Impact of the massive earthquake in Japan on the U.S. supply chain

Deloitte's Point of View

November 2011

Contents

Background

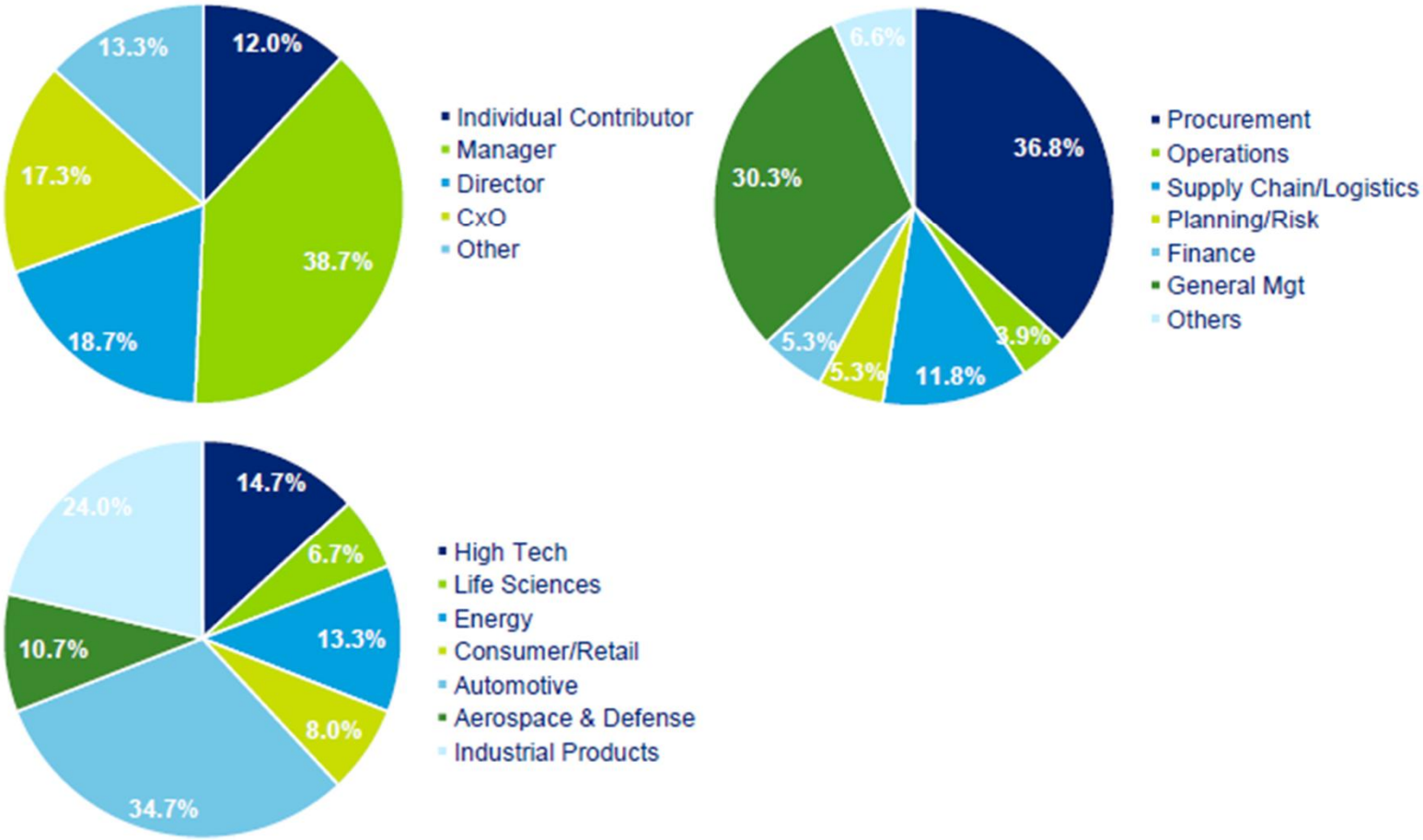
The human side and statistics

- Biggest earthquake to hit Japan in 140 years struck NE coast 3/11/11, triggering a 33' tsunami, plus explosions at Fukushima Daiichi Nuclear Power Plant led to worst nuclear accident since Chernobyl
- 15,405 people were confirmed dead plus 8,095 missing
- 10-days after disaster, 263,915 people in shelters
- Evacuation area with 12-mile radius around TEPCO's plant in Fukushima, 150 miles north of Tokyo
- 70,000 people lived in area
- 136,000 people within a further 6 miles advised to stay indoors
- 216,164 households without electricity 10-days after disaster
- 760,000 households without running water
- 95,107 buildings destroyed
- Disasters destroyed many factories causing Japan's industrial production to plunge 15.3%
- Japanese economy shrank 0.9% in the 1st quarter
- Airports, including Narita, closed, and many rail services halted, all ports shut down
- Massive repair bill estimated to top $300 billion

Survey of supply chain professionals on impacts of the disasters

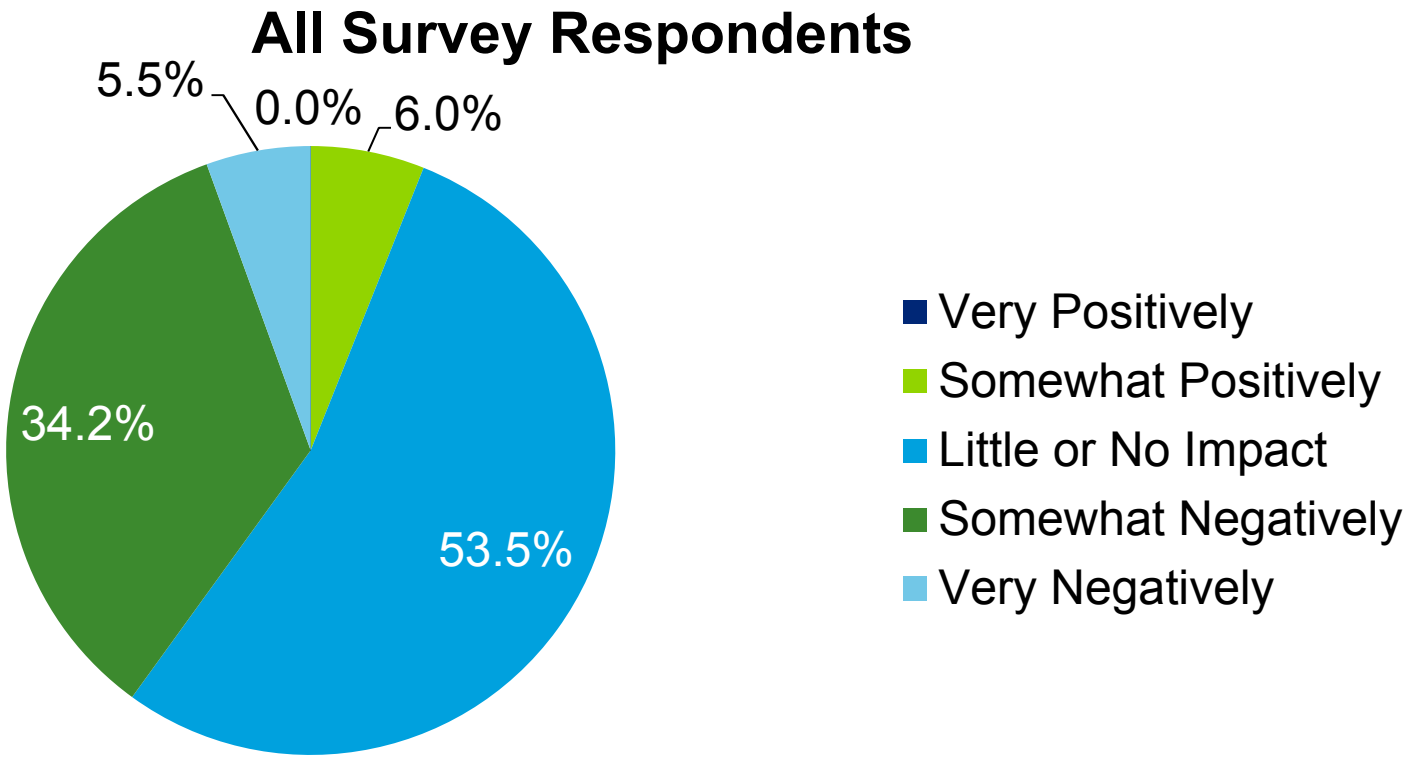
Deloitte conducted a survey among supply chain professionals and CFOs of Japanese companies to gather objective and anecdotal information about the impact of the disasters in Japan on the global supply chain for manufacturers

