BOSTON CONSULTING GROUP

Handbook for Resilient Supply Chain

FEB 7TH, 2022

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What is happening in supply-chain?

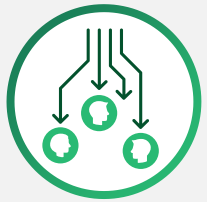
There are four major changes/trends affecting supply chains

Large-scale fluctuations in the global economy

- China has driven world economic growth, and since 2000 it has strengthened its relationship with various ASEAN countries.
- Along with increased ASEAN investments by Chinese companies, ASEAN companies have also expanded their business into China, which has resulted in the formation of a new economic zone.
- In addition to this, there has also been a growing movement to change the status quo by various countries that are becoming increasingly cautious of increasing Chinese presence in global economy.

Diversification of consumers/customers & industries becoming increasingly high-tech

- As consumer preferences continue to diversify, supply chains are becoming more complex due to an increasing move toward personalization of products/services & proliferation of digital purchase behaviors, etc.
- In addition, product lifecycles are getting shorter & products are becoming more high-tech and software based. This in turn has created unexpected conflicts such as competition between automotive and electronics industries on procurement of semi-conductors.



Growing supply chain risks

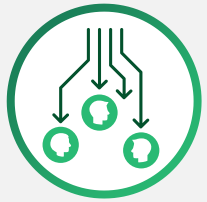
- The global pandemic & large-scale earthquakes have caused a sense of crisis to spread between companies on the risk of supply chain interruptions.
- At the same time, conflicts between major economic powers & increasingly volatile exchange rate fluctuations, etc. have also contributed to the destabilization of supply chains.

Rise of new social values

- Governments & consumers are becoming more aware of social issues such as the environment & human rights.
- The way companies respond to these issues now affect their business activities.
- In order to respond, collaboration between upstream & downstream supply chain operations has now become important & is also affecting the design of the optimal supply chain model.

Source: Boston Consulting Group analysis

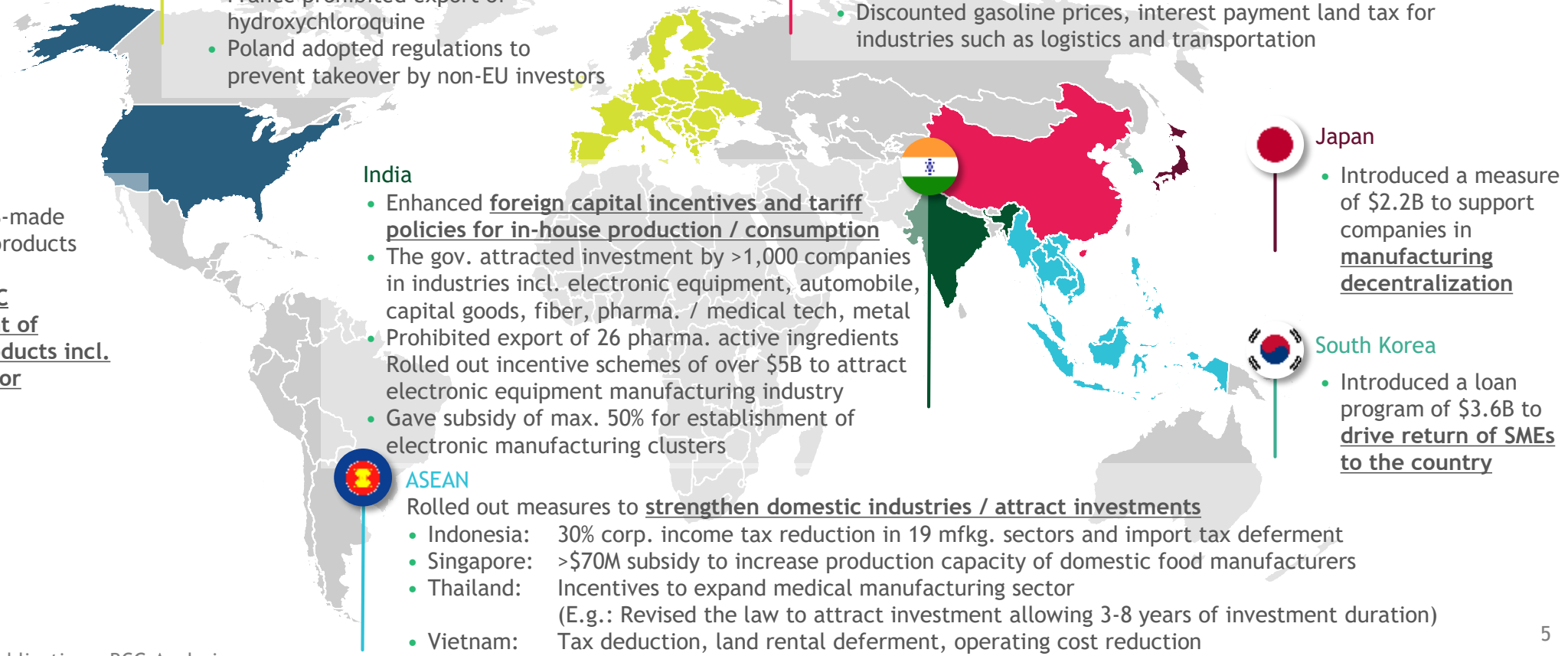
Four changes are making supply chains more complex & unstable



Impacts	Large-scale fluctuations in the global economy	Diversification of consumers/customers & industries becoming increasingly high-tech	Growing supply chain risks	Rise of new social values
Increasing complexity	• Supply chain reformation on a global scale – Elevation of new NW & option consideration	• Channel segmentation, increased number of product SKUs • Increase in mutual collaboration between industries, cross-value chain expansion	• Diversification of external risk factors – Changes in medium- to long-term climate & industrial structures – Current pandemic, economic/political risks, etc.	• Sharing of E2E information, with internal and external parties of the company • Securing traceability – Observance of human rights – Environmental conservation, GHG reduction, etc.
Increasing instability	• Conflict & friction between existing economic zones & emerging economies – US-China conflict (tariffs, regulations, etc.)	• Increase in demand fluctuations • Shorter total lead times & accelerated cycles – From development to manufacturing and shipping	• Increased scope (impact) & frequency of risks – Global/cross-country risks becoming more apparent (pandemic, economic friction, human rights, etc.)	• Frequent revisions of rules forcing company to continuously update and follow latest

Source: Boston Consulting Group analysis

Many countries have been taking measures to protect domestic industries and attract investments to reshape supply chain since around COVID-19 outbreak



EU

- **Enhanced protection of essentials within own countries**
- France prohibited export of hydroxychloroquine
- Poland adopted regulations to prevent takeover by non-EU investors

China

- Promoted exports by increasing export tariff refunds on over 1,500 goods
- Discounted gasoline prices, interest payment land tax for industries such as logistics and transportation

USA

- Purchased US-made agricultural products worth $3B
- Announced **SC enhancement of principal products incl. semiconductor**

India

- Enhanced **foreign capital incentives and tariff policies for in-house production / consumption**
- The gov. attracted investment by >1,000 companies in industries incl. electronic equipment, automobile, capital goods, fiber, pharma. / medical tech, metal
- Prohibited export of 26 pharma. active ingredients Rolled out incentive schemes of over $5B to attract electronic equipment manufacturing industry
- Gave subsidy of max. 50% for establishment of electronic manufacturing clusters

Japan

- Introduced a measure of $2.2B to support companies in **manufacturing decentralization**

South Korea

- Introduced a loan program of $3.6B to **drive return of SMEs to the country**

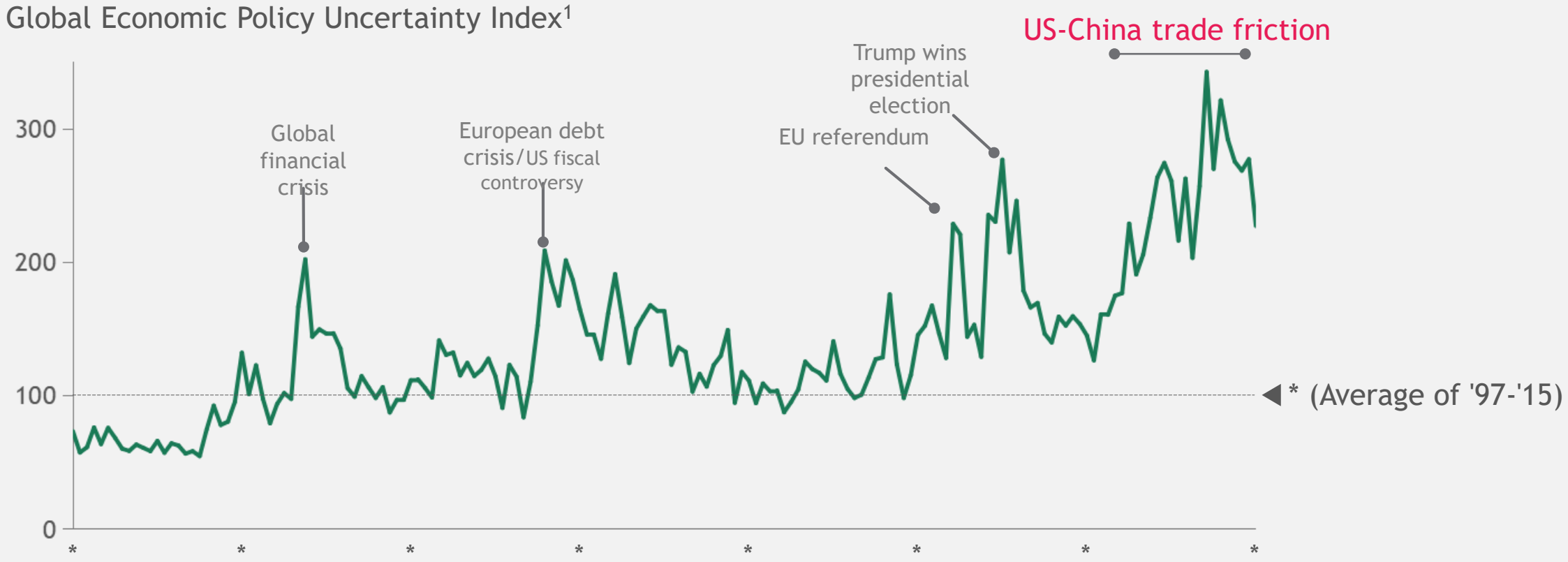
ASEAN

Rolled out measures to **strengthen domestic industries / attract investments**

- Indonesia: 30% corp. income tax reduction in 19 mfkg. sectors and import tax deferment
- Singapore: >$70M subsidy to increase production capacity of domestic food manufacturers
- Thailand: Incentives to expand medical manufacturing sector (E.g.: Revised the law to attract investment allowing 3-8 years of investment duration)
- Vietnam: Tax deduction, land rental deferment, operating cost reduction

Source: IMF; various publications; BCG Analysis

Uncertainty has been rising and peaked in 2019 due to US-China trade war and Brexit



1. Indicator of uncertainty about the future of the economy due to policy impacts, consisting of three components: quantification of newspaper reports on economic policy uncertainty, the number of upcoming tax system reforms, and the degree of inconsistencies between economists' economic forecasts
Source: Haver Analytics; BCG Henderson Institute: Center for Macroeconomics; Boston Consulting Group analysis

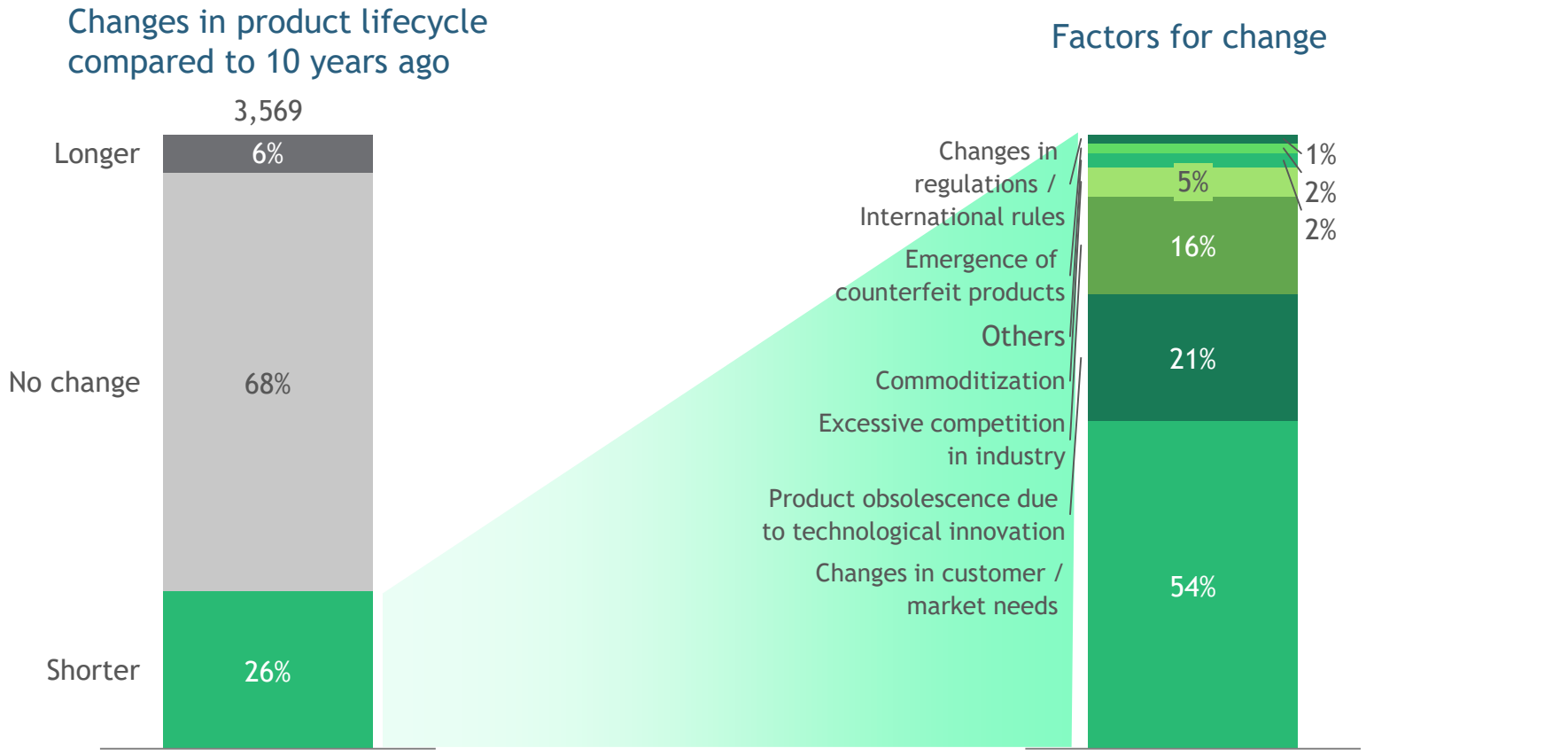
Diversification and increase speed of consumption, and changes in industry structure are making supply chain more complex and instable

	Diversification of consumers	Shortening of product lifecycles	Changes to products & industrial structure
Background	• Diversification of customer needs & products through individualization & personalization • Segmentation of purchase behavior & diversification of channels (e-commerce, etc.) • Utilization of digital to improve expectation towards service quality (quality, product lineup, delivery speed, etc.)	• Shortening of product lifecycles due to consumption behavior, increased product software, accelerated technological innovations & obsolescence	• Reduced added value of production has caused a shift towards software & service models that offer high added value • Products are becoming more high-tech, so semiconductors are becoming a key component in each industry
Impact on supply chain	• Increased number of SKUs[1)] being handled & more complex product mgmt. (including long tails) • More complex channel & demand mgmt. (omnichannel mgmt., etc.)	• Shorter total lead time & accelerated cycle throughout the product's entire development, production and shipping process	• Improved cross-industry interdependence & scramble for capacity & parts between industries

1. SKU : Stock Keeping Unit (number of products)
Source: Boston Consulting Group analysis

Changes in the supply chain are driven by shortened life cycles of the products, coupled with fragmentation and diversified consumption

