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RICE

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I. Overview

Japan's economy has maintained a recovery trend since FY2002, and from FY2003 to FY2007 the economic growth rate continued at a rate of about 2% per year. However, due to the global economic downturn that began with the U.S. subprime mortgage issue in the summer of 2007 and the Great East Japan Earthquake of March 2011, the economy has slowed down.

Recently, the Japanese economy is showing signs of recovery after bottoming out in 2012, and in 2013, the weak yen and high stock prices caused by anticipation regarding financial/economic policies improved private sector investment and consumer psychology, attracting consumer spending, and recovery boosted by public investment centring on earthquake recovery/reconstruction works is expected to continue. Although recovery is forecast for private capital investment and external demand in 2014, there are concerns that rises in consumption tax would cause economic recovery to stall.

The contracting trend in public investment in Japan since the latter half of the 1990s has at last ended, and shifted to recovery. In FY2008, the year of the Lehman Shock, the total public investment was ¥47.2 trillion, just over half that of the peak in FY1992. Since then, due to increased recovery/reconstruction investment following the Great East Japan Earthquake and due to private investment, bottoming out in 2011, the Japanese economy is now experiencing a gentle recovery.

The status of the construction industry in Japan can be summed up as follows.

① The number of construction companies is still declining, with a drop of 21.8% compared to the peak in 2000.

② The number of construction industry employees in 2012 was 5.0 million. In comparison to the peak year of 1997, it is a decrease of 26.6%.

③ Rapid aging of construction workforce is observed, and currently one in three is over 55 years of age. In addition, fewer young workers are entering in the construction industry, compared to other industry section.

④ Japan's overseas construction orders were affected by the worldwide recession, but since then it has increased to ¥1.2 trillion in FY2012.

II. Macro-economic review and forecast

1. Overview of Japan's economy (Figure1,2)

Japan's economy has shown continuous growth at a rate of about 2% per year since 2003, with a continuous albeit gentle recovery. However, due to the global economic confusion that began with the U.S. subprime mortgage issue in the summer of 2007 and the effects of soaring resource prices, Japan plunged into negative economic growth rates during FY2008 and FY2009. The FY2011 economic growth rate was only 0.3% due to the Great East Japan Earthquake of March 2011.

For this fiscal year of 2013, robust consumer spending is happening, before rises in consumption tax towards the end of the fiscal year, as well a rally is anticipated for housing construction before tax rise. In addition, mainly due to earthquake recovery/reconstruction works, public fixed capital formation has increased by 5.9%. In total, real GDP is expected to increase by 2.7% during FY2013.

Figure 1　Macroeconomic Trends (FY)

(Unit: Billion yen)

Fiscal year	1995	2000	2005	2009	2010	2011	2012	2013 (Forecast)	2014 (Forecast)
Real GDP	459,058	476,723	507,158	495,492	512,310	513,689	519,673	533,917	537,106
(YoY change)	2.7%	2.0%	1.9%	-2.0%	3.4%	0.3%	1.2%	2.7%	0.6%
Real private final consumption expenditures	265,891	275,056	292,579	295,027	300,051	304,730	309,689	316,819	314,882
(YoY change)	2.3%	0.3%	1.9%	1.2%	1.7%	1.6%	1.6%	2.3%	-0.6%
(Contribution rate)	1.3	0.2	1.1	0.7	1.0	0.9	1.0	1.4	-0.4
Real government final consumption expenditures	73,617	83,960	92,363	95,951	97,901	99,288	101,339	103,824	104,031
(YoY change)	4.3%	4.8%	0.4%	2.7%	2.0%	1.4%	2.1%	2.5%	0.2%
(Contribution rate)	0.6	0.8	0.1	0.5	0.4	0.3	0.4	0.5	0.0
Real private housing	23,609	20,080	18,345	12,268	12,534	12,999	13,683	14,530	13,816
(YoY change)	-5.7%	-0.1%	-0.7%	-21.0%	2.2%	3.7%	5.3%	6.2%	-4.9%
(Contribution rate)	-0.3	0.0	0.0	-0.7	0.1	0.1	0.2	0.2	-0.1
Real private corporate facilities	60,326	64,986	70,599	62,516	64,791	67,446	66,518	67,864	70,118
(YoY change)	3.1%	4.8%	4.4%	-12.0%	3.6%	4.1%	-1.4%	2.0%	3.3%
(Contribution rate)	0.5	0.7	0.6	-1.7	0.5	0.5	-0.2	0.3	0.4
Real public fixed asset formation	41,704	35,071	24,113	22,124	20,716	20,261	23,291	24,670	22,123
(YoY change)	6.7%	-6.1%	-6.7%	11.5%	-6.4%	-2.2%	15.0%	5.9%	-10.3%
(Contribution rate)	0.6	-0.5	-0.3	0.5	-0.3	-0.1	0.7	0.3	-0.5
Real inventory increase	1,291	341	807	-5,070	-480	-2,609	-3,004	-3,601	-3,363
(YoY change)	-241.5%	-110.2%	-46.3%	-374.4%	-90.5%	443.3%	15.1%	19.9%	-6.6%
(Contribution rate)	0.6	0.8	-0.1	-1.5	1.0	-0.5	-0.1	-0.1	0.0
Real financial services net exports	-4,509	-2,087	8,349	11,719	16,844	11,958	8,268	9,865	15,555
(YoY change)	596.5%	102.6%	56.0%	-4.4%	43.7%	-29.0%	-30.9%	19.3%	57.7%
(Contribution rate)	-0.6	0.0	0.6	0.2	0.8	-1.0	-0.8	0.3	1.1
Nominal GDP	504,594	510,835	505,349	473,934	480,002	473,276	474,605	485,773	496,532
(YoY change)	1.8%	0.8%	0.5%	-3.2%	1.3%	-1.4%	0.3%	2.4%	2.2%

Source: Construction and Economic Forecasts (RICE) for 2013 and 2014, Annual Report on National Accounts(Cabinet Office) for 1995-2012

Note: Real values reflect 2005 prices.

2. Major economic indicators

Figure 2　List of Major Economic Indicators

Fiscal Year	2008	2009	2010	2011	2012	(Forecast) 2013
GDP (real, year(2005), billion yen)	505,803	495,491	512,310	513,689	519,673	533,917
GDP (nominal, year, billion yen)	489,520	473,934	480,002	473,276	474,605	485,773
GDP growth (year, %)	-3.7%	-2.0%	3.4%	0.3%	1.2%	2.7%
Agriculture, forestory, and fishery	7.2%	-9.4%	-1.0%	2.1%	－	－
Manufacturing	0.8%	-17.7%	19.6%	-2.7%	－	－
Services	1.1%	-4.7%	0.0%	0.4%	－	－
Mining	-12.5%	-43.6%	5.9%	1.1%	－	－
Construction	-7.2%	-2.0%	-2.3%	0.9%	－	－
Demographic Indicators						
Population (year, thousands)	127,692	127,510	128,057	127,799	127,515	127,398
Population growth rate (year, %)	-0.06%	-0.14%	0.43%	-0.20%	-0.22%	-0.09%
Total labor force (year, thousands)	66,740	66,500	66,320	65,910	65,550	65,660
Labor force growth rate (year, %)	-0.15%	-0.36%	-0.27%	-0.62%	-0.55%	0.17%
Unemployment rate (year, %)	4.0%	5.1%	5.1%	4.6%	4.3%	4.1%
Inflation rate (year(2010), %)	1.4%	-1.4%	-0.7%	-0.3%	0.0%	0.3%
Financial Indicators						
Interbank interest rate	0.74	0.46	0.34	0.34	0.31	0.23
Short-term interest rate (%)	0.10	0.09	0.08	0.08	0.08	0.07
Long-term interest rate (%)	1.52	1.36	1.19	1.15	0.86	0.75
Exchange rate against US$	103.33	93.53	87.77	79.78	79.79	96.34

Source: Construction and Economic Forecasts (RICE, October 2013), Annual Report on National Accounts (Final Report for 2012, Cabinet Office), Financial and Economic Statistics Monthly (Bank of Japan), Ministry of Internal Affairs and Communications website.

Notes:

1. *The GDP figure for FY2013 is a forecast.Real values: 2005 prices.*
2. *Population figures are estimates as of October 1each year. The FY2013figure is an average value for three months.*
3. *The workforce population and unemployment rates are average values for 12 months. For 2013, the figure is an average value for seven months.*
4. *The inflation rate is a percentage as compared with the previous year's consumer price index. For FY2013, the figure is the rate of increase between FY2012 and July 2013.*
5. *Interbank Interest rates for 2013 are as of the end of August. Others reflect the year-end rates.*
6. *Short-term interest rates are calculated using the average published interest rate for domestic commercial paper.*
7. *Long-term interest rates are the rates on 10-year government bonds.*
8. *Exchange rate for 2013 is as of the end of August. Others are annual averages.*

III. Overview of the Construction Industry

1. Construction investment outlook (Figure3)

Construction investment in Japan for FY2012 (nominal: same hereinafter) was approx. ¥44.9 trillion, of which ¥18.9 trillion was government investment and ¥26.0 trillion was private investment.

According to the recent RICE forecast, construction investment for FY2013 is expected to increase by 9.1% over the previous fiscal year to ¥49.0 trillion.