Profile of survey respondents



Prediction of impact to revenues and profits in 2011

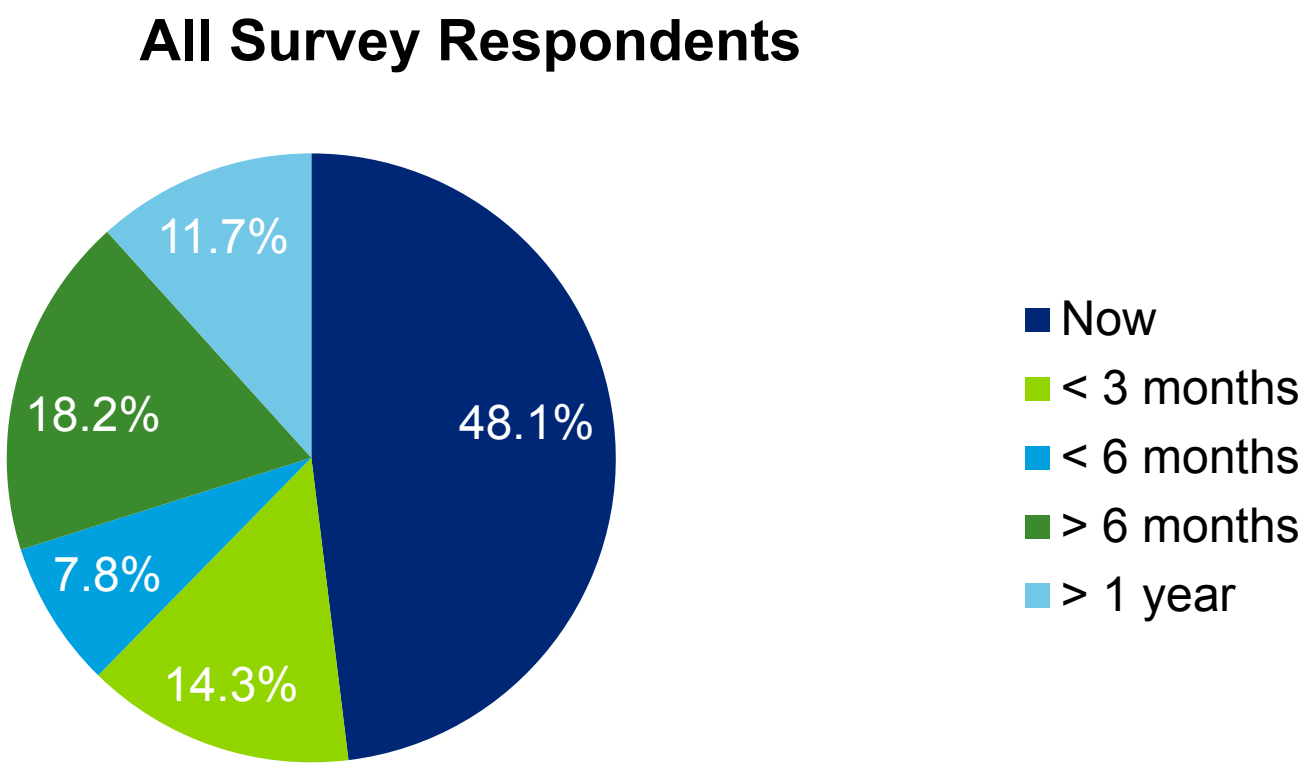
Not surprisingly, 40% of total respondents indicated a negative impact on 2011 revenues and profits, and no one experienced very positive results due to the volatility that was introduced



In heavily co-dependent supply chains, production disruptions caused spillover revenue impacts and distress. Even if a component is produced and delivered to the customer, demand for the product was impacted if the customer was in short supply of some other parts required to build the final product.

Estimated time to resume normal operations

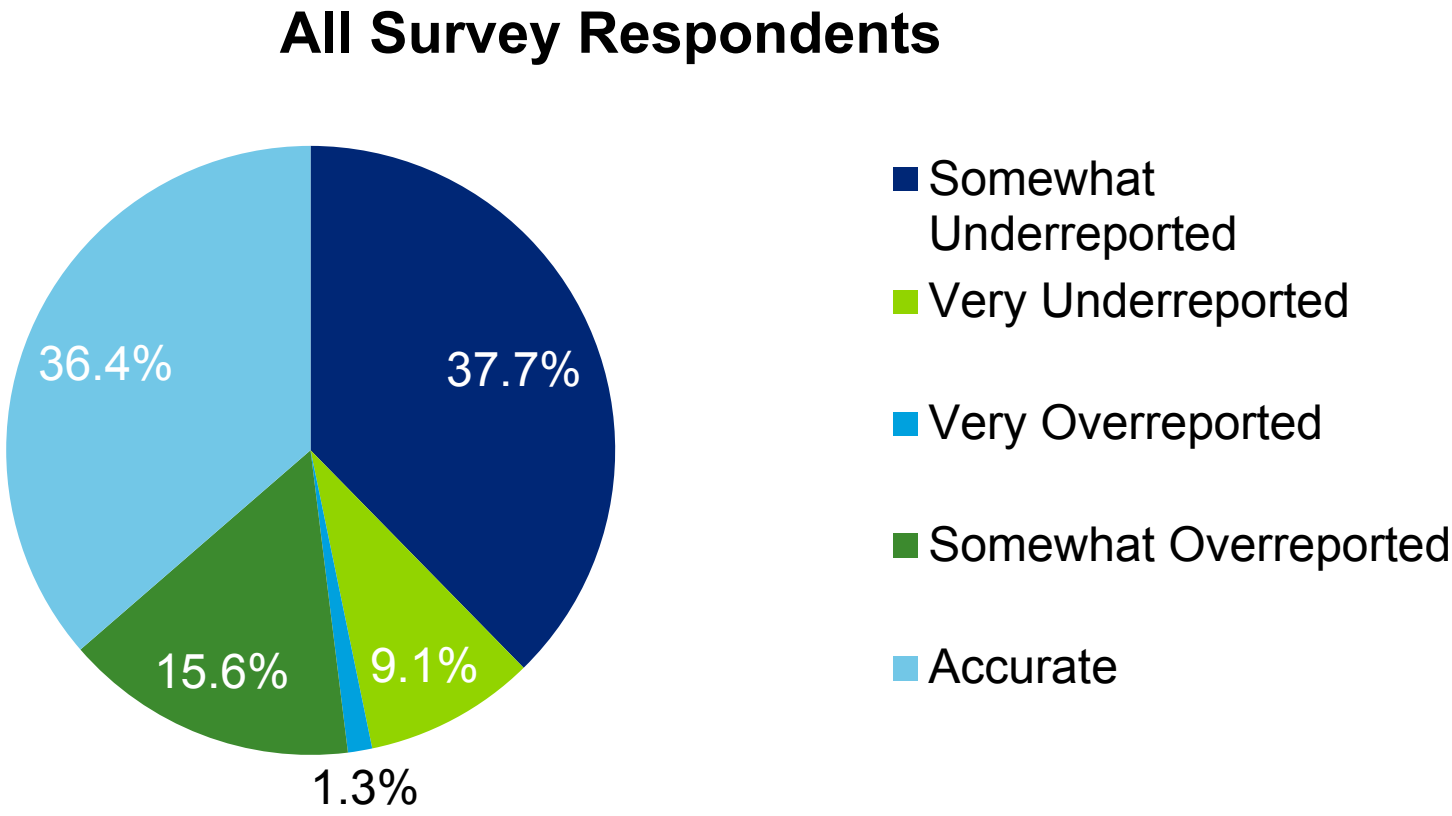
Japan showed remarkable resilience in previous disasters, and 70% of respondents think that the recovery would take Japan less than six months, assuming there are no additional events. However, about 30% have still not recovered fully



Most companies were well-equipped to deal with the near term shocks, and the majority of plants have been able to resume production after modest repair and inspections of the facilities.

Media coverage of the disasters

Perceptions may be impacted by the availability of information on the disaster as 43% of the survey respondents indicated that the impact of the disasters was either somewhat or very underreported by the media.



Survey participants were evenly split between underreported and overreported with no clear distinction by industry.

