中國環境工程學刊 第十二卷 第二期 (民國九十一年)
Journal of the Chinese Institute of Environmental Engineering, Vol. 12, No. 2, pp. 167-174 (2002)

Technical Short Paper

EFFECT AND HAZARD ANALYSIS OF NATURAL DISASTER TO WASTE LANDFILL

Ji-Sen Hwang *

Environmental Protection Administration
Executive Yuan
Taipei 100, *Taiwan*

Key Words: Natural disaster, landfill

ABSTRACT

According to the investigations performed in 1998, there were 272 waste landfill sites in Taiwan. More than half of the sites were located on the hillside, coast, or riverside where they were prone to nature disasters. From 1996 to 2000, landfill incidents resulted in casualties directly and also had negative effect on economic, environment, society and ecology indirectly.

Using the data collected after six major natural disasters in recent years (1996 - 2000), we investigated the effects of those disasters and analyzed the damages inflicted on facilities of landfill sites. Seventy percent of those damages were done to the main constructions, and the storage facilities were hit the worst, 34%. The rest were road structures (17%), synthetic liners (14%), leachate treatment facilities (8%), storm water collections and drainage systems (7%), respectively. According to the meteorological and geological data of those natural disasters, the damage factors were typhoon and rainfall intensities and earthquake magnitude. The stronger the intensity of the typhoons and rainfalls were, the more damages to the landfills were. The main damages were inflicted on the retaining wall. According to the analysis of the damages resulted from 921 earthquake, we have learned that earthquake magnitude 5 and over can damage landfill sites that are located in a fault or its surrounding areas.

In our analysis, most of the damaged landfill sites, 60%, were found to be located on the hillside, 21% were on the coast or riverside and the remaining 19% on the plain. There were incidents, which occurred to landfill sites under construction, in use or, closed, and before, during and after typhoon attacks. The potential hazard factors of landfill sites include location, distribution, usage life, landfill depth, landfill capacity, and timing of a disaster. Our analysis clearly indicates that for landfill sites struck by disasters, damages are accumulative and chain reactive; moreover, the potential hazard factors can still exist after the landfill sites are recovered. Therefore, enhanced maintenance and preventive measures carried out in normal days are far more important than repairing the hardware after a disaster strikes us.

INTRODUCTION

Taiwan is located in a seismic and typhoon belt. Natural disasters occur frequently, and they often cause serious casualty and property damage [1]. In addition, because of the small land and high population density, currently it is difficult to select the most ideal places for landfill sites. Therefore, incineration ash, municipal and industrial waste are mostly treated by landfill. The final deposition sites located on hillside or coast or riverside will have increasing potential dangers because of their usage saturation [2,3,4]. In the past, we set up landfill sites and then piled waste on the hills, valleys, riversides, basins or coasts. High potential dangers of those sites should be investigated because they were set up without properly following the relevant regulations [5,6]. Based on the statistic data in 1998 from Environmental Protection Administration (EPA), Taiwan, 72 sani-

* To whom all correspondence should be addressed.

tary landfill sites in use were on the hillside. Unfortunately, no statistic data have been available for the piling sites [3,4]. Besides, 66 out of those 314 waste disposal facilities were saturated, 21.02%, and 14 sites were still under construction (4.46%). The usage lives of the 46 sites were one year (14.65%), 43 sites one to two years (13.69%), and 145 sites two years or longer (46.18%) [2]. Proper waste disposal has become more difficult after the landfill incidents occurred.

In retrospect, it's important to review and improve [6,7,8,9,10] the infrastructure regarding the incline or collapse of storage structure (retaining wall), inadequate operation and management attributed to improper design, poor construction and overload, which have been often observed at sanitary landfill sites.

As foreign news (YAHOO News) announced in July 2000, Hein and Kaitak typhoon landed Quezon City near Manila, the capital of Philippine, and their heavy rainfalls caused the collapse of a fifteen-meters-high waste landfill site. Lots of waste and mud poured down to hundreds of house roofs. More than 85 people were killed, and more than 3,000 people lost their home. In 1995, the Osaka Kobe earthquake seriously damaged the main infrastructure and the surrounding structures of numerous landfill sites in south of Hyogo County [11]. Therefore, shock resistance capacity of landfill site should be evaluated regularly.

Landfill incidents resulted from natural disasters not only greatly threaten lives and wealth, but also cause secondary public nuisances and pollutions. It is a tremendous loss for the society. Because of the lost capacity of treating waste, people will dump their waste on the streets. Currently, the EPA, Taiwan, is ready for planning to strengthen its preventive approaches.

Therefore, based on our study, we present in this paper a summary of the effects of the landfill incidents caused by natural disasters in recent years (1996 - 2000) and a hazard analysis. This is worth studying and the results can be used as a reference for assisting future decision-making.

MATERIALS AND ANALYSIS METHODS

1. Data Collection

(1) This study collected the usage conditions and background information of sanitary landfill and waste piling sites in Taiwan. It also analyzed the individual items, degrees of facility damaged, and repair cost during 1996-2000 with statistic analysis.
(2) Collection and analysis of data: Relative information such as natural disaster, meteorology and human casualties were collected and summarized for investigating the relationship between those factors described above and the damage extent of the landfill sites. (The information is referred to the Central Weather Bureau of the Department of Transportation, ROC on Taiwan)

2. Study Region and Scope

This study collected data of the damages resulted from natural disasters at those damaged landfills, which included facilities still under construction, in operation, or already closed.

3. Investigation, Evaluation and Analysis

(1) The data collected were used to summarize, analyze and evaluate operations and functions of the damaged landfills after the on-site investigations, meeting or interview.
(2) The information including locations of the landfills in use, damages caused by the disasters, items and degrees of the damaged facilities were analyzed to determine the reasons that damage was caused by natural disaster and to accordingly make potential hazard analysis of the landfill sites. (Possibility analysis of factors that might cause potential disasters in the natural environments was also carried out).