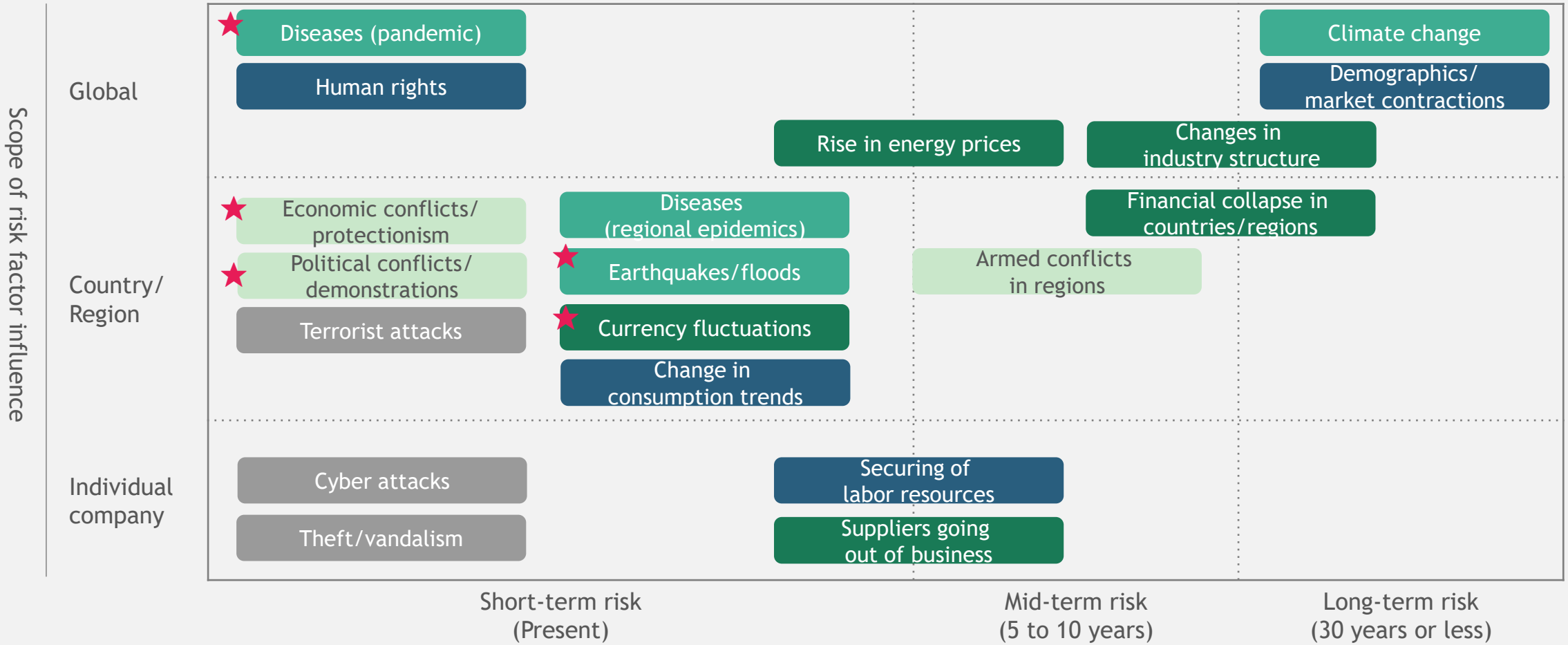
Shortening of product lifecycle



Source: Left: METI『ものづくり白書2016年度版』

Supply chain risk factors have been increasing

■: Natural risk ■: Political risk ■: Economic risk ■: Social risk ■: Crime risk ★Factors influencing the supply chain in the last three years



Source: Publicly disclosed documents, Boston Consulting Group analysis

The Environment, sustainability, and human rights will define the future of the supply chain and accelerate its restructuring

	Human rights	Environmental regulations	Carbon neutrality
Background	• In 2011, UN Human Rights Council approved UN Guiding Principles on Business and Human Rights • Boycott due to inhumane treatment of foreign immigrants, child labor, etc.	• European RoHS Directive and REACH Regulation • Increasing regional/ domestic regulations on water/ air pollution control	• Following the other countries, the Japanese government has also announced its policy to reduce greenhouse gas emissions to zero by 2050
Impact on supply chain	• Confirmation of human rights risks through CSR questionnaires for business partners, voluntary audits of business partners, external audits, etc. are increasingly required	• Compliance with laws and regulations, including green procurement standards, identification and disclosure of chemical substances • Increasing importance in supplier mgmt./ due diligence of products containing chemicals	• Increasing necessity to monitor GHG emissions throughout the supply chain • In addition to energy conservation and efficiency improvements, it is necessary to transform to decarbonized business models
Impact level	Moderate	Moderate	Large
Span	Short- to mid-term	Short- to mid-term	Mid-term (but may advance much quicker)

Source: Publicly disclosed documents, Boston Consulting Group analysis

Child labor, unfair treatment of foreign workers, etc. have raised questions about the ethics of companies, leading to large-scale boycotts

Case	Background / Results
1 Manufacturer (Apparel)	A boycott of a major sporting goods brand after it was revealed that its factory in South-East Asia was forcing children to work long hours in poor conditions
2 Manufacturer (Electrical EMS[1])	A human rights advocacy group released a report on temporary agency workers at a major EMS company in China, revealing violation of labor laws. The company was forced to respond to the problem.
3 Manufacturer (Food)	A lawsuit was filed by a local producer in Africa accusing the company of operating a cocoa production supply chain based on child slave labor; the case has been in court for more than 10 years
4 Retail	A major media outlet reported that Myanmar sailors are being held captive and forced to fish, and their seafood is being sold to major global retailers. The brand was severely damaged.

Companies experienced brand damage as well as lost business opp. due to boycotts

1. Electronics Manufacturing Service
Source: Various public materials, BCG analysis

Case: Human rights-related laws / regulations (Unfair labor practices)

	Country	law / regulation	Year	Overview
	USA	California Transparency in Supply Chains Act	2012	• For retailers or manufacturers operating in CA with global sales of more than $100M • Disclosure imposed, incl. audits of supply chain risk assessments for slavery / human trafficking, and supplier certification of compliance with slavery / human trafficking laws
	UK	Modern Slavery Act	2015	• For profit organizations / companies operating in UK with sales exceeding a certain amount • Requires preparation / publication of annual statement on efforts undertaken to ensure the absence of slave labor / human trafficking
	Australia	Modern Slavery Act	2019	• For companies in Australia with annual revenues of more than A$100M, incl. their subsidiaries • Mandates that modern slavery risks in supply chains and their operations be assessed, analyzed, and reported
	Nether lands	Child Labor Due Diligence Law	2022 Scheduled	• For companies (incl. foreign companies) that provide goods or services in the Netherlands • Mandatory DD on child labor in supply chain, with possible fines and criminal liability (up to €870K or 10% of sales) for violators
	Germany	Supply Chain Due Diligence Act	2023 Scheduled	• For companies with more than 3,000 employees with headquarters, main branch offices, administrative offices, legal offices or branches in Germany • Binding regulation of global SC's responsibility to respect human rights, requiring them to fulfill certain obligations of care in own business areas, actions of contractual partners / (indirect) suppliers

Source: Various public materials, BCG analysis

Tightening of environmental regulations in each country made it necessary to responsibly manage not only own activities but also upstream operations

	Regulation (ex.)	Country	Overview
1	Clean Air Act	USA	• Environmental protection law that requires Environmental Protection Agency to set federal air quality standards to protect / improve air quality, and imposes on states the responsibility to take the necessary measures to achieve these standards
2	WEEE[1)]/ RoHS[2)]	EU	• WEEE mandates collection, establishment of recycling systems and cost sharing for electrical and electronic product waste • RoHS restricts the use of chemical substances that are harmful to the environment / human health in electrical / electronic products
3	Administrative Measures for controlling pollution caused by electronic information products	China	• Environmental regulation known as China's version of RoHS, which sets limits / restrictions on use of lead, mercury, and other hazardous substances in all electrical products manufactured and sold in China, or products imported to China
4	E-waste Rules	India	• Revised in 2016, the regulation not only obliges manufacturers to collect / recycle waste electrical /electronic equipment, but also stipulates the so-called RoHS, restriction of hazardous substances contained

Companies are required to check not only legal compliance of own products/processes, but also compliance of upstream processes

1. Waste electrical and electronic equipment 2. Restriction of use of certain hazardous substance in the Electrical and electronic equipment
Source: Various public materials, BCG analysis

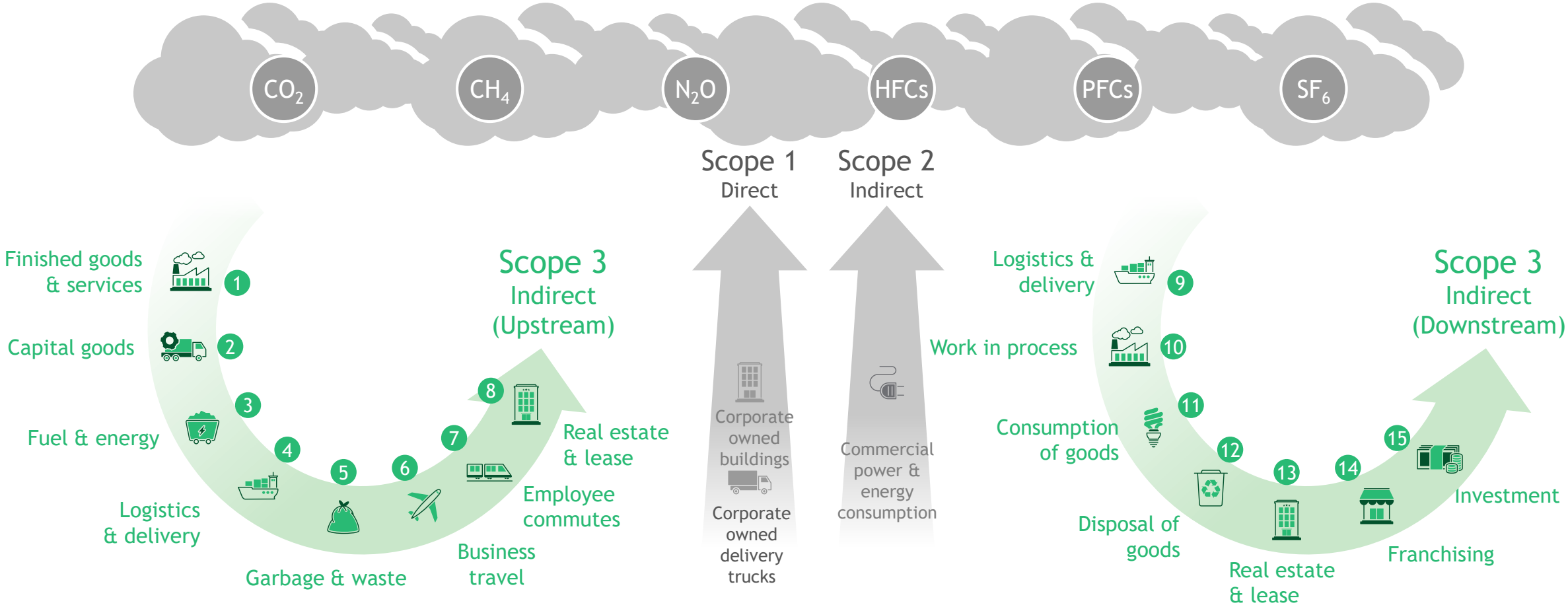
Growing concern for climate change and increasing momentum toward carbon neutrality/ net zero emissions is seen in many countries

Country	Initiative goals for each country
 USA	• Despite withdrawing from the Paris Agreement, President Biden pledges net zero GHG greenhouse gas emissions by 2050
 EU	• Achieve at least -55% of the 1990 level by 2030 • Achieve carbon neutrality by 2050
 China	• Reduce emissions by 2030 and reduce CO2 emissions per GDP by 65% from 2005 levels • Achieve carbon neutrality by 2060
 Japan	• Reduce greenhouse gas emissions by 26% from 2013 levels by 2030, feasible target based on technological / cost constraints • Former PM's policy speech declared the realization of carbon neutrality by 2050

Medium / long-term goals for carbon neutrality have been set in each country and momentum for initiative is increasing

Source: Various public materials, BCG analysis

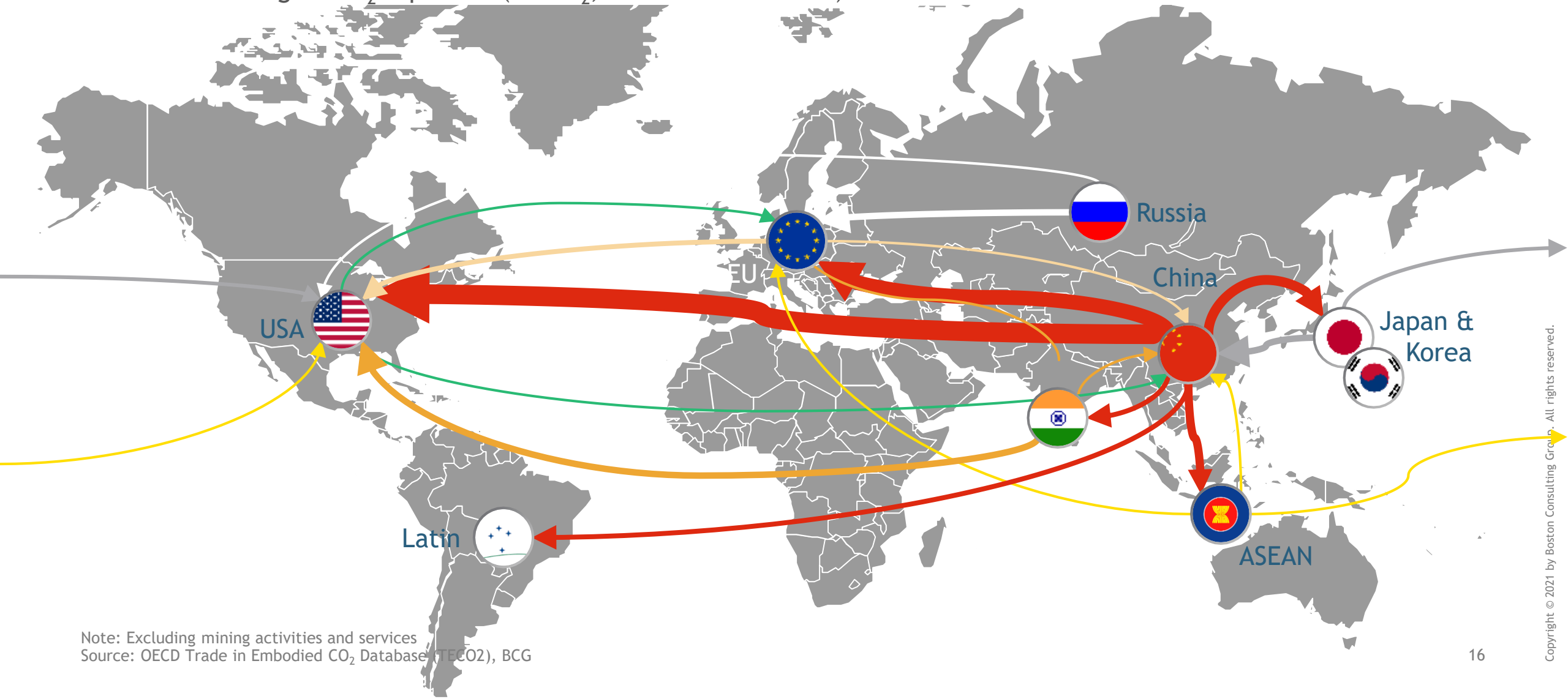
Collaboration between stakeholders of whole SC will be necessary to reduce CO2 emissions



Source: BCG analysis

The entire global supply-chain network including international transportation must be reconsidered for the reduction of GHG emissions

The world's 20 largest CO_2 exporters (Mt CO_2, based on 2015 data)



Note: Excluding mining activities and services
Source: OECD Trade in Embodied CO_2 Database (TECO2), BCG

These 4 changes are affecting the supply chain of industries

	Pharmaceutical/ medical devices	Industrial goods	High-tech	Consumer goods/apparel	Retail
Large-scale fluctuations in global economics	✓ Increasing protectionist policies (such as masks & vaccines) and acceleration of returning to domestic production in some countries	✓ Conflicts between major economic powers have destabilized markets with import restrictions & tariffs, which has caused more structural changes			
Diversification of consumers & customers, industry becoming increasingly high-tech	✓ Digitization of the MR-centric sales model	✓ Increasing competition on procurement between different industries (especially seen in semi-con industry)	✓ Diversification and dispersion of demand, increase in the number of SKUs	✓ Diversification and dispersion of demand, increase in the number of SKUs, omni-channels	✓ Store format diversification, EC
Emerging supply-chain risks	✓ Supply disruption due to centralized supply of the ingredients	✓ Increasing procurement and production risks due to natural disasters	✓ Increasing risks of the centralized supply chains, global scale disconnection	✓ Rising labor costs in production areas, instability of raw material supply	✓ Shrinking market, rising labor costs, decline in profitability
Rise of new social values		✓ Compliance with environmental regulations, GHG reduction, and human rights at the global level	✓ Addressing ESG issues such as human rights and the environment throughout the supply chain Consumer and business partner cancellations		

Source: Boston Consulting Group analysis from interviews with experts & companies

Supply-chain restructures are both threat and opportunity

Threat (crisis)

Chance (opportunity)

late onboarding of global SC restructuring may face a risk of losing their business

- SC restructuring on a global scale is accelerating due to increased risk and changes in the external environment
- Companies are facing a risk of losing their global SC network and competitiveness if they miss the timing of SC reform

Successful SC reform contributes to positional advantages

- Active involvement in the formation of new standards and rules across industries and regions contributes to positional advantages

SC restructuring itself is a new business opportunity

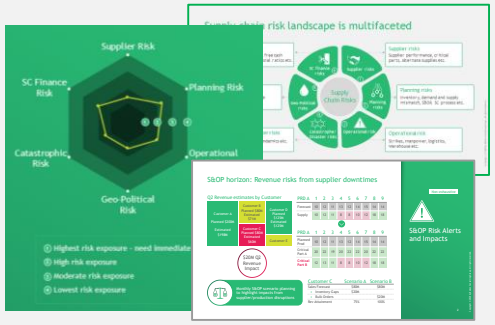
- Collaboration among multiple industries and countries within the same region creates an opportunity for diversifying business and further economic development

Source: BCG analysis

Supply-chain visibility is a starting point to become resilient handling complexity and instability

Basic approach to complexity and instability

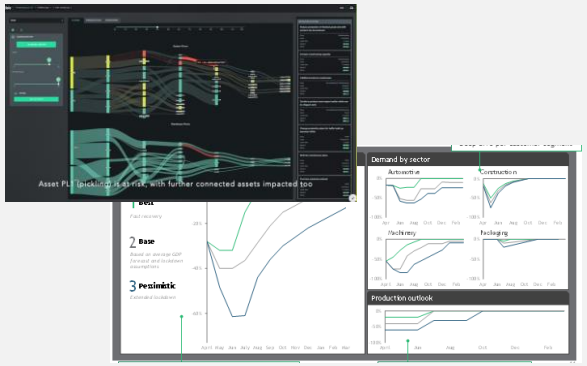
Discovery



Insight into supply chain structure and performance, and market/customer conditions

