

DISASTER SHOWS FLAWS IN JUST-IN-TIME PRODUCTION

Is the global supply chain as good as its most damaged link?



REUTERS/KIM KYUNG-HOO

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TSUCHIURA, JAPAN/DETROIT/
SAN FRANCISCO, MARCH 21

JUST OVER A WEEK AFTER the massive earthquake hit the sprawling Texas Instruments chip plant here, a gardener is reworking the Japanese garden in an inner courtyard of the office tower attached to the plant.

The garden is a symbol of tranquillity and the gardener runs his rake in swooping patterns in the fine gravel that resemble

ripples in a pond.

Although no one is manning the gate or the front desk in the office building, the rest of the plant just outside Tsuchiura -- which locals dub "Tekisasu," or Texas -- appears anything but tranquil.

Dozens of workers in jump suits and hard hats inspect the outside of the plant complex. A conference room on the ground floor of the plant's office tower is packed with white collar workers even though it's a Sunday. TI says the plant will not resume full production until mid-July.

There is no visible damage to the plant.

But if it is structurally sound, the Japan just outside its gates is not. There are cracks in the asphalt on the roads and the concrete walls of older buildings. Gas stations are shut and ration purchases when they do open. Train schedules have been cut sharply. A homemade sign on a hotel window says "Japan: Don't Let This Quake Defeat You."

Soon after the devastating earthquake and tsunami that struck northeastern Japan on March 11, major manufacturers around the world sprang into action. From a conference room at General Motors Co's technical center in the Detroit suburb of



IDLED: A farm just outside the gates of the Texas Instruments plant in Miho, Japan. The plant was shut down by the earthquake that hit Japan on March 11, 2011. **REUTERS/KEVIN KROLICKI**

Warren to the Memphis headquarters of package delivery giant FedEx Corp, teams of employees scrambled to assess the impact on staff, factories and goods.

"Within an hour and 15 minutes we'd established a crisis room after the earthquake," Andy Palmer, senior vice president of Japanese automaker Nissan, said in a telephone interview from his office in Tokyo last week. "From there we were able to see everything unfolding, the priority being on the status and welfare of the employees."

In a globalized economy where manufacturers have moved ever more toward lean inventories and "just-in-time" production -- keeping ultra-low quantities of parts on hand to avoid holding expensive stocks of parts -- a speedy response was vital because a disruption to the global supply chain would spread quickly, shuttering plants employing legions of workers around the world.

Numerous manufacturers and suppliers have already warned of possible supply disruptions that are seen potentially affecting everything from consumer products such as Apple Inc's iPad to Boeing's long-awaited



IPAD: Several key components of the newly released iPad 2 come from Japan, including the battery and the flash memory used to store music and video, according to research firm IHS iSuppli. Above, the components of a first generation iPad are laid out during a teardown by iFixit's Luke Soules, performed in Glen Ellen, Virginia April 3, 2010. **REUTERS/MOLLY RILEY**

Dreamliner.

The most immediate threat to manufacturers stems from the fact that the weakest link in the global supply chain is what Japan is best known for: high-end, highly technical parts like semiconductors, which also weigh very little.

"The earliest impact will be felt with high-cost, low-weight products," said John

Hoffecker, managing director of restructuring advisory firm AlixPartners LP. "They come out of Japan by plane so manufacturers don't have much of a buffer for those products."

Interviewed by Reuters on March 17, Hoffecker said the real impact of supply disruptions for those parts would become evident "in about a week." GM said the parts it gets from Japan are more the high-end electrical type. Chips made by ON Semiconductor, which has shut down facilities in Aizu and Gunma due to infrastructure troubles, are used by automakers in everything from air conditioning to power steering, lighting, braking systems, navigation and lighting.

It is not just a question of high-tech production, but also inventory. Even a split-second loss of power at a memory chip plant, where production takes weeks, can wipe out a large volume of goods.

TOUGH CHOICES

EVEN UNDER NORMAL CONDITIONS, bringing suppliers back online after a disruption can be a lengthy process for the most basic parts. It requires careful calibration and extensive testing. So the

INTERACTIVE

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road to recovery could be a long one.

Speaking in Sao Paulo, Brazil on Friday, GM chief executive Daniel Akerson said it could take two weeks to assess the impact -- and the situation is still uncertain because of Japan's ongoing nuclear crisis.

Manufacturers with backup supply sources are already switching production to them. For those without alternatives, the race is on to find them, leaving many companies chasing the same ones.

