanted to **rebalance** their **EU/US supply chain dependency** on **China** to address COVID risks & logistics challenges

Objective was to **mitigate China-related sourcing risks** by assessing potential alternative countries to purchase from, and transferring critical material sourcing to target countries based on stability and country-risks, cost-levels, and supply availability

Highlights

Company worked to **relocate China-sourcing**, encompassing the end-to-end process from scope assessment and definition to RFQ acceptance:

1) Analyzed China-sourced materials and developed relocation-phasing plan based on criticality
2) Defined a framework for holistically assessing desirability of different country options
3) Assessed desirability of 15 countries on economical, risk and cost factors
4) Shortlisted desirable countries to re-balance sourcing to
5) Identified alternative suppliers and started RFQ-processes on most critical components
6) Built a plan to continue re-location of risky supply for next batches of materials

Key Takeaways

Shortlisted and phased <100m€ of **critical China-spend** to **re-locate**

Safeguarded 500m€ of revenue by **swift 2nd sourcing** and re-location actions across ~15 items

Assessed viability of 15 potential target countries

Developed a plan for target countries according to **desirability** and **geographical footprint**

Managed and drove **RFQ-processes** across 7 categories (e.g. castings, switches, motors)

Built a **process & framework** for continuing re-location of next risky China-sourced items

Note: IC = Integrated Circuit, BOM = Bill of Materials

Playbooks

Integrating Resilience

Sector Overview

Playbooks Overview

A. Near-term Recovery

B. Network Design

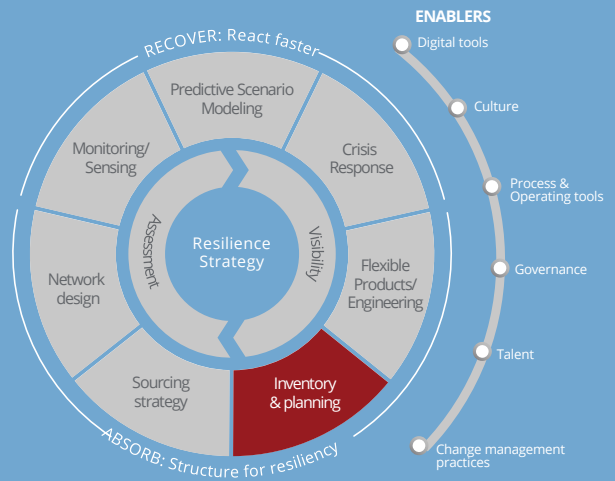
C. Sourcing Strategy

D. Inventory and Planning

E. Flexible Engineering

D

ABSORB: *Inventory & Planning*



What it is:

Data-driven **inventory targets** and **financial impact** based on traditional formulas and additional strategic safety stock for high-risk items

Sales forecast and **demand plan** developed across organization to determine supply and production needs

What "good" looks like:

1. ❑ Evaluate use of strategic **inventory buffers** for most critical inputs
2. ❑ Embed resilience-oriented analysis in regular **IBP/SIOP/S&OP** business cycles
3. ❑ Invest in **planning tool** with inventory visibility and analytical demand targets
4. ❑ Invest in **production scheduling tool** to minimize impact of disruptions when they arise

Enabler legend

Digital tools	Governance	Talent
Culture	Process & Operating Tools	Change mgmt.

Inventory Buffers | Build inventory buffers to protect against critical input shortages and ensure service amid disruption

Key enablers: Process | Change

❑ Evaluate use of strategic **inventory buffers** for most critical inputs

Consider the following levers when optimizing inventory buffer levels to protect against critical component shortages:

Risk & capacity analysis: Analyze supply risk by component type to decide which needs inventory buffer

Time horizon of inventory: Determine the time horizon for safe inventory level based on product lifecycle and obsolescence risk