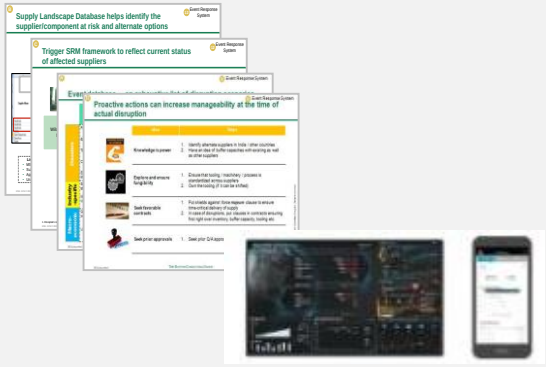
"Supply chain visualization"

Assessment



Organize changes as scenarios, quantify the impact on the business, and determine necessary measures and priorities

Response



Decide on measures to be taken in the short, medium, and long term and formulate action plans

Source: Boston Consulting Group analysis

Increasing visibility has a great impact on the improvement of supply-chain performance

Impact created	Overview
A Impact on sales	• Reducing opportunity loss by improving forecast and supply planning accuracy • Optimizing inventory levels and improving service levels
B Impact on costs	• Responding to uncertainty in raw material supply and unexpected changes in demand • Improving operational efficiency by reducing volatility
C Impact on working capital	• Reducing excessive buffers of raw materials, intermediate products, and finished goods • Reducing inventory by understanding supply and demand fluctuations through analytics

+4~6%
Sufficiency ratio

△7~20%
Production, warehousing, and distribution costs

△15~30%
Inventory in working capital

Source: Boston Consulting Group analysis

Nevertheless, low visibility of supply-chain may have negative impact

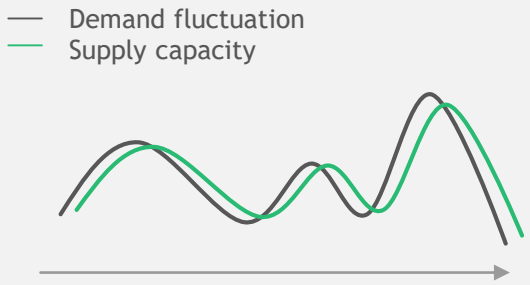
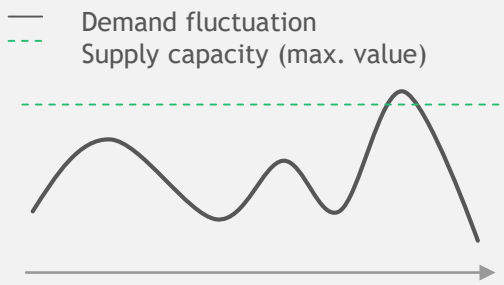
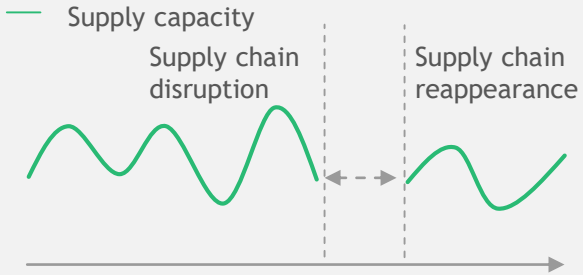
	As visualization has not been realized...		risks occur...		leading to negative impacts
Company-wide / Corporate perspective	Compliance level status is not visible		Apparel Company A: Consumer boycotts lead to brand and sales losses		Loss of sales • Hundreds of billions of yen
	Mgmt. indicators and forecast figures cannot be seen in a timely manner		Electric Company B: Inability to make adequate business decisions, delays in decisions		Reduced business sales costs • Tens of billions of yen
Business division perspective	E2E inventory and consumption prospects cannot be seen		Semiconductor Company C: Balance sheets are severely damaged due to excessive inventory		Inventory depreciation • Tens of billions of yen
	Lack of understanding in business partner strategies		Material Company D: Mass disposal due to sudden discontinuations and procurement terminations		Inventory cancellations • Hundreds of millions of yen per year
	Lack of understanding in the supplier structure		Automobile Company E: Global production suspensions due to unexpected supply disruptions		Loss of sales opportunities • Tens of billions of yen
	⋮		⋮		

Source: Boston Consulting Group analysis from interviews with experts & companies

What is resilient supply chain?

Three ways to strengthen supply chain resilience

What is a resilient supply chain?

	1 Strengthened compliance	2 Strengthened redundancy	3 Strengthened recovery
Concept			
	• Making the supply chain more flexible will allow sudden changes in the supply chain to be tracked while allowing variable operations that follow changes.	• Strategically giving the supply chain a buffer will make room for supply chain to withstand fluctuations.	• Organizing the supply chain's recovery & substitution options will allow it to quickly return to normal operations and minimize impact even during critical events.
Key measures	• Visualization of supply chain • Sophistication of supply chain planning • Strengthening of supply chain execution ability	• Securing of strategic redundancy	• Visualization of supply chain • Sophistication of supply chain planning • Strengthening of supply chain execution ability • Ensuring strategic redundancy

Key elements for supply chain resilience

5 points to be considered for reinforcing both economy × stability (summary)

End-to-end visualization of supply chain

- Install a control tower to visualize the flow of information & the entire supply chain. Establish processes & governance to implement speedy cross-departmental decision-making while monitoring performance E2E.

Sophistication of supply chain planning

- Change from a style of supply chain planning that relies on experience, intuition and guts to one that is data-driven and utilizes analytics. Enhance forecasts & planning through advanced machine learning & optimization.

Strengthening of supply chain execution ability

- Improve the trackability of supply chain planning by introducing automation & labor-saving technology and streamlining and promoting more real-time field operations while also reviewing designs & the number of product SKUs[1].

Better collaboration with stakeholders

- Define the supply chain more broadly, establish control of upstream & downstream supply chain operations, and integrate planning across functions. Also strengthen collaboration with major stakeholders in order to achieve this.

Ensuring strategic redundancy

- Strategically incorporate buffers, such as the procurement & distribution of main components, increasing inventory and securing surplus production capacity, based on the tradeoff between economy & stability.

1. Stock Keeping Unit
Source: Boston Consulting Group analysis

E2E visualization requires data integration/visualization, building a decision-making system/process and the performance monitoring

	Control tower	Decision-making process & system	E2E performance monitoring
Key points	• Integrated data is visualized in a central control tower • Key KPIs and risk indicators are presented in a dashboard in an easily viewable format • Data updates can be presented in near real-time • Collect data and build dashboard according to use case, do not let visualization become an end itself	• Establish a cross-functional, cross-chain organization • Also establish a data-driven decision-making process under the direct supervision of the CEO • Visualize revenue & cost throughout the product life cycle for decision-making	• Visualize status and performance of operations in a single E2E system across companies and suppliers • Continuously improve business, including stakeholders
Anticipated improvement & effects	• SC-wide bottlenecks & risks are identified • SC-wide surpluses & inefficiencies are identified • Data visualization supports decision-making for immediate, medium and long-term issues	• Maximized SC and company-wide aggregation • Mitigation of damage from SC risks through prompt handling	• Stakeholder collaboration is promoted • Entire SC can be optimized

Source: BCG analysis

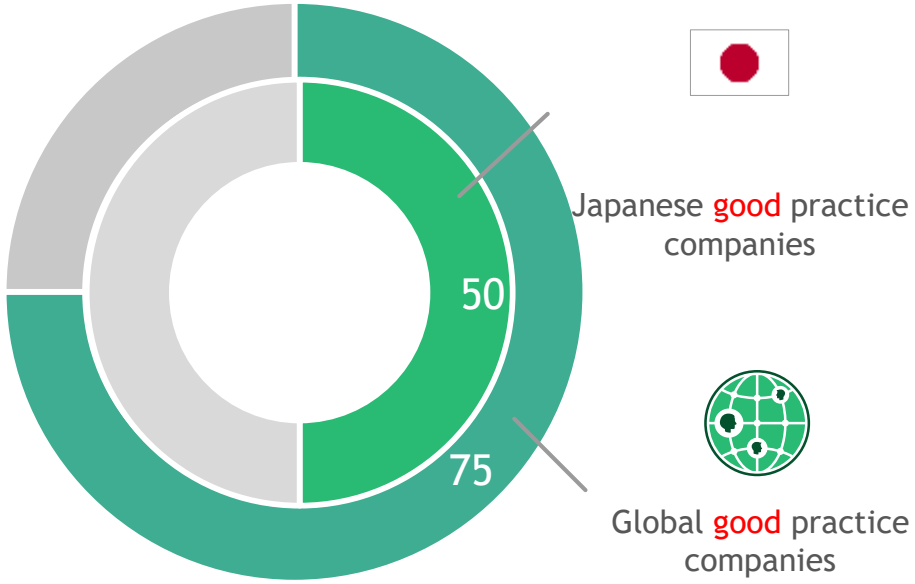
Most companies with good supply-chain practices maintain SC control towers & successfully visualize the SC E2E

Percentage of leading companies having a control tower

% of companies with a SC control tower

: % of companies with SC control tower

: % of companies without SC control tower

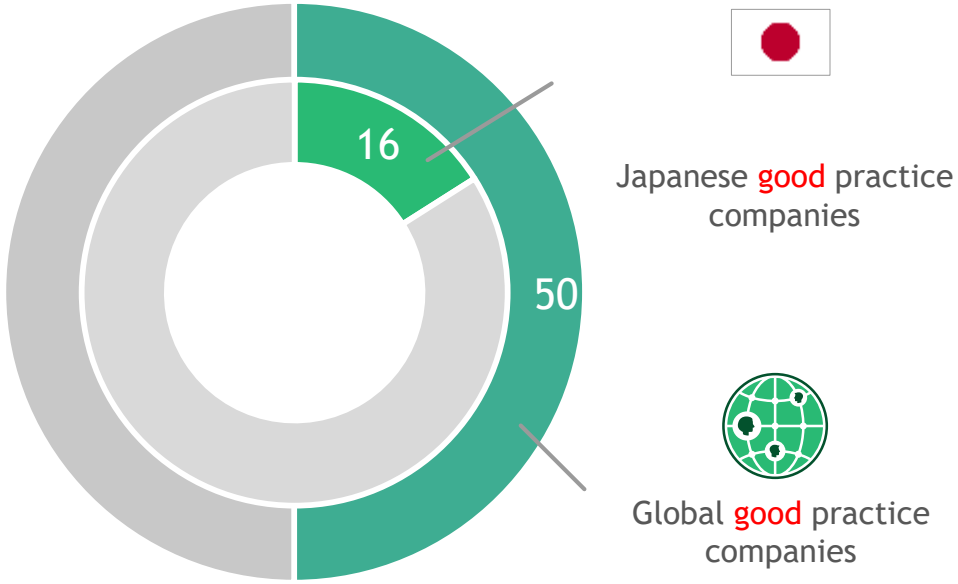


The percentage drops to 50%
limit it to Japanese companies

% of companies that have achieved E2E SC visualization

: % of companies with E2E SC visualization

: % of companies without E2E SC visualization



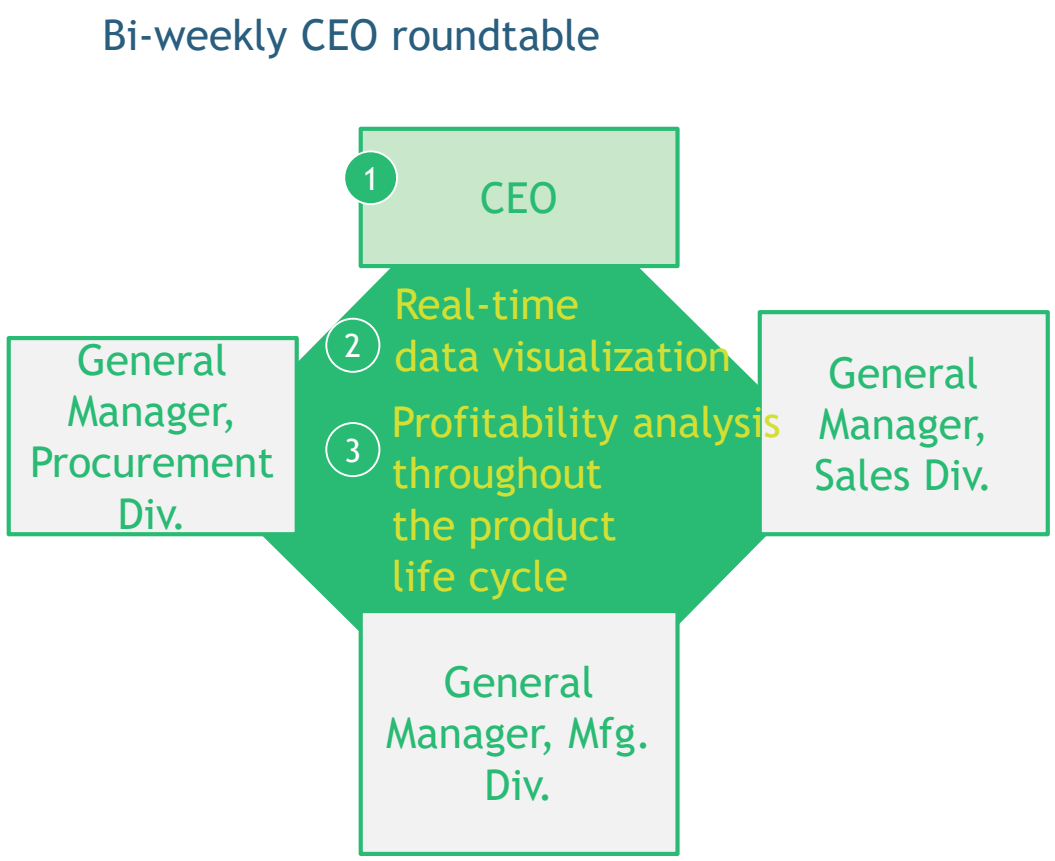
The percentage drops to 16%
limit it to Japanese companies

1. Companies that answered that they have an integrated system for managing procurement, manufacturing and sales, and use data to make cross-functional decisions; 2. Companies that answered that they achieved E2E SC visualization for key products or key suppliers
Source: Interview with personnel of global companies with good management practices; BCG analysis

Good practice

CEO's bi-weekly decision-making process in a leading company

Manufacturing Player Example : Decision-making structure & process with CEO as the leader



1 **Direct discussions between CEOs & divisional leaders**

- The CEO & divisional leaders hold bi-weekly meetings to share current issues for decision making from a company-wide perspective

2 **Real-time visualization & data-driven decision making**

- Data is visualized in real-time, and prompt decisions are made based on the essential data

3 **Profitability analysis throughout the product life cycle**

- Profitability/cost analysis by product type is performed, and actions for production & sales are considered to maximize revenue throughout the product life cycle

Source: Expert Interviews; BCG analysis

Good practice

Establish a process to consolidate worldwide procurement decision-making in SC control tower department

Manufacturing Player Example : Procurement decision-making system/process initiated by the SC control tower

- In addition, there are 3 to 5 planners in each subsidiary
- Including expats in each country, the total number of employees is 200 to 300

1 Information consolidated by control tower dept.

- consolidation and monitoring of all information such as sales status, demand fluctuations in the last 6 months, product status, etc.

2 Worldwide consideration of procurement volume and suppliers in line with demand fluctuations

- Simulate additional procurement/production scenarios for countries/areas where demand is expected to increase
  - Urgency: High
    - Procurement plan combining geographical advantage and suppliers with short LT
  - Urgency: Low
    - Procurement plan including suppliers with the best cost

3 Communication to procurement planners (managers) in each country

- The procurement plan designed by SC control tower dept. is communicated to procurement managers in each country and procurement operations are executed

4 Each factory is only responsible for quality, not procurement

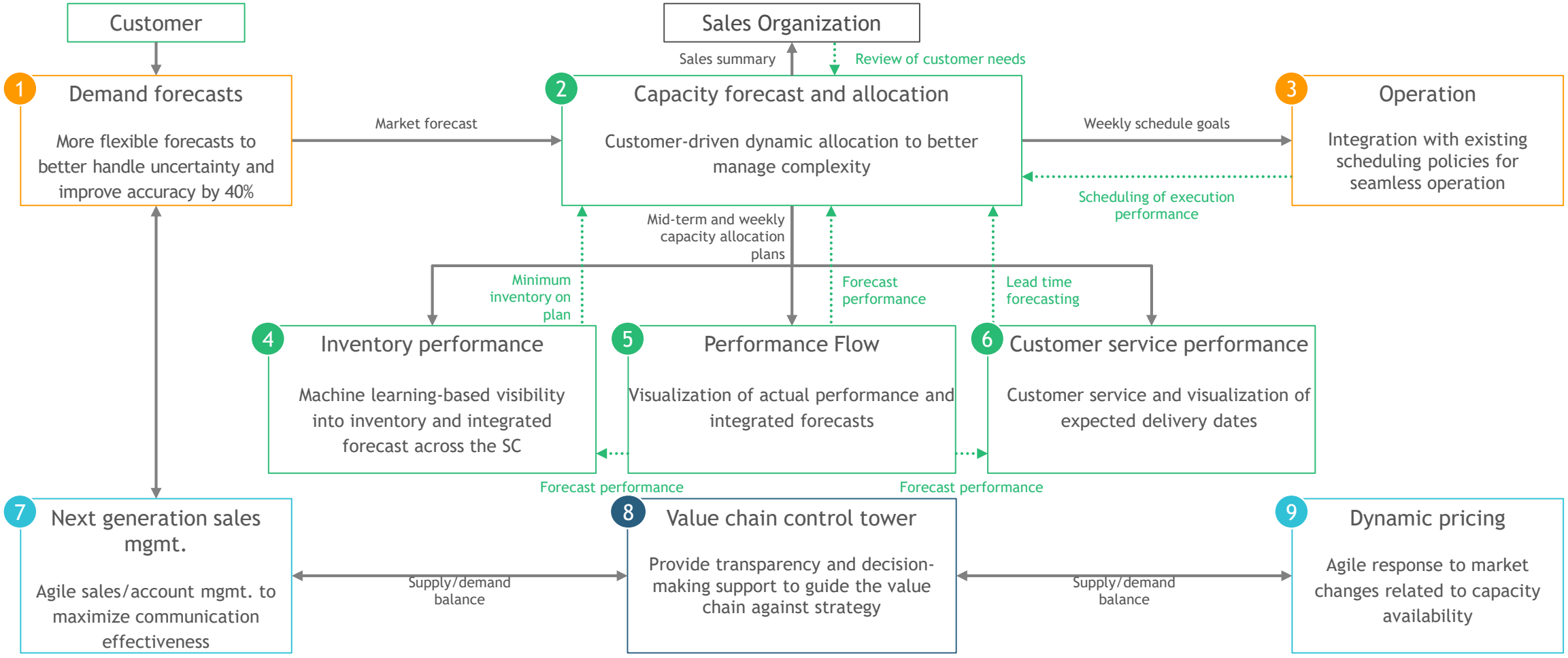
- Each factory accepts raw materials/components ordered by the SC control tower dept. and planners and is not involved in procurement

