

EFFECTS OF THE GREAT EAST JAPAN EARTHQUAKE ON INDUSTRIES IN PORT CITIES

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ABSTRACT

This paper aims to summarize damages and the recovery process of enterprises and manufactures in port cities affected by the Great East-Japan Earthquake and Tsunami from published information such as newspaper articles. The database is organized by city and by industry type. At the same time, characteristics of each port city before the Earthquake are reviewed based on industrial, trade and port statistics. Also, recovery status of trade is investigated from trade statistics after the Earthquake by port and commodity.

INTRODUCTION

The Great East Japan Earthquake of 11 March 2011 and the multiple large aftershocks in early April damaged the activities (e.g. production and logistics) of enterprises and manufactures in the Tohoku and Kanto regions. Generally, there is less information available on damages of private companies caused by earthquakes and tsunamis compared with those of public infrastructure because of privacy issues. Public bodies wishing to know the extent of damages to private companies often conduct questionnaire and interview surveys but in most cases the results are not open to the public as much of the information is confidential. However, putting the difficulty of obtaining information on individual companies aside, it is highly informative to summarize the damage and recovery process by industry type and the relationship of its location (e.g. ground condition and inundation height) to the degree of damage and recovery speed, for a discussion of policies on disaster mitigation considering influences on private companies.

Therefore, the purpose of this paper is to summarize basic information and develop a database on the damage and recovery process of private companies by industry and by port, using only public sources such as newspaper articles and trade statistics which anyone can access. The

database will be able to contribute to the discussion above. The next chapter describes the scope and method of this paper, then the characteristics of industrial activities in the entire affected area are summarized by ports in the following chapter. Next, as an example of the database summarized by individual port city, the results of Hachinohe city are shown. After that, the extent of recovery in terms of trade amount of representative goods of some port cities is shown for comparison. Finally, an example of an application of the database is given and conclusions are shown.

SCOPE AND METHOD

INTENDED INDUSTRY AND ACTIVITIES

This paper mainly focuses on manufacturing industry but also includes the following notable industries which were major industries in the affected area i.e., electric power plant, gas manufacturing plant, oil tank facility to stock petroleum products, and service station to stock cement. Also, major events pertaining to the fishing industry and livestock industry are summarized because they are closely related to fishery processing industry and feed production industry. On the other hand, distribution industry and retail industry are not included.

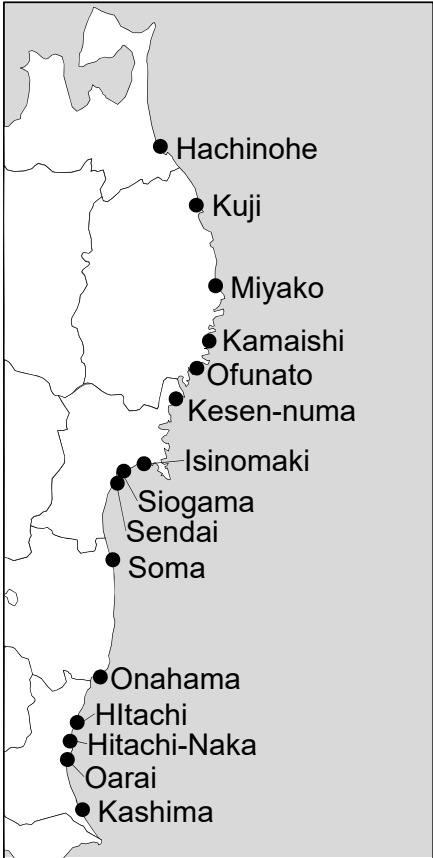


Figure 1: Major Ports Located in the Affected Area from the Earthquake Disaster

Information obtained from newspapers was related to production facilities and logistics functions of each factory, not including relief supplies. Because few articles on logistics recovery were found, the major focus of the database is on the damage and recovery of production capacities. The author also developed a database on the recovery of port infrastructure, which is not shown in this paper due to paper limitations.