Even if they do find alternative sources, getting them to produce the right part is a lengthy process involving design and factory testing.

"The production of any part can be moved over time, but in the short term it's a huge challenge," said Fred Hubacker, executive director at consultant and turnaround specialist Conway MacKenzie. "It takes more than weeks and less than years. It's certainly

not something that can be done overnight. It's generally not cost effective to move to a new supplier."

In the meantime, manufacturers face tough choices as inventories dwindle. They may be forced to halt production on some models as parts run out, or channel shared parts to popular models to maintain output.

"If you are looking at risk management in a situation like this you would want to protect the vehicles you sell the most of," said Dan Cheng, leader of A.T. Kearney's automotive practice in the Americas.

GM has already idled a plant in Louisiana making pickup trucks with low sales volumes, plus suspended production at a plant in Spain and canceled two shifts at a plant in Germany making cars for its loss-making Opel unit. "We are optimizing the usage of parts that are or might be in short supply as a result of the earthquake in Japan," said spokesman Klaus-Peter Martin.

"TRYING TO UNDERSTAND THE SITUATION"

Details of the extent of the damage in Japan have been slow to emerge, not least

because communications with badly affected areas were impossible in the days after the 9.0 magnitude earthquake. While many companies have provided updates on which plants are out of action, Austin, Texas-based Freescale Semiconductor provided a rare glimpse of how its employees coped after the disaster.

The coastal city of Sendai was hit by a 10-meter (33 feet) tsunami following the quake, causing catastrophic damage. Freescale has a facility there making accelerometers, pressure sensors and other chips for cars that shut down after the tsunami.

Spokesman Rob Hatley said fast-thinking Freescale employees elsewhere in Japan leased trucks after the quake to get emergency supplies like dry food, water, clothes and batteries to their colleagues in Sendai who are shifting production to other facilities and moving inventory to customers.

"We run a global supply chain, so the same resources, skillsets, problem solving and ingenuity that we put in our fab every day, we continue to apply in our current environment," Hatley said.



OUT OF GAS: An employee cleans as a sign reading "out-of-stock" is displayed at a gas station in Tokyo March 18, 2011. **REUTERS/TORU HANAI**

"WE ARE REALLY IN A PHASE WHERE WE ARE TRYING TO UNDERSTAND THE SITUATION WITH OUR SUPPLIERS."

Within days of the disaster, major local manufacturers said their plants had been affected. Companies from automaker Toyota Motor Co -- which makes 38 percent of its vehicles in Japan -- to consumer electronic giant Sony Corp reported stoppages and in several cases manufacturers said they did not know when production would resume.

Big suppliers like Shin-Etsu Chemical, the world's leading maker of silicon wafers, and chip maker Texas Instruments have also reported that quake damage has hurt production. Japan produces 57 percent of the world's wafers and around 20 percent of its semiconductors.

Texas Instruments declined to say which customers are affected by the closure of its Miho plant, the one with the Japanese garden. But a list of TI customers obtained by Reuters includes Apple, Nokia, the world's largest cellphone maker by volume, and auto safety gear maker Autoliv Inc. On its web site, Autoliv says it provides parts to all the major automakers and that GM is its largest customer, accounting for 14 percent of its sales in 2010. It was not possible to determine which of them are served by the Miho plant.

The plant also makes Digital Light Processing chips, a key component in many video projectors. Texas Instruments is the main manufacturer of DPL chips, making their steady supply crucial to projector manufacturers like Optoma Technology Inc and Vivitek Corp. Vivitek is working closely with TI to monitor the availability of the crucial chips and guarantee their supply, a Vivitek spokeswoman said.

NSK Ltd, Japan's largest manufacturer of ball bearings, said none of its plants were damaged, but it did not know when it would be able to resume full production "due to uncertainty over power supply."

A list of NSK's automotive customers obtained by Reuters reads like a who's who of global automakers, including majors such Ford Motor Co, Fiat and Volkswagen -- though again it was not clear which customers receive parts from NSK's Japanese plants.

Chris Swartwout, vice president in charge of human resources and supply chain and logistics for NSK in North America, said he could not discuss which of the company's customers were affected. "We are really in a phase where we are trying to understand the



BATTERED: Scattered containers are seen at a devastated factory area after an earthquake and tsunami in Sendai, northern Japan, March 13, 2011. **REUTERS/KIM KYUNG-HOON**

situation with our suppliers," he said. "The situation is still being assessed."