Source: Expert Interviews; BCG analysis

Good practice

Entire SC optimization through E2E visualization and demand forecasting

Manufacturing Player Example : Supply chain S&OP

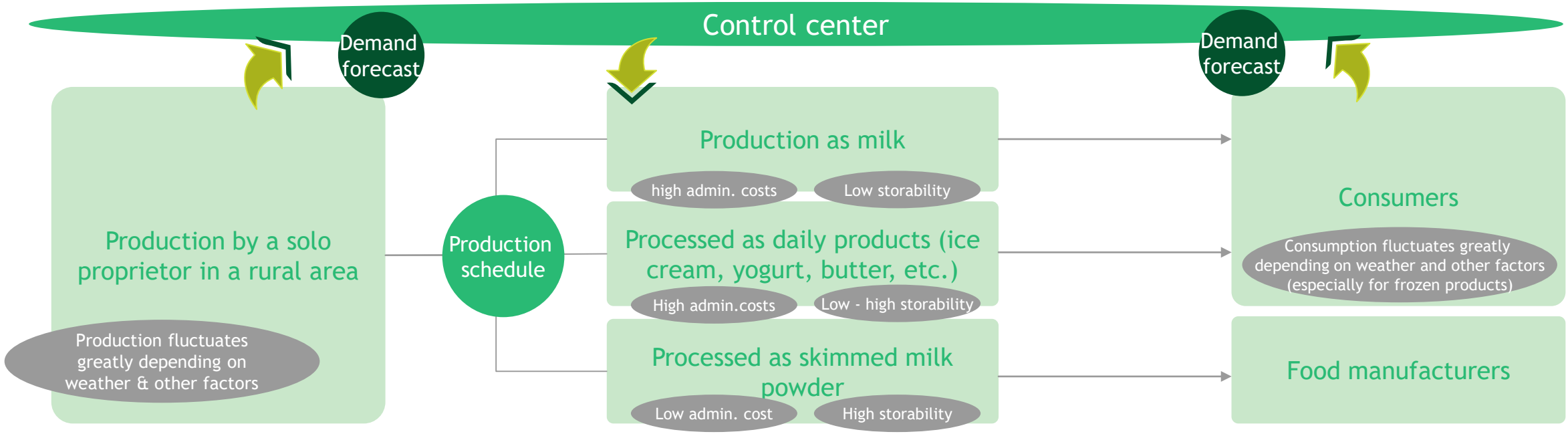


Source: BCG Project Database Process Industries

Good practice

Optimize production & sales operations while visualizing E2E for products with high fluctuations

Daily product manufacturer x (India): Design ops. across the SC



- Sole proprietors produce raw milk in rural areas. It is collected at collection centers located in each rural area and processed and commercialized at production plants
- While a stable supply of milk, the main product, is required, both the supply & demand sides are highly volatile due to weather and other factors
- While collecting supply and demand data on a daily basis, forecast supply and demand based on historical trends as well, and adjust the production portfolio of processed products based on storability and administrative costs on a daily level

Source: Expert interviews, BCG analysis

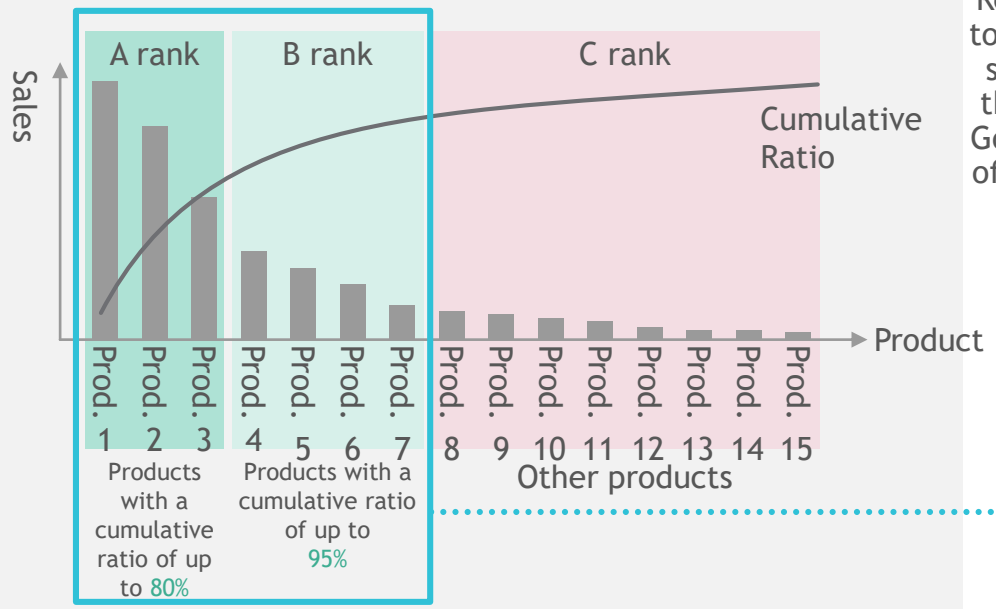
Good practice

Constant review of SC planning to best meet by product × customer demand

Manufacturing Player Example: Product/customer segmentation to identify focus points

Product

- At the product level, products consist of A (80% of sales), B (15% of sales), C (4% of sales), D (1% of sales)
- Forecast accuracy is 95% for Product A, 90% for Product B, 85% for Product C and over 80% for Product D



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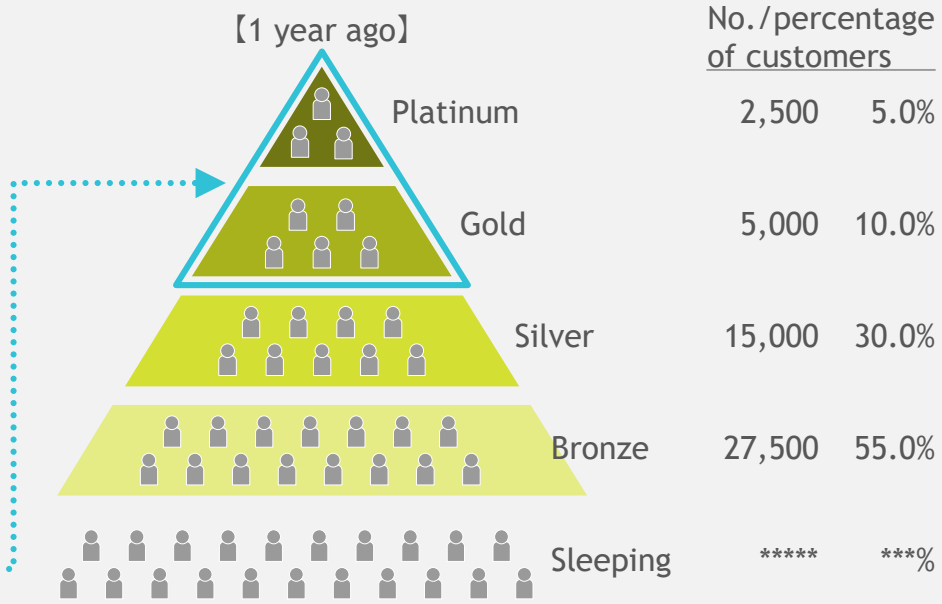
Restructure the SC to focus on product segments A and B that Platinum and Gold customers are often /highly likely to buy

Prioritize rebuilding of SC network to meet supply/demand

Customer level

Customer level is classified as Platinum, Gold, Silver or Bronze.
For Platinum and Gold customers, only A and B are monitored.

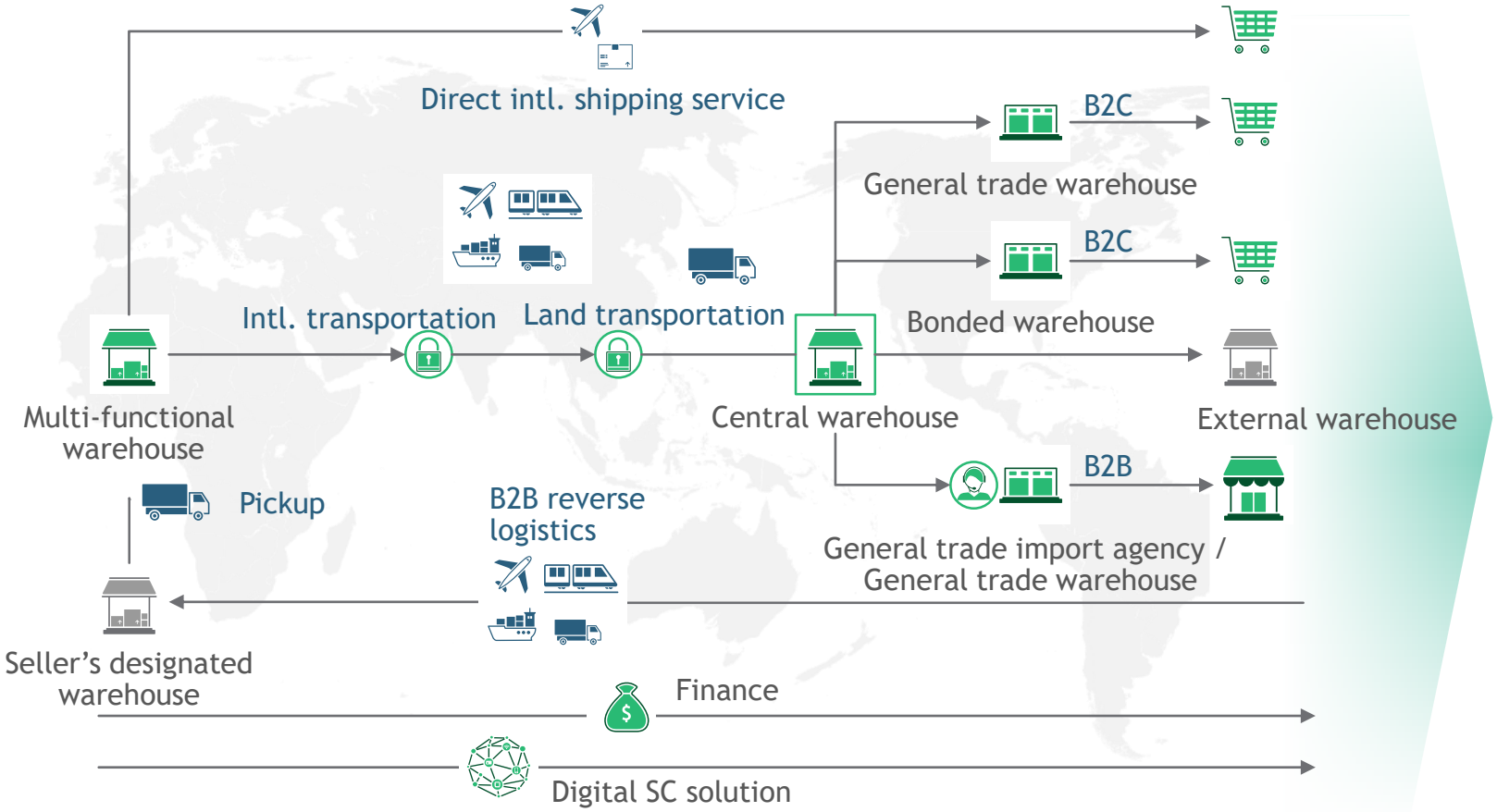


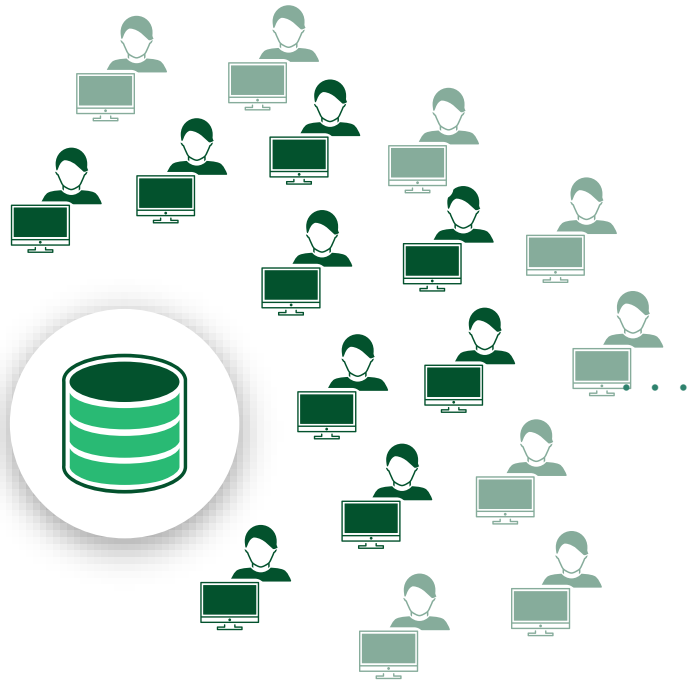
Identify SKUs to be prioritized from large number of SKUs and immediately review SC network to meet those SKUs

Good practice

Hundreds of data scientists are working on E2E analysis of all information in SC to achieve an optimal SC

Retailer Example : Optimizing logistics through in-depth E2E performance analysis





Consolidating data in a single location, hundreds of data scientists work on analysis with the ultimate goal of reducing lead time

- Quantitative and real-time understanding of lead time for all flows
- Identify bottlenecks and constantly examine ways to contribute to reducing lead times.
  In some cases, suppliers are switched even at a higher cost to reduce the overall lead time

Good practice

Coordinate production & sales plans by collecting E2E information on important items and key stakeholders

Manufacturing Player Example (India): Design operations across the SC by identifying focus areas

See (understand)

A SC visualization by control tower

- Real-time monitoring of key indicators by SKU for each sales channel/account
  - Sales, invent. valuation, invent. count, CP info,, lead time, OEE, throughput, # of orders, etc.
- SDGs indicators regularly monitored/quantitively assessed
  - Amount of waste of critical chemicals specified by authorities

① Supplier development/mgmt.

- B Constantly seek alternative suppliers for major items

Develop

C Stabilization of the plan

- Procurement/production planning conducted on a monthly basis
- When a change in plan for important item occurs, production priorities are fine-tuned on a weekly/daily basis

① Plan sophistication

- D Demand forecast by SKU using AI implemented SCP software

① Data sharing with major suppliers

- E Collect and share data related to critical components in mfg. with raw material Tier1/Tier2 suppliers

Sell

F Redundancy securement

- To cope with downtime due to short notice orders and breakdown of tools/machines, prepare for 1.3 times higher demand for items with high growth potential

① Data sharing with major dealers

- G System linkage with dealers to keep track of inventory and sales performance

Source: Expert interviews, BCG analysis

SC planning is also becoming more sophisticated with digital technology

	SC digital twin	Scenario based S&OP[1)]	AI-based demand forecast
Objective	• Simulate the flow of goods across the SC and analyze the risks associated with asset/operational bottlenecks and inventories by variations in planning	• Support decision making and assess the impact of multiple possible scenarios as a basis for business unit planning, linked to cost/revenues	• Collect and cluster internal/external sales, geographic, and customer attributes data, etc., and forecast demand using AI technology
Execution example	• Simulate base amount and fluctuation of demand / production for the next 12 ks to estimate backlogs and required inv. buffer cost • Simulate the impact of product mix change in the SC and link to AI-based decisions	• Analyze multiple demand scenarios and their impact on sales/SC to adjust production plans	• Implement a new demand forecast method based on machine learning technology to improve the accuracy of forecasting
Usage cycle	0-12 weeks planning	1-12 months planning	1-12 months planning

1. S&OP : Sales and operations planning
Source: BCG analysis

Good practice

Visualizing the flow of goods and bottle necks in the supply-chain by simulation

Manufacturing Player Example: Supply Chain Digital Twin

Simulate the execution of demand / production plan using more than 100 facilities / machines

Estimate the following

- Production loss/retention
- Inventory reduction opportunity
- Staffing/resource allocation needs
- Needed capital investment

Source: Expert Interviews; BCG analysis

Good practice

Building Supply-Chain Digital Twin to enhance risk assessment and response through simulation across supply chain

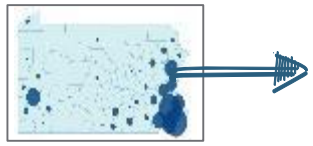
Manufacturing Player Example: Enhancing risk analysis using Supply Chain Digital Twin

Material risk

- Are there any materials difficult to procure?
- How much inventory is available?
- Which SKUs are exposed to material risk?

Human risk and production capacity

- What are the risks faced by field workers?
- Which production lines are affected?
- Which SKUs are affected by production risks?



Supplier risk

- What are the labor risks of external sites?
- Which SKUs are affected by production risk?