For government construction investment, government directed/subsidized public works expenditure is forecast to rise by 13.1%, and local government works expenditure 1.0%, for an 11.5% increase over the previous fiscal year. For private residential investment, housing rush before rises in consumption tax is also anticipated, and a year-on-year increase of 7.0% is forecast. For private non-residential investment, capital investment on civil engineering infrastructure is expected to remain at high levels, and a 7.7% overall year-on-year increase is forecast.

Figure 3　Construction Investment Forecast

(Unit: ¥1 billion)

FY	1995	2000	2009	2010	2011	2012	2013 (Forecast)
Nominal construction investment	79,017	66,195	42,965	41,928	41,890	44,900	48,980
(YoY change)	0.3%	-3.4%	-10.8%	-2.4%	-0.1%	7.2%	9.1%
Nominal government construction investment	35,199	29,960	17,935	17,982	17,210	18,860	21,030
(YoY change)	5.8%	-6.2%	7.3%	0.3%	-4.3%	9.6%	11.5%
(Contribution rate)	2.5	-2.9	2.5	0.1	-1.8	3.9	4.8
Nominal private residential construction	24,313	20,276	12,840	12,978	13,380	13,980	14,960
(YoY change)	-5.2%	-2.2%	-21.6%	1.1%	3.1%	4.5%	7.0%
(Contribution rate)	-1.7	-0.7	-7.4	0.3	1.0	1.4	2.2
Nominal private non-residential construction	19,505	15,959	12,190	10,968	11,300	12,060	12,990
(YoY change)	-1.8%	0.7%	-19.0%	-10.0%	3.0%	6.7%	7.7%
(Contribution rate)	-0.4	0.2	-5.9	-2.8	0.8	1.8	2.1
Real construction investment	77,727	66,195	41,181	40,050	39,444	42,870	46,230
(YoY change)	0.2%	-3.6%	-7.7%	-2.7%	-1.5%	8.7%	7.8%

Source: Construction and Economic Forecast (RICE), Construction Investment Forecasts (MLIT).

Notes:

1. *Real values reflect 2005 prices.*
2. *Private non-residential construction investment = private non-residential building investment + private civil engineering investment.*

2. Construction companies

The number of licensed construction companies in Japan as of end March 2012 was 470 thousand, a decrease of 2.9% from the same month of the previous year. (Figure4) In comparison to the peak of March 2000, it is a decrease of 21.8%.

The number of construction-related companies is also slightly declining in recent years. (Figure5)

Figure 4　No. of Construction Companies, and Composition Size,

Year	2009		2010		2011		2012		2013	
	(thousand)	Percent of total	(thousand)	Percent of total	(thousand)	Percent of total	(thousand)	Percent of total	(thousand)	Percent of total
No. of registered contractors (total)	509	100.0%	513	100.0%	499	100.0%	484	100.0%	470	100.0%
Breakdown of registered contractors by size classification										
8 Sole proprietor	106.1	20.8%	107.9	21.0%	102.4	20.5%	97.0	20.1%	91.8	19.5%
7 Corporation with less than ¥3 million in capital	4.3	0.9%	5.8	1.1%	7.2	1.4%	8.4	1.7%	9.7	2.1%
6 Corporation with ¥3 million up to ¥10 million in capital	187.2	36.8%	189.7	37.0%	186.2	37.3%	181.9	37.6%	178.2	37.9%
5 Corporation with ¥10 million up to ¥20 million in capital	130.2	25.6%	129.0	25.1%	123.6	24.8%	118.4	24.5%	113.5	24.2%
4 Corporation with ¥20 million up to ¥100 million in capital	75.3	14.8%	74.9	14.6%	73.6	14.8%	72.3	14.9%	71.0	15.1%
3 Corporation with ¥100 million up to ¥1 billion in capital	4.5	0.9%	4.4	0.9%	4.4	0.9%	4.3	0.9%	4.2	0.9%
2 Corporation with ¥1 billion up to ¥10 billion in capital	1.1	0.2%	1.1	0.2%	1.0	0.2%	1.0	0.2%	1.0	0.2%
1 Corporation with ¥10 billion or more in capital	0.4	0.1%	0.4	0.1%	0.4	0.1%	0.4	0.1%	0.4	0.1%

Source: Survey of on the Number of Licensed Construction Companies (MLIT)

The number of construction consultant businesses is shown in the figure below.

Figure 5　No. of Registered Construction-Related Businesses
(by Business Type and Net Registered Number)

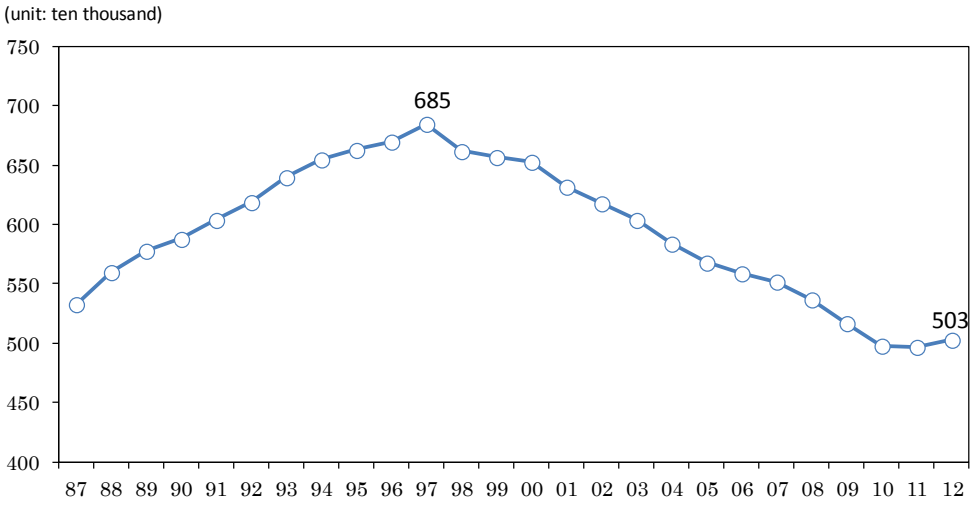
Business Type	Fiscal Year[2]	2009	2010	2011	2012	2013
Surveying[1]	No. of registered companies	13,324	12,974	12,695	12,566	12,436
	YoY change (%)	-2.6	-2.6	-2.2	-1.0	-1.0
Construction consulting[1]	No. of registered companies	3,993	3,952	3,991	3,935	3,941
	YoY change (%)	-1.2	-1.0	1.0	-1.4	0.2
Geological surveying[1]	No. of registered companies	1,305	1,286	1,289	1,265	1,263
	YoY change (%)	-2.3	-1.5	0.2	-1.9	-0.2
Net number of companies	No. of registered companies	15,057	14,605	14,200	13,951	13,773
	YoY change (%)	-0.5	-3.0	-2.8	-1.8	-1.3

Source: Registration Status of Construction-Related Companies (MLIT)
Notes:
1. Including companies with multiple registrations.
2. As of the end of March in each fiscal year.

3. Employees and construction labour

The number of construction industry employees in 2012 was 5.0 million. In comparison to the peak year of 1997 (6.9 million), it is a decrease of 26.6%.(Figure6)

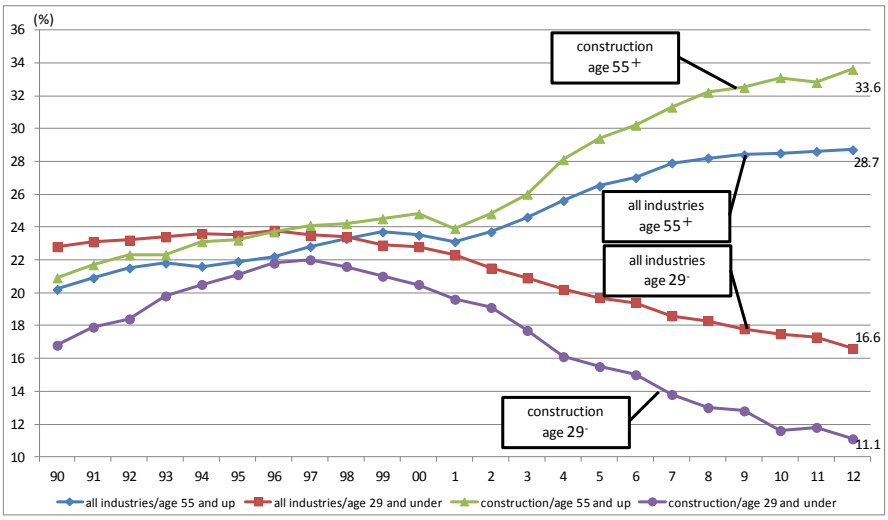
Figure 6　Number of Construction Industry Employees



Source: Labour Force Survey (Ministry of Health, Labour and Welfare)

Looking at trends in age composition among construction industry employees, in 2012, about 34% of employees were aged 55 or higher, while about 11% were aged 29 and under, indicating that aging in the employee population is progressing. In addition, the percentage in the young adult age group has dropped significantly. (Figure7)

Figure 7　Age composition of Construction Industry Employees



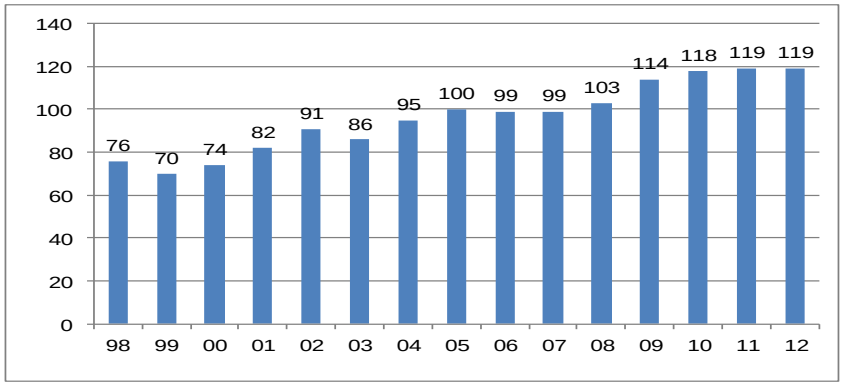
Source: Labour Force Survey (Ministry of Health, Labour and Welfare)

4. International transactions in the construction market

① Overseas construction companies in Japan (Figure8)

As of FY2012, the number of overseas construction companies (overseas corporations and Japanese corporations with over 50% foreign capitals) holding construction licenses in Japan was 119.