Immediate impact on the supply chain

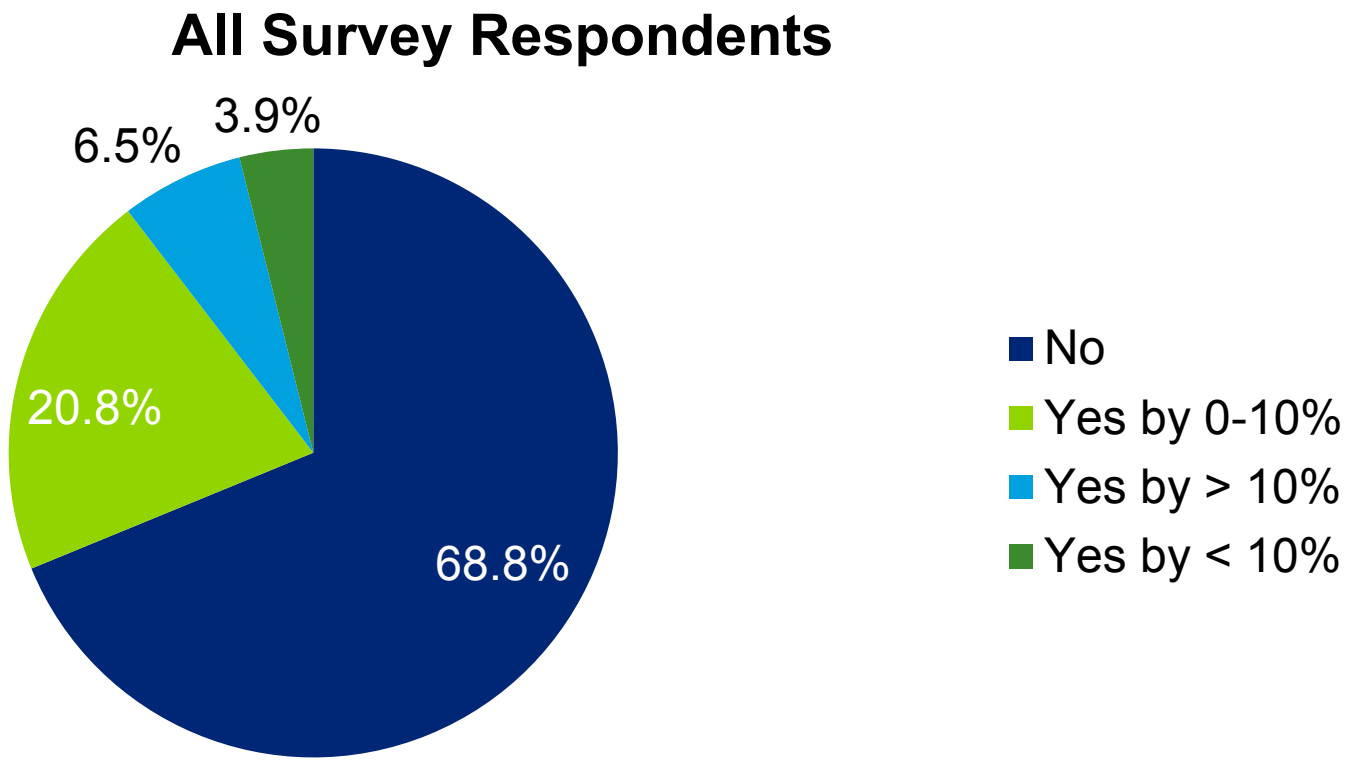
- Primary concerns for resuming normal operations included
  - Deliveries of components from manufacturers in Japan
  - User plants with heavy reliance on components from Japan returning to normal volumes
  - Resumption of production by deeper tier suppliers

Energy

- Root cause of disruptions was persistent electrical shortages
- Rolling blackouts and rotating production schedules were employed to balance energy use
- Further complicating recovery efforts, NE and SW regions on different power grids
- Prior to tsunami, Fukushima nuclear facility produced 2.7% of power
- Debates over nuclear energy gathered renewed urgency domestically and abroad
- Nuclear energy accounts for >30% of Japan's total electricity supply
- Japanese government encouraged cogeneration to supplement centralized power
- Japan looking into hydroelectric, liquid natural gas (LNG) and gas turbines as viable and safer
- Expected to increase nuclear energy to 50% of total production by 2030
- 9-months to completely seal off the radiation emanating from damaged reactors, and 10-30 years to dismantle and decommission damaged reactors

Reduced production due to the disasters

Closer to home, only 25% of companies participating in Deloitte's survey reported decreased manufacturing operating patterns and production output in the wake of the disaster.



In an initial response to the disaster and subsequent rolling blackouts, many manufacturers adopted a rotating production schedule in order to balance energy use.

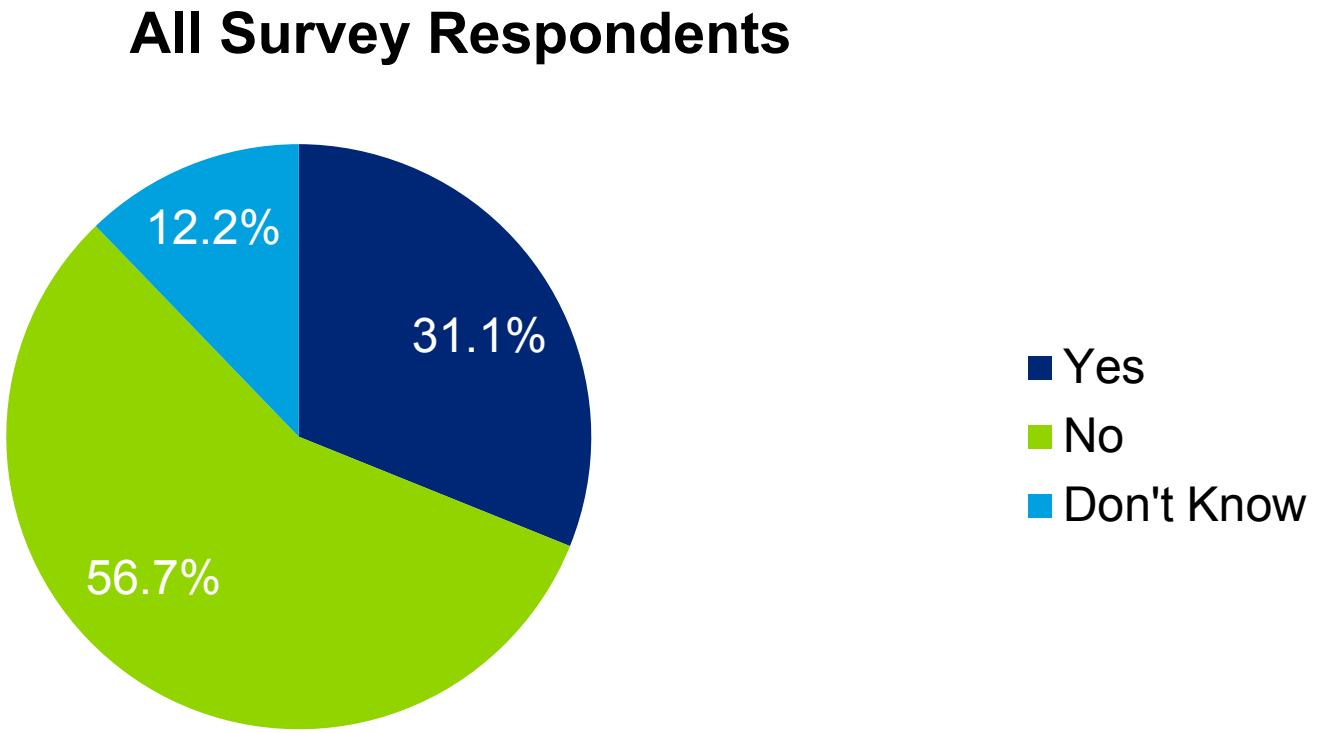
Potential future and longer-term impacts

In recovery

- Most companies well-equipped to deal with near term shocks
- No companies stated plans to relocate manufacturing operations
- Some economists indicate manufacturers need to shift production out of Japan to smooth disruptions, but Thailand, which was a preferred location, has had massive flooding
- Series of natural and political events exposed concentration risks in global supply chains
- Lower-cost manufacturers from Taiwan, South Korea and China might supplant incumbents

Resourcing or qualifying alternate suppliers due to shortages

One of the findings from survey is that companies increased activities related to resourcing or qualifying alternate suppliers



31% of respondents indicated resourcing due to delivery shortages, 18% due to pricing and 28% due to lead time issues

Full extent of impact took a while to sort out

- Earthquake, tsunami and nuclear reactor damage called into question JIT
- For Japan, JIT and lean inventories are pragmatic approaches to manufacturing
- Land mass small, roughly size of California, with facility space at a premium
- JIT necessary and logical: make and ship small quantities in order to replenish what is consumed
- Toyota Production System replicated, resulting in dependence on reliable supply chains
- Items with long transportation lead times already en route from Japan, delayed impact
- Softened blow that would have been felt in pure global JIT system and allowed suppliers time to react
- Some supply chain challenges particularly at lower levels of the supply chain, took weeks to emerge
- Longer-term impacts seen in custom electronics, standard electronics and specialty materials
- Specialty resins, solvents and cleaners comprise another affected group deep within the supply chain
- Tool and die makers, as well as their subcontractors, were also impacted
- OEMs typically do not have full Bill of Material and sourcing visibility beyond tier 2

Pricing affected

- No evidence of price increases for blanket contracts
- Prices for spot buys and for components and materials tied to a commodity pricing index increased
- In the near-term, steel prices decreased due to slack demand
- General commodity demand has increased in the mid-term due to both reconstruction needs and manufacturers' needs to increase production and catch up on lost units
- Increased global demand has driven up prices, compounding already visible inflationary effects

Another round of distress?