"INFORMATION IS PARAMOUNT"

THE CRISIS ROOM AT GM'S technical center in Warren, Michigan, is one of four the company has worldwide -- one each for North America, South America, Opel/Vauxhall and GM International.

GM's Chief Global Manufacturing Officer, Diana Tremblay, said the room is staffed constantly -- with around 25 people when she last visited on Thursday -- and contains lists of all plants around the world, all vehicle models and key parts like powertrains. There are regular conference calls and email updates as information comes in about GM's broader supply base. Tremblay says GM leaves decisions on plant shutdowns until the last possible minute.

She said the decision last Thursday to idle its Shreveport, Louisiana, plant, which makes low-selling Chevrolet Colorado and GMC Canyon pickup trucks, was necessary because the workers are "4/10s" that is, they are working four 10-hour shifts Monday to

LIVE COVERAGE

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Thursday and needed to be told before the weekend.

Tremblay said GM could not say how long the plant would be closed, nor which others could be affected. "There are no games being played here, we just don't know," she said. "And I can assure you it's not from a lack of effort."

FedEx, which flies low-weight, high-tech parts out of Japan, also immediately set up a global planning team after the earthquake and began helping customers assess the situation after finding that all of its employees escaped the disaster unscathed. "We were very fortunate," said Doug Cook, vice president of international planning and engineering at FedEx unit FedEx Express.

Apart from shutting the nearest facility to the damaged Fukushima nuclear plant, he



HIGH, AND DRY: Two overturned ships are seen near a port area hit by the tsunami and earthquake in Hachinohe, Aomori prefecture, Japan March 13, 2011. **REUTERS/ALY SONG**

said the company is running normal service in and out of Japan and is screening all outgoing packages for radiation.

Cook said FedEx account executives in Japan are working "day in, day out" with customers to see if they need alternative locations for deliveries and pickups and to provide assessments of the situation on the ground.

"Information is paramount," he said. "It enables people to understand what's going on."

Norman Black, a spokesman at rival UPS said the company stands ready to help customers move items to other factories overseas if they determine they have to move production.

Obtaining information is a problem right now because the supply base below the top suppliers is opaque.

"When it comes to the supply base companies tend to focus on the level below them," A.T. Kearney's Cheng said. "It's simply time consuming and cost prohibitive to go deeper than that across your supply base."

Barry Tarnef, a senior risk specialist at property insurer Chubb Corp, said the murky

"SHOULD YOU HAVE JUST A SINGLE STRATEGIC SUPPLIER, SHOULD YOU HEDGE YOUR BETS AND HAVE SOME REDUNDANCY?"

nature of the supply base may mask the fact that somewhere down the chain a company may "control the lion's share of the market."

"If something happens to that one company it could shut down an entire industry," he said.

DEJA VU

EXPERTS HAVE BEEN recommending for years that manufacturers diversify their supply base. After all, recent history is full of examples of widespread supply chain disruptions and their consequences for manufacturers reliant on too few sources -- from the attacks on Sept. 11, 2001 to Hurricane Katrina in 2005 and the cloud of

volcanic ash from Iceland that shut down Europe's skies last year.

In the wake of such events, some companies have implemented strategies to diversify their suppliers and production. But according to Gad Allon, an associate professor of managerial economics and decision science at the Kellogg School of Management at Northwestern University, they are the exception rather than the rule. "A minority of companies have a good understanding of operational risk," he said. "The majority do not."

Toyota has been gradually implementing a strategy so that all of its models can be produced in more than one plant around the world. But that does not include the Prius, which is only made in Japan, leaving Toyota stuck. Multiple suppliers can also reduce the risk of disruptions.

"Should you have just a single strategic supplier, should you hedge your bets and have some redundancy?" said James DeLoach, managing director and risk management expert at consulting firm Protiviti. "These are tough calls. But once you've made your call, you've got to play the hand you dealt yourself."

That's why companies are faced with these issues right now."

TrueCar.com's Jesse Toprak said that prior to the earthquake Prius models in California were selling on average \$300 below the dealer invoice price. Within four days, the price was \$1,000 above the invoice price. Toprak said the price will continue to rise because the high-mileage Prius is popular among environmentally conscious consumers.

But in the longer term if the price gets too high, customers interested in a Prius to save money on fuel will balk at the cost. "At some point, the math just won't make any sense for most people," Toprak said.

SAVE NOW, PAY LATER

SUNIL CHOPRA, a professor of operations management and information systems at the Kellogg School of Management, says the lure of single suppliers is they make life easier for manufacturers and are cheaper to manage.