Figure 8　No. of International Construction Companies Holding Construction Licenses in Japan

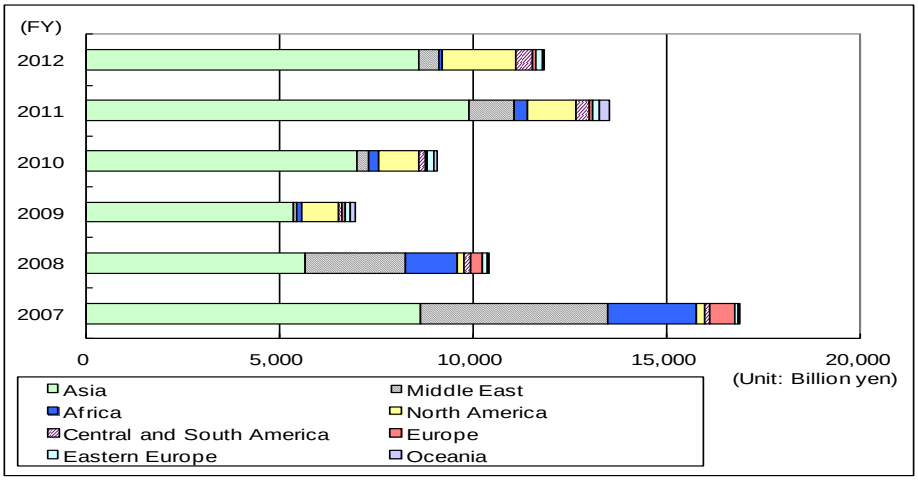


Source: MLIT

② Japanese construction companies overseas (Figure9)

The value of Japan's overseas construction orders received exceeded ¥1 trillion for the first time in 1983. Since then, this remained at around ¥1 trillion for about twenty years, and in FY2007, the value of orders received reached the highest recorded value of ¥1.682 trillion. With the effects of the global recession, the figure dropped to ¥0.697 trillion in FY2009, but this recovered to ¥1.1828 trillion in FT2012.

Figure 9　Overseas Construction Orders of Japanese Companies



Source: The Overseas Construction Association of Japan. Inc

③ Japanese construction consultant companies overseas (Figure10)

The overseas sales of Japanese construction consultant companies has recovered since the world recession and has remained at around ¥400 billion from FY2009 onwards, with sales for FY2012 reaching ¥458 billion.

Figure 10　Overseas Sales of Major Japanese Construction Consulting Companies (by Region)

(Unit: ¥1 billion)

Fiscal year	2009	2010	2011	2012
Domestic sales	383.7	318.5	375.7	415.5
(YoY change)	11.8%	-17.0%	18.0%	10.6%
Public sector	334.7	270.7	332.4	370.1
(YoY change)	12.2%	-19.1%	22.8%	11.4%
Private sector	49.0	47.8	43.4	45.3
(YoY change)	9.3%	-2.4%	-9.3%	4.5%
Overseas sales	49.1	49.7	46.3	42.5
(YoY change)	28.7%	1.4%	-6.9%	-8.2%
total	432.7	368.3	422.0	458.0
(YoY change)	13.5%	-14.9%	14.6%	8.5%

Source: The Overseas Construction Association of Japan. Inc

IV. Recent trends – Airport concessions

Introduction

In the "Japan Revitalization Strategy" approved by the Cabinet in June 2013, the Japanese government announced that over the next ten years, the business scale of PPP/PFI projects that utilize private sector funds and knowledge to develop, operate and update public infrastructure, will be increased to ¥12 trillion. (Currently ¥4.1 trillion)

Specifically, on the airport sector, "The Act for the Utilization of Private Sector Capability for the Operation of Government Administration Airports" was passed through the Diet in June 2013, and the "right to operate public facilities, etc." (so called "concessions") was established through the revision of "The Act on Promotion of Private Finance Initiative" (hereinafter the "PFI Act"). The PFI Act enabled the public airport authorities to retain ownership of airports while commissioning their operation to private sector businesses through concession contracts.

1. What are concessions?

"Concessions" refers to a public infrastructure administration system widely used in European countries such as France, etc. Specifically, while the state or local authority retains ownership, the "right to operate public facilities, etc." is set for public infrastructure that has the potential for revenue such as water and sewerage supply systems, toll roads, airports, etc. These rights are then purchased from the government by private sector companies who undertake the operation of said infrastructure, and continue operation while drawing revenue.

On the authorities' side, the merits are that the ownership of the facilities remains in their hand, while the risks of operation are transferred to the private sector, and concession payments paid by the private investors can be utilized for the early recovery of facility construction costs.

Meanwhile, concessionaires can increase revenues by combing their own business and by creating synergy with the operation of their own facilities.

By providing better services, private sector businesses will be able to achieve greater satisfaction among the users.

2. Current status of national and local airports

According to a Japanese government committee report on airport operation, there are 97 airports in service, of which 4 are under the administration of airport companies such as Narita International Airport Corporation, 28 are under the administration of national government (of which 9 are joint-use airports shared with the self-defense forces, etc.), and 65 are under the administration of local authorities.

Figure 11　Overview of Airports in Japan

Type		Founder and Administrator	No.	Overview
Hub Airports	Private administration airports	Airport companies	4	Narita Intl. Airport, Kansai Intl. Airport Osaka Intl. Airport, and Chubu Intl. Airport
	National government administration airports	Minister of Land, Infrastructure and Transport	19	Tokyo Intl. Airport and airports that serve as hubs for the international air transportation network or the domestic air transportation network
	Specific local government administration airports	(Founder) Minister of Land, Infrastructure and Transport (Admin) Prefectural governor, etc.	5	Asahikawa, Obihiro, Akita, Yamagata and Yamaguchi Ube airports
Local government administration airports		Prefectural governor, etc.	54	Airports other than hub airports, that serve important roles in the formation of international air transportation networks and the domestic air transportation network.
Joint-use airports		Minister of Defence, etc.	9	Airports used by the Japanese government and Japanese citizens, that are available for public duties (Misawa Airport, Komatsu Airport, etc.)
Other airports		Minister of Land, Infrastructure and Transport, Prefectural governor	6	Airports specified under Article 2 of the Airport Act, excluding hub airports, local government administration airports and joint-use heliports

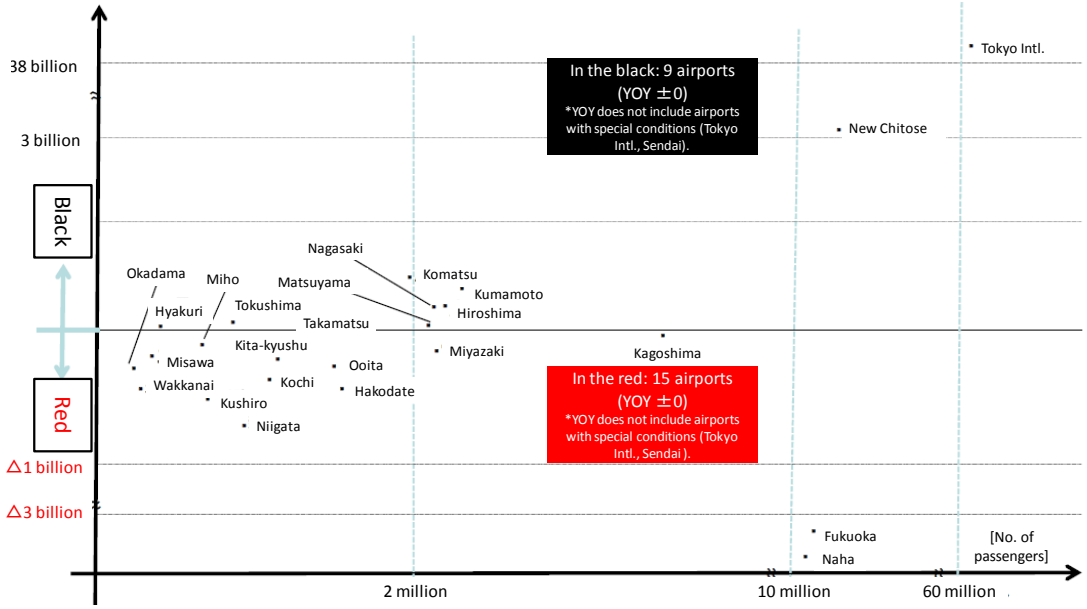
Source: MLIT

With national government administration airports, the MLIT manages the "Aviation related business" pertaining to basic airport facilities such as runways, taxiways, aprons, etc. (in joint-use airports, joint-use facilities such as runways are managed by the Ministry of Defense). Although landing fees, etc. which comprise the sources of revenue have preset deductions depending on route, taking the balance of payments for all airports in a fiscal year into consideration, basic national uniform tariffs (fare schedule data needed to calculate fares) are determined through notices. Consequently, in addition to a lack of usage fee settings that flexibly exploit airport characteristics, since the landing fee income of all airports nationwide is managed as a pool, there is

little transparency concerning the income and expenditure of each airport, and the absence of incentives to increase revenue and reduce costs (efficiency incentives) has been highlighted.