Real-time simulation (incl future outlook)

- What is the demand outlook/status of main orders?
- What is the main gap btw forecast/actual results and what are the causes?

Risk summary dashboard

- Which SKUs are at risk? (based on raw materials, processing, labor, factory capacity, and inventory)
- Which SKUs should be substituted?

Identification of product substitutes

- What risks are preventing fulfillment of customer orders? (Evaluate based on SKU risks)
- Is the SKU available at the time of the latest procurement negotiation?
- What alternatives are available?
- What is the relative ranking of alternatives? (Evaluate based on profitability and availability)
- What alternatives are appropriate to balance overall customer demand?

Source: Expert Interviews; BCG analysis

Good practice

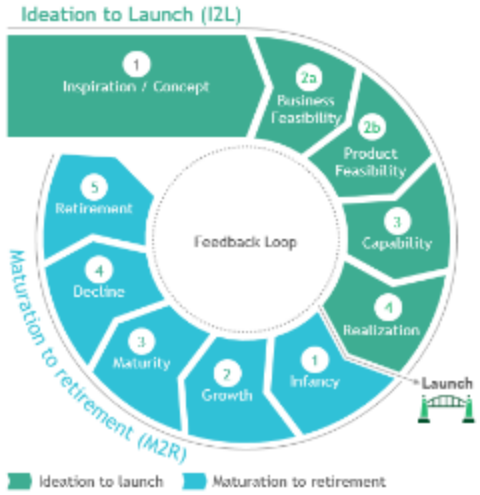
Building Supply Chain Digital Twin to optimize inventory at each stage through simulation of sales/logistics along product lifecycle

Retailer Example: Inventory optimization along product lifecycle using Supply Chain Digital Twin

Product lifecycle mgmt.

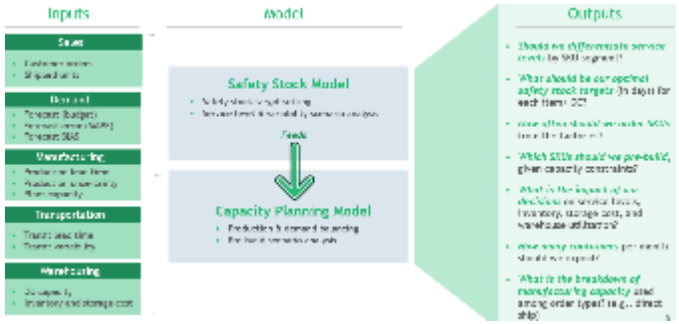
- Define stage, criteria, analysis, process, and meeting frequency
- Define role and responsibility
- Build a performance dashboard

※ Review SKUs in the preliminary stage



Inventory target optimization

- Calculate safety stock based on supply/demand fluctuation data
- Create inventory plan based on factory production capacity
- Train and monitor teams to ensure continuous inventory mgmt.



25% reduction in finished goods inventory (identify room for further 25% reduction)

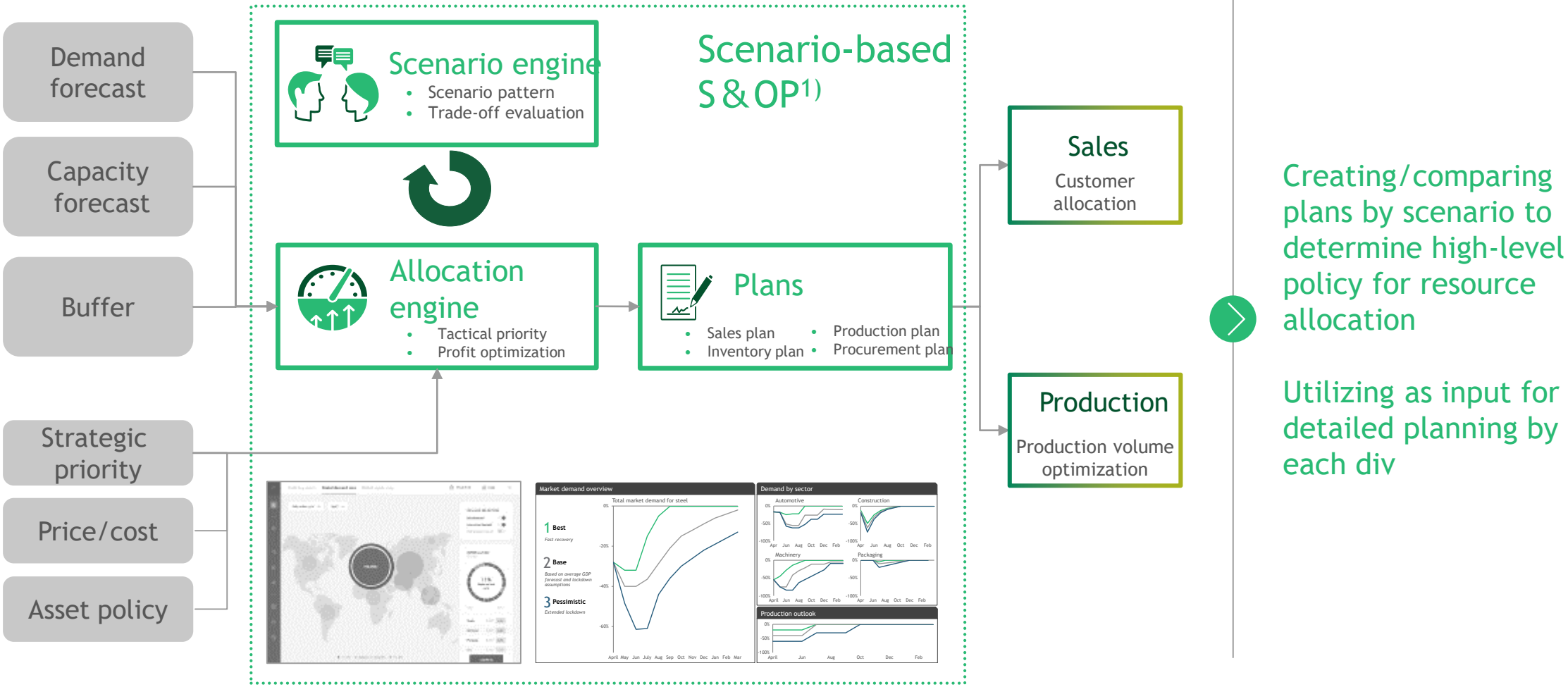
99% achievement of inventory standard

Source: Expert Interviews; BCG analysis

Good practice

Analyzing multiple scenarios to quickly determine direction of supply-chain planning

Manufacturing Player Example: Scenario-based S&OP[1)]



Creating/comparing plans by scenario to determine high-level policy for resource allocation

Utilizing as input for detailed planning by each div

1. S&OP : Sales and operations planning
Source: Expert Interviews; BCG analysis

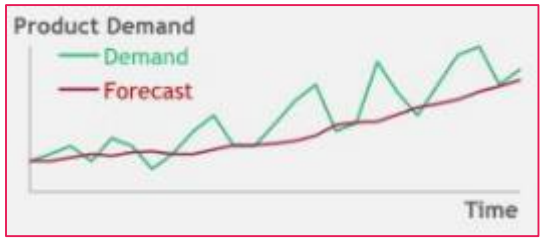
Good practice

Applying advanced AI/machine learning to continuously enhance operation

Retailer x: Enhancing demand forecast with AI

Traditional forecast by SKU[1)]

Product:
Jersey dress
Ladies
Concept X
Price 11.99
EUR



Machine learning-based demand forecast with more detailed attribute input

Brand: Concept x

Rank_fsp: 35,2113

Price: 11,99

Dpt : Ladies

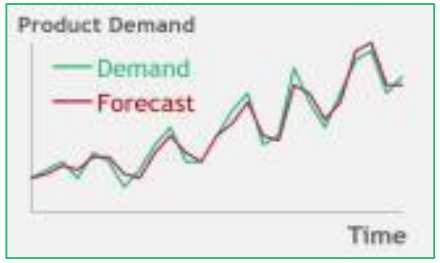
Lifespan:21 weeks

Graphical apprerance: Striped

Color name: mixed_black_white

Assortment mixid: Casual_5

Month start: 4



Accumulating operational know-how as own data to keep the competitiveness

1. SKU : Stock Keeping Unit
Source: Expert Interviews; BCG analysis

Good practice

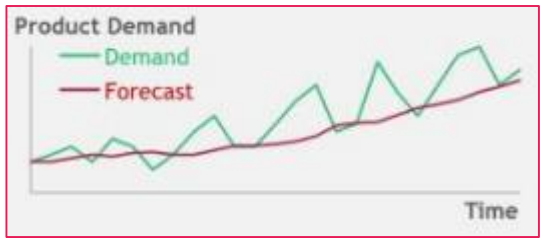
Applying advanced AI/machine learning to continuously enhance operation

Manufacturing Player Example: Enhancing demand forecast with AI

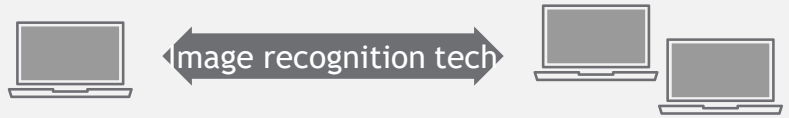
Traditional forecast by SKU[1)]

Input info for forecast

- Latest sales results
- Past sales results
- Similar sales (in-house) results
- …etc.

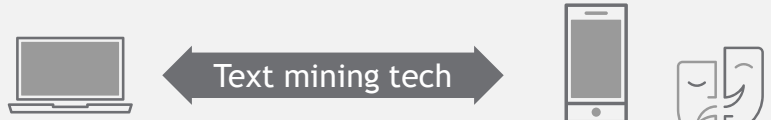


Machine learning-based demand forecast with effective use of external data and increased input



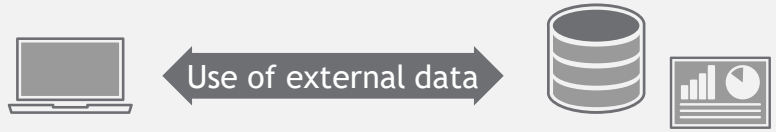
1 Input info for forecast (Adding external info)

- Identifying similar products by image recognition to understand sales status of competitors' similar products



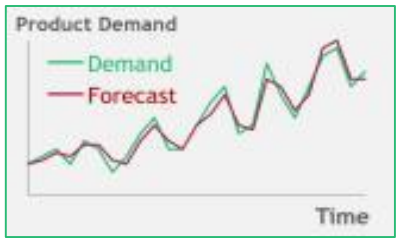
2 SNS keyword analysis

- Trend analysis with text mining tech, etc.



3 Buying external data

- Buying market data by 3rd party companies for analysis



Accumulating operational know-how as own data to keep the competitiveness

1. Stock Keeping Unit

Source: Expert Interviews; BCG analysis

Necessary to review and restructure product/operation from the overall optimization perspective

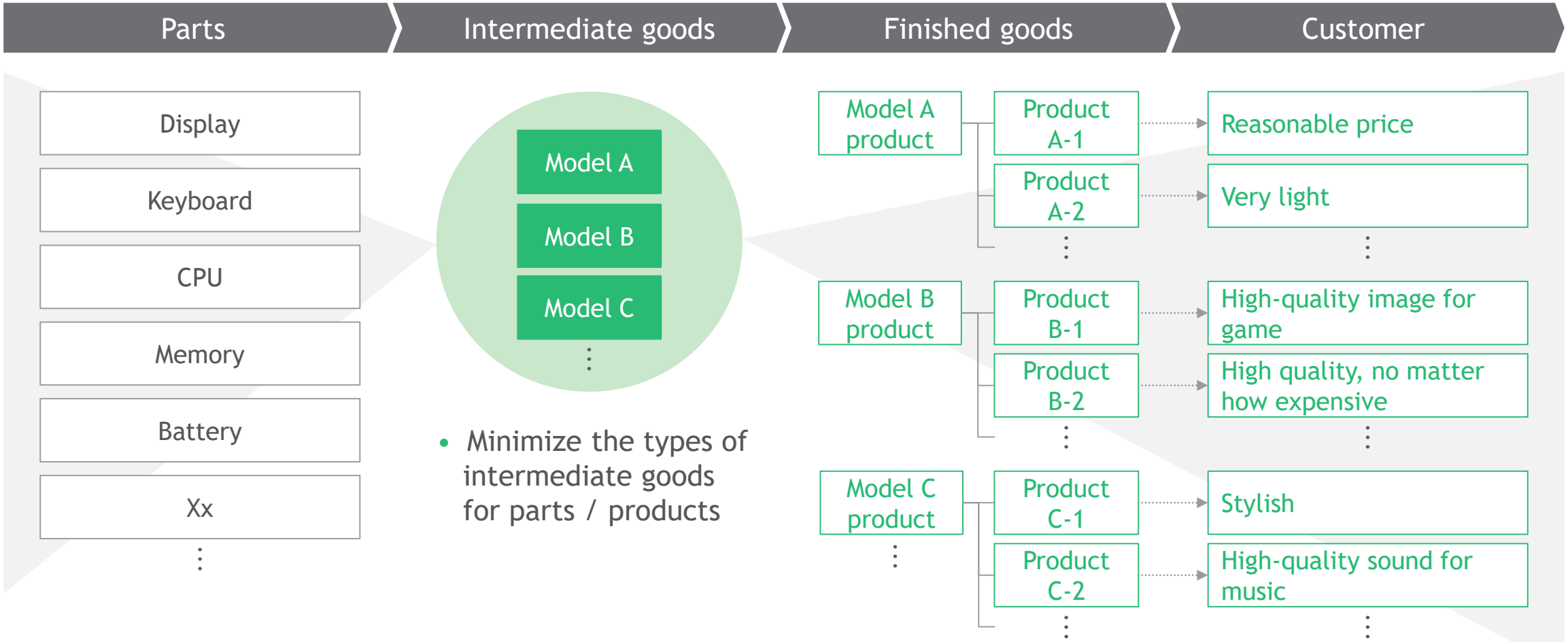
	Optimized design	Simplification / modularization of operation	Automation of operation / labor saving	Biz performance diagnosis and continuously improve
Details	• Analyzing total cost from design stage, incl. procurement /manufacturing/logistics/service as well as sales, to optimize # of SKU[1]/ specification/ design	• Simplifying and modularizing operation as much as possible to make it easier to rearrange or relocate lines	• For tasks that machines can do (repetitive and patterned work), actively using robots and IoT/sensors to reduce man-hours and promote standardization	• Analyzing biz performance on a regular basis, identify points of high volatility/inefficiency, and execute continuous improvement activities
Expected improvement/ impacts	• Reducing procurement cost in supply chain • Reducing manufacturing lead time	• Improving manufacturing transfer/flexibility among bases and lines • Reducing man-hours for master/ data maintenance	• Automation of data acquisition / man-hour reduction • Real-time visualization	• Improvement of operational efficiency • Promotion of biz standardization

1. SKU: Stock Keeping Unit
Source: BCG analysis

Good practice

Optimizes SC by reducing types of intermediate goods but maintains finished product SKUs to meet diverse consumer needs

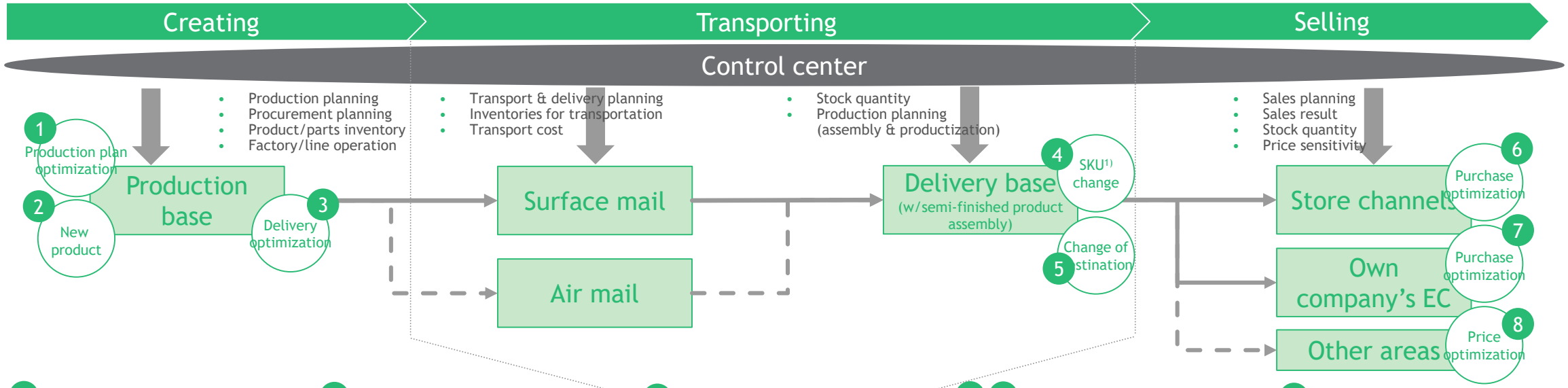
Manufacturing Player Example: Supply chain optimization through engineering



Good practice

Leading companies make swift decisions based on data accumulated in control centers in real time to develop highly flexible operations

Manufacturing Player Example: Construction of overall operations for flexible supply chain (1/2)



1 Production plan optimization
- Manage optimal production quantity weekly/every 3 days based on actual demand trends & carry out production using a multi-product assembly line

2 New product composition in stock parts
- New product & SKU[1] development using early stopping & parts for unpopular model numbers

3 Delivery optimization
- Optimize shipping P/F[2] in surface mail & air mail based on actual demand trends & transport cost
- Optimized delivery plan according to tradeoff analysis on transport cost & profit-earning opportunity

4 SKU[1] change
- Management of finished goods & semi-finished products ratio in assembly base based on actual demand trends

5 Change of destination
- Change of shipping destination (region & store) based on actual demand trends
- Reshipment of old models to Tier2 markets when new models are released

6 7 Purchase enticement optimization
- Enticement according to price & delivery date of models with high inventory risk based on actual demand trends
- Adjustment of inventory for stores according to promotions in EC channels, etc.