"If you're saving 5 pennies per unit then the \$100 million you could lose in a disruptive event doesn't show up in your results today," he said. "That's what drives companies toward single-sourcing. But how many units at 5 pennies per unit do you have to produce to make up for that big loss?"

Chopra and others like D&B Supply Management Solutions' Mike Krechevsky expect events in Japan and their impact on the supply chain will force major manufacturers to think about the need for reserve plans.

"This is going to open up a lot of eyes," Krechevsky said. "Many organizations are going to step back and take a look at this and see if they have contingency plans for such a thing."

But Chopra says companies talked about diversification after previous disasters and past experience shows that when the dust settles manufacturers will select the cheaper option to boost their bottom line.

"We'll see a surge now in companies talking about diversification," he said. "But as this fades into memory decision makers will not take disruptive events into account to the extent that they should."

"In six months they'll discount the risk all over again."

"THE RIGHT THING TO DO"

IF THERE IS ANY DEBATE on whether the Japan quake will force a rethink on suppliers, there is apparently none about just-in-time production. No one interviewed for this article expected any change.

JAPAN QUAKE TOLL

Worst affected prefectures
With assessed damage or flooding

LATEST DEVELOPMENTS

- 1 Miyagi Prefecture**
Police said they believe 15,000 people had been killed in the prefecture alone
- 2 Fukushima Prefecture**
Tests detect radiation above the national safety level in spinach and milk produced near the Daiichi nuclear plant. Residents advised not to drink tap water
- 3 Tokyo** Much smaller traces of radioactive iodine have also been found in the city's water

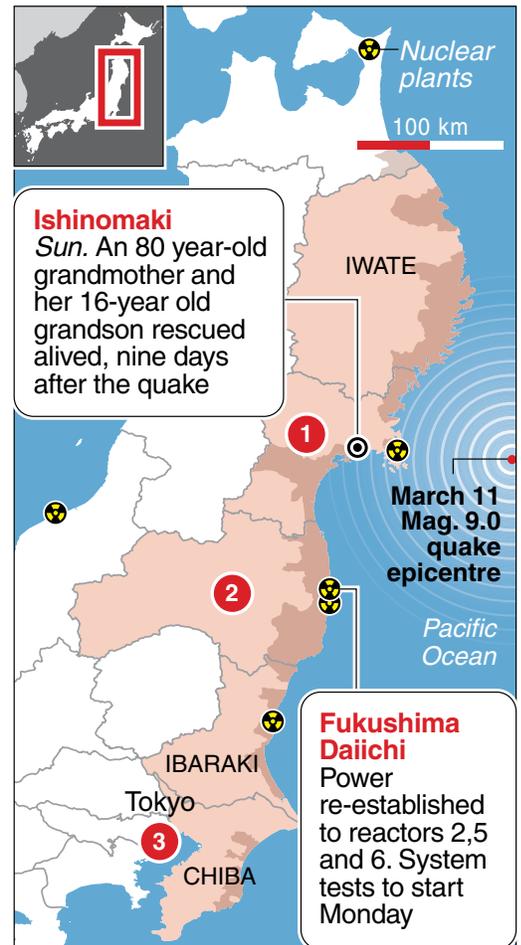
DAMAGE as of 0200 GMT on Mon.

- At least 14,637 structures were completely destroyed
- At least 1,449 roads, 51 bridges, 15 railways damaged
- 242,927 households without electricity
- 938,000 households remain without water in 12 prefectures
- Some 349,349 people living in 2,300 evacuation centres

CASUALTIES Worst-hit prefectures Official figures as of 0200 GMT, Mon.

	Killed	Missing	Injured
TOTAL	8,649	12,877	2,702
Miyagi	5,244	3,413	988
Iwate	2,650	5,023	143
Fukushima	699	4,436	220
Ibaraki	19	1	636
Chiba	16	3	194

Sources: Reuters, OCHA, Japan National Police Agency



GM's Tremblay has been with the company since just before her 18th birthday in 1977. Back then, inventories were much bigger, bringing "lots of extra cost and lots of extra confusion."

"Years ago you had a lot of stock lying around," she said. "The big change is that there's not all that inventory lying around anymore. It's far better not to have all that inventory."

"But the opposite is true when you have

supply chain disruptions," she added. "That's the tradeoff."

"On balance, it's still the right thing to do."

