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Cisco SCRM in Action: 2011 Tōhoku Earthquake

The Roppongi (六本木 or "six trees" in English) district was Tokyo's most popular nightlife district. Redevelopment projects from 2000 to 2011 for elegant retail, leisure and residential space, offices, and luxury hotels had made Roppongi appeal to a much wider range of visitors and residents.[1] A little before 3 p.m. JST on Friday, March 11, 2011, panic struck guests in the elevators of the Ritz Carlton Hotel, housed in the famous midtown tower, when they felt a severe jolt, and thought for a moment that they were in a free fall. Fortunately for the guests, the elevators stopped at the next floor and the doors opened. They exited and raced to the stairs to rush out of the building. Unbeknownst to the guests, 240 km north of Tokyo, an 8.9 magnitude earthquake had struck the northeast coast of Japan at 2:46 p.m. JST. Twenty four minutes later, more than 8,000 km away, near Cisco's headquarters in San Jose, California, the following alert popped up on Trent Marchuck's smartphone screen:

As Cisco's supply chain incident manager, Marchuck was responsible for monitoring potential disruptions to Cisco's vast global supply chain. Marchuck was used to late night alerts, but this alert had his attention. Following Cisco protocol, he immediately escalated the alert to his manager, James Steele, Cisco Director of Supply Chain Management. At 10:50 p.m. PST, Steele's phone rang. Even though Steele was relatively new

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©2013 Prof. Ravi Anupindi. This case was developed by Professor Ravi Anupindi with assistance from research associate Kristin Welling for the purpose of class discussion. Ravi Anupindi is David B. Hermelin Professor of Business Administration & Professor of Operations Management and the Program Director for the Master of Supply Chain Management Program at the Ross School of business. The intent of this case study is to look at lessons learned and best practices with a view toward contributing to cross-industry dialogue for effective responses to similar situations.

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to his role as program director of Supply Chain Risk Management (SCRM), this was not his first late night phone call. Answering his phone, he assumed someone was calling to follow up on a project or to debrief him on a meeting.

"James … it's Trent. Sorry to call so late, but there has been an incident in Japan," Marchuck said.

Marchuck was one of Steele's direct reports, and an incident manager. He and his team were the front line for monitoring global events that posed risk to Cisco's supply chain. Steele's thoughts turned to Cisco's Japanese operations and suppliers.

"What's happened? Is it serious?" Steele asked. Like many electronic OEMs, Cisco's supplier footprint in Japan was sizeable.

"There's been an 8.9 magnitude earthquake in Japan that has hit in the ocean off the northeastern coast," Marchuck said.

Steele and Marchuck immediately took stock of the situation and what was needed.

"OK Trent, you were right for calling me immediately — this could get bad," Steele said. "Let's get our team spun up. I'll send word up the management chain that we're investigating. Looks like it's going to be a late night."

As Steele got off the phone, he began running through the risk to Cisco's supply chain, and based on his team's crisis playbook, began formulating a set of key questions that would have to be addressed as soon as possible: How many suppliers do we have in the region? What do those suppliers make and how many products could be impacted? Do we have backup for those suppliers? How can we assess the actual impact on the ground? How do we get a senior team together, if needed, given we're heading into the weekend? And, more pointedly — How bad could this get?

This was not the first earthquake to impact Cisco's operations in Japan (see **Exhibit 1** for past earthquakes.) The company's business continuity plan (BCP) and its SCRM capability was developed for exactly this type of incident (see **Exhibit 2** for major disruptions that have impacted Cisco operations). Steele started placing calls to his team. They would have to quickly develop a picture of what was at risk in Cisco operations as well as an understanding of the impacts to the hundreds of Cisco suppliers in Japan. With the help of his team, Cisco BCP, and the expertise of the broader Cisco Supply Chain organization, he felt confident that his team would be able to get the situation under control. Little did Steele and his team know in those early hours of the crisis that the initial earthquake would trigger a series of events that would cause the largest supply chain disruption in modern history.

Tōhoku earthquake

On March 11, 2011 at 2:46 p.m. JST, an 8.9 magnitude earthquake struck off the coast of northeastern Japan. The epicenter of the first quake was located approximately 64 km east of the industrial city of Sendai.[2] An hour later, a deadly tsunami with waves as high as 10 m struck the 670-km Japanese coastline. The tsunami's destruction was immediate and widespread, with waves reaching 16 km inland along Japan's east coast.[3] It was believed that the earthquake could rupture a fault zone with a length of 500 km and width of 200 km.[4] In the course of just a few days, more than 60 aftershocks of more than 6.0 in magnitude would hit Japan. Many of the aftershocks were accompanied by tsunami warnings, although additional tsunamis did not strike the area.