INTENDED AREA AND COMPANIES

This paper targets all major companies and factories located in the affected coastal municipalities in the Tohoku and Kanto areas, because the author specially focuses on the damage and recovery of the inundated companies. However, for comparison, the companies which were not inundated in the target area are also included into the database. Figure 1 shows major ports of the affected area

There are 21 newspapers targeted in this paper including national papers such as Nihon Keizai Shimbun (Japanese Economic Newspaper) and Mainichi Shimbun, local papers both at the prefectural level (e.g. Kahoku Shimpo, which covers the entire Miyagi Pref.) and city level (e.g. Kamaishi Fukko Shimbun, which covers Kamaishi City area, Iwate Pref. which suffered heavy damage from the tsunami but resumed operations three months after the disaster), and trade papers on industrial business (e.g. Nikkei Sangyo Shimbun and Nikkan Kogyo Shimbun), maritime business (Nihon Kaiji Shimbun), and logistics business (Nikkan Cargo, LNEWS, etc.). The database was developed based on the articles from 12 March 2011 to 31 December 2011.

The author made a list of the major companies located in the affected area from various sources such as port planning map, city map, city database and business directories, as well as newspapers. At the same time, the list was checked for the leaks by some statistics including trade statistics, industrial statistics, and port statistics. The developed database was also checked from the newspaper database by searching by company's name.

CHARACTERISTICS OF INDUSTRY AND TRADE IN AFFECTED AREA BEFORE EARTHQUAKE DISASTER

Figure 2 shows the volume of trade for each port city both inbound and outbound. Note that the year shown in the figure is different by source due to the availability of the latest data. It is found that there is a general correlation between size of industry, trade amount, and cargo amount handled at port for each port city. A major exception, however, is Sendai-Shiogama port in which the trade and cargo amount are relatively larger than the size of economy of the direct hinterland (i.e., Miyagino-Ku of Sendai City, Tagajo City, Shiogama City and Shichigahama Town); the other exception is Ibaraki port in which the trade and cargo amount are quite smaller than the economy of the direct hinterland (i.e., Hitachi City, Tokai Village, Hitachi-Naka City, and Oarai Town). The reasons for these anomalies are that Sendai-Shiogama port is a regional hub of Tohoku region in which the cargo is collected from all of Miyagi Pref. and other prefectures of the Tohoku region, while in the case of Ibaraki most materials and products to/from the manufactures located in Hitachi City and its neighboring area (e.g. Hitachi, Ltd. and its group companies) are transported by truck from/to Tokyo Metropolitan Area and traded with foreign countries through the ports in the Tokyo Bay area.

Another finding is that although gross sale of fishery for each port city is smaller than the amount of manufactured products and trade, not only in Kesen-numa, which is a famous

fishing city, but also in Hachinohe and Ishinomaki the gross sales are larger compared with other cities.