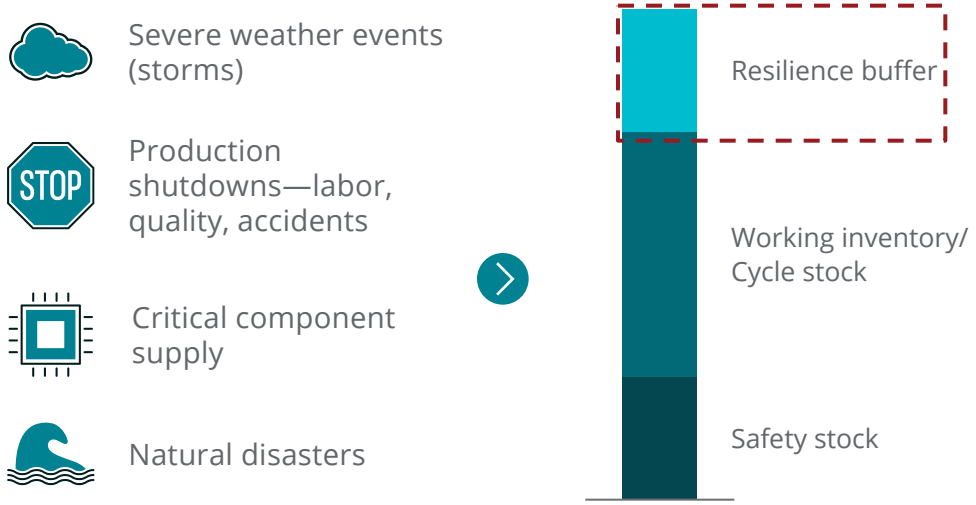
Stock reservation method: Select the best method & stage for stocking inventory e.g., geographic location (global/regional), single site vs. redundant locations, product allocation, inventory targets

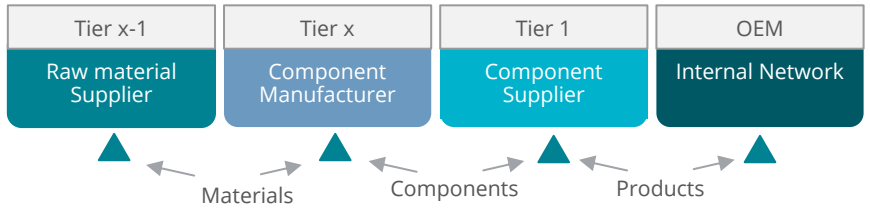
Contractual model: Select the best fee / contractual model (e.g., fee paid by original manufacturer, customer, or shared by both)

Volume allocation: Allocate inventories internally according to the set rules / criteria such as…

- Fair-share across plants
- Forecast as only source of truth
- Exposure to contractual obligations to customers

Incorporate risk insights to define the right levels and locations to store operating inventory buffers





Establish multi-tier collaboration to maintain inventory buffers at different points of the SC

Planning Processes | Integrate resilience-oriented metrics to strengthen traditional Sales, Inventory, Operations Planning cycle

Key enablers

Governance | Process | Change

❑ Embed resilience-oriented analysis in regular **IBP/SIOP/S&OP** business cycles

Feature resilience in each element of the IBP/SIOP/S&OP process:

1 Demand Review
- Develop demand scenarios at highest level of granularity possible (e.g., geography, channel, SKU) to pinpoint share of revenue/profitability at risk of disruption
- Factor in growth rates by product category in forecasting

2 Supply Review
- Analyze external supply risks (e.g., suppliers, components, regions)
- Analyze internal supply/capacity risks (e.g., plant/DC footprint)
- Identify options/scenarios to meet demand (e.g., inventory buffers, additional capacity, alternate sources)
- Re-assess channel makeup & shift planned volume where necessary

3 Demand-supply alignment
- Recalibrate and remap forecast plan often to flag potential demand/supply mis-alignment
- Revise inventory projections and adjust stock levels as needed

4 Executive business review
- Debate demand/supply scenarios & trade-offs (e.g., level of demand uncertainty, risk in current supply, and mitigation levers/cost)
- Align on plan and communicate decisions (e.g., volume and capacity alignment, stock level decisions)

Planning Tool | Implement digital tool to coordinate inventory & planning across the organization and plan for disruption scenarios