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The worst damage occurred in cities and villages along the northeastern coast within the Miyagi prefecture. Fatalities and injuries were estimated in the thousands for this region due to its proximity to the earthquake epicenter and tsunami impact zone. More than 2,000 bodies washed ashore along the coastline in the days following the tsunami.[5] In addition to the loss of life and structural damage from the events, the debris swept ashore by the tsunami created more destruction. The 23-foot wave washed buildings and fishing vessels on to land, damaging homes, power lines, and roadways.[6] Residents were left to survive without water or electricity for more than a month. (See **Exhibit 3** for photos of the devastation caused by the events and **Exhibit 4** for a map of areas impacted by the quake.)

Nuclear plants at the dominant power companies in the northern region — Tokyo Electric Power Company (TEPCO) and Tōhoku Electric Power Company (TEP) — were impacted, causing explosions and radiation leaks. Eleven nuclear reactors across the Fukushima Dai-ichi, Fukushima Dai-ni, Onagawa, and Tokai Daini stations were automatically taken offline. TEPCO lost approximately 25% of its 78-GW generating capacity. The loss of power hit Tokyo and regions north and northeast of the city. Both TEPCO and TEP announced rolling blackouts across. TEPCO officials indicated that the company would not discriminate between residential and commercial customers when it came to blackouts. Nevertheless, due to the dynamic nature of power supply and demand, it was difficult to predict the timing and duration of blackouts. Surplus power was generated in the western regions of Japan, however, as a result of a frequency mismatch (60 Hz in the west vs. 50 Hz in the north and northeast) and limited converter capacities, the surplus could not be redirected.

Two days after the first earthquake, the Japanese government released information about potential radiation leaks from melting fuel rods caused by failed systems at one reactor and explosions at two others.[7] The Fukushima plant began leaking radiation. The Japanese Nuclear and Industrial Safety Agency reported radiation levels inside the plant of up to 1,000 times normal (0.1 microsievert per hour) and 8 times normal outside. Eleven kilometers south, at the Fukushima II plant, a state of emergency was declared. The nuclear impact zone suffered structural damage and loss of water and electricity, similar to the epicenter zone, but those living and working in this area were also subject to evacuations. Within a 20-km radius of the plants, residents and workers were required to leave the area due to radiation concerns. Anyone within 30 km was advised to remain indoors.[8] Reports of damage to liquid natural gas plants and oil refineries and the potential for fuel shortages were concerns.

The impact to Japanese transport infrastructure was also severe. Many sections of Tōhoku highway were destroyed. Train services in Tokyo were disrupted temporarily, and due to rolling blackouts that lasted several weeks, trains were not running on time or as often. The tsunami flooded the Sendai airport, while other airports suffered minor damage and were shut down temporarily. The port infrastructure suffered mild damage. Most of the major ports of Japan were on the western coast, and east coast ports, including those in Tokyo, were largely located to the south. Telecommunication services (both mobile and landline) were severely impacted. Undersea communication cables were severed, reducing the country's network capacity by 30%.

Japan and the electronics supply chain

Japanese suppliers were critical to the electronics and semiconductor industries. Japanese electronics held significant market share across several sectors: consumer electronics, 17.1%; semiconductor, 21.3%; NAND Flash[i], 35.7%; dynamic random access memory, 13.6%[ii]; and thin film transistor, 9.8%.[iii9] Japan

i NAND Flash is a memory technology that keeps data even when the power supply is cut off. It is popularly used in digital cameras, portable MP3 players, USB disks, among other devices.
ii Dynamic Random Access Memory is popularly used in computing and communication devices.
iii The primary application for Thin Film Transistor (TFT) is Liquid Crystal Displays (LCD). TFTs are made using a wide variety of semiconductor materials.

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consumed 24% of worldwide silicon, manufactured 65% of the world's semiconductor silicon wafers, sold 35% of all semiconductor equipment, and was the largest supplier of critical materials, including photoresists, photomask blanks, packaging and assembly, and printed circuit board materials.[10] The country was also home to a number of manufacturers of materials that were used in the production of semiconductors including silicon, glass, resins, and chemicals, among others. (**Exhibits 5-a and 5-b** show the location of various electronic facilities in Japan.)