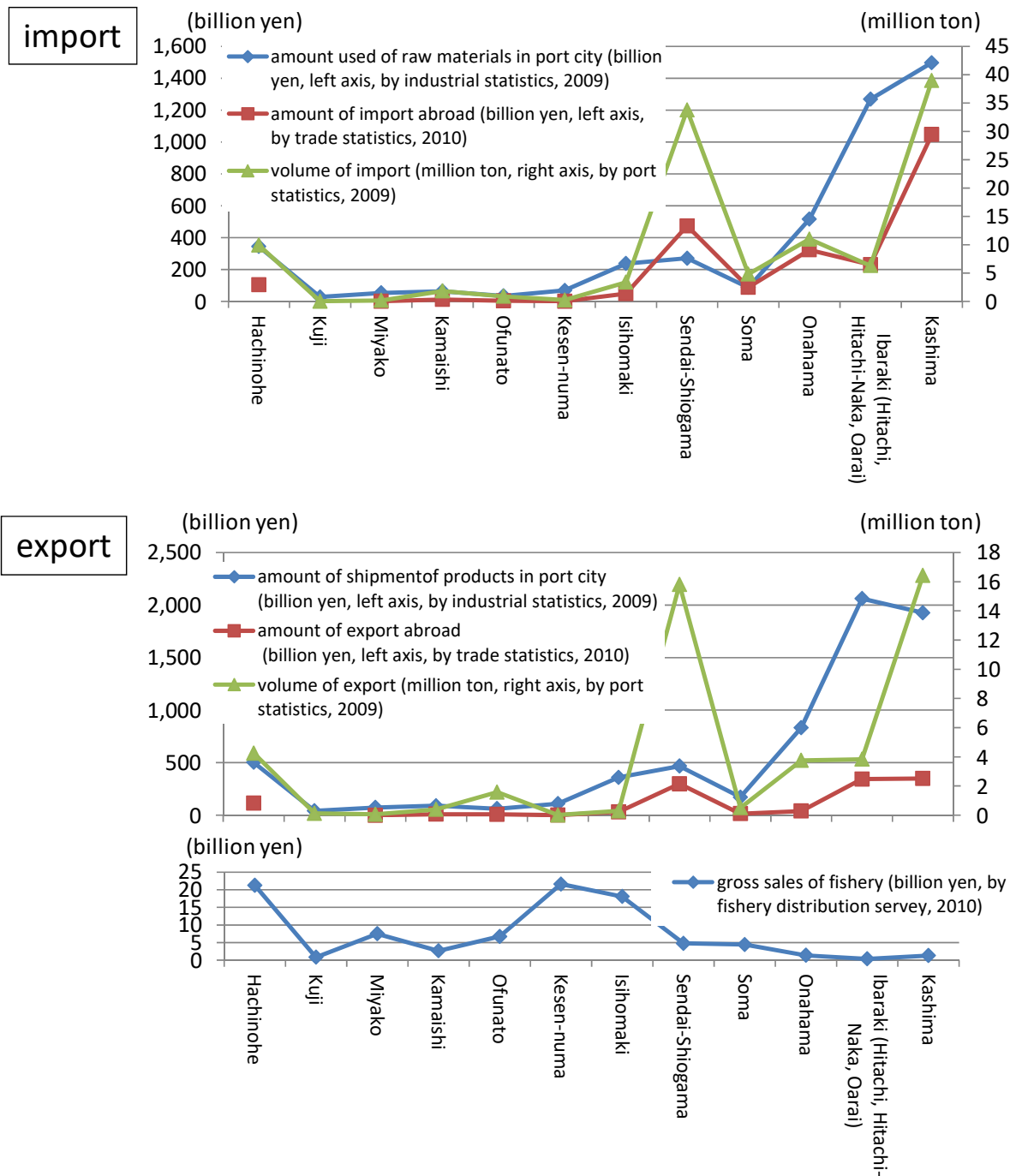


Figure 3: Comparison of Amount of Economic Activities, Trade Amount, Cargo Volume and Gross Sales of Fishery of Port Cities (by inbound and outbound)

AN EXAMPLE OF DATABASE DEVELOPED BY INDIVIDUAL PORT CITY

This chapter shows an example of the database the author developed from newspaper articles on damages and recoveries of companies by industry and by port city. An example of Hachinohe City, Aomori Pref. is hereinafter shown, which is the most northerly located of the the major cities affected by the tsunami disaster.

According to Japan Industrial Statistics (in 2009), major industries in Hachinohe City were Pulp and paper manufacturing industry, Food manufacturing industry, Steel industry, Beverage, cigarettes, and feed manufacturing industry, etc. Major foreign export goods handled in Hachinohe Branch Customs were ferroalloys, printing machines and their ancillary parts, vessels, semiconductor manufacturing machines, while major foreign import goods were corn and soybean oilcakes for feed processing, nickel ores for ferronickel manufacturing, woodchip for paper mills, zinc ores and lead ores for zinc smelting, according to Japan Trade Statistics (in 2010). On the other hand, according to Japan Port Statistics (in 2009) aggregated in tonnage basis, major export goods were limestone and cements, while additional import goods other than those listed from the trade statistics were coals and heavy oils, which were considered mainly imported from other Japanese ports by domestic ships. Out of the goods exported and imported described above from the trade statistics and port statistics, only printing machines and their ancillary parts was considered to be mainly manufactured in a factory located in Hirosaki City, Aomori Pref. (i.e. Canon Precision Inc.), while all of other goods were mainly used or produced in factories in Hachinohe City. The major factories in Hachinohe Port area are shown in Figure 4, including Mitsubishi Paper Mills, Hachinohe Smelting (zinc smelting), Tokyo Tekko (steel), Feed mill complex consisting of a silo and six feeds manufacturing factories, Pacific Metals (ferroalloy), Epson Atmix (atomic processing), Ulbac Tohoku (semiconductor manufacturing machinery), Kitanihon Shipbuilding, thermal power plants mainly using coals (Tohoku Electric Power, Taiheiyo Energy Center, and Mitsubishi Paper Mills), several oil tank facilities importing petroleum products, Hachinohe Cement and other company's cement service stations (i.e. distribution facilities), Sumimetal Mining (limestone), etc.