Key enablers: Digital | Process

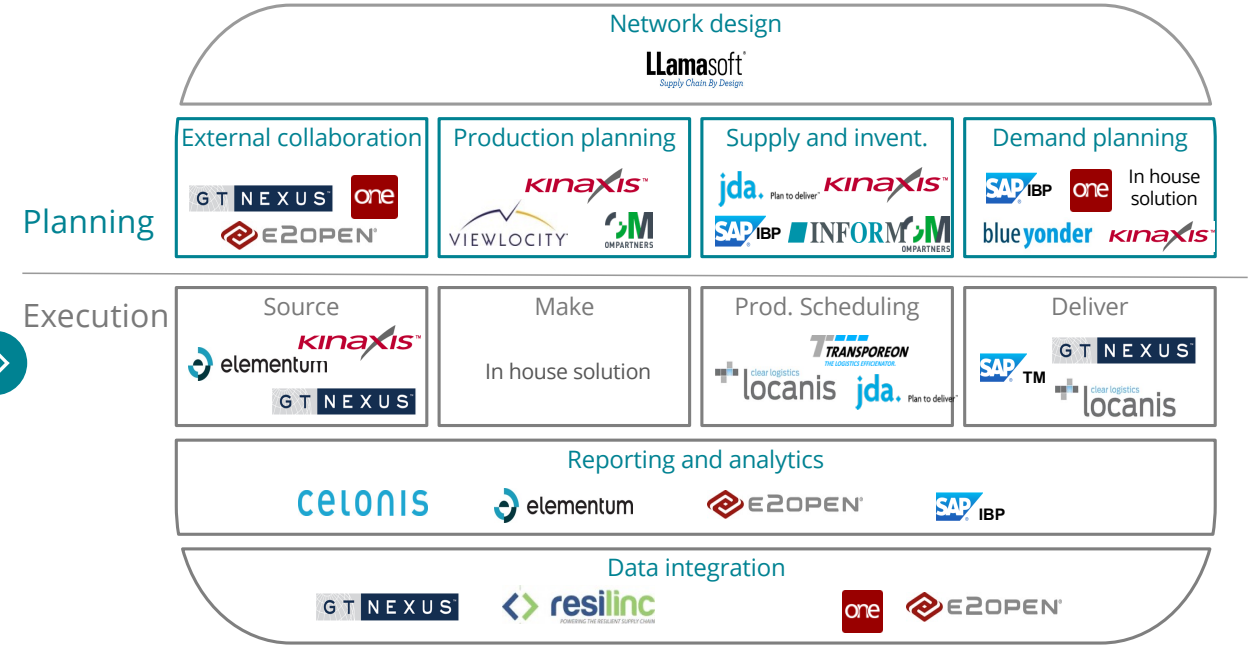
❑ Invest in **planning tool** with inventory visibility and analytical demand targets

Implement robust **planning** tool to **improve accuracy** of demand forecasts, production targets, inventory levels, and other key metrics to **manage complex networks** and **accelerate** decision-making in crises

Leverage the planning tool to facilitate…
- Demand planning
- Supply planning
- Integration and scenario planning
- Management business review
- Communications
- Long range capacity planning

Consider integrating tool with control tower for optimal centralized visibility and actionability

Example non-exhaustive list of potential tools for planning and execution
(see subsequent page for further context on executing production scheduling)



Implement tool with multiple functionalities to coordinate planning across the organization

Production Scheduling Tool | Leverage digital tool to increase production scheduling flexibility and optimize throughput during disruption

Key enablers

Digital | Process

❑ Invest in **production scheduling tool** to minimize impact of disruptions when they arise

Implement **production scheduling tool** that leverages **optimization algorithm** to determine highest value adjustments when navigating disruption