The massive earthquake and tsunami that followed affected countless manufacturing facilities. Semiconductor wafer production was down by an estimated 25%. A number of semiconductor wafer fabrication facilities (or fabs) on the east coast were initially shut down. Some facilities suffered serious damage and would not be operational for several weeks. Rolling blackouts would make existing fab operations that required long hours of stable power difficult. Upstream, factories producing critical materials were also affected. For instance, Mitsubishi Gas Chemical announced delays of bismaleimide-triazine (BT) resin[iv] production through May of 2011. BT resin was a key material in semiconductor fabrication. The shortage of semiconductors would have a vertical impact. Raw silicon wafers that were used as "blanks" for many applications were also affected. Several plants owned by the Shin-Etsu Chemical Corporation — the region's largest silicon wafer producer — were impacted creating a worldwide shortage of this key building block for a number of applications.

In the aftermath of the disaster, Japanese companies experienced human resources issues, loss of electricity and water, structural problems, destruction of major transportation channels, and radiation concerns. Depending on the impact zone, production would be halted from a week to a few months. Warnings circulated throughout the semiconductor industry to qualify replacement materials in the event of further delays,[11] and with looming shortages, prices were expected to rise.

Cisco Systems

Founded in 1984, Cisco Systems, Inc. (CSCO) was one of the world's leading providers of Internet technologies that enabled global communications. A pioneer in the Internet Protocol (IP) router industry, Cisco designed and manufactured IP-based networking and information technology and sold its products to consumers, small businesses, enterprises, and service providers worldwide.

By 2013, Cisco's product portfolio was comprised of more than 200 product families and 12,000 products. These products were targeted to consumers, small- and medium-size offices, large enterprises, as well as the world's largest telecommunications service providers.

Cisco's Supply Chain Operations was a central function within Cisco that collaborated with other Cisco teams and external partners to plan, design, manufacture, deliver, and ensure the quality of the company's products and solutions. Its charter encompassed the entire value chain, including the customer experience. (See **Exhibit 6** for Cisco's Supply Chain organizational chart.)

Cisco actively managed operational risks across its business. A number of factors, however, made Cisco's supply chain risk management efforts particularly challenging. The first was Cisco's 100%-outsourced manufacturing model. The company worked with several Electronics Manufacturing Service partners in more than 30 global locations for production of its printed circuit boards, as well as the assembly, testing, and order fulfillment of its products. Second, Cisco produced a broad range of products using a Configure-to-Order manufacturing model in which customer orders triggered the configuration and final assembly of

iv Bismaleimide-triazine (BT) is material used in laminate substrates, which are structural components used in semiconductors.

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products. Because of this, Cisco had a very lean supply chain with minimal positioned material or finished goods and work-in-progress inventory that could be used in the event of a disruption. Finally, as part of its technology and growth strategy, Cisco had an average of 10 acquisitions each year. The company was constantly integrating acquired company supply chains, each with its own risk management challenges, into its operations.

While Cisco outsourced all manufacturing, most of its core products were designed and developed internally. Retained knowledge of product technology and deep organizational expertise were critical control points for the company and were reflected in the Supply Chain Operations charter. Product technology knowledge started in each Cisco business unit (where product profit and loss was held) in the engineering and product development functions. However, Supply Chain Operations partnered closely with business unit engineering groups to develop and launch products as well as design and operate the supply chain. Supply Chain Operations worked with the business units to ensure the right choice of partners, to maintain quality, and to interface with customers. The technology and product expertise in Cisco Supply Chain Operations was a key competitive differentiator for the company. Across the Supply Chain functional groups, Product Operations was responsible for working with the business unit engineering teams for the development and launch of new products. (See **Exhibit 7** for how functions were aligned across the Cisco value chain.) Product Operations retained key technical skills in the design of products and worked with Global Sourcing Management (GSM) and Global Manufacturing Operations to identify the right supplier and manufacturing partners. GSM had a deep understanding of the electronics supplier base across many commodity areas worldwide. The Technology and Quality group, also within Supply Chain Operations, had a broad group of component engineers, who worked with GSM and the respective business units to develop key manufacturing, test, and quality systems as well as processes to support product creation from design to production**.**

SCO also had a strong customer interface role through Cisco's Sales Account and Customer Operations. Supply Chain Operations was responsible for product quality and order fulfillment (the two central parts of the customer experience), and maintained a substantial role in customer escalations and issue resolution.