An example of database by industry (Pulp and paper manufacturing industry) is shown in Table 1. Hachinohe Factory of Mitsubishi Paper Mills Ltd. is one of the representative factories in Hachinohe City. Since it is located outside a port breakwater, damages and inundation height due to tsunami were relatively heavier compared with other factories located in the port area inside the breakwater; therefore, full recovery of production was also later (in middle of November 2011) than those of other major factories. However, the

recovery process was faster than that of Ishinomaki Factory of Nihon Paper Industries, which is located in Ishinomaki City of Miyagi Pref. and the most heavily damaged from the tsunami among factories in the pulp and paper manufacturing industry. In addition, it is also found from the database that Hachinohe Coastal Railways resumed its operation in early June following the first resumption of production of Mitsubishi Paper Mills' factory.

The author developed this kind of database for all major industries in all affected port cities and other coastal areas, including more than 1200 newspaper articles. The entire database is shown in Shibasaki (2012) but it is in Japanese only.

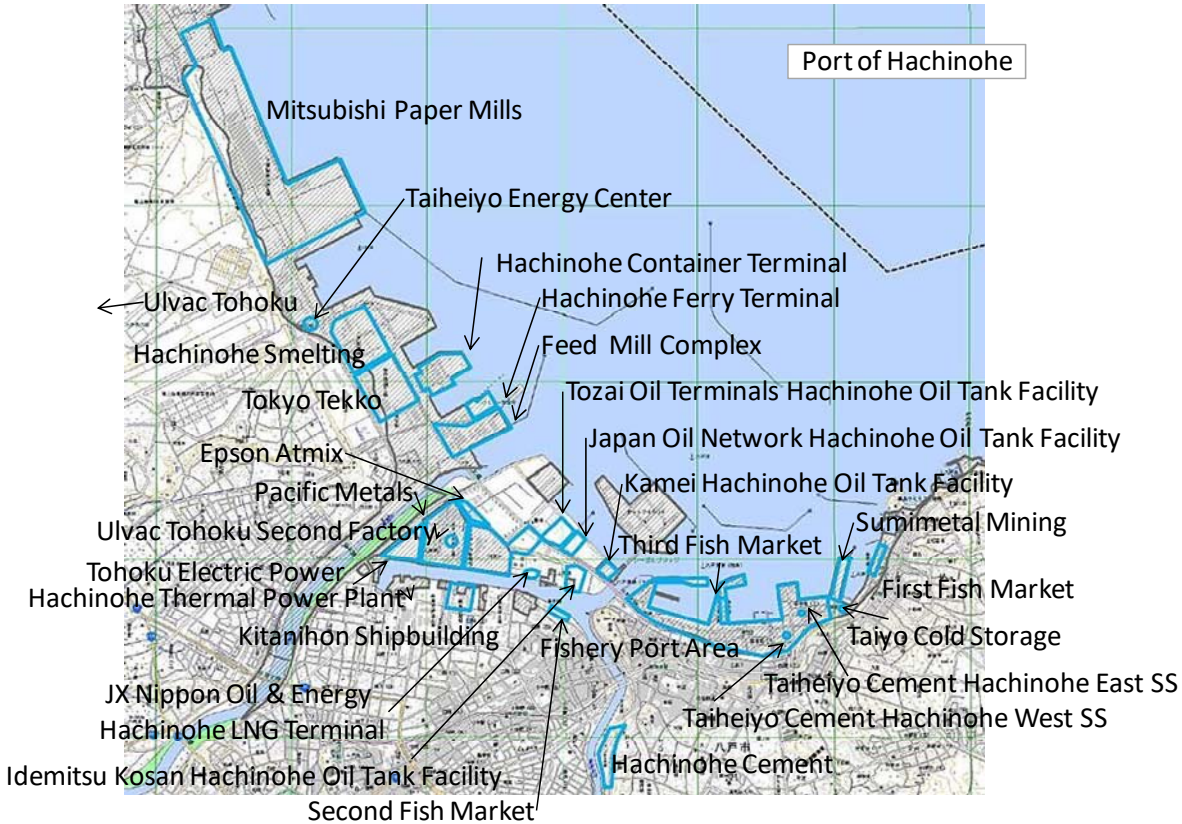


Figure 4: Location of Major Factories and Other Related Industrial Facilities in Hachinohe Port Area (pictured on an inundation map made by Geospatial Information Authority, in which the hatched area is inundated by tsunami)