8 Price/price protection optimization
- Optimization of selling prices & price protection measures based on market price sensitivity

1. Stock Keeping Unit; 2. Platform
Source: Expert interviews, Boston Consulting Group analysis

Good practice

Building mechanism for flexibility in each manufacturing/logistics/sales processes

Manufacturing Player Example: Construction of overall operations for flexible supply chain (2/2)

Creating

A Platforming (standardization of design)
- Standardize/ generalize intermediate goods to establish a biz model that can minimize inventory risk in launching new product

B SC plan review in collaboration with suppliers
- Analyze root-causes together with suppliers when delays in manufacturing occur
- If delays in procuring raw materials are the cause, find other sources even if the cost increases slightly, and discuss burden sharing with suppliers in such cases

C Frontline of final manufacturing
- Standardize /objectify intermediate goods as much as possible to bring final processing /assembly of products to local front line
- Build a biz model to meet regional specifications, etc.

Transporting

D Multiple routes for delivery
- Set up multiple delivery and replenishment bases to stock intermediate goods, etc.
- Strengthen logistics network/system through "decentralization" and "multiple routes"

Selling

E D2C channel as a regulating valve
- Offer discounts on the company's website for products falling short of the original sales plan
- No discounting if sales are as planned

Source: Expert Interviews; BCG analysis

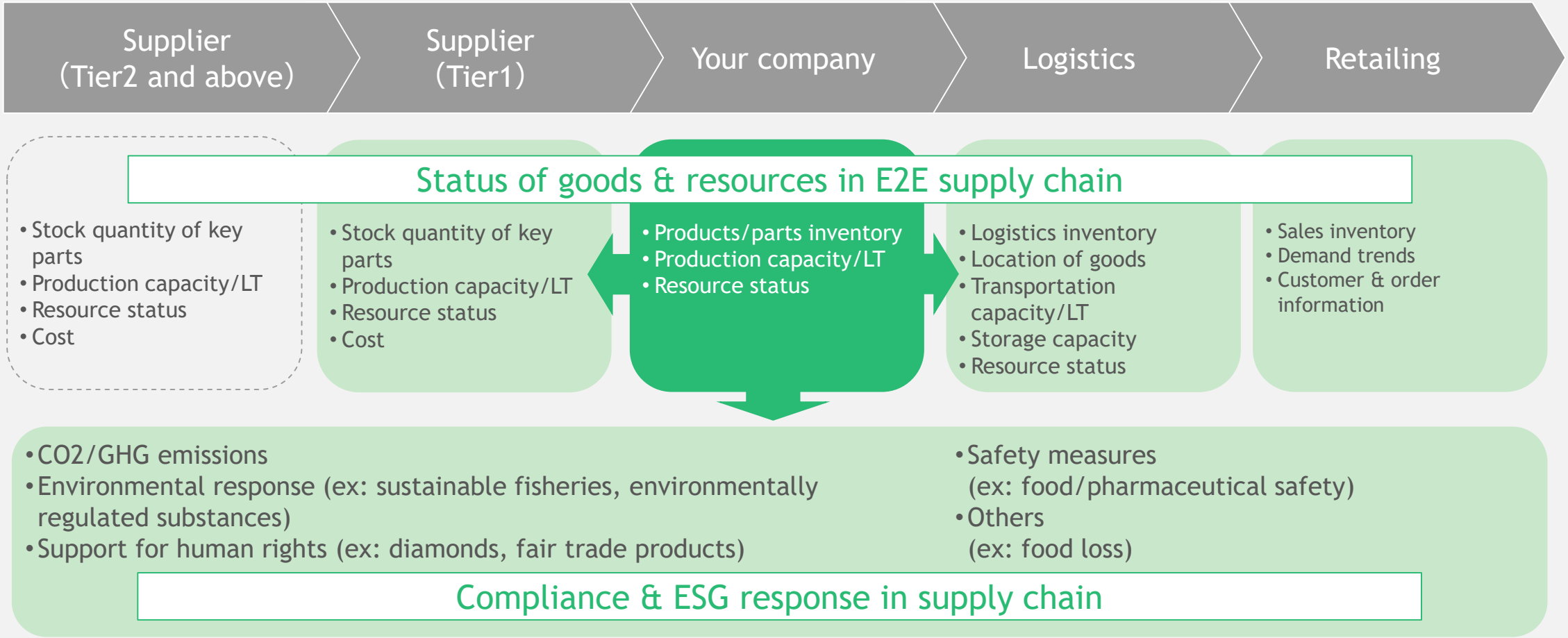
Necessary to develop data sharing method and standard rules for accelerate the collaboration and onboarding of external partners

	 Infrastructure/tools for data sharing	 Standard rules for data sharing	 Partner onboarding
Details	• Developing infrastructure and methods for data sharing/exchange to promote data acquisition from partners • Providing relevant in-house biz system and cooperating in development of platform for data acquisition, for partners lagging behind in systemization	• Confirming/maintaining and standardizing internal data governance rules and contracts in advance for data sharing/exchange with partners	• Promoting onboarding to data sharing/exchange programs while offering incentive/ penalty to partners
Expected effect	• Data sharing/exchange automation/systemization for i) reduction of burden for data sharing, ii) improvement of the data quality • Obtaining information from partners lagging in systemization	• Expediting internal data sharing procedures with partners • Improving transparency/security in data sharing exchange	• Strengthening reciprocal relation based on data sharing/exchange with partners

Source: BCG analysis

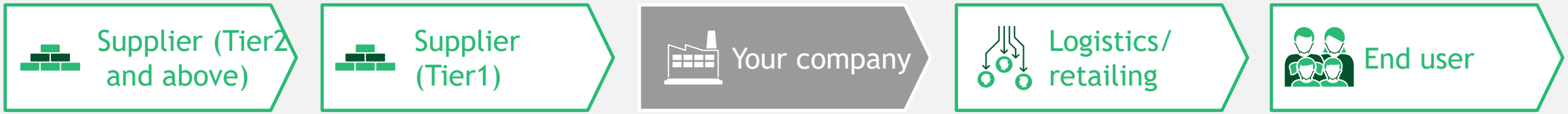
The scope of supply-chain visibility has been expanding

Scope of supply-chain visualization



Source: Boston Consulting Group analysis

It is necessary to strengthen grips on entire supply chain through collaboration with upstream/ downstream stakeholders



Strengthen cooperation with supply side

1 Visualization of trading partner structure
- Visualizing upstream suppliers to understand supply chain bottlenecks and risks

2 Visualization of utilization rate / inventory
- Real-time monitoring of suppliers' capacity and utilization rates, work-in-process/inventory status, etc.

3 Thorough compliance with rules
- Thorough compliance with rules on environment/sustainability, human rights, quality standards, etc.

4 Production / supply planning collaboration
- Asking for cooperation for flexible incr/decr production while sharing the company's procurement plan

5 Cooperation in design/production tech development
- Enhancing product design/ tech collaborating with suppliers

Strengthen cooperation with demand side

6 Visualization of distribution inventory/demand
- Real-time sharing of distribution intermediate/shelf inventory and end demand

Source: BCG analysis

Data sharing can be achieved using various methods determined based on consideration of the level of collaboration and necessary cost

Data sharing/exchange with external partners

Method	Outline	Pros	Cons
i Collaboration in Excel	• Filling in needed info in the format agreed upon btw 2 companies beforehand • Delivery by email is common	• No system cost required • Easy to change format • Some automation is possible	• High risk of input/mgmt. errors • Man-hours for importing / processing • Not suitable for high frequency, real-time data linkage
ii File output /upload	• The one system inputs/uploads EDI and other pre-fixed format files(CSV file, etc.) and the other system automatically acquires the data	• Low system cost • Reduces operational errors by automation	• Man-hours for changes • Not suitable for high frequency, real-time data linkage
iii Collaboration btw systems	• P2P linkage of systems btw the company and its partner • Many packages including API for external linkage in each operation such as ordering/order receipt, accounting, etc.	• No operational errors due to full automation	• Fixed system cost needed • Difficult to change freely • Connections tend to be complicated
iv Collaboration in data PF	• Data infra such as DDP to link with other internal/external systems in a hub-and-spoke model	• Flexible collaboration • Data centralization • Data governance improvement	• Fixed system cost needed • Data talent needed
v Collaboration on a common PF	• Industry giants/org. take the lead in establishing a cross-industry data platform • Various stakeholders in the industry use the platform to exchange info/make transactions	• No development investment needed as individual company • Common use of external data • Acquisition of new biz	• Takes time to standardize • Industry investment is needed

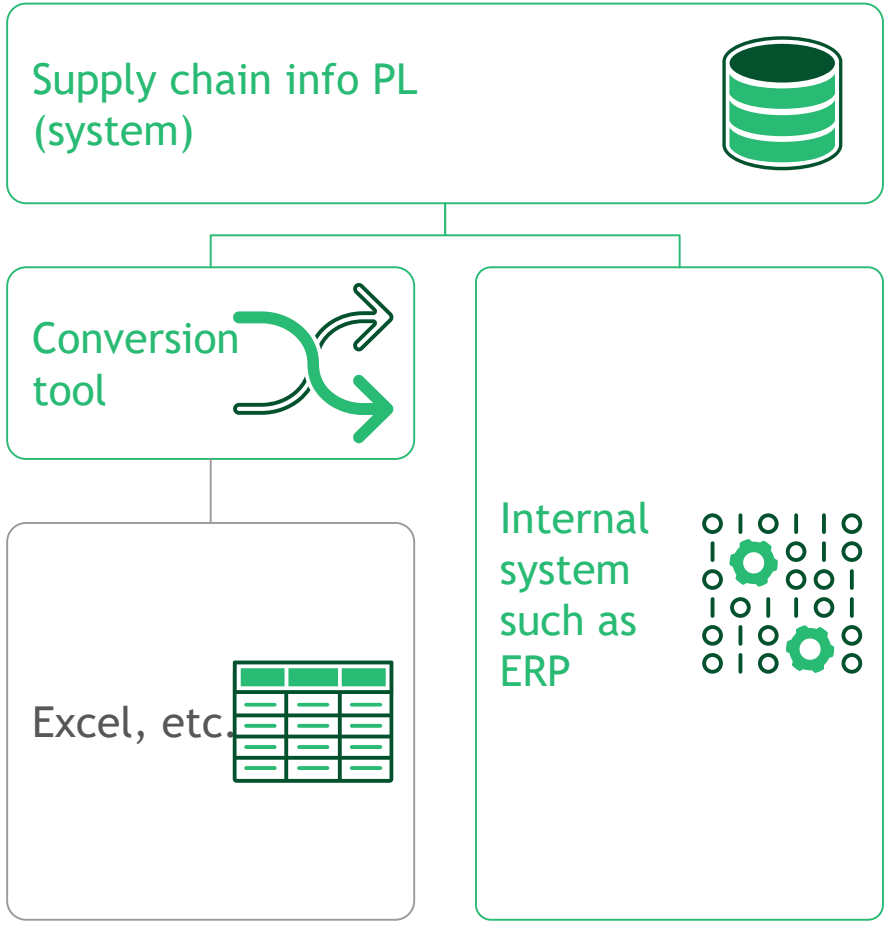
Source: Expert Interviews; BCG analysis

Good practice

Provide tools & systems to suppliers to accelerate supply-chain data sharing

Manufacturing Player Example: Supplier collaboration

System configuration image



Source: Expert Interviews; BCG analysis

Points for getting suppliers to use the system

1. Explain mutual benefits and request using the in-house system to suppliers
   - Provide ordering/production scheduling/payment functions, etc.

2. Cover the cost for providing system to suppliers as HQ expense
   - Several 100K-M yen per company for installation cost
   - Collect only 20K yen monthly usage fee
   - Over 80% of 3,500 suppliers have already installed the system
   - Determine whether or not to request the use of a common system based on suppliers' past performance/ on-site audit results

3. Provide gradual IT capability enhancement support to suppliers with low IT literacy
   - Excel formulation
   - Excel macro
   - Systemization
   - Linkage with the in-house common system …etc.

To encourage data sharing, identification of the rights and obligations and designing templates in advance would be necessary

Items to be agreed upon for data sharing & exchange

Items to be covered in the data sharing agreement	Description
1 Purpose of use of data (permissions & restrictions)	• Clearly state in writing the purpose & scope of collecting/using/sharing data • Also clearly state in writing the permissions & restrictions for using the data • Obtain consensus from users beforehand
2 Data access & storage rules	• Clearly state in writing the rules for storing data (anonymization technology, retention period, etc.) • Make the data inaccessible to unauthorized third parties • Ensure that employees who leave the company do not take data assets & other intangible assets
3 Data quality & accuracy	• Ensure that only trusted parties do what they are explicitly authorized to do & return the data • If needed, agree beforehand how data accuracy will be secured – Whether or not to have an audit performed by a third party, etc.
4 IP of the data	• Clarify IP addresses & where rights such as processing data, algorithms & data platforms belong (data alone will not become copyrighted material) • Consider protecting trade secret information regarding new value obtained from machine learning, analyses of collected data, etc. (control information leakage, etc.)
5 Price setting (profit sharing & guarantee)	• Define how concerned parties receive compensation & how profits generated from the use of data will be shared • Clearly state in writing beforehand how decisions will be made when insufficient data aggregation/measurements or unexpected phenomenon occur

Source: Boston Consulting Group analysis

There are several levers to strengthen the relationship with the stakeholders

Levers for strengthening relationships with stakeholders

One-sided relationship

Bilateral relationship

Use crisis

- Make the supply chain more visible by demanding the disclosure of information regarding the supplier's customers, production capacity, operation rate & inventory status as part of efforts to formulate a BCP for the pandemic, disasters, etc.

Use cause

- Make the supply chain more visible by demanding customers to disclose information in connection with enhanced response towards carbon neutrality & environmental regulations (RoHS directive, etc.)

Incorporate into contract terms

- Make the supply chain more visible by incorporating data collaboration & information disclosure into the trade terms for new customers

Strengthen commitment

- Secure cooperation by offering favorable conditions, such as increased volume & priority procurement, to suppliers who cooperate with data collaboration & the disclosure of information

Expand business support

- Strengthen collaborative relationship with customers by providing production technology, know-how & data, then create a relationship that makes data collaboration & information disclosure easy

Relationship with stakeholders needs to be strengthened while combining these levers

In many cases, consideration on bilateral relationships is necessary for strong relationships

Source: Boston Consulting Group analysis

Good practice

Create cooperative relationships by reciprocally sharing supply-chain data

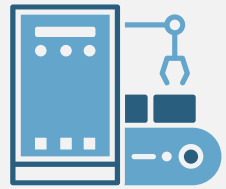
Manufacturing Player Example: Benefits achieved by collaborating with the suppliers

Procurement side benefits

- More flexible procurement
  - Since maximum production volume for each supplier can be identified, it is possible to discuss a need to search another supplier in advance in case demand fluctuates
- Win-win relationship
  - Give incentives such as increased procurement volume and contract extension to suppliers who cooperate in data sharing and operation sharing

Supply chain data sharing

Supply side benefits



- Future volume projection
  - Able to directly see downstream demand
- Proactive business opportunities
  - By detecting demand increase, able to step forward to increase production
- Win-win relationship
  - Since the production capacity and mfg. status are visualized, able to build an equal relationship without being pushed

Source: Expert Interviews; Boston Consulting Group Analysis

Good practice

“Carrot and stick" to realize the sharing of supply chain data

Manufacturing Player Example: Designing "Carrot and stick" for supplier collaboration

Support (=carrot)

Provision of a common system
- Provide major functions such as ordering and production schedule without charging

Reduced supplier risk
- Buy surplus inventory if demand decreases from the initial plan

Incentives for cooperators
- Increase order volume of suppliers who are active in data sharing, etc.