Cisco footprint in Japan

As an electronic OEM spanning the consumer and enterprise sectors, Cisco had an extensive footprint in Japan, across a number of key commodity groups including: silicon (Application Specific Integrated Circuits, Programmable Logic Devices, etc.), power, optics modules, and electro-mechanical, among others. Not only did the company have a large set of Tier 1 suppliers, it also had a number of sub-tier suppliers, primarily for highly engineered commodities such as silicon, optics, and power management. (**Exhibit 8** shows a sample multi-tier supply chain for a Cisco router.) Cisco also used suppliers in Japan for prototyped parts for new product introductions and to test equipment parts. The company's printed circuit board final assembly and test operations were located mainly in China, Mexico, Southeast Asia, and the US. Cisco also maintained logistics partners at key distribution hubs to facilitate the staging and fulfillment of customer orders for its products. As with many OEMs, Cisco's supplier base had been a mix of single source and dual source/alternatively qualified sources. (See **Exhibit 9** for a Cisco supplier map in Japan.)

Initial Response

After the notification from Marchuck, Steele took the first steps based on Cisco's supply chain crisis management process — understand the overall impact and risk to Cisco, its size, scope, nature, and potential evolution. Key questions to address included: What is the overall Cisco footprint in the impacted region? What is sourced, made, and distributed there? How large a portion of Cisco's revenue stream is aligned to

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these resources and pathways? What is the impact, and what is the current disposition of Cisco's suppliers and partners? Marchuck knew he needed quick answers. Within three hours, his team, using SCRM program BCP data, managed to preliminarily identify all suppliers/nodes and single sources of supply that could be impacted.

The potential for impact to Cisco operations was alarming, based on the number of suppliers identified. The next few days were busy as the team reached out to suppliers by phone and e-mail, but reaching suppliers was easier said than done. The team had to contact at least 200 suppliers based on BCP data. Some of the contacts were unreachable. Employees were first and foremost concerned about the safety of their own families and colleagues. Many suppliers provided materials to multiple OEM and were busy with other customers. In a few cases, the team had the wrong phone numbers or e-mails to suppliers, while there was no contact information for others. The gaps were understandable — the BCP program included over 1,200 suppliers and that supplier footprint was constantly changing. One of the suppliers that Cisco reached confirmed that while everything was fine with operations, production could be delayed because the materials and components it needed were sourced from a supplier that may have been impacted. It was likely that the plant Cisco's supplier received the materials from was severely damaged, but the supplier could not confirm the extent the damage. Marchuck discussed the situation with his team members. Cisco BCP data only captured information on its Tier 1 suppliers and had little visibility with sub-tier suppliers. While Cisco's Tier 1 suppliers could sometimes provide information on the state of its sub-tier suppliers, other times this information was lacking.

Marchuck and his team felt the urgency to improve their collective understanding of the impact of the disaster on the entire supply chain. With the knowledge they gained from their supplier impacts, the team began working on prioritization and mitigation recommendations. Prioritization and mitigation recommendations were dependent on impact assessments. Due to the scale and complexity of the disaster, it was clear that different mitigation actions would be necessary across the supply chain. Cisco's crisis management had never operated at this scale. The combination of earthquake, tsunami, radiation, shortages of energy and food, and disrupted transport and communication infrastructure was unprecedented. Each of these issues could impact suppliers differently. Was there a coherent way to assess and manage the different impacts? What was the best way to keep track of mitigation strategies and the cost, while keeping the company's C-level apprised of the situation and responding to the media and public with consistent messaging.

Impact across the Organization

John Smith, Vice President of Corporate Quality, was responsible for key engagements with Cisco customers. He interfaced with supply chain and the sales account teams. Smith knew that the most important constituency during the Japan crisis was Cisco's customers. As the event made headlines worldwide, customers, concerned over the implications it could have on the global supply chain, began to contact Cisco about their orders. Due to Japan's high level of exposure to the technology industry, many customers were concerned that product orders would be delayed (or even cancelled) due to material shortages and limited inventory. As Smith walked into his office the morning of March 15, his phone rang. It was Jim Welch from one of Cisco's largest customers.

"John, I have been watching the news and am shocked by the scenes of disaster. I hope all is well with your personnel in Japan," Welch said. "How does the disaster impact your shipment to us in three weeks? Can I still expect the delivery on time? We were considering some new service roll outs in the next quarter. Before talking to sales, I would like to get some assessment on the long-term impacts of the disaster on your ability to deliver the new line of routers we need to support the roll out."

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Smith told Welch that Cisco was constantly assessing the situation, and that he would get back to him shortly with specific answers. After the call, Smith wondered how to respond to customer inquiries like this; surely there would be many more calls. There were no guarantees that customers would call him. What if they called sales directly?

Nancy Chang, Senior Director of Product Operations, was responsible for partnering with Cisco engineering to develop and launch new products into the supply chain. She interfaced with the business units, as well as a wide range of companies developing prototype components for Cisco for use in new products. In the afternoon of Friday, March 11(one day after the earthquake, PST), Chang received a call from Jill Higgins, Vice president of Engineering for one of the business units she supported.