MLIT opened estimate of each airport's balance sheet in FY2011 including income and expenditure. The estimate shows operating profit and loss figures for 26 airports, of which 90% were in the red. In addition, according to EBITDA[1] (earnings before interest, taxes, depreciation, and amortization) calculations, for "Aviation related business only", 9 airports were in the black and 15 were in the red. Even adding "Non-aviation related business" such as retail revenues, 18 airports were in the black and 6 were in the red. As is apparent, optimization of management efficiency has not been realized for each airport.

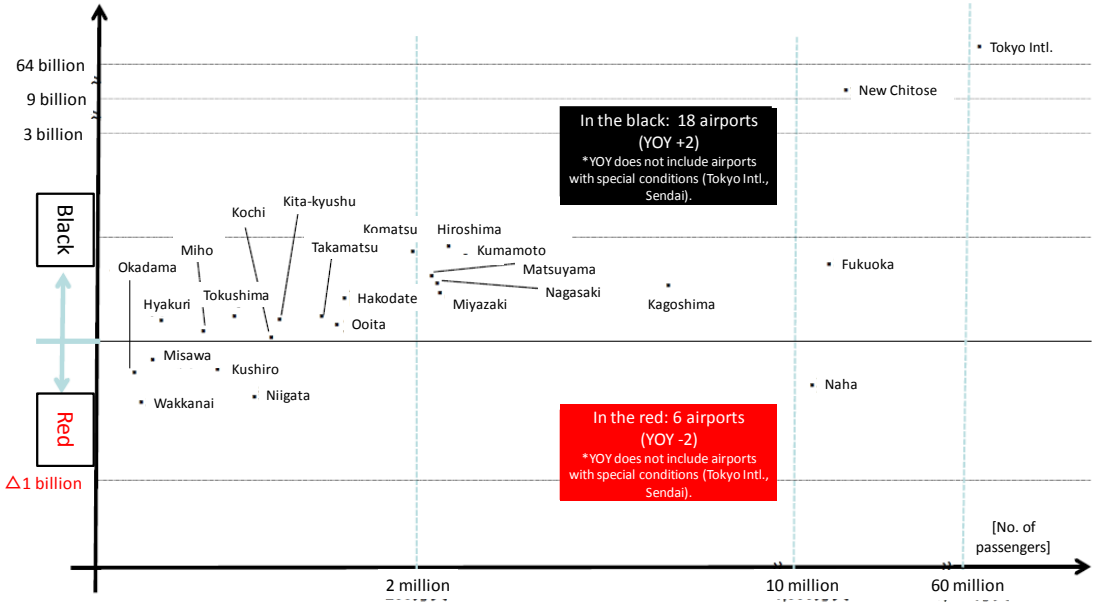
Figure 12　Income/expenditure for each airport (before EBITDA) – Before total



※This graph does not include 2 airports. (Sendai, Yao)

[1]Table showing cash-flow for each airport derived through business over one year. The formula is ordinary profit and loss + interest paid + depreciation. Before total (aviation related business), non-operating income "local authority contribution for construction income" and "receipts in to general accounts" were subtracted.

Figure 13　Income/expenditure for each airport (before EBITDA) – After total



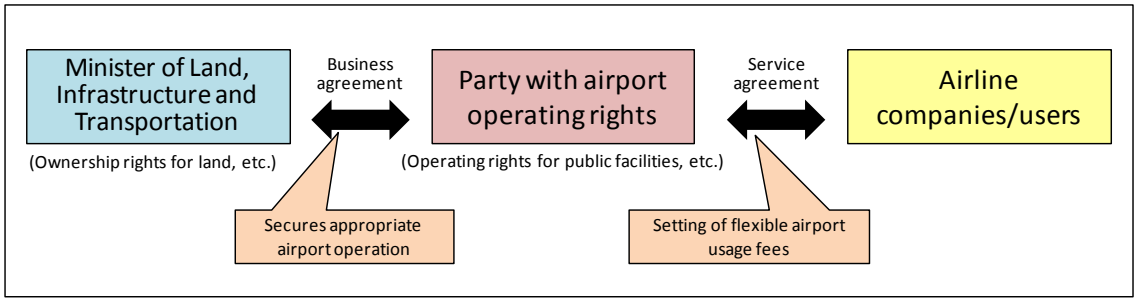
※This graph does not include 2 airports. (Sendai, Yao)

(Source: MLIT, Results of income/expenditure estimation per airport, FY2011)

In Japan, apart from Narita, Kansai and Chubu Intl. Airports which are operated by private companies, "Non-aviation related business" are separately managed from airport management. Thus, there was no scheme to integrate both businesses for more efficient use of airport facilities.

To improve this situation and realize truly attractive airports, it is considered necessary to construct a mechanism that will bring in private sector knowledge and funds, as is the case with overseas airports, so the concession system is introduced. "The Act for the Utilization of Private Sector Capability for the Operation of Government Administration Airports" was enacted in June 2013. The act clearly states that "In order to promote airport operation, etc. by utilizing private sector capabilities, the Minister of Land, Infrastructure and Transportation (MLIT) shall take the necessary measures to establish basic policies, and, in relation to airports, etc. under the administration of the MLIT, specify operating rights for public facilities, etc. and where operation, etc. will be undertaken, establish special provisions under related laws, etc.". The act also states that, "Regarding local government administration airports, in accordance with the judgments of the local authorities that are the airport's founder and administrator, similar special measures shall be established under the PFI Act, the Civil Aeronautics Act and the Airport Act."

Figure 14　Basic concessions scheme



(Source: MLIT)

3. Concessions to Kansai International Airport and Osaka International Airport

The first law to apply concessions to airport operation is the "Act on the Integration of Kansai International Airport and Osaka International Airport". The act was brought into effect on the 1st of July in 2012.

As shown in Figure 16, this law aims to utilize concessions, following the integration of Kansai International Airport and Osaka International Airport in FY2014, for the purpose of allowing the national government to retain ownership of both airports (national government is the shareholder of the newly established New Kansai International Airport Company, Ltd.) while transferring operational rights to the private sector. The Kansai International Airport has currently debt at ¥1.0062 trillion for the past. This amount will be repaid once concession is realized and the further revitalization of both airports through private sector know-how is anticipated.

New Kansai International Airport Company, Ltd. will acquire the terminal building operations from Osaka International Airport Terminal (OAT). After integrated operation of both airports and terminal buildings is achieved, then concession transaction process will start, which is expected to take place in FY2014.

Figure 15　Operational schemes for the two airports

※Passenger terminal building ,etc. at Osaka International Airport are operated by Osaka International Airport Terminal Co.,Ltd.

(Source) New Kansai International Airport Company, Ltd. Overview

4. Conclusion

The key for the success of concessions system is that whether private sector businesses can deliver corporate value and improve business balance through integration of airport activities. In case of large-scale disasters, airports serve extremely important roles as hubs for rescue/medical activities, so close cooperation between concessionaires and administrative authorities is essential.

The concession of the Kansai International Airport and Osaka International Airport will be a test case for Japan, and future progress of this endeavour will be worth keeping a close eye on.

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Ⅰ. Executive Summary

The Great East Japan Earthquake, with a magnitude of 9.0, occurred on March 11, 2011, and Japan suffered tremendous earthquake and tsunami damage. Nationwide, the total area flooded by the tsunami was 561km^2, with total fatalities at 15,883, and another 2,656 persons still listed as missing. Furthermore, with regards to damage to housing, 126,483 homes were completely destroyed and 272,287 homes were partially destroyed, and damages are estimated at around ¥17 trillion.

While many businesses were damaged by this unparalleled earthquake, the construction companies, which retained their materials, equipment and their capabilities in terms of personnel, applied their extensive knowledge of local geography, terrestrial phenomena and conditions and above all their sense of mission, and commenced work to open up emergency transportation routes and build provisional temporary housing immediately after the earthquake. Since the disaster and through to this day, these companies have been fulfilling a central role in the recovery of infrastructure, the disposal of the huge amounts waste generated by the disaster and the reconstruction of towns.