- In a heavily codependent supply chain, OEM production cuts caused spillover revenue impacts
- Even if a component supplier can effectively make and deliver its product to the customer, demand for that component can be impacted if the customer is short of other parts required to build the end item
- There are a couple potential distress scenarios
  - Customers don't pay suppliers
  - Suppliers can't handle customer volumes increases due to working capital constraints
- Other incidents, like flooding in Thailand, have aggravated the potential for distress

Delays in new product and process innovation

- The urgent focus on resuming production caused delays in new product and process innovation
- The flow of new products will not stop, but product introductions or deployment of new technologies may be delayed, as companies direct scare resources towards simply returning to regular production
- In some cases, companies making tooling and equipment were impacted by the disasters

Potential positives

- Companies with a broad range of suppliers and on stockpiles of raw materials were better positioned
- Some manufacturers are re-shoring or in-sourcing to shorten supply chains, as the economics have changed due to currency rates, tiered labor rates, energy costs and global supply chain risk
- "Made in USA" appears to be making a comeback, as manufacturers increase investment in the U.S.

Opportunities for new technology

- Japan may gravitate towards more modern technologies, rather than replacing what was once there
- There is potential for increased adoption and expansion of newer technologies in this environment
- Expanded use of cell phones over land lines; satellite television vs. cable; and higher speed trains
- A similar phenomenon has occurred in neighboring economies that are leapfrogging mature regions
- Reconstruction presents technology providers an opportunity in an important developed market
- The disasters in Japan have highlighted the risk to power and utility disruptions
- The situation may provide the impetus to explore alternative sources and methods of power generation
- Certain Japanese facilities have renewed focus on building on-site co-generation capabilities
- Facilities that are significantly dependent on a continual supply of clean power may need to reevaluate the risk/return equation for utility independence
- Exploration of clean energy alternatives will likely find renewed traction

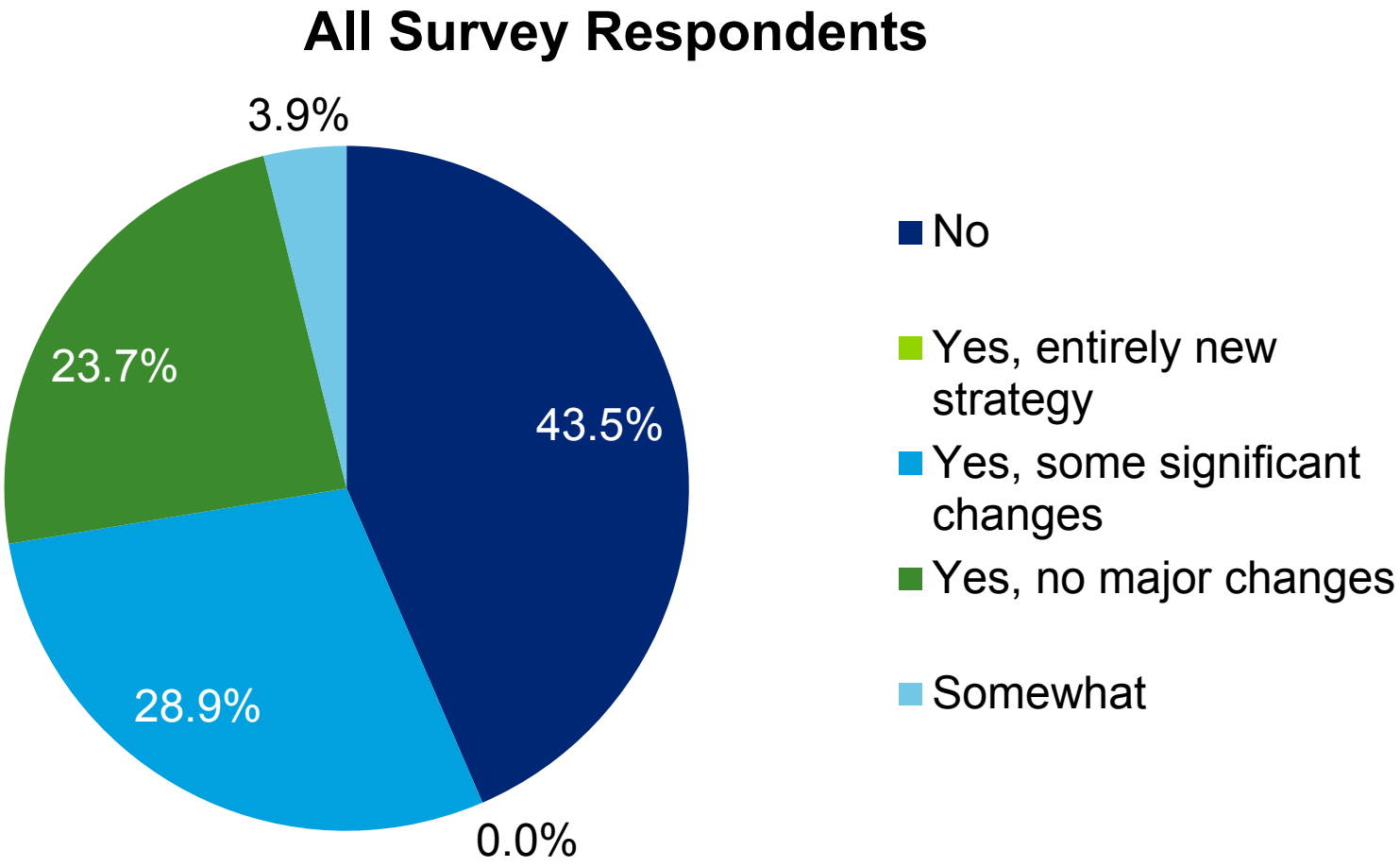
Conclusions and recommendations

Our research has focused on the effects of a series of disasters in Japan, but we have to ask ourselves: what will the next incident be?

- A wide range of risks could produce global supply chain disruptions similar to Japan
- Industry specialists believe that such disruptions will likely hit more frequently in the coming years, as more companies locate operations in countries with nascent manufacturing industries
- Companies should reflect on and answer the following questions
  - Are our suppliers managing risk as carefully as we do?
  - Will a disruption at one of my supplier locations impact our customers or our reputation?
  - Are they committed to being a reliable supplier and to the prosperity of our business?
  - Have they taken reasonable steps to protect their ability to meet their business obligations?

Rethinking global supply chain strategy

According to our survey, almost 58% of respondents plan to rethink their supply chain risk strategy, and 42% plan to extend their strategy deeper in the supply chain tiers



We recognize that striking a balance between proactive and reactive approaches is necessary to sustain a viable business case

- Consider developing a strategy to mitigate the impact of a major disaster on the supply chain
- The starting point is to develop an effective risk profile model that is subject to continuous improvement
- The risk profile should include a clear plan to break away from high-risk suppliers or suppliers that can become high risk after a major disruption
- This profile might include financial viability, operational shortcomings and strategic differences
- In creating a risk profile, the following critical variables should be considered
  - Likelihood of disruption
  - Severity of disruption
  - Time to resume material flow
  - Time to resource
  - Degree of specific, specialized engineered capability
  - Depth in the tiers, which is correlated to amount of material in the pipeline
  - Availability of alternative sources of supply
  - Capacity available at alternative sources
  - Responsiveness and relationship with alternative sources
- Each industry will likely weigh each variable differently

Assured Supply Center (ASC)

The objective of the ASC is to ensure the uninterrupted flow of the right material to the point of use (POU) across the event horizon and life cycle of the part and supplier relationship