(Additional reporting by Ben Klayman, Deepa Seetharaman and Bernie Woodall in Detroit; Helen Massy Beresford in Paris; Bill Rigby in Seattle; and Suzanne Cosgrove in Chicago; Editing by Jim Impoco and Claudia Parsons)

JAPAN QUAKE IMPACT ON PORTS

THE FOLLOWING IS A ROUNDUP of the effect on ports of the devastating earthquake and tsunami that struck the northeast coast of Japan.

PORTS

- Cosmo Oil's terminal at the port of Chiba has resumed vessel cargo operations, but onshore facility work remains. The firm's terminal was the only one damaged at Japan's top oil and LNG port.
- Shipping companies are confident of keeping goods moving through Japan's ports, using spare capacity at the largest to deal with cargo displaced from those devastated in last week's earthquake and tsunami.
- Japanese ports handled 19 million units -- measured in twenty foot boxes -- of container shipments last year. As much

as 7 percent of that had been shut off after the quake and tsunami hit northern Japan.

- Two piers at the medium-sized Onahama seaport in Fukushima prefecture are now available for 30,000 tonne vessels.
- Japan's Sendai Gas says it will likely take more than a month to restart its Shinminato liquefied natural gas facility. All the remaining LNG terminals in Japan are in operation.
- The northeast coast ports of Hachinohe, Sendai, Ishinomaki and Onahama are so severely damaged that they are not expected to return to normal operations for months.
- Hachinohe handles a wide variety of goods, including fuel products to the local fishing fleet and U.S. military

installations in Japan and South Korea. Other ports handle goods ranging from coal and rubber to LNG and machinery.

- The large container and oil port of Kashima is also closed, but officials expect four of the 11 berths to resume operations in two weeks.
- Other damaged ports include Hitachinaka, Hitachi, Soma, Shiogama, Kesenuma, Ofunato, Kamashi and Miyako. The ports handle products ranging from sugar and non-ferrous metals to cars and wood products.
- The quake has damaged or destroyed three dry bulk vessels operated by Nippon Yusen Kaisha, one from Kawasaki Kisen Kaisha and one from Mitsui O.S.K. Lines.

(Compiled by Randy Fabi in Singapore; Editing by Manash Goswami)

Japanese ports damaged by earthquake

Est. 2010 total seaborne trade

\$1.5 trillion

- Ports closed
- Ports with some piers open
- Other major ports (including LNG/crude)



CLOSED OIL PORTS and TERMINALS

- 8. **Sendai**, JX Nippon Oil and Energy Corp
The fire at its oil refinery land shipping facility was extinguished at around 0600 GMT on Mar 15. The port remains closed.
- 13. **Kashima** — closed
It is the 9th largest port in Japan by payload in 2010.
- 14. **Chiba**, Cosmo Oil
The fire at the Cosmo Oil terminal has not been extinguished as of 1000 GMT on Mar 15. The Chiba port is opened but the Cosmo Oil terminal remains closed.

CLOSED DRY CARGO PORTS and TERMINALS

- From North to South (see map)*
- | | |
|---------------|--|
| 1. Hachinohe* | 8. Sendai |
| 2. Miyako* | 9. Soma |
| 3. Kaimashi | 10. Onahama — 2 piers have reopened |
| 4. Ofunato | 11. Hitachi |
| 5. Kesenuma | 12. Hitchinaka |
| 6. Ishinomaki | 13. Kashima |
| 7. Shiogama | |

These ports have been seriously damaged and are expected to offline for months or even years.

As at 0630 GMT Mar 17
Sources: World Port Source, Lloyd's list, Inchcape Shipping Services. *Hachinohe and Miyako are expected to reopen by end of Thursday, Mar 17.



COMPANY ROUND-UP

FACTBOX



ROAD BLOCKS: Residents walk past overturned cars in an area hit by a tsunami and earthquake in Hachinohe, Aomori prefecture, Japan March 13, 2011. **REUTERS/ALY SONG**

JAPAN QUAKE IMPACT ON AUTO MAKERS, ELECTRONICS FIRMS

FOLLOWING IS A round-up of the impact of Japan's devastating earthquake and tsunami on auto makers and electronics makers.

AUTO MAKERS

■ Toyota Motor Co has halted operations at its 12 main assembly plants in Japan. That closure has been extended to

Tuesday (March 22), and will result in lost production of 95,000 vehicles. From Monday (March 21), Toyota had said it

would begin making car parts at plants near its base in Toyota City, central

Japan, for overseas assembly facilities. It had said it would resume this week making parts for service centres to repair vehicles already on the road.