Earthquakes are not the only natural disasters that occur in Japan. Japan has a long thin shape with a mountainous region running all the way through the archipelago, and as 70% of the land is either mountainous or hilly terrain, stream gradients are extremely steep. Furthermore, in addition to high annual precipitation, rainfall is concentrated in the early summer rainy season and the typhoon season, so landslides and flooding can easily occur. Even in relation to these types of disasters, construction companies perform a central role in emergency responses such as the maintenance of erosion controls and levees, the emergency recovery of roads and waterways, the removal of deposited sands, etc. and urban flooding measures, etc.

At this conference, we will be introducing the responses to disasters in Japan, focusing on the efforts of construction companies.

Ⅱ. Disaster Reduction Japan

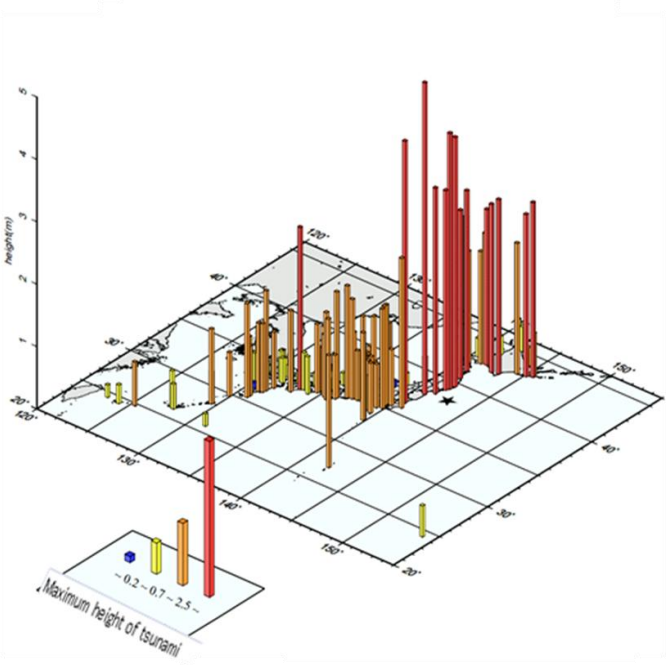
1. The Great East Japan Earthquake

(1) Summary of the Great East Japan Earthquake

① Summary of the Earthquake and Tsunami

At 14:46 hours on March 11, 2011, a magnitude 9.0 earthquake occurred off the Sanriku coast of the North-Eastern. Tremors were recorded over a wide area of Japan from Hokkaido to Kyushu, and this earthquake also triggered a huge tsunami.

Figure 1: Tsunami observation status



(Source) Japan Meteorological Agency

(Reference) Comparison with the earthquake off the coast of Indonesia/Sumatra in 2004

An earthquake, Mw9.1, occurred off a peninsula about 20km south of Banda Aceh on the Island of Sumatra, Indonesia. The maximum recorded height of the subsequent tsunami was 48.9m. The tsunami reached Indonesia, Thailand, Malaysia, India, Sri-Lanka, the Maldives and as far as the African continent, and the total number of fatalities and missing persons is said to be in excess of 300,000.

Figure 2: Major earthquakes world wide since 1950

Year	Location	Magnitude
1960	Chile	9.5
1964	Gulf of Alaska	9.2
2004	**West Coast of Northern Sumatra, Indonesia**	**9.1**
2011	**Great East Japan Earthquake**	**9.0**
1952	Kamchatka peninsula	9.0
2010	Maule Coast, Chile	8.8
1906	Ecuador Coast	8.8
1965	Aleutian Archipelago, Alaska	8.7
2005	Northern Sumatra, Indonesia	8.6
1950	Assam, Tibet	8.6
1957	Aleutian Archipelago, Alaska	8.6

(Source) Japan Meteorological Agency

② Outline of damage

The Great East Japan Earthquake was the largest in recorded history of Japan, and as this earthquake triggered a tsunami, the damages were extensive. The total area flooded by the tsunami was 561km², and as of February 2013, the total number of fatalities was 15,883and 2,656 persons are still listed as missing. In addition, 126,483 homes were completely destroyed, 272,287 were partially destroyed, and infrastructure such as roads and waterways were extensively damaged.

Figure 3: Damage status ①

Fatalities/missing	Fatalities: 15,883, Missing persons: 2,656
Building damage (Homes)	Completely destroyed: 126,483, Partially destroyed: 272,287
Waterway damage	2,115 sites
Levee revetment damage	Complete or partial damage to about 190km of a total 300km levee revetment through the three prefectures of Iwate, Miyagi and Fukushima of the North-Eastern
Port/harbour damage	International and important ports/harbours: 11, Regional ports/harbours: 18
Sewer system damage	Terminated sewage treatment sites: 18 (coastal sewage treatment sites in Iwate, Miyagi, Fukushima and Ibaraki prefectures) Damage to 957km of sewage pipes and rains out of 66,086km covering 137 cities and towns, etc.
Total road damage	15 expressway routes, 69 sections of national highways under direct government management, 102 sections of national highways under the management of prefectures, etc. 539 sections of prefectural routes
Area flooded due to tsunami	Iwate prefecture: 58km², Miyagi prefecture: 327km², Fukushima prefecture: 112km²

(Source) Created from materials by NPA and MLIT

Figure 4: Damage status ②

(Source) Tohoku Regional Bureau, MLIT

(Reference) Estimated damage amounts

As of June 2013, total damages by the Great East Japan Earthquake are estimated at ¥16.9 trillion including rehabilitation of destroyed infrastructure and relocation of communities toward inland areas. The total national recovery budget for 2011 – 2013 was about ¥23.6 trillion.

Figure 5: Estimate damage amounts

Item	Estimated damages
Buildings, etc. (Housing/sites, shops/offices, factories, machinery, etc.)	Approx. ¥10.4 trillion
Lifeline facilities (Water, gas, electricity, communications/broadcasting facilities)	Approx. ¥1.3 trillion
Social infrastructure facilities (Waterways, roads, ports/harbours, sewage systems, airports, etc.)	Approx. ¥2.2 trillion
Agriculture, forestry and fishery related (Agricultural land/facilities, forestry/fishery related facilities, etc.)	Approx. ¥1.9 trillion
Other (Educational facilities, healthcare/welfare related facilities, waste disposal facilities, other public facilities, etc.)	Approx. ¥1.1 trillion
Total	Approx. ¥16.9 trillion

(Source) "Damage Estimates for the Great East Japan Earthquake", Cabinet Office

(2) Efforts of Construction Companies

① Initial response by construction companies

With the Great East Japan Earthquake, many local construction companies in the affected areas suffered serious damages, with their executives, employees and their families falling victim to the disaster. Many company buildings were damaged and their equipment and materials were washed away. However, under their own initiative, construction companies in these regions conducted surveys of damage status within their immediate vicinities, and in response to calls from government, implemented works to remove debris from roads and repair uneven surfaces, and to confirm the status of collapsed bridges. The large and medium sized construction companies established disaster response headquarters, put their cooperative systems on standby and began preparations to undertake safety checks on the properties of their customers. The dispatching of support personnel, the shipment of relief supplies and the shipment of materials for recovery works, etc. also commenced from an early stage.

Column: "Operation Comb"

"Operation Comb" involved the opening up of multiple routes from the Tohoku Expressway and National Route No.4, which run north to south in the inland areas of the North-Eastern, to the various national routes that run along the coastal areas, like the teeth of a comb, in order to secure rescue and relief routes.

Due to the unimaginable size of the tsunami, the regions along the Pacific coast suffered catastrophic damage and became isolated due to the amounts of debris generated by the disaster. In order to secure emergency routes to the coastal areas, prefectural staff, the Ground Self-Defense Force, construction companies and personnel from the Ministry of Land, Infrastructure, Transport and Tourism, worked together to break through this debris, and had opened 11 routes by the day after the disaster (12th) and 15 routes by the 15th. This enabled passage for ambulances, and police and self-defense force vehicles, allowed medical teams to gain access to the affected areas, and enabled the distribution of relief supplies.

The reason why this opening of routes was concluded in such a short time is that, following the damage to roads observed after the Great Hanshin-Awaji Earthquake of 1995, the Tohoku region implemented a seismic reinforcement measures on 490 bridges, and this was a significant factor that contributed to the avoidance of life-threatening damages such as collapsed bridges.

These opened routes also functioned as materials transportation roads for recovery works.

Figure 6: Operation Comb in Progress

(Source) Tohoku Regional Bureau, MLIT

○ **Emergency recovery**

Construction companies commenced work immediately after the earthquake and proceeded vigorously in the recovery of facilities such as roads, ports/harbours, airports, railways and waterways, etc. In addition, with regards to emergency provisional housing, at the time of the disaster, local authorities estimated the need for such housing at 52,000 units. In the construction of emergency provisional housing, local construction companies, as well housing manufacturers, sought to meet the demand, with 4,000 units built by construction companies, 1,300 units built by the Fukushima General Construction Association and 2,700 units built by another 11 construction companies. After about 6 months from the disaster, construction of 51,000 of the required 52,000 housing units had been completed.

Figure 7: Emergency recovery of Bridge (Rikuzen-Takata City, Iwate Prefecture)

(Damage status) After emergency recovery (July 12, 2011)

(Source) Tohoku Regional Bureau, MLIT

Figure 8: Emergency recovery of coast works (Iwanuma city, Miyagi Pref.)