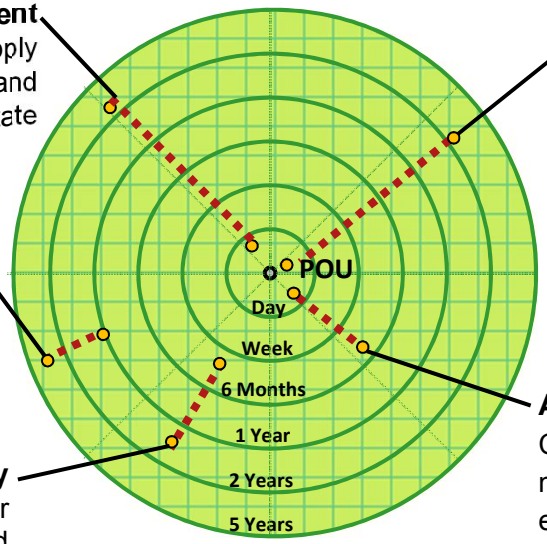
ASC in Support of an Integrated Supply Chain

Product Development → Order Management → Sourcing & Procurement → Manufacturing Operations → Logistics & Delivery → Service & Dealerships

Assured Crisis & Extreme Event Management
Manage natural and man-made supply disruptions to assure continuity of supply and rapid recovery to the pre-crisis state

Assured Capacity
Use long-term aggregate demand requirements and supplier's capacity, to identify potential constraints within the supply chain

Assured Capability
Utilize supplier's capability and monitor aggregate demand requirements / planned changes to identify potential issues of capabilities



Assured Delivery
Track deliveries / movement of material through the supply chain to ensure delivery of product to POU. Identify and understand supply network complexity to maintain / develop efficient supply networks

Assured Performance
Conduct analysis on key supplier performance metrics to identify potential or actual issues to ensure efficient and uninterrupted flow of material to the point of use (right parts, right quality, right time, right place)

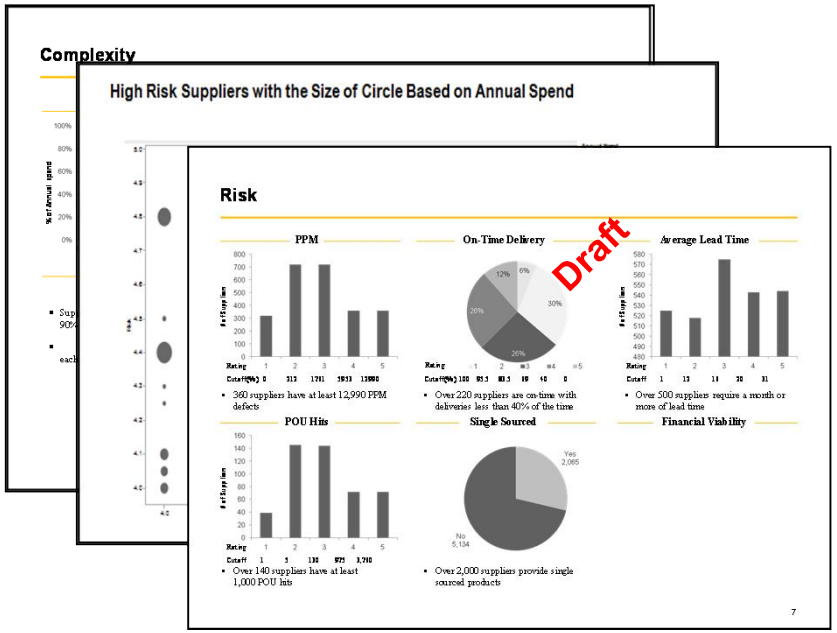
ASC Activities

Monitor → Analyze → Identify → Prioritize → Provide Recommendations → Support / Direct Resolution

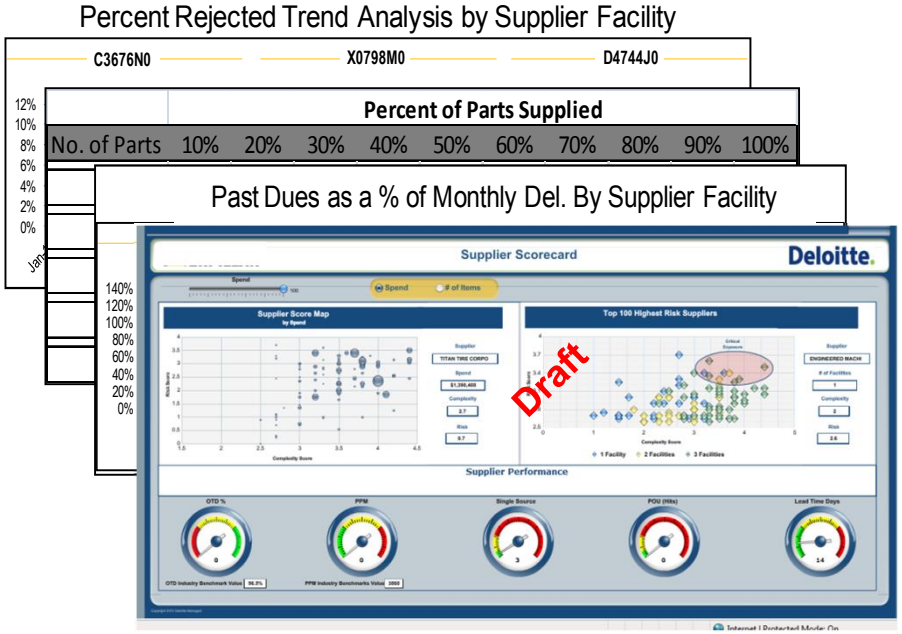
Assured Performance

Conduct analysis on key supplier performance metrics to identify potential trends or actual issues which may interrupt the flow of material to the point of use

Supplier Risk Profile



Trend Analysis



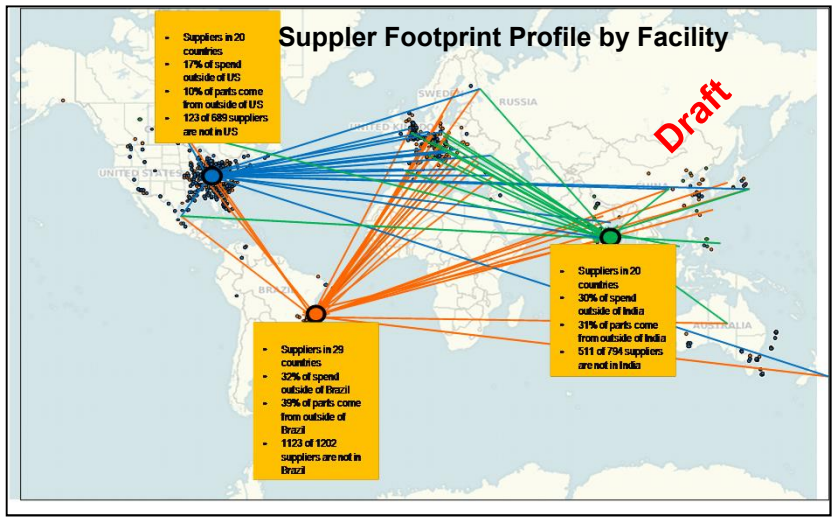
- Provides visibility to the suppliers with the highest potential impact on the global supply chain based on complexity and risk metrics
- Presents information to ensure focus is on the suppliers that have the largest potential impact based on performance and value in the supply chain

- Analysis of leading indicators (operational, financial, and strategic) for supplier performance metrics provides visibility to performance trends allowing issues to be addressed prior to disruption
- Detailed analytics identify trends and compare performance across the supply chain to proactively identify potential issues within the supply chain

Assured Delivery

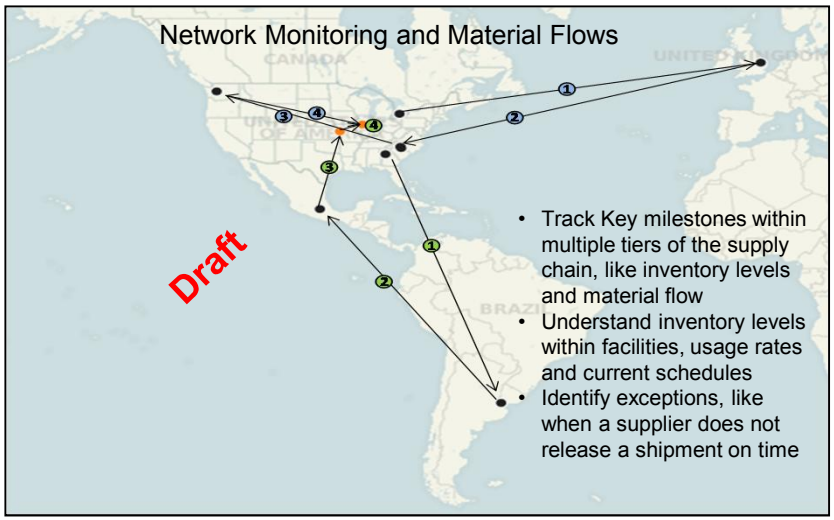
Track movement of material through the supply chain to ensure delivery to point of use. Identify and understand supply network risk to develop or maintain efficient supply networks