Duty / Penalty (=stick)

Required data sharing
- Obtain consent from suppliers to grasp the production capacity, inventory, and operating status

Request for flexible response
- Obtain consent to work hard in line with fluctuations in demand

Sanctions on non-cooperators
- Notify business risks due to non-sharing of data and suppress order volume

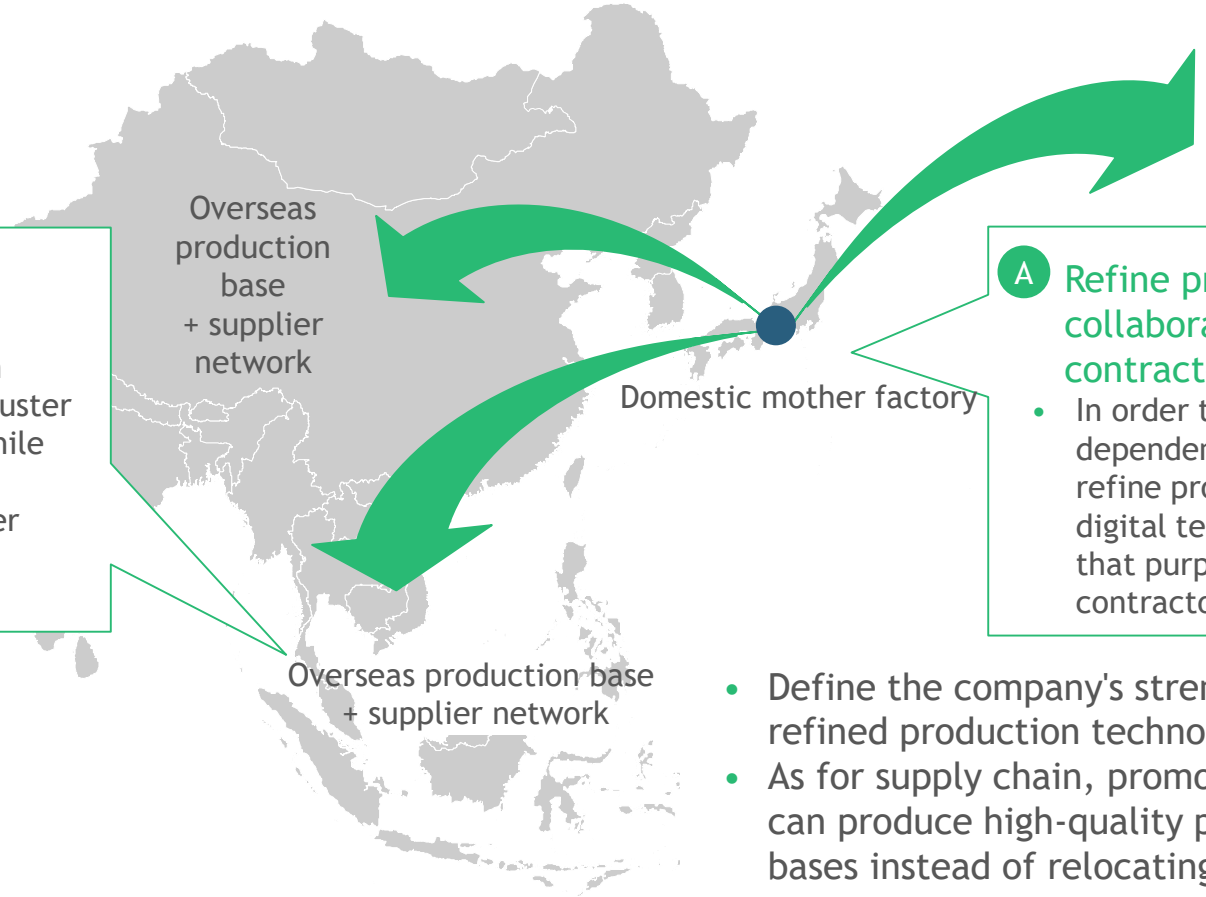
Promote expansion of cooperation with readiness to reduce transactions with suppliers who do not cooperate

Source: Expert Interviews; Boston Consulting Group Analysis

Good practice

Build a model to grow together with suppliers by positioning them as "partners"

Manufacturing Player Example: Efforts to collaborate with their suppliers



B Develop suppliers through collaboration

- Gather local suppliers at the Innovation Center and aim to develop them as a cluster by refining quality and cost together while providing tech.
- Allow suppliers to do business with other companies and encourage further competition

A Refine production technology in collaboration with suppliers and contractors

- In order to realize manufacturing non-dependent on production bases and people, refine production technology centered on digital technology and manufacturing for that purpose while involving suppliers and contractors at domestic mother factories

- Define the company's strengths as high quality through refined production technology
- As for supply chain, promote the creation of a system that can produce high-quality products at the same cost in any bases instead of relocating production bases in pursuit of costs
- Build a model that aims to grow together with suppliers while fostering them as continuous business partners

Source: Expert Interviews; Boston Consulting Group Analysis

Good practice

Even overseas, obtaining data from suppliers is not easy. Mgmt. conducts direct negotiations while providing incentives and support to obtain cooperation

Approaches to supplier collaboration in manufacturer x (India)

Initiatives for supplier collaboration	Summary
Direct negotiation by top mgmt.	• The CEO's commitment is important because it requires high-level decision-making regarding the economics and stability of the SC and investment. Promote the PJ as a company-wide PJ involving related departments as a strategic initiative directly under the CEO.
Granting of incentives	• While no specific penalty is set, preferential treatment (priority procurement, commitment of procurement volume, etc.) is provided to suppliers who cooperate in providing data • At the same time, suppliers who cooperate are recognized as "excellent suppliers" and promoted to the public
Support for digitization	• For suppliers that are lagging behind in digitation, provide tools for data collection. Promote the creation of a system that enables quick provision of data

Source: Expert Interviews; BCG analysis

Strengthen SC by strategically incorporating operational buffers in addition to decentralized / multi-line SC structure

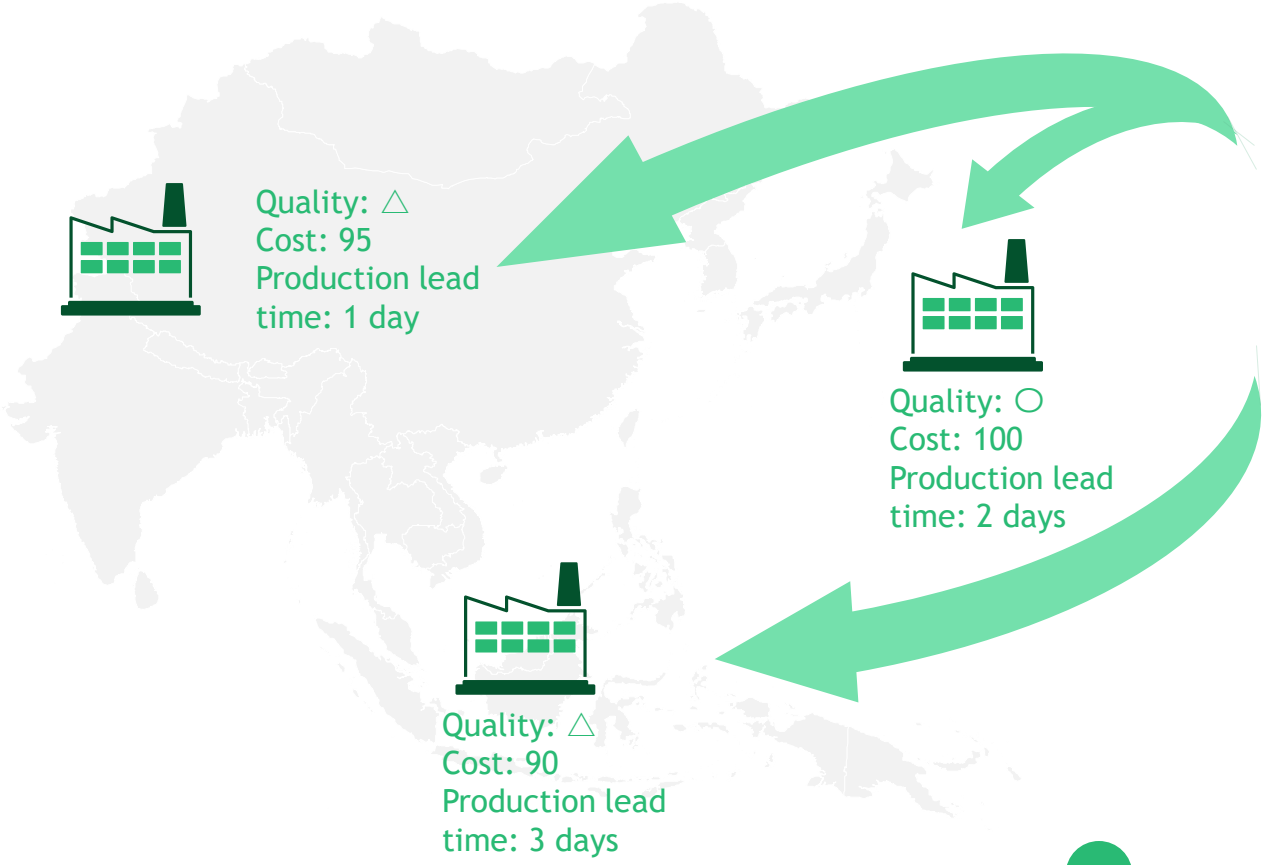
Procurement network	Production network	Channel / Customer
• Optimize inventory of raw materials and parts	• Expand production and organizational capacity of existing factories to increase flexibility	• Optimize finished product inventory for increased resilience
• Redistribute procurement among existing suppliers in various regions	• Reconsider the strategy of in-house production or external procurement	• Reconsider the distribution strategy (e.g., outsourcing vs. in-house)
• Persuade suppliers to move production bases to another region	• Authorize backup contract manufacturers in case of disruption or confusion	• Reconsider the composition of transportation (e.g., air vs. maritime)
• Certify new suppliers and diversify suppliers	• Move or localize own production base overseas	• Add new distribution partners
• Procure from a new supplier in another region	• Promote digitalization to offset rising labor costs due to relocation	• Move warehouses and distribution to areas closer to the final market

Source: Boston Consulting Group Analysis

Good practice

Some companies maintain a system enables multiple factories production in order to optimize product quality and cost and respond to the risk of supply chain disruption

Manufacturing Player Example: Building multi-line supply-chain network



SC control tower

Demand is increasing rapidly and need to deliver quickly even if it costs more

or

Need to prioritize cost even if quality is compromised

or

Since the third supplier in a certain region went bankrupt, parts are likely to run out temporarily

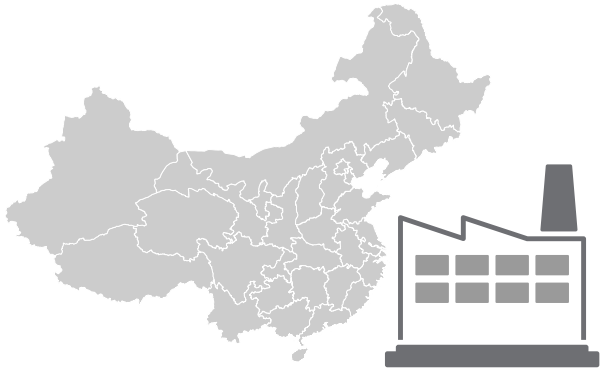
Adjust constantly to run the optimum production system according to the capacity of each factory and the environment (procurement / distribution cost, labor cost, worker skill level, etc.)

Good practice

Some companies manufacture same products in multiple countries to control profitability by adjusting production according to exchange fluctuations

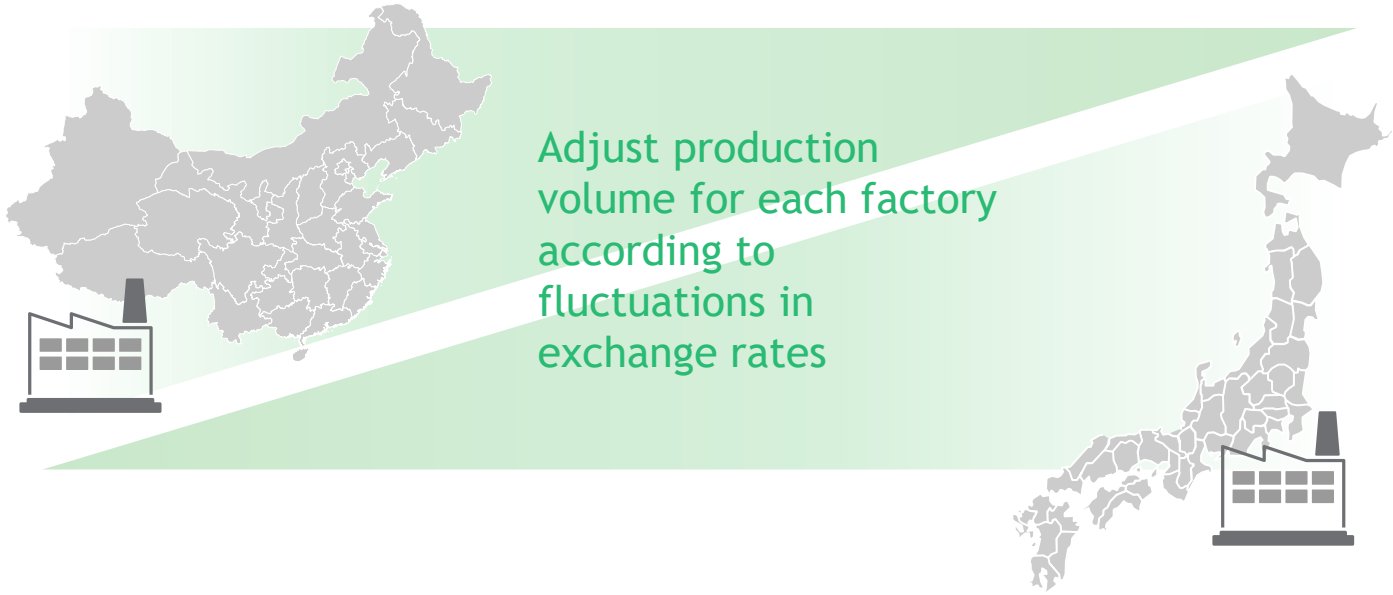
Manufacturing Player Example: Dealing with exchange rate fluctuation by adjusting the country of production

Companies with low redundancy



- Easily affected by currency fluctuations and profits are unstable due to extreme concentration of production bases

Companies with high redundancy (good practice)



- By having manufacturing factories in multiple countries, able to adjust the production volume in response to currency fluctuation for the same products and stabilize profits

How can supply chain be more resilient?

Key points for the supply chain resilience transformation

In order to successfully achieve supply chain resilience, securing the top mgmt's commitment, forming cross functional initiative, and adopting agile approach would be the key

Key points to consider	Summary
 Securing commitment of top management	• The commitment of the CEO is important because advanced decision-making regarding investments & the economy x stability of the supply chain will be needed down the road. Strategic initiatives under the direct supervision of the CEO will be promoted as related departments are involved for the entire project.
 Forming cross-functional initiatives	• Clearly identify & promote the initiatives that should be implemented by both corporate & the business functions. For measures that should be carried out across businesses (reorganization of base NW, strengthening of digital infrastructure & capabilities for improving visualization, etc.), form a structure involving all the necessary stakeholders.
 Promotion of agile approach	• Should not aim to conduct each measure perfectly all at once. Instead, first clearly identify the overall direction & targets that will be aimed for and confirm the outcome of each measure. Then gradually carry out each measure starting from the most prioritized and revise direction in the course if necessary.

Source: Boston Consulting Group analysis according to advanced case studies & interviews with experts.

Approach to the supply-chain resilience

Three step approach starting from understanding current situation would be relevant for companies to enhance resilience of their supply chain

Understanding the current situation

1 Visualization of supply chain model

- Visualize production/procurement/selling destination & production/transaction status by item and organize as supply chain model.

2 Supply chain risk evaluation (simple diagnosis)

- Quickly evaluate supply chain resilience (resurgence & trackability of changes) based on supply chain resilience framework. Organize possible options for action after identifying where issues are located.

Formulating a strategy & plan

3 Organization of supply chain risk scenarios

- Organize assumed short-term & medium- to long-term business environment change drivers, then organize multiple change scenarios anticipated by your company.
- Establish your company's baseline scenarios based on the probability of each scenario & driver.

4 Designing of resilience policy & initiative priority

- Discuss basic policy & scope of economy x stability for your company's supply chain resilience.
- List up measures needed to respond to baseline scenario, conduct simulations & set priorities for possible actions while evaluating impact on supply chain economics & how difficult realization will be.

5 Formulation of plan for promoting resilience initiative

- Design the promotion schedule, tasks & system after organizing the overall image of resilience measures as a blueprint.

Execution

6 Creation of promotion system

- Form a promotion T/F, involving corporate & the HR Dept., as an organization under the direct supervision of the CEO. Establish a system to manage the execution & progress of initiatives executed at the corporate & HR Dept. level while at the same time establishing the overall PMO.

7 Promotion of agile implementation

- First, start from measures that will form the starting point for resilience (supply chain visualization, enhanced decision-making process, etc.), then promote while reaping the benefits.

Things to be aware of for SMB

No essential difference exists depending on the size of the company; however, more complicated handling is required to cope with the with restriction in source/budget. Since it is difficult to take a holistic approach, it is effective to adopt narrowly-focused approach

Key points to consider for resilience	Summary
 Selection and promotion of necessary initiatives	• Evaluate priorities based on ① return on investment (costs required for realization and improved profits and risks) and ② degree of difficulty in realization, while sorting out the essential To-Be and necessary initiatives for the own business • Identify the min. no. of initiatives to be implemented, and develop a roadmap to expand them step by step while gaining benefits
 Fundamental review of the way business is conducted	• Decide not only what to do, but also what not to do in order to promote within a limited system/budget. Control priorities to prevent the overall workload from becoming bloated
 Enhancement of digital/IT literacy	• Essential to recruit/train digital/IT personnel and strengthen digital literacy as an organization. While sharing the necessity of digitization, also develop quick-win initiatives to create effects at an early stage and raise the level of employees
 Promotion under the leadership of the president	• The president takes the leadership in promoting reforms. While appointing a person in charge of promoting digital/IT, build a system that promotes the trinity in cooperation with biz units

Good Practice

Improved collaboration and resilience through supply chain visualization

In order to provide internationalization, environmental protection, TCFD, and safety at the procurement stage, we will promote the safe and secure supply of products and responsible corporate activities through cooperation with suppliers.

SUSTAINABLE DEVELOPMENT GOALS

LIXIL

Good Practice

LIXIL Co., Ltd. Company Profile

Examples of initiatives for supply chain resilience: LIXIL (1/7)

Date of establishment	September 19, 1949
representative	Kinya Seto, Representative Executive Officer, President and CEO
head office	2-1-1 Oshima, Koto-ku, Tokyo
Capital	68,418 million yen
Sales	1,378.2 billion yen (fiscal year ended March 31, 2021)
Number of employees	56,097 (including consolidated employees) (ended March 31, 2021)
Business Description	• Water Technology Business (Provision of water-surrounding equipment such as toilets, baths, and kitchens) • Housing Technology Business (windows, entrance doors, exteriors, interior building materials) • Building Technology Business (Creating a city where people can work and live)
Number of production bases	44 bases in Japan Overseas 67 bases

Source: LIXIL Co., Ltd.