"Nancy, it's Jill. I know that Supply Chain Operations must be swamped with the Japan response. I just heard from the engineering teams working on the next generation 10G line card, and we have a major issue that we are going to need to bring you in on," she said. "The team just let me know that we have a small prototype shop near Sendai that is producing some key components for the project. Their factory is completely wiped out. Luckily, no one was injured, but they are reporting that all their inventory and machining has been destroyed. This is going to have a significant impact on our ability to keep to our launch schedule in two months."

A number of concerns came to Chang's mind. The first was that Cisco launched several thousand new products every year and that many of the suppliers that assisted with product development were not part of Cisco's BCP program. As a result, there was little visibility into the resiliency of these suppliers. While immediate concerns were on impacts to order fulfillment for current products, Cisco also was exposed to potential impacts on new product launches. Chang began to sketch out how Cisco could quickly get a handle on the "hidden supply chain" that supported new product introduction, as well as supply chain nodes that were part of newly acquired companies that were not necessarily in Cisco's enterprise systems.

"This could quickly snowball and have unforeseen impacts to Cisco quarters down the road as opposed to just the next month," Chang thought as she picked up the phone to call Steele. She knew that prototypes would be a key exposure. Other areas that came to mind were test equipment suppliers and core manufacturing infrastructure located in Japan. The impacts would cut across all aspects of Cisco's operations.

Bill Tyler, Director of Communications for Supply Chain Operations, had not had a moment's rest since the event. Cisco's main Corporate Communications group was looking to the Supply Chain Operations team to provide some type of guidance on the potential impact to the company's bottom line.

"We have quarterly earnings guidance coming up in less than a month and we need to understand if this is going to have a material impact on our top line and bottom line," Tyler said during a call earlier that day.

In addition to questions coming from the top, functional vice presidents from across the organization were demanding answers. Marketing had to know if product launches were going to be delayed. Sales account teams needed answers for their customers. Analysts and the general media would want to understand Cisco's position. He would have to gain an understanding of the mitigation plans quickly to formulate a communications strategy.

Was there a way to structure and manage the whole process with so many moving parts? Should decision making be centralized? If so, what was the best strategy to collaborate seamlessly across multiple groups while coordinating the actions of key decision makers spread across the world?

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Exhibits

Exhibit 1

Major Earthquakes in Japan

Date	Scale	Name	Epicenter	Death Toll
1/17/95	7.2 Mw	Great Hanshin Earthquake	Northern end of Awaji Island	6,434
5/4/98	7.5 Mw	1998 Ryukyu Islands earthquake	22.30°N 125.30°E	0
10/23/04	6.9 Mw	2004 Chuetsu earthquake	Ojiya, Niigata	40
3/20/05	7.0 Mw	2005 Fukuoka earthquake	In the Genkai Sea about 6 km (3.7 mi) northwest of Genkai Island at the mouth of Fukuoka Harbor	1
8/16/05	7.2 Mw	2005 Miyagi earthquake	About 55 km (34 mi) due east of the Oshika Peninsula in Miyagi Prefecture	0
11/15/06	8.3 Mw	2006 Kuril Islands earthquake	About 160 km (99 mi) due east of the southern tip of Simushir in the Kuril Islands	0
1/13/07	8.1 Mw	2007 Kuril Islands earthquake	46°28.8′N 154°04.48′E	0
3/25/07	6.9 Mw	Noto Peninsula Earthquake	About 11 km (6.8 mi) due west of the southern end of the town of Wajima	1
7/16/07	6.6 Mw	Chuetsu Offshore Earthquake	About 29 km (18 mi) west of Niigata	11
6/14/08	6.9 Mw	2008 Iwate-Miyagi Nairiku earthquake	About 1 km (0.62 mi) east of Narusawa Onsen in northwest Iwate Prefecture	12
8/9/09	6.9-7.1 Mw	2009 Izu Islands earthquake	33.144°N, 138.040°E, depth 303.1 km	0
8/11/09	6.5-6.6 Mw	Tokai Area Earthquake	33.8°N, 138.50°E, depth 20.0 km	1
2/26/10	7.0 Mw	Ryukyu Islands earthquake	25.902°N, 128.417°E, depth 22.0 km	1
12/21/10	7.4 Mw	Bonin Islands earthquake	26.866°N, 143.739°E, depth 14.9 km	0
3/8/11	7.2 Mw	2011 Tōhoku earthquake foreshock	38.424°N, 142.836°E, depth 32 km	
3/11/11	9.0 Mw	2011 Tōhoku earthquake	38.510°N, 142.792°E, depth 24.4 km	15,839
3/11/11	7.1 Mw	2011 Tshoku earthquake aftershock	38.106°N, 144.553°E, depth 19.7 km	