Use optimized production scheduling to…

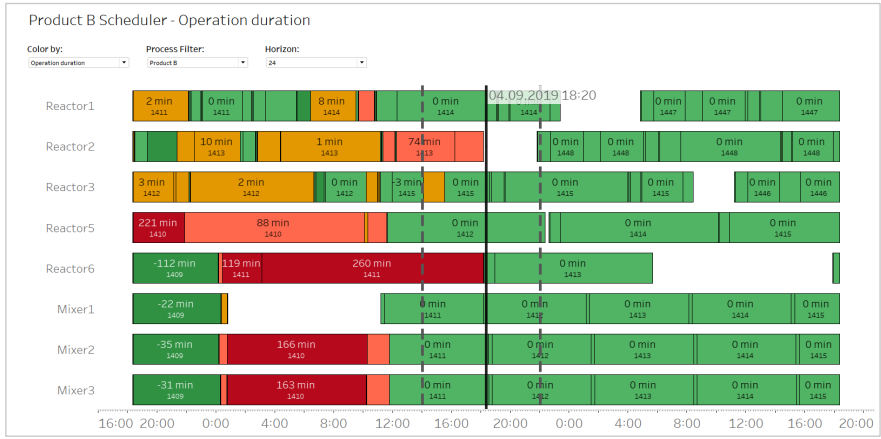
- **Minimize cost of impact** to operations during disruption (e.g., equipment outage, labor shortage)
- **Maximize throughput dynamically** (in real time) to optimize amid resource scarcity (e.g., supply, capital, labor)

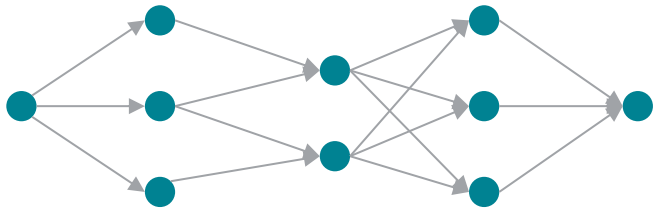
Consider the following areas of investment:

- **Data & analytics talent** for initial algorithm configuration and ongoing live data adjustments
- **Live data platform** with all relevant production information

Consider integrating tool with control tower for optimal centralized visibility and actionability

Example: Easy-to-use, detailed production schedule





Input Step 1 Step 2 Step 3 Output

Model production process with the help of graph networks and constraint programming to include all relevant physical dependencies and possibility of parallel production

Example | Company uses inventory buffers to mitigate against potential shortages

Context

Company implemented a **Business Continuity Plan** (BCP) after natural disaster, requiring suppliers to stockpile anywhere from **two to six months**' worth of chips.

Company was **less impacted** by COVID than many other manufacturers.

Highlights

Company **prioritizes** items that are **procured** from **suppliers**

- Requirement for suppliers to stockpile 2-6 months of priority items

The company **shares the cost** of retained inventory with its supplier network

- Cut in-house inventory cost
- Ensure parts availability with no lead time

Key Takeaways

Company moved from **just-in-time manufacturing** sequences to future-proof production **during the crisis**

Company closely tracked supply chain issues, identified bottlenecks early, and took necessary action to overcome supply chain concerns

Example | Revamped E2E planning for capacity-constrained manufacturer

Context

Manufacturer's **capacity** was **constrained**, and issue was exacerbated by **lack** of rigorous, **integrated process** for managing allocation

Faced several business challenges:

- Suboptimal service levels
- Ineffective processes for IBP[1], S&OE[2], and materials planning meaningful decisioning
- Limited data availability to inform decision making and multiple disjointed technology ERPs[3]

Issues identified:

- No clear product segmentation or allocation policies, leading to poor CFR[4] for most strategic customers
- Limited guardrails around inventory management & unclear decision rights, leading to suboptimize inventory mix

Highlights

Conducted a **rapid diagnostic** and triage of the end-to-end **planning** and supply chain processes, detecting pain points, prioritizing the way forward, and identifying opportunities to achieve "quick wins."

People & processes

- Redesigned S&OE process with focus on problem resolution & decision-making capabilities
- Established new meeting cadence to stabilize planning operations
- Identified key organizational talent gaps

Digital

- Developed roadmap to enhance tech architecture and digital capabilities
- Conducted preliminary vendor assessment and developed business requirements in preparation for proof-of-concept testing
- Designed dashboard requirement to support revised S&OE process and improve decision making

Key Takeaways

Business outcomes

- Increased overall CFR, with largest increase for most strategic customers
- Ensured more predictability for suppliers, leading to fewer unexpected supply chain shocks
- Improved cross-functional coordination

Value

- $70M+ Annual bottom-line impact from fulfilling committed orders
- ~3pp In-projected case-fill rate increase
- 40% Reduction in obsolete inventory