Table 1: An Example of Database on Damage and Recovery Process by Industry (Chips and Paper Manufacturing Industry in Hachinohe City)

Date Happened	Date Published	Name of Companies	Name of Factories	Municipality	Paper of Source	Description
2011/3/11	2011/3/12	Mitsubishi Paper Mills (MPM)	Hachinohe Fac.	Hachinohe City	Nikkei Sangyo Shimbun	shut down. The first floor was inundated by tsunami.
	2011/3/17	MPM	Hachinohe Fac.	Hachinohe City	Daily Tohoku	Schedule of resumption cannot be planned. Situation of facility damage has been investigated since supply of electric power has been recovered.
	2011/3/23	MPM	Hachinohe Fac.	Hachinohe City	Daily Tohoku	Partly resumption of production will be expected in middle of May. Facilities for home-generation of electricity will resume in late April. Although the electric equipment had been largely damaged, the damage of buildings and paper machines were relatively small
2011/4/11	2011/4/10	Hachinohe Coastal Railways (HCR)		Hachinohe City	Daily Tohoku	starting a test run.
	2011/4/26	MPM	Hachinohe Fac.	Hachinohe City	Daily Tohoku	will resume its production on 25 May, reconstruct a production system of main products until Aug. to Sep., and fully resume within Mar. 2012.
	2011/4/27	MPM	Hachinohe Fac.	Hachinohe City	Nihon Kaiji Shimbun	The first chip carrier ship after the earthquake will enter at Port of Hachinohe until the week
	2011/5/12	MPM	Hachinohe Fac.	Hachinohe City	Daily Tohoku	Gross amount of damage is 11.6 bln. JPY, full resumption of production will be until the end of the year.
2011/5/13	2011/5/14	HCR		Hachinohe City	Daily Tohoku, Nikkan Kogyo Shimbun (5/16)	Because the damages of facilities themselves were relatively small, freight transport by rail will resume as MPM factory resume on 25th Mar.
2011/5/24	2011/5/25	MPM	Hachinohe Fac.	Hachinohe City	Daily Tohoku (5/28 also)	partly resumption of production (2 paper machines out of 7).
2011/5/26	2011/5/28	MPM	Hachinohe Fac.	Hachinohe City	Daily Tohoku	One smearing machine has resumed
2011/6/2	2011/6/3	HCR		Hachinohe City	Daily Tohoku	Operation has restarted with five wagons (half of the former number) because the MPM factory resumed.
2011/6/19	2011/6/21	MPM	Hachinohe Fac.	Hachinohe City	Daily Tohoku	The third paper machine has resumed (reaching as 35% of the former producing capacity)
	2011/6/21	MPM	Hachinohe Fac.	Hachinohe City	Iwate Nippo	The full resumption of production will be on November in one month advance than expected before.
2011/7/19	2011/7/21	MPM	Hachinohe Fac.	Hachinohe City	Daily Tohoku, Nikkei Sangyo Shimbun (7/28)	Producing capacity reaches to 55% of the former one by resuming the fourth paper machine and second smearing machine.
2011/7/8	2011/7/21	Hyogo Clay	Hachinohe Fac.	Hachinohe City	Daily Tohoku	Production of calcium carbonate as paper coating material has been resumed. Recovery schedule has substantially moved up than the expected that more than one year.
2011/8/29	2011/8/31	MPM	Hachinohe Fac.	Hachinohe City	Daily Tohoku	Producing capacity reaches to 70% of the level before the earthquake by resuming the fifth paper machine
2011/9/29	2011/10/1	MPM	Hachinohe Fac.	Hachinohe City	Mainichi Shimbun, Iwate Nippo, etc.	Sixth paper machine has resumed, reaching to 90% of the former producing capacity.
	2011/10/26	MPM	Hachinohe Fac.	Hachinohe City	Nihon Keizai Shimbun	The sales performance of September surpasses the planned.
2011/11/15	2011/11/16	MPM	Hachinohe Fac.	Hachinohe City	Nihon Keizai Shimbun, Nikkei Sangyo Shimbun, Daily Tohoku, etc.	Fully resumed.