Source: Wikipedia

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Exhibit 2

Major Cisco Supply Chain Disruptions

Event	Date	Key Challenge
Sichuan (China) Earthquake	May 2008	8.0 M earthquake strikes central China creating widespread casualties, infrastructure damage and impact to suppliers.
Global Financial Crisis	October 2008	Economic downturn, instability and uncertainty creates liquidity/financial viability risks for key suppliers.
H1N1 Flu Pandemic	May 2009	Initial outbreak in Asia and Latin America creates high risk of multiple global operations disruptions.
Iceland Volcanic (Eyjafjallajokull) Eruption	April 2010	Persistent volcanic ash cloud disrupts key air transportation/logistics lanes into/through-out Europe.

Source: Cisco

Exhibit 3

Pictures of Devastation

Source: Daydaypaint.com

Source: japansociety.org.uk

Source: eqecat.com

Source: thenational.ae

Source: jfkl.org.my

Source: yourtravelchoice.org

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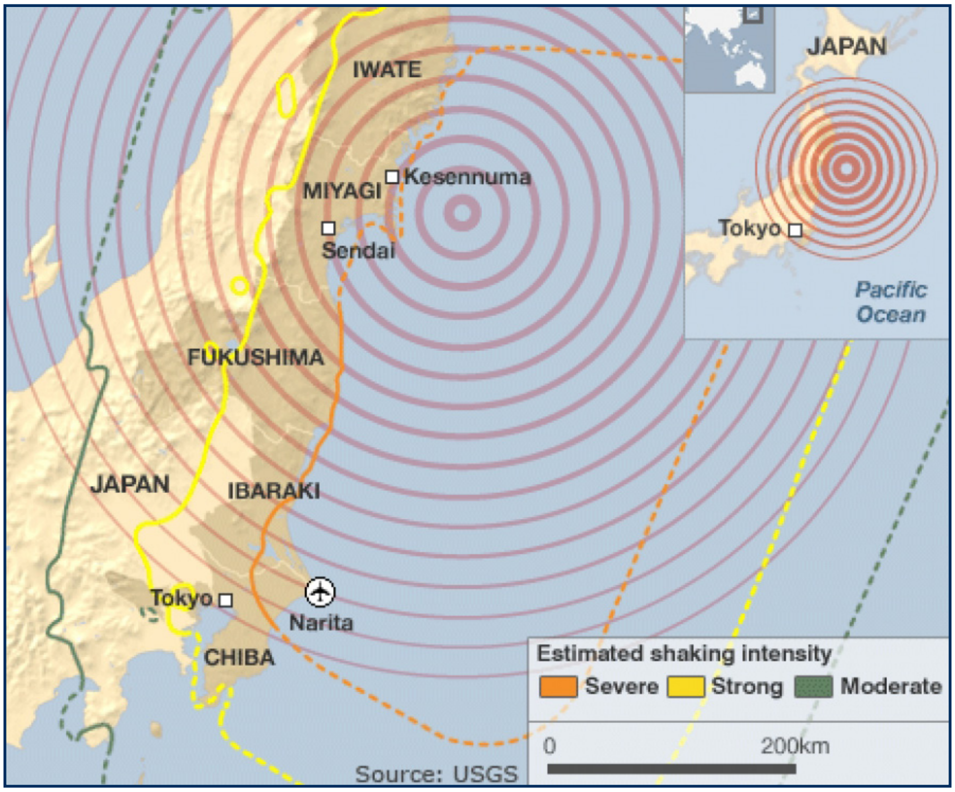
Exhibit 4