Supplier Footprint by User Plant



- Facility-based supplier footprint analytics provides visibility into the actual material flow from tier 1 suppliers to user plants
- Visualize the complexity of the supply base, real-time
- Identify areas of greater risk and complexity in the supply chain based on supplier locations and modes of inbound transportation in relationship to the user plants

Multi-Tier Network Monitoring

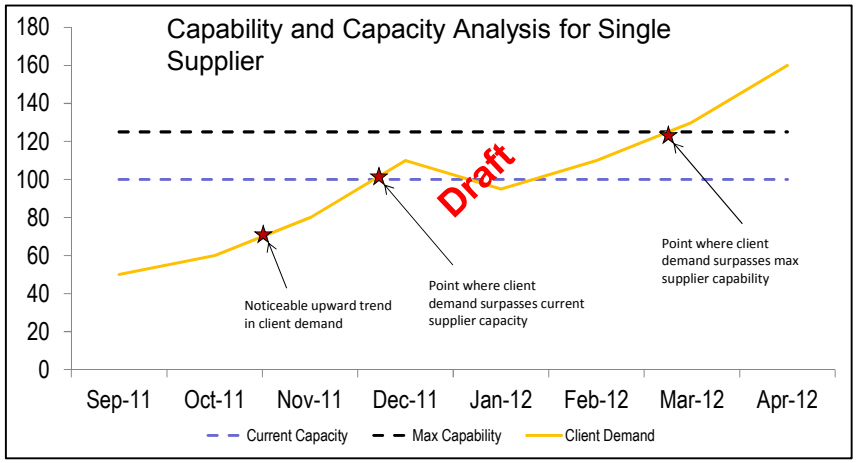


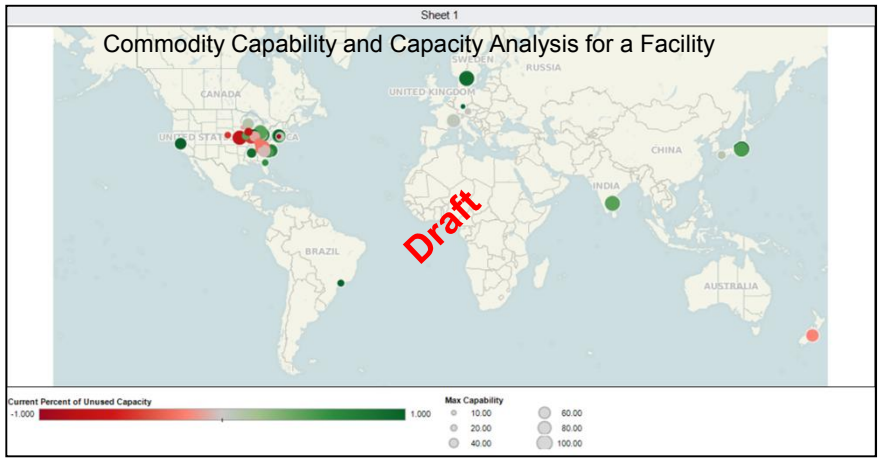
- Provide visibility to the flow of material within multiple tiers of the supply chain for critical parts to identify exceptions and interruptions as early as possible
- Identify late shipments for tier 1 suppliers and provide ability to assess the impact to production
- Evaluate key component network material flows to identify cost and risk reduction

Assured Capability and Capacity

Aggregate demand requirements with the supplier's capacity and capability to identify potential issues with meeting both near term and long term requirements

Capability and Capacity Analysis





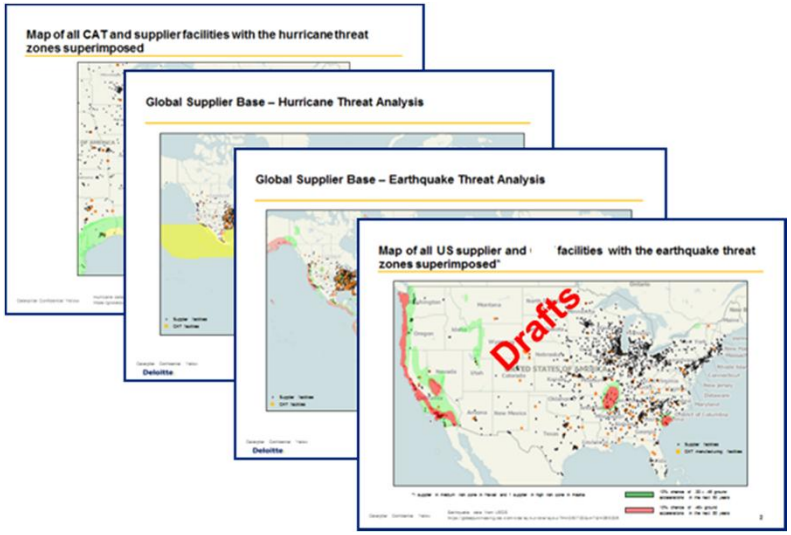
- Aggregate and analyze demand requirements to provide visibility where requirements exceed current capability and capacity of a supplier in order to highlight and to address issues
- Analyze trends in demand to identify potential spikes to avoid potential disruptions

- Provide visibility into suppliers' ability to meet future demand requirements, as well as conduct simulations to identify additional bottlenecks in the supply chain as demand changes
- Identify capacity constrained suppliers and address issues in advance of delivery schedules

Assured Crisis and Extreme Event Management

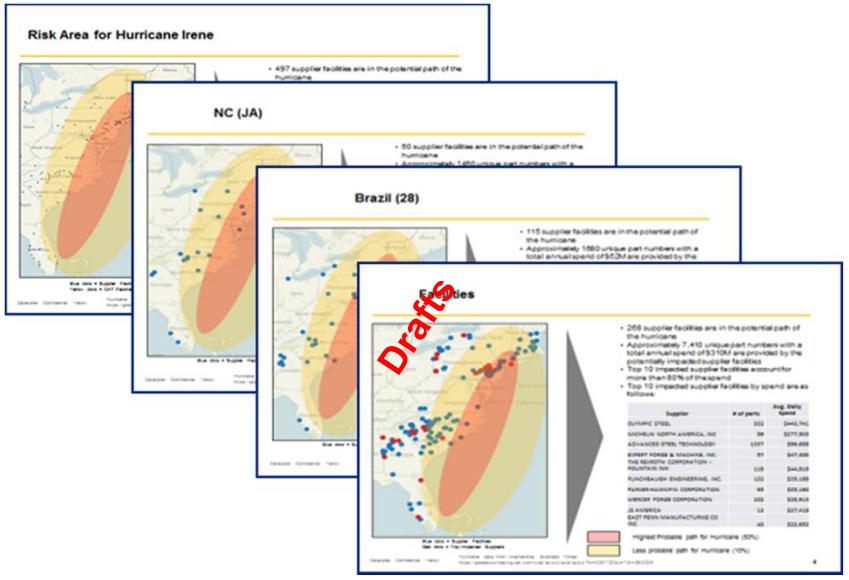
The objective is to simulate and manage supply chain crises to assure continuity of supply and rapid recovery in the wake of an extreme event

Hurricane & Earthquake Risk Assessment



- Assess the risk of potential natural and manmade disasters proactively to identify the greatest potential for supply chain disruptions based on location of single sourced part families, commodities and materials through the tiers, as well as other vulnerable areas
- Information is utilized to examine the current supply chain, to understand risk mitigation options and to develop strategies to reduce the impact of extreme events in the supply chain

Hurricane Impact Analysis



- An analysis was recently provided for potential supply chain disruptions and resultant highest impacted tier 1's and user plants
- Information was utilized by supply chain risk areas to contact the supply base and user plants to understand contingency plans, potential disruptions of material and to develop strategies to keep the lines running

ASC Master Global Supplier Database

The data are fed real-time from numerous sources in order consolidate the information for the most timely, well-informed decision making