(Source) Tohoku Regional Bureau, MLIT

Figure 9: Emergency housing

(Source) MLIT

○ **Removal and disposal of Tsunami debris**

As previously stated, the earthquake and the tsunami caused by the Great East Japan Earthquake generated 19.3 million tons of waste and 10.2 million tons of tsunami debris. The debris were an obstruction to the smooth progress of land utilization for reconstruction, and also constituted fire hazards, breeding grounds for harmful insects and noxious odours, early removal and disposal was necessary.

To this end, the prefectures set up "Disaster waste processing actions plans" defining processing procedures and schedules, and work is progressing with the aim of completing all waste processing by March 2014, within three years of the disaster.

For processing, the general procedure was to dismantle waste at the disaster sites, and then to transport the waste to initial temporary placement sites for rough sorting and rough crushing. This waste was then collected and transported to a secondary temporary placement site for intermediate processing (crushing, sorting, incineration, etc.), finally followed by recycling and disposal.

Joint ventures (JV) have been commissioned to undertake each disposal classification in this series of processing, and the construction companies that possess the wide ranging know-how to cover the establishment of waste disposal facilities, the improvement of foundations, the removal of various toxic wastes and responses to radiation, and recycling technologies, form the core of these JVs.

As of July 2013, 76% of disaster waste and 50% of tsunami debris had been cleared, and of the processed disaster waste, 82% was recycled.

Figure 10: Flow of disaster waste processing

① Temporary placement

② Separation processing

③ Incineration facility

④ Incineration ash recycling facility
Special chemicals are used to render incineration ash generated from incinerated waste insoluble (by sealing in heavy metals, etc.), cement is then used to solidify this ash into granules, which is then used as reconstruction material once safety has been confirmed.

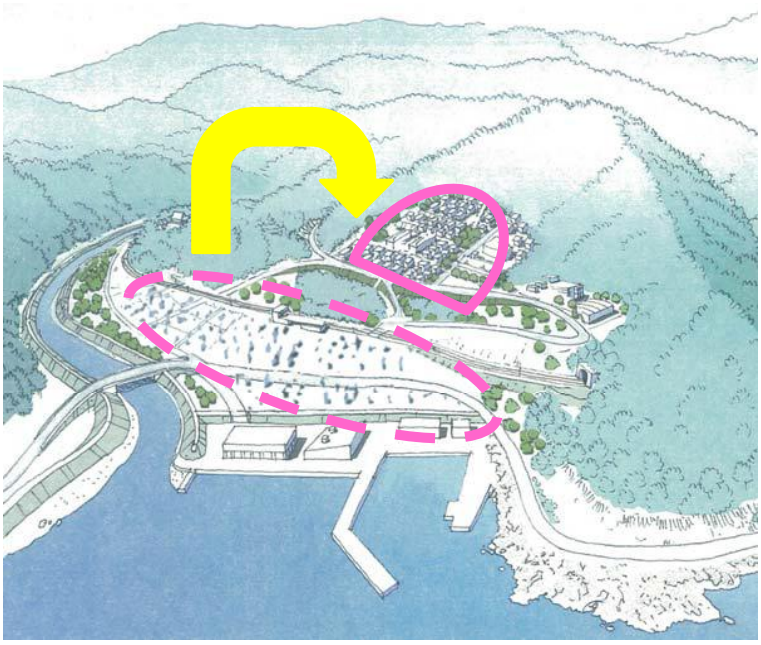
(Source) MOE, Japan Federation of Construction Contractors

○ Town reconstruction

In the regions that were damaged by the Great East Japan Earthquake, town reconstruction projects, such as the relocation of towns to higher ground and land readjustment are undertaken. In relation to areas where disasters occurred and disaster risk areas, with regards to residences that are located within areas that are recognised as being unsuitable for residential purposes, schemes such as those listed below are being used to promote collective relocation. As of the end June 2013, development had commenced at 119 sites; 36% of sites for which plans for such projects have been made.

It is necessary to carry out large-scale construction speedily while the workers of constructing agency is short, so the new type of contract system, CM method, has been performed instead of a previous contract system. Generally, in the application of CM method, the assistants of the contracting agency, Construction Manager, carry out various management services such as the examination of the design and the construction ordering method, process control, and the cost control. This CM method has been already utilized in 15 districts of the stricken area, and the construction companies have taken the central role.

Figure 11: Envisaged relocation to higher ground



(Source) Created from MLIT materials

③ Infrastructure contributed to damage mitigation

As seen with roads that functioned as coastal levees and levees that functioned as evacuation shelters and protected residents' lives against the tsunami, existing infrastructure demonstrated preventive and mitigating capabilities in addition to their normal functions.

○ **Road as a shelter (Sendai-Tobu Road)**

This road was built on an earthen embankment (7-10m), and about 230 persons evacuated themselves toward this road as a shelter, and they have escaped the tsunami. This highway structure also demonstrated a preventive function by inhibiting the flow of the tsunami and debris from penetrating into inland areas.

Figure 12: Disaster mitigation by the "Sendai-Tobu Road"

(Source) Tohoku Regional Bureau, MLIT

○Contributing to emergency transportation (Sanriku Expressway)

The Sanriku Expressway was not damaged by the earthquake or tsunami as its route was planned on high ground following consideration of a past tsunami, and consequently contributed greatly to emergency transportation, etc. and played as an alternative logistics network during the reconstruction stage.

Figure 13: Sanriku Expressway

Sanriku Expressway　　National Route No.45

(Source) Tohoku Regional Bureau, MLIT

④ Issues presented by the Great East Japan Earthquake

Although many lessons were learned from the Great East Japan Earthquake, the major issues that arose immediately after the earthquake are given below.

○ Fuel Shortages

In addition to the disruption of the fuel supply as roads in the affected areas were severed, the refineries of oil distributors ceased operations due to tsunami damage, and after 2 to 3 days, fuel shortages constituted a serious hindrance to recovery activities. Fuel shortages were alleviated in early April.

○ Loss of Construction equipment

Construction equipment suffered significant damage by seawater from the tsunami and being washed away. Construction equipment is essential to the continuous operation of construction companies and their involvement in recovery/reconstruction activities. With regards to emergency temporary housing, due to the huge volume required, there were concerns about materials shortages and completion within the fixed period was doubtful. In addition, this earthquake forced many construction companies to replace their construction equipment, and in replacing this equipment,

these companies had to take on new debt on top of their existing debt.

○ Construction company cash-flow

With regards to construction company cash-flow, various issues arose such as issues concerning payments related to construction work conducted on sites that had been washed away by the tsunami, and issues concerning non-payment for emergency recovery work and debris removal work, etc. Aware that the assistance of local construction companies was essential to recovery, the government implemented cash-flow support measures such as the simplification of fee-for-service payments in relation to work conducted in the affected areas and increased percentage outlay for advance payments, etc. These efforts were successful, and the cash-flow and financial conditions of construction companies in the affected areas did not become as harsh as initially feared, and according to business confidence surveys, data now shows evidence of improvement since the earthquake occurred.

⑤Preparing for mega-scale disasters

Japan is a land of disasters, and the occurrence of major earthquakes such as the Nankai Trough Earthquake and the Tokyo Inland Earthquake, which will be described later, has been envisaged. Efforts that aim to prepare for future large-scale disasters through cooperation between the agencies involved, by creating business continuity plans for construction companies and disseminating/promoting greater cooperation with administrative authorities, and by establishing wide-area cooperation that extends beyond regional boundaries, are currently in progress.

○ Creating Business Continuity Plans (BCP) for times of disaster

In order for the construction industry to fulfill its social mission in times of disaster, construction companies must, of their own accord, maintain a stance that enables them to continue business operations. For construction companies, BCPs for times of disaster must not only minimize damage to the company and business interruption, they are also important for rapid engagement in emergency recovery and secondary disaster prevention activities demanded by local societies. The main items contained in BCPs are as follows.

(1) Creation of emergency response plans, preparation of manuals for each division

- Organization of responses that the company should undertake along a time-line immediately after a disaster occurs.
- Preparation of chain-of-command, organizational structure, emergency contacts lists, and response manuals for each division.

(2) Creation of advance measure implementation plans, and their implementation

- Creation of implementation plans for advance measures that will facilitate the achievement of target times, and ensuring the implementation of these plans.

(3) Plans to train, maintain and improve, and their implementation

- Setting forth training plans and ensuring their implementation. Evaluating results and linking this to further improvements.
- Creation of implementation plans for the maintenance and improvement of plan documents and manuals, etc. and periodic reviews.

Although the progress of these efforts toward business continuity focuses on administrative agencies and major construction companies, it is also important to promote business continuity efforts among the local construction companies to whom cooperation will be offered.

○ **Overarching, trans-regional cooperation among stakeholder**

In the event of a large-scale disaster, in order to respond to demand for cooperative action from the construction industry as a whole, centring on the prefectural constructors associations of the affected areas, proactive cooperation towards disaster recovery activities undertaken by administrative agencies, etc. through close cooperation between the Associated General Constructors of Japan, regional blocks and the prefectural constructors associations of neighbouring prefectures is necessary.