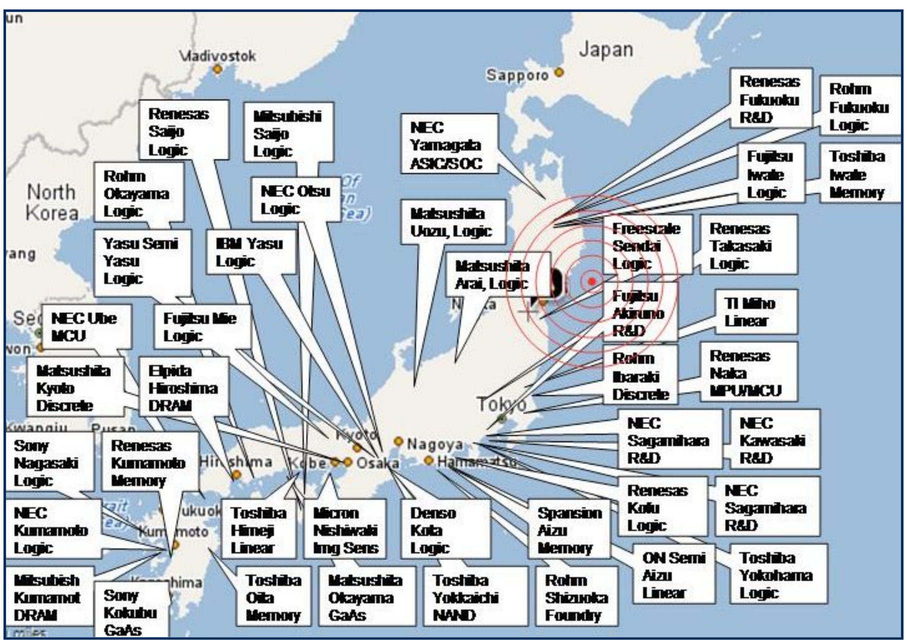
Areas affected by the quake



Source: Nihon International Group Co. Ltd.

Exhibit 5-a

Location of Semiconductor Fabs in Japan



Source: Objective Analysis.

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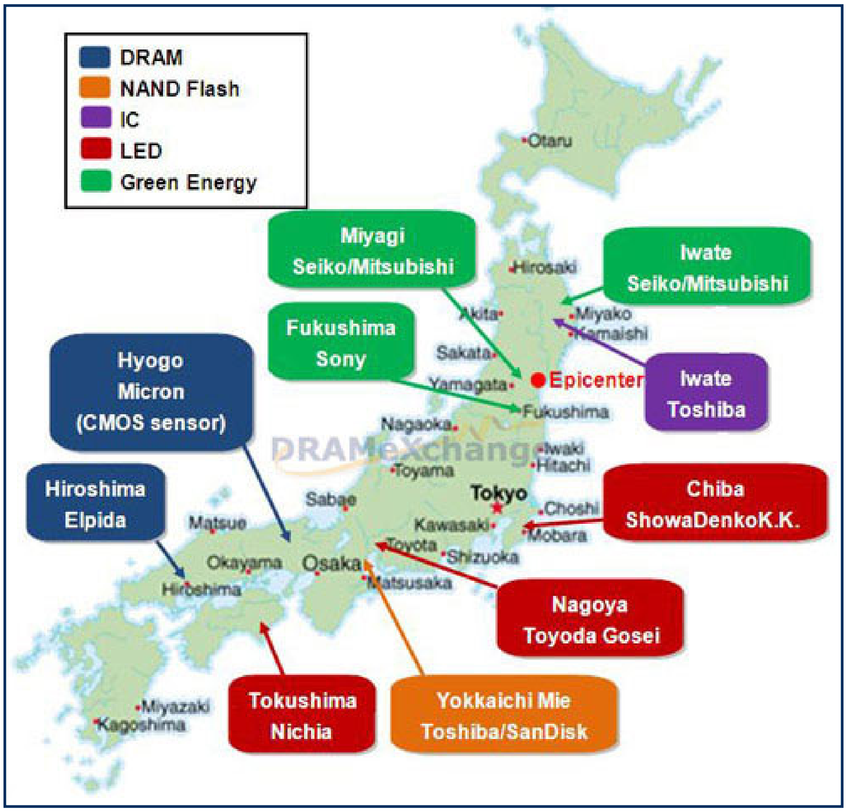
Exhibit 5-b