■ Honda Motor Co is extending the production halt in Japan to Wednesday (March 23) from March 20. Honda's announcement came after the automaker distributed a memo to U.S. dealers saying

it would review each dealers' product allotments for vehicles to be built after May.

Honda made 69,170 cars in January in Japan, which accounts for a round a quarter of its production.

■ Nissan Motor Co said Monday it resumed limited operations at five of its plants in Japan with vehicle production set to start Thursday. Nissan said production of repair parts for overseas manufacturing restarted at its Oppama, Tochigi, Yokohama,

Kyushu and Nissan Shatai plants. Vehicle production will start Thursday and will continue while supplies last, the company said. Restoration of its Iwaki engine plant in northern Japan will take longer than the other plants, the company said. Nissan made 81,851 cars in January in Japan, where it manufactures 23 percent of its vehicles. Goldman Sachs has calculated that one day's lost production costs Nissan about 2 billion yen in profit.

■ Mazda Motor Corp said it plans to suspend production at two plants in southwestern Japan until Sunday (March 20), but has not yet decided how to proceed after that.

■ Fuji Heavy Industries Co said all five of its car and parts-related plants for its Subaru-brand vehicles in Gunma prefecture, north of Tokyo, will be shut at least until Sunday.

■ Renault Samsung, the South Korean unit of French car maker Renault SA, said it will cut back on weekend and overtime production because of a potential parts shortage.

■ General Motors, the largest U.S. automaker, said it would temporarily idle its pick-up truck plant in Louisiana due to a parts shortage. GM's South Korean unit said it, too, was considering cutting back on weekend and overtime production.

ELECTRONICS MAKERS:

■ Sony Corp opened one factory, which makes optical films used in LCDs, and adhesives, on Wednesday. Seven plants, which make an array of devices from IC cards to Blu-ray discs to lithium batteries, remain closed. Sony is not sure when the plants will resume operations. Some of those plants' output is supplied to other manufacturers, including customers overseas.

■ Toshiba said output was still halted at a factory in Iwate prefecture making system LSI chips for microprocessors and image sensors. It has begun work to bring the factory back on line, but has no timeframe to resume output. Toshiba said an assembly line at a plant in Japan making small liquid crystal displays for smartphones and other



NO PLAY: A Sony playstation controller is seen at an area that was devastated by last week's earthquake and tsunami, in Kesenuma, north Japan, March 19, 2011. **REUTERS/KIM KYUNG-HOON**

devices will be closed for a month to repair damaged machinery.

■ Canon said it may not be able to resume production this week at three plants that sustained serious damage in the quake. One makes lenses, another ink jet printers and the third produces equipment for making LCD screens. Canon said it was also forced to suspend production until Friday at one of its main plants in Oita, on the southern island of Kyushu, where it makes cameras, lenses and compact photo printers. The world's largest maker of digital cameras said it was having difficulty securing necessary parts.

■ Nikon Corp said four of its production facilities were closed, including two of its precision-equipment plants, but the effect on cameras and lenses is seen as minor, since most output for those devices is in Thailand. Nikon does not have a timetable to re-open the plants.

■ Panasonic said none of its northern Japan manufacturing facilities, including those making optical pick-ups and other electronic parts, digital cameras and audio equipment, were badly damaged, but it

would take time to resume operations as infrastructure needed to be restored.

■ Renesas, the world's No.5 chipmaker, said it has halted operations at 8 of its facilities and was unsure when it would restart production there.

OTHERS

■ Shin-Etsu Chemical, the world's leading maker of silicon wafers, said two of its plants near the worst-hit areas remain offline. The firm has not said when it will restart operations. Some of the wafers made here are shipped to chip companies overseas. Shin-Etsu is trying to boost production elsewhere, particularly of 300-millimetre wafers, to make up the shortfall.

■ Jamco, a Japanese company making galleys for the long-awaited Boeing 787 Dreamliner, said delivery of the component could be delayed if gasoline becomes even more scarce.

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CHAOS: Scattered containers are seen at a devastated factory area after an earthquake and tsunami in Sendai, northern Japan, March 13, 2011. **REUTERS/KIM KYUNG-HOON**

COVER PHOTO: Smoke and scattered containers are seen at a devastated factory area after an earthquake and tsunami in Sendai, northern Japan, March 13, 2011. **REUTERS/KIM KYUNG-HOO**

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