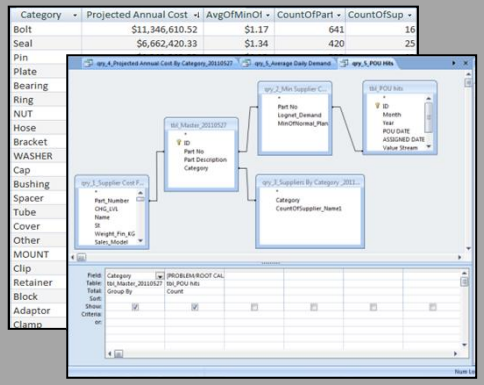
Supply Lead Time Database

Total lead time by part number, supplier facility, and receiving facility

Part Availability Database

Delivery exceptions since 1/1/11 by user plant attributable to supplier quality and delivery issues

Client Global Supplier Database



Purchasing Roles Database

- Lead Buyer
- Purchasing Manager
- Commodity Manager
- Purchasing Director
- Risk Manager

Supplier Performance Dashboard

- Annual spend
- On-time delivery
- PPM
- Part numbers per facility
- Supplier process qualification status

Client Facilities Database

Client facility names, codes and locations

Suppliers by Client Facility Database

Suppliers by client facility and number of direct parts supplied

Supplier Facilities Database

Supplier facility names, codes, addresses and key contacts

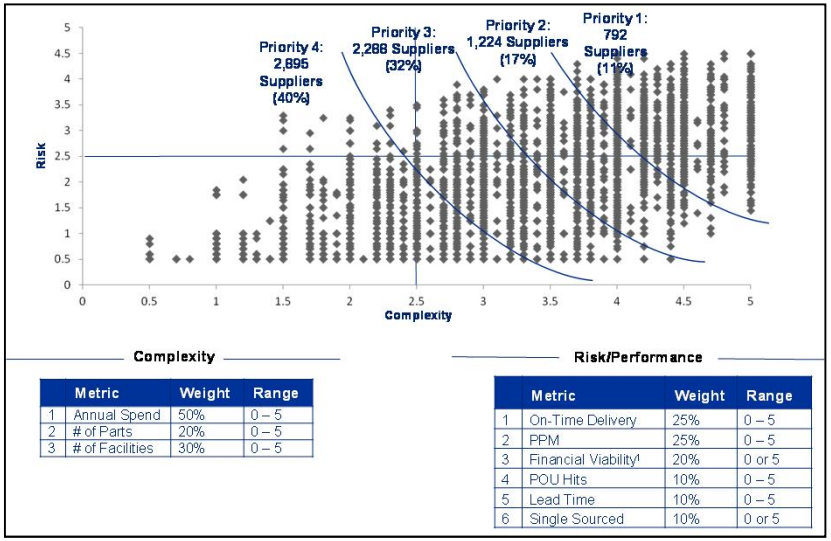
Critical Parts Database

Critical part numbers and supplier facilities that provide critical products

Supplier Risk Profile Model

The model incorporates a risk profile analysis using objective scoring charts to understand complexity and generate metrics with a proprietary Deloitte algorithm

Risk Profile



Complexity

	Metric	Weight	Range
1	Annual Spend	50%	0 – 5
2	# of Parts	20%	0 – 5
3	# of Facilities	30%	0 – 5

Risk/Performance

	Metric	Weight	Range
1	On-Time Delivery	25%	0 – 5
2	PPM	25%	0 – 5
3	Financial Viability[1]	20%	0 or 5
4	POU Hits	10%	0 – 5
5	Lead Time	10%	0 – 5
6	Single Sourced	10%	0 or 5

Scoring Charts

Complexity

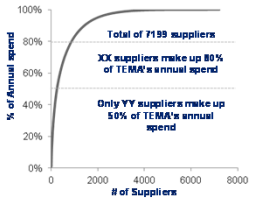
Metric	Weight	Cut-Off	Score	# of Suppliers
Annual Spend	50%	-$10,000	0	33
		$0	1	1,407
		$9,049	2	1,440
		$86,901	3	1,439
		$536,962	4	1,440
		$3,106,328	5	1,440
# of Parts	20%	0	0	0
		1	1	1,360
		3	2	2,955
		31	3	1,442
		121	4	721
		330	5	721
# of Facilities	30%	0	0	0
		1	1	3,808
		2	2	1,013
		3	3	1,590
		9	4	419
		14	5	369

Risk

Metric	Weight	Cut-Off	Score	# of Suppliers
PPM	25%	-30000	0	4,719
		0	1	320
		212	2	720
		1761	3	720
		5953	4	360
		12990	5	360
% Delivery On-Time	25%	0.00%	5	5,278
		40.00%	4	120
		69.05%	3	577
		83.33%	2	504
		95.45%	1	499
		100.00%	0	221
Average Lead Time	10%	0	0	4,494
		1	1	525
		12	2	518
		16	3	575
		20	4	543
		31	5	544
POU Hits	10%	0	0	6,727
		1	1	39
		5	2	145
		128	3	144
		975	4	72
		3,761	5	72
Single Sourced	10%	No	0	5,134
		Yes	5	2,065
Financial Viability	20%	Yes	0	-
		No	5	-

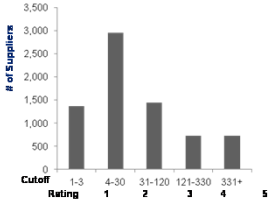
Complexity

Annual Spend



- Suppliers with a rating of 5 represent over 90% of the total annual spend
- TEMA spends at least $X.1M annually at each supplier facility with a rating of 5

# of Parts

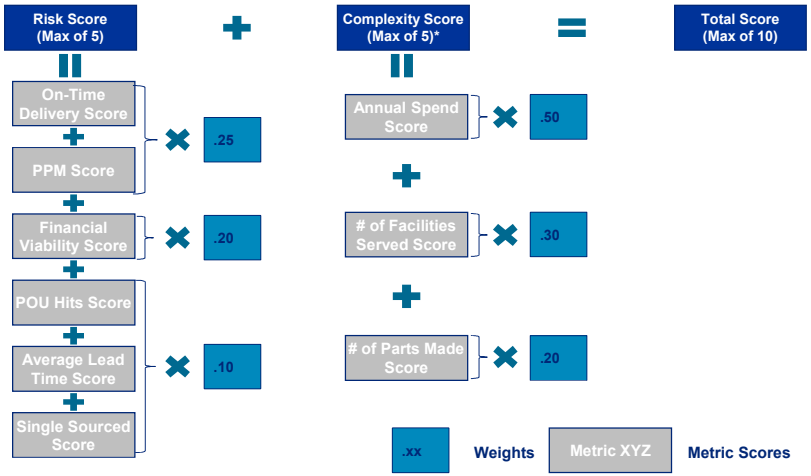


- Top 10 global pain supplier facilities provide over 200 parts each
- TEMA gets more than X,000 parts from 219 different suppliers

# of Facilities

- Top 10 global pain supplier facilities provide parts to at least Y TEMA facilities each
- Over 660 suppliers provide parts to 10 or more facilities

Algorithm

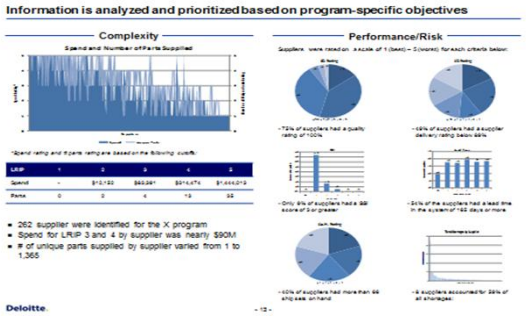


Supplier Collaboration & Development Approach

Our approach utilizes a suite of proven tools that enable us to accelerate SC&D benefit capture

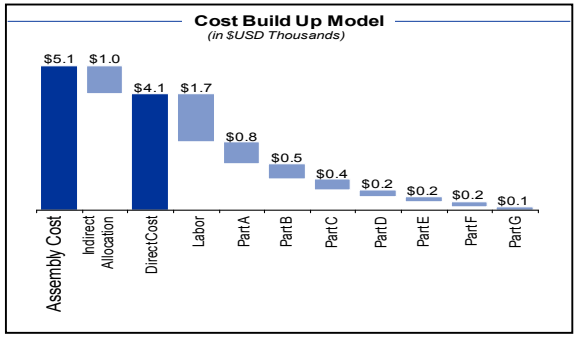
Prioritization / Assessment Model

- Prioritization and assessment model uses internal data to determine initial focus group of suppliers
- Baseline metrics focus on developing a model to align prioritization with objectives of engagement