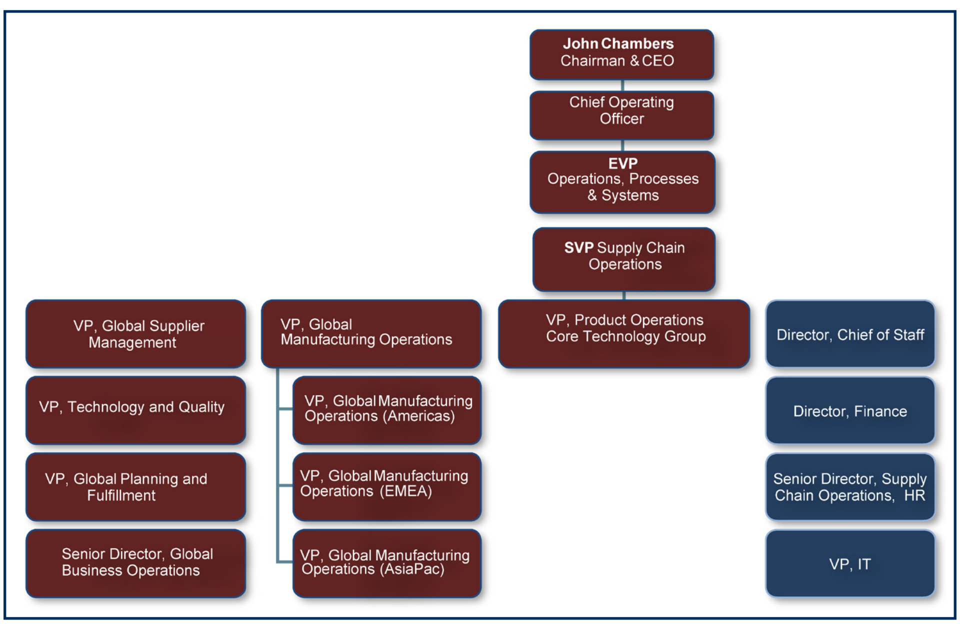
Location of other electronics facilities



Source: DRAMeXchange.com

Exhibit 6

Cisco Supply Chain Operations Organization



Source: Cisco

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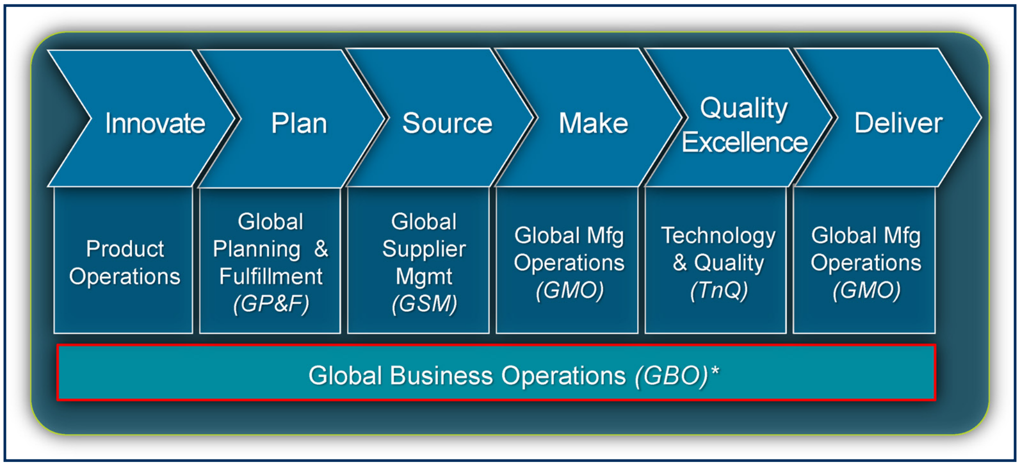
Exhibit 7

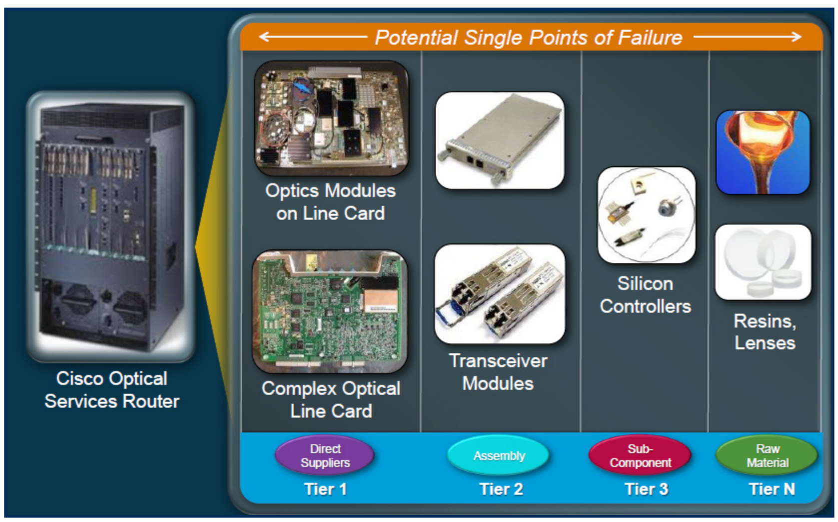
Supply Chain Operations Functional Alignment



Source: Cisco

Exhibit 8

Sample Supplier Map for a Router



Source: Cisco

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Exhibit 9

Cisco Supplier Footprint in Japan (illustrative)

Source: Cisco

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Endnotes

1 Japanguide.com <http://www.japan-guide.com/e/e3031.html>. Accessed 11 January 2013.

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