1. IBP = Integrated Business Planning; 2. S&OE = Sales & Operations Execution; 3. ERP = Enterprise Resource Planning; 4. CFR = Case Fill Rate

Playbooks

Integrating Resilience

Sector Overview

Playbooks Overview

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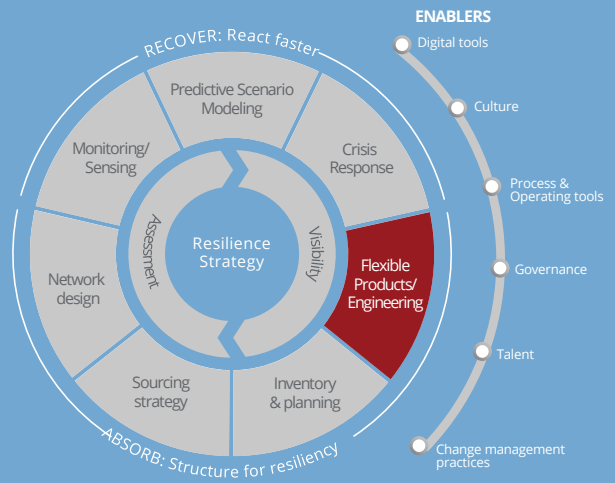
E

ABSORB: *Flexible Products & Engineering*



What it is:

Embedding resilience in the design and engineering process to streamline day-to-day, routine changes in operations and to better withstand structural disruptions

What "good" looks like:

1. ❑ Queue up planned redesigns based on product and component **obsolescence risk**
2. ❑ Pursue **proactive redesign** "quick wins" where engineering effort is low
3. ❑ Incorporate resilience in **routine design & engineering** for new and existing products
4. ❑ Develop rapid, agile **emergent design** process to use during disruption

Enabler legend

Digital tools	Governance	Talent
Culture	Process & Operating Tools	Change mgmt.

Obsolescence Risk| Structural resilience is bolstered by periodic product and component lifecycle reviews

Key enablers: Governance | Change

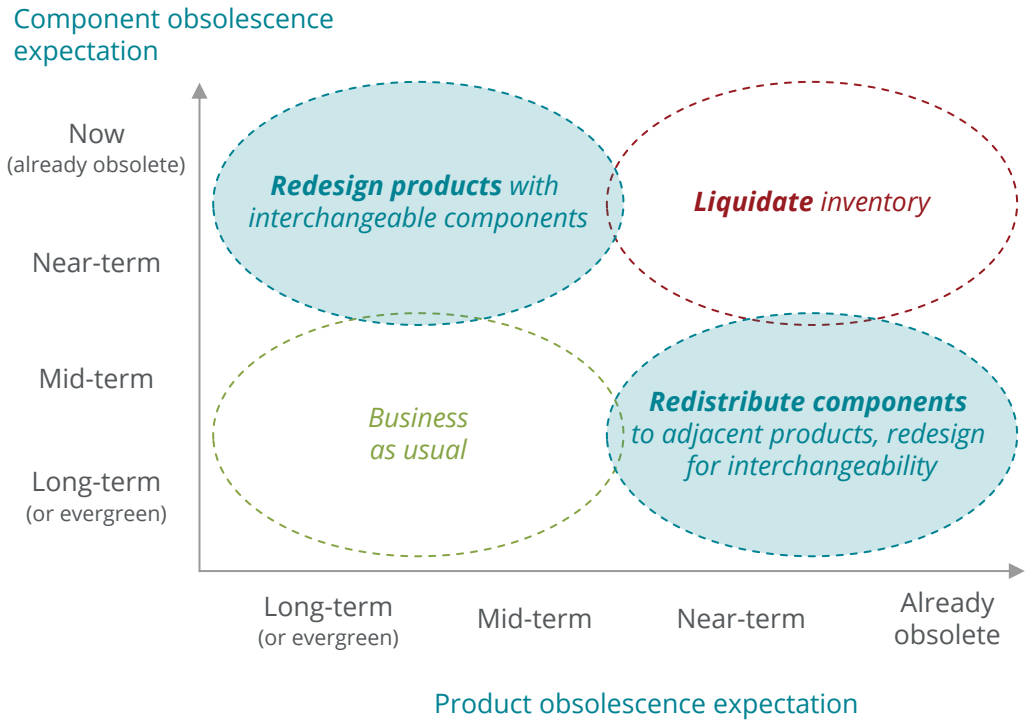
❑ Queue up planned redesigns based on product and component **obsolescence risk**