Notes: For an event that was run by multiple newspapers, some of their name are often omitted.

RECOVERY STATUS OF INDUSTRY AMONG PORT CITES FROM TRADE STATISTICS

After the earthquake, out of the statistics described in the previous chapter, the Japan Trade Statistics have only been published on the web. Figure 5 shows rates of monthly trade amount (by foreign export and import) in 2011 compared with that on the corresponding month in 2010, for top 10 commodities (in HS 4 digit level) in Hachinohe Branch Office of Japanese Customs. The 100% line in the figure stands for the same amount of trade with the previous year. Also, plot lines are omitted from the figures in case that the trade amount of the month in 2011 and/or 2010 is zero.

From the figure, it is found that influences of the earthquake and tsunami disaster vary among commodities. For example, export of paper and paperboard resumed in July but had not fully recovered by the end of year 2011; in other words, the pace of recovery was a little bit behind that of Mitsubishi Paper Mills' factory described in the previous chapter. The export of zinc also had not fully recovered by the end of the year. Meanwhile, export of printing machine and its ancillary parts (considered mainly from a factory in other city, which was not directly damaged from the earthquake) was resumed within April, and mostly recovered in June. Exports of most of other commodities also had recovered by June or July and some of them enjoyed a temporary increase over the period of a month or more as a reaction to the decreased production in the first half of the year. The pace of recovery in importing major materials and goods seems faster than that in exporting. For most commodities, the recovery can be observed from April.

For comparison, Figure 6 to 8 show the same rates of monthly trade in 2011 in Ishinomaki, Sendai-Shiogama and Kashima Port. In Kashima Port (Ibaraki Pref.) shown in Figure 8, where damage was considered the lightest among these four ports, the influences of the earthquake on export and import are difficult to find for some commodities, because some of the major factories located in Kashima port (e.g. Kashima Factory of Sumitomo Metal Industries) resumed full operations within a month. On the other hand, recoveries of exports and imports in two ports (i.e. Ishinomaki and Sendai-Shiogama) in Miyagi Pref. were far behind those in Hachinohe and Kashima. In particular, in the port of Ishinomaki, which was one of the most heavily damaged ports due to tsunami, exports and imports of almost all commodities had not recovered by the end of year 2011.

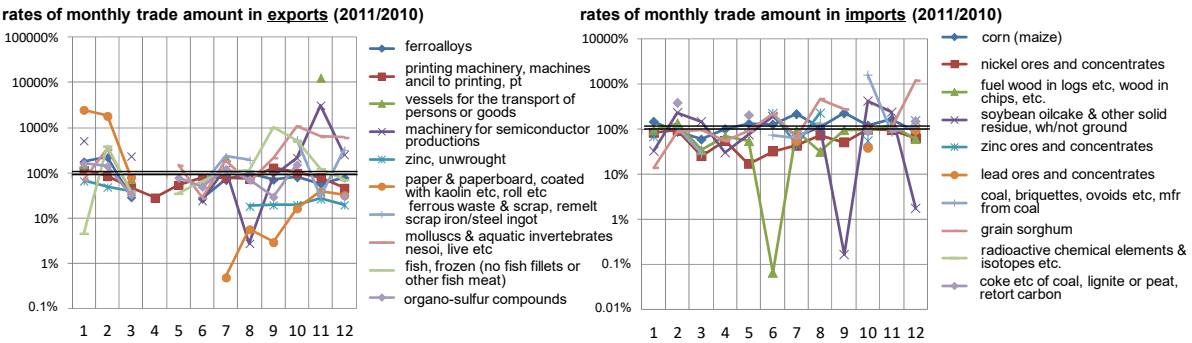


Figure 5: Rates of Monthly Trade Amount (by Foreign Export and Import) in 2011 Compared with the Corresponding Month in 2010, for Top 10 Commodities (in HS 4 Digit Level) in Hachinohe Port (source: Japan Trade Statistics)