Beginning in 2008, regional constructors associations of the four Tokai prefectures of the Central Japan, set forth pre-determined rules concerning mutual support in the event of large-scale natural disasters. The four Shikoku prefectures of the Western Japan subsequently established mutual support agreements in 2012, covering wide-area disasters, so emergency disaster measures will be implemented swiftly and smoothly through mutual cooperation.

In preparation for the Tokyo Inland Earthquake and the Tokai/Tonankai/Nankai chain reaction earthquakes, etc. that are expected to occur in the near future, it is necessary to pro-actively promote mutual support agreements within individual regional blocks, prepare a structure through which the entire regional block can respond effectively.

○ **Public-private agreements**

In order to achieve swift and accurate responses in relation to disasters, it is necessary to establish sufficient advance communications between administrative agencies and the construction industry. To this end, general construction associations have concluded disaster agreements with prefectures and the regional bureaus of the MLIT covering basic items such as specific cooperative operations and cost burden, etc. in times of disaster.

Disaster agreements provide a basis for organized cooperative activity by the construction industry in times of disaster, and as such, set forth advance measures (advance information exchange, notification of implementation structure, appointment of debris processing sites, awareness/notification of available equipment/materials status), details of activities (appointment of responsible officers/operational directors, provision of equipment/materials, information gathering through local surveys, maintenance of roads/waterways and removal of obstacles, emergency recovery works), and cost burden, etc.

(Reference) Response to the Nankai Trough and Tokyo Inland earthquakes

① Nankai Trough earthquake

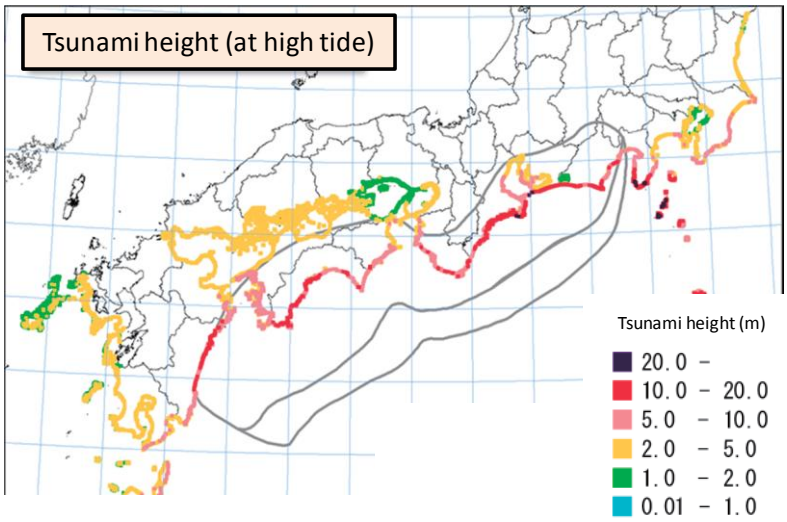
The Nankai Trough, running from Suruga Bay of the Central Japan to Kyushu of the Central Japan, is formed at the boundary where the Philippine Sea plate meets the

Eurasian plate of the Japanese Archipelago. Historically Magnitude 8 class mega-earthquakes occurred on a cycle of 100 to 150 years in the Nankai Trough, triggering three Tokai, Tonankai and Nankai earthquakes in the past. There are concerns that an earthquake will occur in this area during the first half of the 21st century.

A working group for the study of measures against large earthquakes occurring in the Nankai Trough was established under the Central Disaster Management Council headed by the Prime Minister in 2012, and this group estimated tsunami height, flood area, etc. as well as human damage, damage to buildings and damage to the economy, etc. In future, with regards to advance disaster prevention and responses and preparations for when disasters occur, this group is scheduled to promote holistic disaster prevention measures.

For more information on a simulation of a tsunami generated by a Nankai Trough earthquake, please refer to: http://www.youtube.com/watch?v=PB10ksFhhTk.

Figure 14: Maximum tsunami height



(Source) Cabinet Office "Nankai Trough Large Earthquake Model Review Committee", material

② Tokyo Inland Earthquake

If a large earthquake hits the Tokyo metropolitan area, this will have a serious adverse effect on citizens' lives and economic activities throughout Japan. Large magnitude 8 class earthquakes are estimated to occur in the metropolitan area every 200 to 300 years. In addition, several magnitude 7 class "Tokyo Inland" earthquakes are expected to occur and the imminent possibility of such events has been highlighted.

To this end, a working group of seismologists was established under the Central Disaster Management Council to review measures against Tokyo Inland earthquakes, and this group has summarized ways of ensuring the continuity of government operations and rescue measures for the huge numbers of workers who might be stranded, having difficulty in returning to their homes. The revision of damage estimates and measures against Tokyo Inland earthquakes, based on reviews of future

earthquake distribution and tsunami height, is scheduled.

(3) International aid in the Great East Japan Earthquake

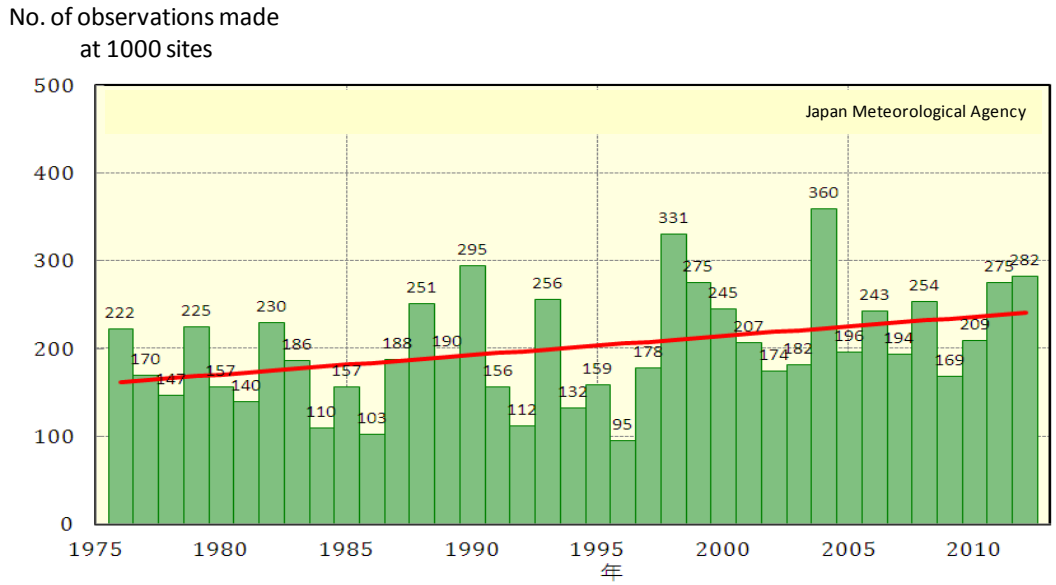
In relation to the Tohoku-Pacific Coast Earthquake, Japan has, as of December 2012, received aid from 163 countries and regions, and 43 international organizations, and has received supplies and donations from 128 countries, regions and organizations. The support provided by the rescue teams from each country, the rescue dogs, nuclear power specialists, and also the human support provided by the U.S. military in Japan, material support in the form of food, medicine and blankets, etc. and offers of assistance from over 670 NGOs, has been hugely encouraging for the people of Japan.

2. Disaster Prevention against landsides and flooding

(1) Characteristics of Japan's land and climate

The land structure of Japan is a long thin shape with a mountainous region running all the way through the middle of the archipelago. As 70% of national land is either mountainous or hilly, the terrain is precipitous and there is little sufficiently wide flat land available for habitation. Furthermore, rainfall is concentrated in the monsoon and the typhoon season, so flooding and landslides can easily occur. In recent years, the frequency of short-burst concentrated downpours has increased, and this has heightened the danger of flooding and landslides occurring. For the future, as the IPCC presides, temperature increases, greater frequency of heavy rains, increased intensity of typhoons, rising sea levels, and greater fluctuations in rainfall, etc. are expected.

Figure 15: No. of times rainfall greater than 50mm/hour has been observed over one year



(Source) Japan Meteorological Agency

(2) Landslide/flooding incidence status in Japan and measures

① Incidence status of landslides/flooding

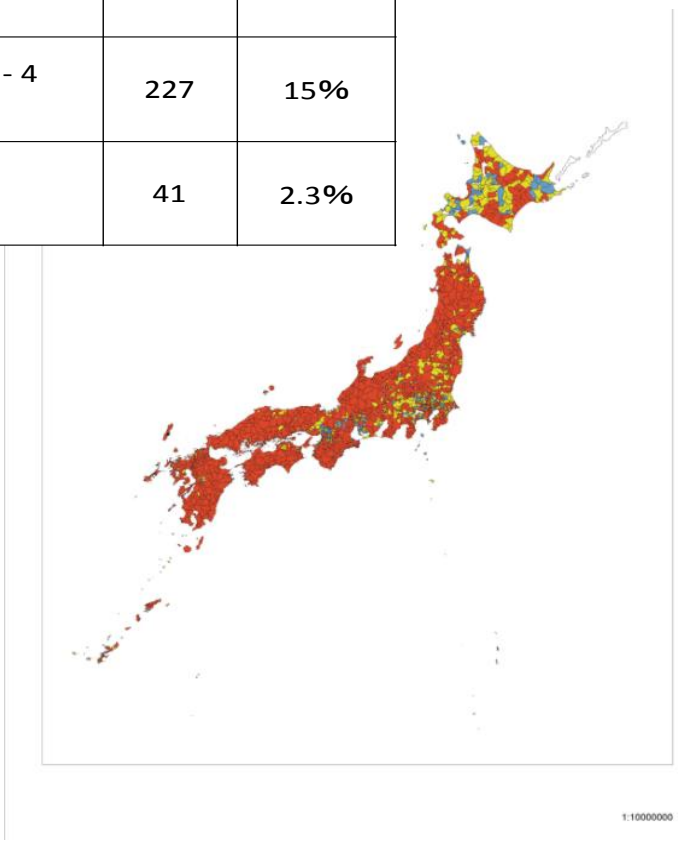
The average annual number of landslide incidents occurring in Japan over the past ten years (2002 – 2012) is in excess of 1,000. A large percentage of the victims of natural disasters are attributable to landslides, which have caused enormous levels of damage. The causes of landslides can be broadly classified into three categories; "concentrated downpours", "volcanoes" and "earthquakes". The concentrated downpour that is still fresh in memory is the North Kyushu Downpour of July 2012, which caused 268 landslides and enormous damage with 23 fatalities/persons reported missing. In addition, in 2011, downpours accompanying typhoon No.12 caused an enormous landslide in the central Japan peninsula area.