Categorize products based on best estimate of component and product lifecycle, driven by supplier, customer, and internal company factors (e.g. launch of new generation products)

Prioritize redesign for products with
- **Near-term component obsolescence** date, as reported by manufacturer and
- Long-term expected **product longevity**

Consider redesign to improve component interchangeability in cases of
- Long-life components with significant **inventory position** and
- Products nearing **end of lifecycle**

Example product and component obsolescence risk matrix



Proactive Redesign| Low effort design changes to de-risk changes prioritized to immediately begin building Flexible Engineering capability

Key enablers
Process | Change

❑ Pursue **proactive redesign** "quick wins" where engineering effort is low

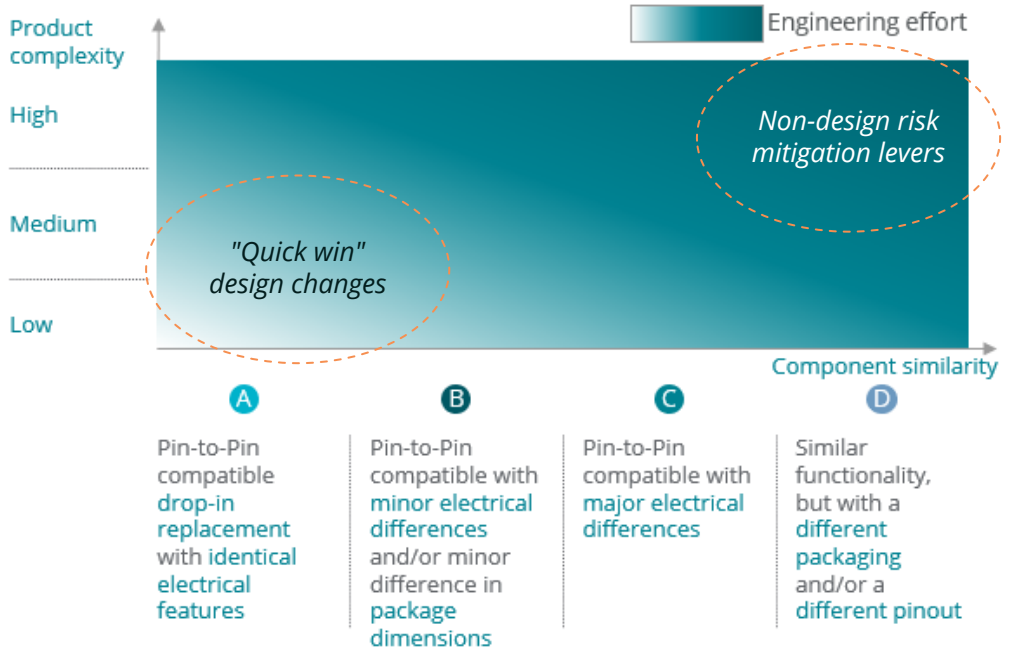
Pursue **"quick win" design changes** for high-risk products characterized by :
- Low product complexity
- High component compatibility

Pursue simple changes through **low-effort engineering** tactics:
- Component interchangeability
- Design standardization

Benefits include:
- **Simplified supply chain** from reduction in number of input variants required
- Higher order volume of one component type results in increased **negotiation power** with suppliers

Pull **other risk mitigation levers** (e.g. multi-sourcing) when high-risk product is not a good candidate for redesign

Example product development quick win matrix



Redesign effort determined by product design complexity and alternate input similarity

Routine Design & Engineering| Throughout product development lifecycle, integrate flexibility to reduce exposure to high-risk inputs and suppliers