Good Practice

Supply chain management policy by Lixil

Examples of initiatives for supply chain resilience: LIXIL (2/7)

LIXIL reflects the concept of the Sustainable Development Goals (SDGs) in its CSR activities based on its corporate purpose: “make better homes a reality for everyone, everywhere”

Green procurement standards

1. Establishment of an environmental mgmt. system
2. Environmental compliance measures
3. Thorough mgmt. of chemical substances
4. Reduction of greenhouse gas emissions
5. Water resource conservation
6. Resource recycling promotion
7. Biodiversity conservation

- Propose parts/raw materials that are highly effective in resource recycling and waste reduction and monitor the status of waste emissions including suppliers. Continuously improve to reduce emissions

Source: LIXIL Co., Ltd.

Good Practice

LIXIL has been working to strengthen its SC as a strategic theme for many years

Examples of initiatives for supply chain resilience: LIXIL (3/7)

Issues in SC, background of initiatives

- Numerous manual works/ paper documents have long existed, and the biz systems of the old companies remained even after the integration in 2011, which required time to duplicate forms and reflect them in data and resulted in decline in productivity
- In terms of biz processes, the ops of each company remained in parallel, and management of inventory, orders, production, and sales were not linked, and the responsibilities of each dept. were unclear
- Relationship with stakeholders/biz flow were complicated, making it difficult to place appropriate orders with suppliers and to link info

Initiatives for the SC resilience

A Check of sales channels, review of processes and simplification of forms

B Establishment of SC-related structure, responsibilities/ authority setting, and decision-making process

C Stakeholder involvement/establishment of mutually beneficial environment

D Establishment of digital infra, renewal of SCM system

Source: LIXIL Co., Ltd.

Good Practice

In addition to the company-wide review of processes, also implemented from the involvement of external stakeholders to the digital infra building

Examples of initiatives for supply chain resilience: LIXIL (4/7)

Specific initiatives

A Check of sales channels, review of processes and simplification of forms	• Visualize data held by the system and check sales channels
	  – Visualize the entire system from production to logistics and sales
	  – Quantitatively monitor and improve the environmental impact of the entire SC, from raw material procurement to parts, products, and disposal
	• Introduce a biz system that encourages employees/partners to propose biz improvements in addition to eliminating duplication of biz processes company-wide

B Establishment of SC-related structure, responsibilities/authority setting, and decision-making process	• Establish a cross-departmental team directly under the president • Visualize/link data and create KPI to enable each company and dept. to make/evaluate decisions fairly – In addition to mgmt. and performance evaluations, established new KPI for individual work (incl. biz learning level and employee satisfaction)
C Stakeholder involvement /establishment of mutually beneficial environment	• As an org. directly under the president's control, conduct procurement activities in stable partnership with suppliers based on the 10 principles of the UN global compact: human right, labor, green procurement environment, and anti-corruption • Build mutually beneficial relationships while supporting the improvement of IT capability thru gradual usage steps from excel forms to macros to system use, depending on the situation and IT literacy of the biz partner
D Establishment of digital infra, renewal of SCM system	• Identify areas for systemization based on sales channels, biz requirements/processes • Renovate/build systems in various areas, add function as add-ons (modify/build company-wide systems incl. systems of sales, production mgmt., procurement/logistics *incl. overseas)

Source: LIXIL Co., Ltd.

Good Practice

In building the digital infra, promote introduction of common systems across the value chain, including collaboration with external suppliers

Examples of initiatives for supply chain resilience: LIXIL (5/7)

Initiatives for digitization

- Implement systemization/data linkage in a top-down manner, prioritizing speed
- Introduce a SCM system that enables to grasp the entire SC, incl. suppliers, production, sales
- Check the performance/delivery status of suppliers/dealers, and conduct on-site audios
- Ask suppliers who meet the criteria to provide benefits of using the common system

Achievements and benefits of digitization

1. The system provides major functions such as production planning, order receipt, inventory mgmt., contracts, and payments
2. For suppliers with good relationships established, the system provides/links info such as increased procurement, contract renewal, new product dev., and market
3. As suppliers can grasp production plan info on the system, they can respond to rising raw material prices in advance
4. The accuracy of product production forecasts is improved by updating data as needed and using AI

Most of Lixil's suppliers/sales partners have already implemented a common system

Source: LIXIL Co., Ltd.

Good Practice

Planning to promoting carbon visualization, and strengthen SCV appeal to investor/market

Examples of initiatives for supply chain resilience: LIXIL (6/7)

achievements thru resilience initiatives

- Grasp the inventory/receiving status of raw materials, main/sub-materials for parts throughout the entire SC
- Reduce cost thru bulk ordering, communize parts/materials
- Reduce employee overtime, evaluation indicator
- Grasp the production date and time, distribution and on-site response status, and enable post-delivery responses such as maintenance
- Confirm sales results, and use them for marketing the next dev. products
- Provide advice on gradual improvement of IT literacy to suppliers and customers yet to adopt IT
- Promote sustainable partnerships, and contribute to strengthening supplier structure

challenges and directions for further improve

- Build a platform to digitally capture information related to info security (hacking, info leakage, etc.)

  (security score card etc.)
- Based on TCFD (Task force on Climate-related Financial Disclosure), currently building a system to consider CO2 as a cost and to add prices independently as a factor for making decisions on capital investment (considering the impact of Internal Carbon Pricing(ICP)) in order to reduce greenhouse gas emissions from biz activities
- Determine optimal production bases/distribution routes early
- Actively use SC visualization to appeal to investors, other companies, and the market
- Recruit/train DX personnel

Source: LIXIL Co., Ltd.

Good practice

Contribute to the resolution of QOL and social issues through SC resilience and initiatives with each stakeholder

Example of SC resilience: LIXIL (7/7)

LIXIL contributes to the improvement of quality of life and the resolution of social issues through proactive engagement with stakeholders

Source: LIXIL社提供

Good practice

Key points for SC resilience obtained from specific cases

Actions to resolve issues (actual initiatives)

- Promote under the ownership of president at once in accordance with triggers such as M&A and overseas plant launch

- In order to improve productivity and to compete overseas in the future, it is important to streamline operations and share information across departments. Accordingly, a project was set up with managers from both corporate and business departments to work on SC optimization

- Strong awareness of the importance of making sure that operations can be handled by anyone and can change at any time

- Strategic use of SCV not only to improve in-house productivity and optimize operations, but also to appeal to investors, other companies, and public opinion
- Creation of new evaluation items using data newly acquired through system integration. Return to incentives

- Initially, the system will be implemented overseas and partly in Japan.
- Identify problems in advance and gradually expand the scope

- Provide support for system integration to group companies and their secondary stores.
- For customers with low IT literacy, support for gradual improvement of IT capability from Excel forms to macros to system use

Implications for SC Resilience

Commitment from top management

- Promote it as a company-wide agenda, led by the CXO class

Promote initiatives at each level of corp. and business unit

- Structure to promote cross-functional initiatives in cooperation with corporate, while involving business dept.

Promote agile approaches

Gradually expand from business-critical areas

- Starting with important suppliers/retailers, take time to explain carefully, and involve them in using the common system

Source: Expert Interviews; Analysis by The Boston Consulting Group

What are the immediate step?

First, understand the company's SC model and maturity level, and identify problem areas as a basis for developing strategies /plans

Understand the current situation | **Strategy and planning** | **Implement**

1 Visualization of SC Model
- Visualize the production, procurement, sales destination, and production/transaction status for each major product. Organize as SC model

2 SC risk assessment (simple diagnosis)
- Quickly assess the resilience of SC (ability to follow changes and recurrence) based on SC resilience framework. Identify problem areas and organize options to address them

3 Organize SC risk scenarios
- Organize the drivers of change in the business environment that can be expected in the short, medium and long term, and identify multiple scenarios of change that the company can expect
- Based on the probability of each scenario/driver, set a baseline scenario for the company

4 Design resilience policy and prioritization of initiatives
- Discuss the basic policy and acceptable line of economic efficiency and stability for the company's SC resilience
- Assess the required actions to meet the baseline scenario, conduct simulations, evaluate the impact on the economic efficiency of SC and feasibility, and set priorities for options for initiatives

5 Develop a plan for the promotion of initiatives for resilience
- Design a promotion schedule, tasks, and structure based on a blueprint of the overall picture of the initiatives for resilience

6 Establishment of a structure for promotion
- Form a promotion T/F involving corporate and business depts. as an initiative directly under the CEO. Establish a structure to implement and manage the progress of initiatives at corporate and business dept. level, while setting up an overall PMO

7 Promote agile execution
- Starting with initiatives that will be the basis for resilience (e.g., visualization of SC, upgrading of decision-making processes), promote these initiatives while gaining benefits from them

Source: Boston Consulting Group analysis based on leading-edge case studies and expert interviews

Analyze & understand company's resilience level with assessment framework

SC resilience assessment framework

		Lv.1 Basic	Lv.2 Developing	Lv.3 Leading	
1	Understanding SC structure	• Grasp primary suppliers	• Grasp secondary to tertiary suppliers	• Identify suppliers further upstream than tertiary	 E2E visualization of supply chain
2	SC data collection	• Some of the company's own data (inventory, capacity, etc.) also needs to be checked on a case-by-case basis	• Data is updated and retrieved by the company on a regular basis • Data is checked when problems occur	• Both own and supplier data is updated and available on a regular basis or in real time	
3	Data-driven forecasting & planning	• Forecasting that relies on the past experience of those in charge • Lack of visualization and analysis of the plan	• Forecasting based on data and statistics • Planning visualization and simulation (digital twin, etc.)	• High level forecast based on AI and machine learning • AI-based planning recommendation and optimization	 Sophistication of SC planning
4	Company-wide governance & decision-making	• Management and decision making by department	• A cross-functional person responsible for SC manages and makes decisions across the business	• Decision-making process and structure under the CEO as a company-wide agenda	
5	Engineering SC integration	• Design and engineering processes and SC are disconnected and fragmented	• Design is partially optimized considering SC (SKU[1])/product specifications, etc.)	• Overall design is optimized taking into account SC (SKU[1])/product specifications, etc.)	
6	Flexibility of operations	• Unable to secure extra staff and capacity	• Secure about 10-20% extra capacity and personnel within the range of steady demand fluctuation	• Secure excess capacity and personnel to cope with demand fluctuations of nearly 30%	 Strengthening of SC execution capability
7	Business potential	• Work and know-how belong to each base and person in charge, making it difficult to transfer across sites	• Transferable to another location and person in charge with certain training and handover of duties	• Standardized and streamlined operations can be easily transferred to other locations and personnel	
8	Business resilience	• No BCP plan or risk scenario	• Risk scenarios and BCP plans in place	• BCP is ready to be implemented at any time	
9	Stakeholder collaboration	• No linkage with external stakeholders on data and operations	• Some data is linked with external stakeholders (EDI[2]), cloud tools, etc.)	• In addition to data, planning and operations are linked for total optimization (JIT/VMI[3]), etc.)	 collaboration with stakeholders
10	Procurement redundancy	• No redundancy, most components are single source	• Secure redundancy in some major components	• Secure redundancy in most components	 Securing of strategic redundancy
11	Production redundancy	• Production in a single (specific country/factory)	• Production at multiple sites (by region, multiple sites in Japan, etc.)	• Multiple production sites (by consumption areas)	
12	Inventory control	• No clear rules on safety stock holdings, and varies depending on the location and the person in charge	• Rules for safety stock holdings are defined and optimized for critical products	• Safety stock rates and rules have been defined across the company for most products	

1. SKU: Stock Keeping Unit; 2. EDI: Electronic data interchange; 3. VMI: vendor managed inventory
Source: Boston Consulting Group analysis

Ref.) Items of the resilience assessment framework

Evaluation item	Outline & concept of items
1 Understanding the SC structure	• To what extent does a company have a complete picture of its own SC, including suppliers?
2 SC data collection	• To what extent does a company capture in-house & suppliers' SC data such as inventory & capacity?
3 Data-driven forecasting & planning	• Is the company planning & forecasting are data-driven & sophisticated?
4 Company-wide governance & decision-making	• Are cross-divisional SC management & decision-making set from a company-wide perspective?
5 Engineering SC integration	• Are the design and engineering processes intergraded and optimized in the SC process?
6 Flexibility of operations	• Is it possible to meet the sudden changes & increases in demand?
7 Business potential	• Can the operation be flexibly extended & shared across multiple sites & personnel?
8 Business resilience	• Are risks identified & BCP plans set?
9 Stakeholder collaboration	• Does the company collaboratively integrate its operation & data with external stakeholders (suppliers, logistics providers, distributors, etc.)?
10 Procurement redundancy	• To what extent is multi-sourcing available in the procurement process?
11 Production redundancy	• To what extent are the production bases decentralized?
12 Inventory control	• Is a clear and optimized inventory control set from a company-wide perspective?

Source: Expert interviews, BCG analysis

Thank you for your attention.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List of good practices

Category	Company	Initiatives
End-to-End supply chain visualization	1. Mfg. industry 2. Mfg. industry 3. Mfg. industry 4. Mfg. industry（India） 5. Mfg. industry 6. Retail 7. Mfg. industry（India）	• Building a decision-making process led by the CEO • Establishment of SC control tower for global procurement decision-making • Monitoring E2E based on demand forecasting • Operation design across supply chains • Identification of focus points through product and customer segmentation • Logistics optimization through in-depth E2E performance analysis • Operation design based on visualization across supply chains
Upgrading of supply chain planning	8. Mfg. industry 9. Mfg. industry 10. Retail 11. Mfg. industry 12. Retail 13. Mfg. industry	• Visualization of bottlenecks using SC digital twins • Sophistication of SC risk analysis through simulation • Inventory optimization along the product lifecycle through simulation • Policy decision of supply chain plan using scenario analysis • Building models that continue to evolve operations using AI/machine learning models • Effective use of external data and model construction using advanced AI/machine learning models
Strengthening of supply chain execution capabilities	14. Mfg. industry 15. Mfg. industry	• Engineering supply chain optimization • SC consistent data-driven operation management with control towers
Strengthening of cooperation with stakeholders	16. Mfg. industry 17. Mfg. industry 18. Retail/Mfg. industry 19. Mfg. industry 20. Mfg. industry（India）	• Providing systems for sharing data with suppliers • Creating cooperative relationships to share supply chain data • "Carrot and Stick" to realize the sharing of supply chain data • Build a growing model with suppliers • Management provides direct negotiation, incentives and support
Ensuring strategic redundancy	21. Mfg. industry 22. Mfg. industry	• SC optimization by production adjustment (double track) of the same product across countries • Responding to exchange rate fluctuations through cross-country production adjustments
Story of change toward SC resilience	23. Mfg. industry	• Steps, measures, promotion system and essence for robust SC/transformation

Glossary (1/2)

Abbr.	Formal name	Outline description
BOM	Bill of Materials	• A list of parts and components of a product, mainly used in the manufacturing industry • Shows hierarchical structure, components of a product, and basic info of each part
Data Lake	Data Lake	• A generic term for a data storage system that holds big data from many sources in its native/raw format • Unlike data warehouse (DWS) where data is structured/processed for a specific purpose, it stores structured/semi-structured/unstructured data and keeps data in more flexible format for future use
EC	E commerce	• A generic term for retail biz to sell and buy products and services on the Internet - B2B EC: Biz-to-biz transactions (e.g., trading of raw materials and parts, cloud services for biz, etc.) - B2C EC: Transactions that company offers its products/services to consumer (e.g., Amazon, Rakuten) - C2C EC: transactions bet individuals (e.g., Mercari, Yahoo Auction)
ERP	Enterprise Resources Planning	• A plan or concept to properly distribute and effectively utilize resource elements (people/goods/ money/info) that are the basis of corporate mgmt • Or, refers to “core info system” for appropriate resource mgmt
MES	Manufacturing Execution System	• A system that grasps and manages manufacturing process and provides instructions and support to workers • Can be linked to each process in the production line (procedure mgmt, receiving/shipping mgmt, quality mgmt, maintenance mgmt, etc.)
OEE	Overall Equipment Effectiveness	• An index used to improve efficiency of production facilities, calculated based on operating rate, performance, and quality • Compare 100% OEE vs. actual facility efficiency to identify sources and types of losses and issues in the manufacturing process
PLC	Product Lifecycle	• S-shaped curve product/market growth pattern consisting of four stages: introduction, growth, maturity, and decline • Or, as a mktg term, refers to the period from when a product is launched to when it leaves the market
PLM	Product Lifecycle Management	• A system to quantitatively grasp and optimize the flow of a specific product unit: “planning⇒design⇒production⇒sales⇒maintenance⇒disposal • A system equipped with a group of functions incl necessary data creation, verification, and mgmt
TMS	Transport Management System	• Online mgmt system to control travel data and dispatch of company truck, fuel and other transportation costs

Glossary (2/2)

Abbr.	Formal name	Outline description
SCM	Supply Chain Management	• Management that links the flow of goods and money with info flow in a process of raw materials/parts procurement → production → logistics/distribution → sales to and aims at total optimization by sharing and coordinating info throughout SC
SCP	Supply Chain Planning	• Planning for each stage of SC • Or a general term for info system and software for planning
SCV	Supply Chain Visibility	• Visualization with data to track part or product manufacturer to final destination in procurement - manufacturing - logistics process • Aims to improve and enhance SC by making data available to all stakeholders, incl customer
S&OP	Sales and operations planning	• Concept developed from SCM, and refers to a method to optimize entire SC by accelerating decision-making processes mainly in sales/production/ procurement • While SCM and SCP mainly manage “goods” such as quantity and volume, S&OP focuses on “money”
SKU	Stock keeping Unit	• A unit to count "minimum number of items" for inventory control. In general, SKUs are separately managed in the following cases – When price, color, size, packaging, sales unit quantity, etc. differs – When net quantity of product differs, such as 100g or 200g – Set products with different combinations and prices …etc.
WMS	Warehouse Management System	• A generic term for system designed to support warehousing operations, incl warehousing and inventory management of cargo, materials, and products • Real-time inventory management, incl stock inquiry, replenishment, history/lot/ SKU / temperature mgmt