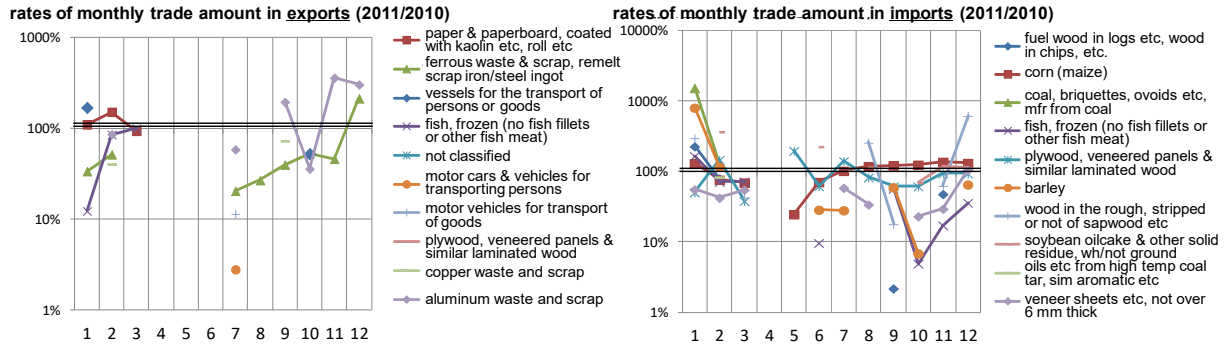


Figure 6: Rates of Monthly Trade Amount in 2011 Compared with the Corresponding Month in 2010, for Top 10 Commodities in Ishinomaki Port

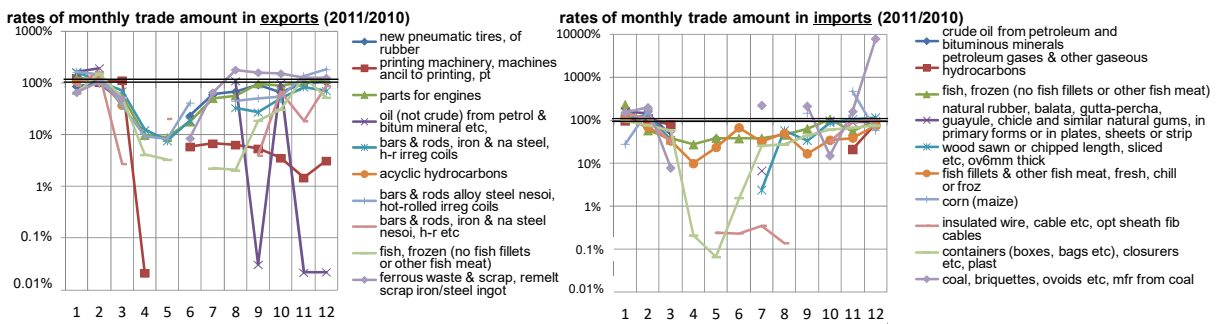


Figure 7: Rates of Monthly Trade Amount in 2011 Compared with the Corresponding Month in 2010, for Top 10 Commodities in Sendai-Shiogama Port

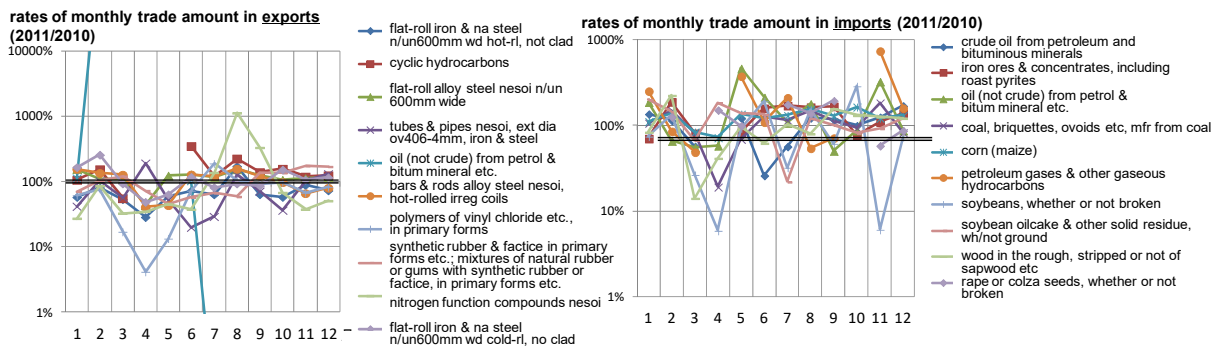


Figure 8: Rates of Monthly Trade Amount in 2011 Compared with the Corresponding Month in 2010, for Top 10 Commodities in Kashima Port

CONCLUSIONS

This paper summarized the damage and recovery process of companies and factories in port cities affected by the Great East Japan Earthquake, particularly the tsunami. The author developed a database of newspaper articles by industry and by port city, also confirmed the recovery status of import and export commodities from trade statistics, although all of them

were not described in this paper due to paper limitations. Because the database is organized only from the published information, anyone can review the relationship of location of factory with damage and recovery process, and their differences between industrial types. The implications of these relationships would be useful when discussing disaster mitigation policies as they pertain to industrial activities.