Key enablers

Governance | Process | Culture

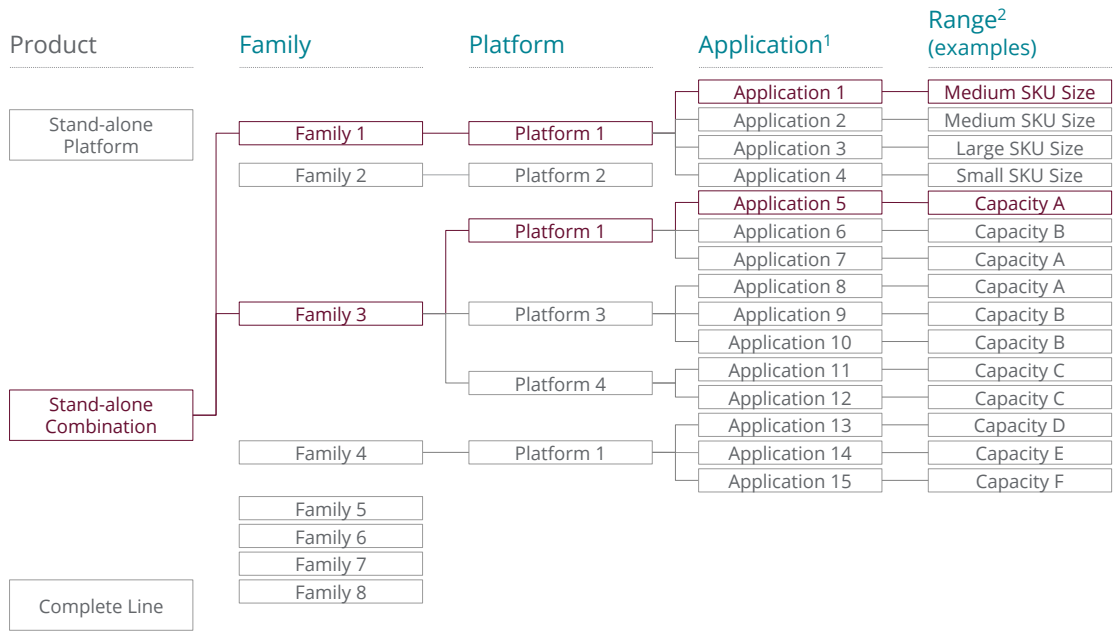
❑ Incorporate resilience in **routine design & engineering** for new and existing products

Incorporate resilience criteria in design process for both new product introductions and existing Value Analysis / Value Engineering processes to **consider risk in addition to cost and functionality**

Consider best-in-class resilience levers:

- Identify **design alternatives** to high-risk components to decrease dependence in cases of unmitigatable single-sourcing
- **Remove vendor specifications** for high-risk components to create optionality in case of shortages
- **Simplify design** specifications that do not impact functionality (e.g. packaging, aesthetic elements)
- Enable **modularity** and **late-stage differentiation** (postponement) to create optionality
- Involve **procurement specialists** in design decisions to consider interdependence with sourcing
- **Rationalize portfolio** to reduce SKU proliferation which requires bespoke sourcing without adding customer value
- In new product development, shift **product mix** to consist of ~30% bespoke, ~30% standard drop-ins, and ~40% common component architecture

Example modular design map linking product families, platforms, and applications, to the exact SKU



1. Commercial name 2. Technical name plus size

Emergent Design | Establish proper governance for expedited redesign process improvements to quickly pivot during disruption