Furthermore, when looking at changing trends in the incidence of short-burst downpours with over 50ml/hour rainfall and heavy rains of more than 200ml/day, both

are increasing, and incidents of flooding and inundation damage, etc. are occurring. Although central and local governments have paid much effort in strengthening flood-proof facilities and have steadily improved flood control safety levels, recent extreme meteorological disasters such as the Kyushu downpour of July 2012 caused significant damage. As shown in the figure below, the vast majority of municipalities in Japan experience at least one flood or landslide per year.

Figure 16: Number of landslide disasters occurring between 2002 and 2011

	Municipalities with 10+ floods/landslides	983	58.2%
	Municipalities with 5 - 9 floods/landslides	449	25.7%
	Municipalities with 1 - 4 floods/landslides	227	15%
	Municipalities with 0 floods/landslides	41	2.3%



(Source) MLIT

② Efforts against landslides and floods, and their effectiveness

○ Landslide measures taken in relation to typhoon No.12 of 2011

- Damage caused by typhoon No.12, 2011

As this typhoon was large and slow-moving, extremely moist air flowed in around the typhoon over a prolonged period, causing record breaking heavy rains to fall over a wide area centring along the mountains from West Japan to North Japan. In some regions, the heavy rainfall exceeded 2,000mm which is almost same as total annual

rainfall of usual years. General damage in the Kinki region came to 72 fatalities, 16 persons reported missing, 65 persons injured, 3,390 houses completely or partially destroyed, 4,398 inundations above floor level and 9,336 inundations below floor level (Fire and Disaster Management Agency (FDMA), March 19, 2012).

- Efforts by construction companies

Together with the approach of the typhoon, and as torrential rains fell over a prolonged period causing waterways to flood and landslides, local construction companies reacted promptly, and devoted themselves to emergency recovery of roads/waterways, etc. and the removal of earthen deposits, etc.

Figure 17: Emergency works on a collapsed road

Figure 18: Emergency removal of earth from waterways

(Source) Mie prefecture of the Central Japan

- Damage mitigated by facilities

Although landslides occurred widely as a result of downpours rainfall, many landslides were trapped by sediment control dams.

Figure 19: The effects of landslide prevention works (Wakayama prefecture)

(Source) MLIT

- **Advanced efforts in measures against landslides (Introduction of large-scale collapse monitoring and warning system)**

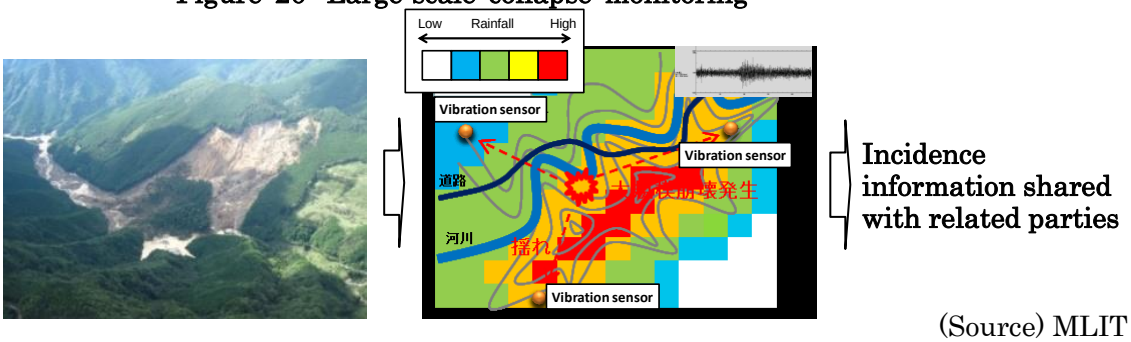
The MLIT is currently building a large-scale monitoring and warning in the regions where risk of deep-seated collapses is particularly high. This system will utilize early technologies such as rainfall radars, large-scale ground movement detection systems, and satellite image analysis to confirm collapse sites and measure the scale of collapses.

Column: Large-scale collapse monitoring and warning system

As typhoon No.12 of 2011 caused multiple large-scale landslides called "deep-seated collapses", the MLIT, working in cooperation with the relevant municipalities, employed various technologies such as vibration sensors and satellite image analysis, etc. and installed the world's first monitoring/warning system for large-scale collapses in the Kii mountains of the Central Japan, based on the recognition that a system that enables early understanding and sharing of information on location and scale when a deep-seated collapse occurs is essential to the prevention of damage.

When a deep-seated collapse occurs, vibration sensors detect large-scale ground movement. The location is estimated from the time differences in vibrations reaching 3 or more vibration sensors, and satellite radar is used to pinpoint location and measure scale regardless of time of day or weather conditions. Incidence information is shared with related parties.

Figure 20: Large-scale collapse monitoring



(Source) MLIT

○ **Underground flood prevention reservoirs**

In recent years, the frequency of heavy rainfalls in Tokyo exceeding 50ml/hour has increased. This type of heavy rainfall has a tendency to concentrate in particular areas and it is possible that this increasing trend in heavy rainfall frequency will continue.

For the Kanda River Basin in Tokyo, in order to mitigate inundation damage, the 540,000m^3 Kanda River/Ring Road No.7 Underground Flood Control Reservoir (Kan-7 Underground Reservoir) was installed (in 1997) under the ground below Ring Road No.7.As a result, inundation damage in the Kanda River Basin was significantly mitigated.

Figure 21: Shield Machine

Figure 22: Underground Flood Control Reservoir

Figure 23: Damage status mitigation effect of the flood reservoir (1993 and 2004)

	Typhoon No.11 (August 1993)	Typhoon No.22 (October 2004)
Total rainfall (per hour)	288(47)mm	284(57)mm
Inundated area	85ha	Less than 1ha
Inundated homes (below/above floor)	3,117 units	7 units

(Source) MLIT

○ **Flood control consideration for environment**

The Maruyama River in Hyogo prefecture of the Central Japan was greatly damaged by floods caused by typhoon No.23 in 2004. The occasion was exploited to implement works such as the raising of levees, the deepening of river channels and the rebuilding of bridges, etc. that would mitigate future flood damage. Further downstream, harmony with the natural environment and scenery is fully considered in the promotion of waterway maintenance, as the area is located within a national park and registered under the Ramsar Convention. The regeneration of large-scale wetland environments in the areas inside the flow of the river aims to secure wetland areas almost as large as those in the past that provided habitat for many storks (about 160ha) and regenerate high quality wetlands.

Figure 24: Downstream inundation status (October 2004 flood)

Figure 25: Envisaged wetland regeneration

(Source) Kinki Regional Development Bureau, MLIT

Ⅲ. Conclusion

Japan is a country in which many disasters occur, and every year, the occurrence of earthquakes, typhoons and heavy rains cause serious damage to citizens' lives and property. The construction companies, who are the active stakeholders in these disaster scenarios, have performed extremely important roles.

With the Great East Japan Earthquake, construction companies performed central roles beginning with initial responses immediately after the earthquake, and with regards to emergency recovery of main lifeline and public services, etc. practically completed all recovery works within six months of the March 2011 disaster.

For the accurate implementation of recovery/reconstruction following the Great East Japan Earthquake and disaster prevention/mitigation measures in preparation for future disasters, it is essential to bring together the expertise of the construction companies and related agencies, etc. and improve knowledge and technologies through international cooperation.Meanwhile, responses to anticipated disasters are also being handled with a sense of urgency. Large-scale earthquake/tsunamis that will affect wide areas, such as the Nankai Trough earthquakes and Tokyo Inland earthquakes are anticipated. The danger of flooding and landslides has also increased, and the implementation of disaster prevention/mitigation measures has become a matter of urgent need.

Multiple disasters such as earthquakes and floods are occurring in Asian countries, too. Sharing disaster related knowledge will certainly benefit member countries of Asia construct. Working towards building nations with assured safety and security against natural disaster, Japan's experience and responses will, contribute to other member countries.