An example of application of the developed database is shown below. Figure 9 shows the relationship between inundation height of each factory (which is estimated by subtracting altitude from the actual inundation height from sea level) and the number of days needed for full resumption of production after the earthquake, which is available from the database. From the figure, it is found that the recovery date of a factory tends to be later as its inundation height is larger. For example, if the inundation height of a factory surpasses 2 meters, at least 100 days would be required until full production could resume. The author hopes the developed database can be utilized for this kind of discussion.

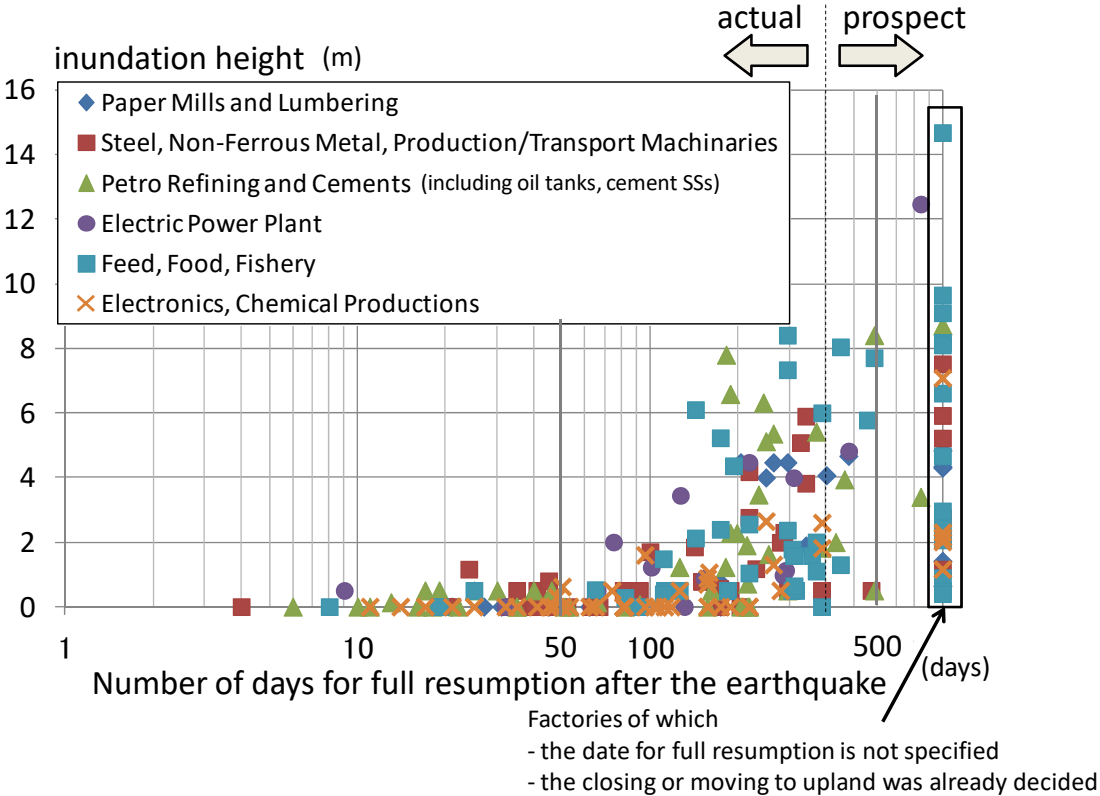


Figure 9: An Example of Usage of Database Developed: Relationship between Inundation Height and Days for Full Resumption of Productions after the Earthquake

REFERENCES

(1) R. Shibasaki (2012) *Damage and Recovery Process of Industries and Logistics in Port Cities Caused by the Great East Japan Earthquake*, Technical Report of National Institute for Land and Infrastructure Management, No.677, 106p. (in Japanese).