Key enablers

Governance | Process | Change

❑ Develop rapid, agile **emergent design** process to use during disruption

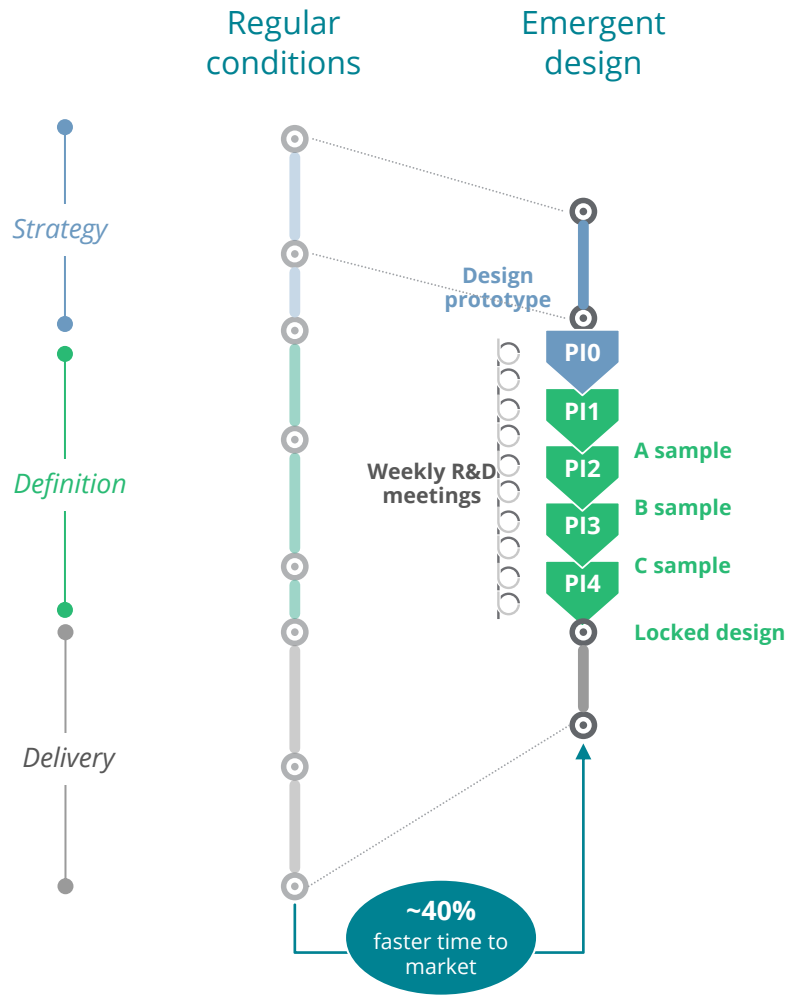
Institute a rapid, agile emergent design process as an **exception-based R&D approach** that supports high service levels and resilient supply chains amid actual and threatened disruptions

Incorporate design process mechanisms such as:

- Proper **governance,** emergency **budgets** and timely escalation mechanisms
- **Expedited approval process** for limited-scope design changes (e.g. lowering number of hours of durability testing)
- Explicit evaluation of **risk trade-offs** with speed, cost (e.g. potential liability vs. aesthetic matter)

Focus on outcomes such as:

- Higher usage of **component substitution**
- More **prompt recertification** (i.e., no company-driven red tape)
- **Specification deviations** only if requested by customer



Example | Supply chain risk management transformation at a large MedTech company

Context

Company was dealing with a shortage of semiconductor components for Printed Circuit Board Assemblies (PCBAs) and wanted to **transform their supply chain risk** monitoring **and mitigation strategy**

Key goal: Implement a data-driven approach to mitigate component supply risks

Additional company context:

- **High-risk portfolio** of critical medical devices with few alternate options for patients
- **Aging device designs** with many parts nearing obsolescence
- **Minimal cross-functional** and cross-BU data collaboration
- **Transactional relationships** with critical suppliers and limited long-term strategic alignment

Highlights

Implemented a data room and control tower to improve **visibility of supply risks** for electro-mechanical devices, enable **proactive risk mitigation**, and empower strategic supplier engagement

Developed a consolidated view of the PCBA supply chain with data links to functions & BUs, suppliers, and external data providers

Functions and BUs

- Bills of Materials (BOMs), device economics, sales forecasts and LRPs, product launch plans, assessments from R&D, MA, and RA

Suppliers

- 3-year forecasts of supply capacity and anticipated shortages

External data providers

- Risk metrics for semiconductors and other electronic components

Designed **cross-functional governance** structure and processes to address supply risks across the device lifecycle

Key Takeaways

Resilience transformation executed the following:

Decision framework for device re-design incorporating regulatory considerations

Cloud-based data room for rapid assessment of risks in the PCBA supply chain

Prioritization of risk mitigation actions based on potential impact to patients and business

Data driven, strategic approach to build and manage supply base

Defined **cross-functional governance** to monitor and address supply risks

NEMA
National Electrical Manufacturers Association
www.nema.org