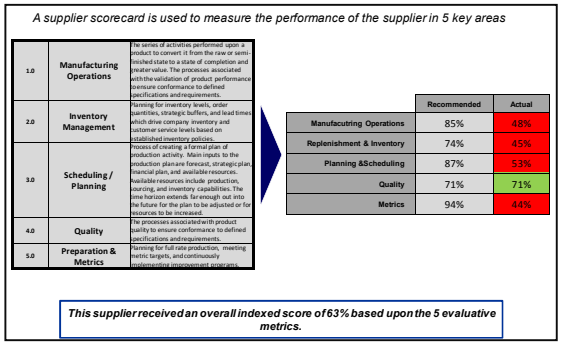
Cost Buildup Model

- Cost buildup model is used to identify cost drivers and evaluate supplier's pricing
- Information gathered in the cost buildup model along with identified opportunities for cost improvement are used to determine target price and negotiate new pricing



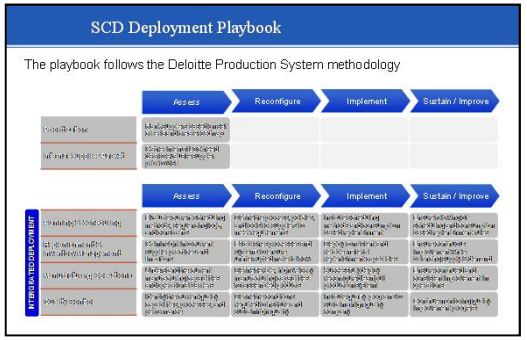
Engagement Scorecard

- Engagement Scorecard is used to summarize the assessment of the supplier's capabilities
- The scorecard can be customized to the specific objectives of each engagement



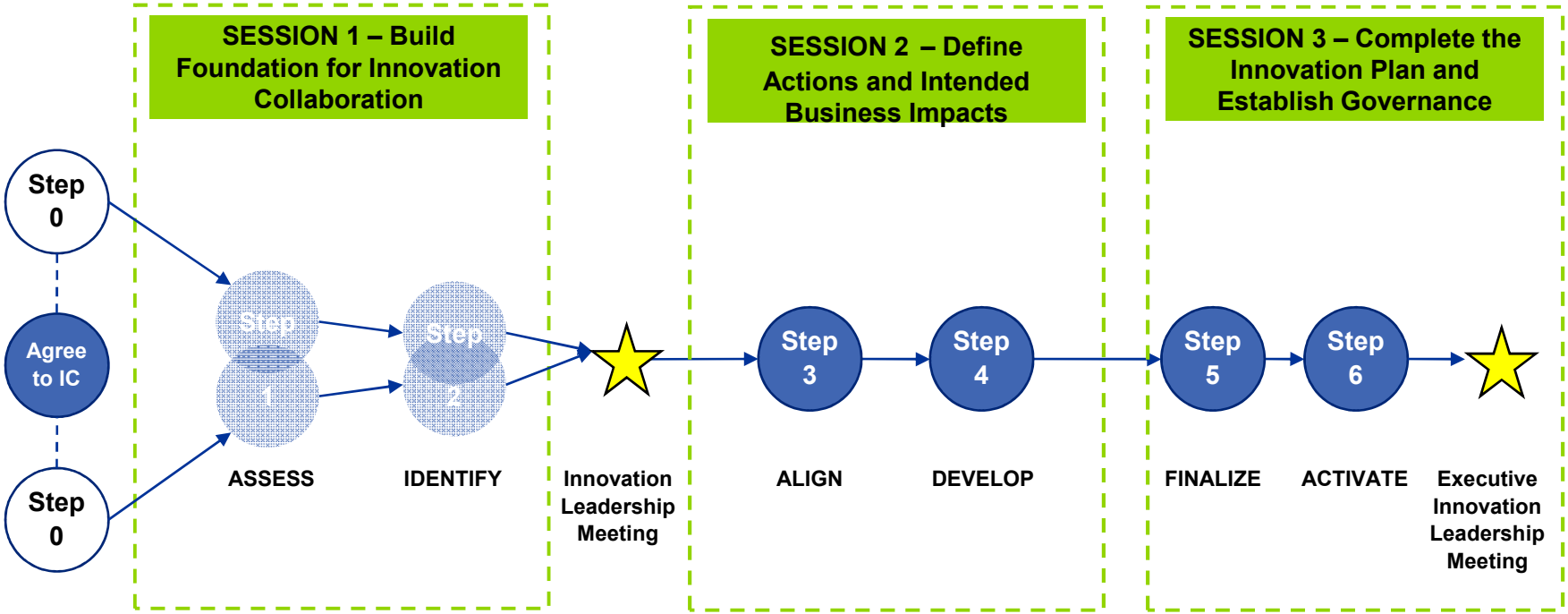
Engagement Playbook

- Six major sections on the playbook are Prioritization, Supplier Packet, Planning & Scheduling, Replenishment & Inventory Management, Manufacturing Operations, and Quality Control



Innovation Collaboration

Deloitte's methodology offers a collaborative approach that works to align suppliers and customers to meet common innovation goals



Key Outputs		

▪ Customer and supplier fact book
▪ Current state assessment
▪ Ideal innovation collaboration outcomes and results
▪ Ground rules for fair game and off-limit topics
▪ Independent 1-year and 3-year visions
▪ Preliminary list of prioritized innovations
	▪ Aligned joint vision and timeline
	▪ Agreed list of joint initiatives
	▪ Initiative details, benefits and anticipated investment
	▪ Tactical initiative plan including dependencies and resource constraints
	▪ Preliminary innovation plan
		▪ Finalized innovation plan
		  ▪ Strategic and product vision
		  ▪ Joint opportunities and initiatives
		  ▪ Initiative details and timelines
		  ▪ "Quick Wins" and "Big Ideas"
		▪ Innovation scorecard
		▪ Management calendar

Supply Chain Risk Assessment Approach

Deloitte brings a cross-functional team to each supply chain risk engagement in order to deliver a comprehensive and analytically rigorous assessment in a repeatable manner

	Assess Supply Chain Risk	Develop Recommendations to Reduce Risk	Finalize Risk Assessment
Key Activities	▪ Tailor approach ▪ Create current VSMs ▪ Calculate schedule conformance at each node ▪ Review demand expectations ▪ Develop capacity analysis and identify constraints ▪ Map material flow and inventory locations/levels ▪ Develop Voice of the Customer ▪ Identify business imperatives ▪ Establish baseline risk level (Composite, Strategic, Financial and Operational)	▪ Determine opportunities for – Manufacturing operations – Product and customer portfolio – Supply base and logistics ▪ Develop high-level business case and implementation roadmap ▪ Develop detailed timeline ▪ Identify roles and responsibilities ▪ Develop governance policies and metrics ▪ Identify systems and processes to be modified, as well as action plans	▪ Implement tracking system ▪ Formalize governance model ▪ Present assessment report ▪ Develop key parameters and model for risk adjust pricing ▪ Validate that systems and processes are modified ▪ Present assessment findings and recommendations ▪ Confirm/update business case and implementation roadmap
Deliverables	▪ Supply chain diagnostic tool ▪ Supply chain VSMs ▪ Demand vs. capacity analysis ▪ Inventory snapshot, trend and target analysis ▪ Voice of the customer results ▪ Conformance to schedule analysis ▪ Target inventory analysis	▪ Opportunities and action plans matrix ▪ Preliminary business case ▪ Preliminary implementation roadmap ▪ System and process analysis ▪ Detailed timeline ▪ Roles and responsibilities matrix ▪ Governance policies and metrics	▪ Risk reduction tracking system ▪ Business case ▪ Implementation roadmap ▪ Assessment report ▪ Risk adjusted pricing model ▪ Validation sign off ▪ Final assessment and recommendation report

Risk Adjusted Pricing Methodology

RAP uses a modified Failure Mode and Effects Analysis (FMEA) approach to apply risk factors to supplier pricing proposals. RAP is useful when developing target pricing to objectively evaluate multiple offers

- Deloitte's RAP multiplies a risk factor to a price for goods or services based on an evaluation of risk
- Key components of risk can be categorized as financial, operational and strategic
- Financial risk is composed of supplier health, currency value, ownership structure, payment terms, etc.
- Operational risk is determined by quality, delivery, innovation, lead time, supply chain complexity, transportation mode(s), etc.
- Strategic risk considers the relationship with the supplier, locations used for manufacture, design, and customer service, as well as other geographic and geopolitical considerations

Supplier	Base Price	Financial Factor	Operational Factor	Strategic Factor	RAP Factor	RAP
Incumbent	$38.43	3	3	4	36	$53.80
China	$28.34	4	4	3	48	$42.51
Germany	$42.18	2	1	3	6	$50.62
UK	$41.09	3	2	2	12	$53.42
Tennessee	$39.87	1	2	1	2	$39.87
Pennsylvania	$40.75	2	1	2	4	$44.83