4. Methods of Data Analysis

(1) Damages and dangers of the landfills caused by natural disasters were evaluated with statistic analysis.
(2) Microsoft Excel software was used to determine the parameters of those factors. We then applied differentiation analysis and relevant coefficient to the analysis when it was deemed necessary.

RESULTS AND DISCUSSION

1. Locations of the Waste Landfill Sites in Operation

According to the investigation in October 1998, there were 272 sanitary landfill sites or piling sites already in operation. Out of those 272 sites, 123 were located on the hillside (45.2%), 17 sites were located on the coast or riverside (6.3%), and 132 sites were located on the plain (48.5%). In other words, more than half of the sites investigated, 51.5% were located on the hillside , coast , or riverside , and those areas were

Table 1. Damage of waste landfill sites on natural disaster (1996-2000).

Natural disaster name (occurrence time)	Damaged landfill site (area)
Herb (08/01/1996)	Keelung City Tenwiten site, Keelung City Bardords site, Taipei County Jinshan Shiang, Taoyuan County Dayuan Shiangl, Hsinchu City Nalau, Hsinchu City Jensaeli site, Miaoli County Miaoli City, Miaoli County Touwu, Miaoli County Toufen Jen, Miaoli County Tzauchiau Shiang, Miaoli County Nungjeng Shiang, Miaoli County Gungguan Shiang, Taichung County Dali City, Taichung County Dadu Shiang, Taichung County Shalu Jen, Taichung City South site, Changhua County Ershue Shiang, Changhua County Lugang Jen, Changhua County Fushing Shiang, Changhua County Yuanlin Jen, Changhua County Tianwei Shiang, Nautau County Junglian Shiang, Yunlin County Gukeng Shiang, Yunlin County Luenbei Shiang, Chiai County Lioujiau Shiang, Chiai County Dapu Shiang, Chiai County Dungshr Shiang, Tainan County Baihe Jen, Tainan County Nanshi Shiang, Kaohsiung County Chishan Jen, Kaohsiung County Daliau Shiang, Kaohsiung County Neimen Shiang, Kaohsiung County Linyuan Shiang, Pingtung County Muden Shiang, Penghu County Baisha Shiang, Ilan County Toucheng Jen, Hualien County Haulien city, Hualien County Shoufeng Shiang.
Winnie (08/19/1997)	Keelung City Bardords site
Zeb (10/17/1998)	Taipei County Wugu Shiang, Taipei County Linkou Shiang, Taipei County Rueifang Jen, Taoyuan County Guanyin Shiang, Taoyuan County Dayuan Shiang, Taoyuan County Pingjen City, Taoyuan County Dashi Jen, Changhua County Fangyuanl Shiang, Yunlin County Taishi Shiang, Chiai County Alishau Shiang, Chiai County Juchi Shiang, Kaohsiung County Neimen Shiang, Kaohsiung County Chishan Jen, Penghu County Hushi Shiang, Penghu County Baisha Shiang , Hualien County Hualian City, Hualien County Jian Shiang, Hualien County Shincheng Shiang.
Earthquake (09/21/1999)	Hsinchu County Jubei City, Taichung County Shinshe Shiang, Taichung County Dungshr Jen, Taichung County Dali City, Yunlin County Tuku Jen, Chiai County Juchi Shiang, Chiai County Putz City, Chiai County Minshung Shiang.
Kai-tak (07/09/2000)	Pingtung County Hengchuen Jen
Bilis (08/23/2000)	Taipei County Bali Shiang (in construction)

prone to natural disasters. They had to be protected from nature disasters with preventive measures. Another finding we had was that the set up of the 117 waste piling sites (43%) was not in compliance with the landfill installation regulations. This violation should not have happened, and the enforcement of the regulation should be strengthened.

2. Damages and Effects Caused by Landfill Incidents

(1) Damages to life, property and economic: From August 1996 to August 2000, six natural disasters including earthquakes and typhoons resulted in landfill incidents. Various degrees of damages happened to 67 sanitary landfill sites (Table 1). Judged from the casualty caused by the collapse of landfills, Zeb Typhoon has been reported to cause seven deaths and eight injuries and has been considered to be the worst typhoon. The second is Winnie Typhoon that caused one death and ten injured. One person was killed in Bilis Typhoon. There were nine deaths totally, and the death toll was 6.4% of all death incurred in all the natural disasters combined at that time. In addition, there were 18 injured, which constituted 7% all reported injuries. One house and two cars were destroyed because of the collapse of landfills in Zeb Typhoon.

(2) Cost of Compensations:

① Landfill incidents caused nine deaths. The government paid out about sixty million dollars (NTD) to the claims in compensation and relief funds.

② After Herb and Zeb typhoons, the central government subsidized four hundred and fifty millions dollars (NTD) to recovery the sanitary landfills. The recovery fee for each site averaged around 3.4 millions dollars (NTD). In addition, hundreds of emergency workers were dispatched for the landfill incidents at Wu Gu Township in Taipei County and Ba Do Zi in Keelung City.

(3) Social aspect:

① Impact on the safety of local residents and traffic: Zeb Typhoon caused the collapse of Hsin Liao landfill located at Linkou Township in Taipei County. Several hundred tons of wastes were poured down to the river ditches, houses and roads. It destroyed utility poles at Tai Shan Township, located two or three kilometers from the site, causing power outage.

② Government's image was tarnished, and public protest followed: After the casualties became known by the public, public protests sprang up in the neighborhood. Local people started to have increasing doubts about landfill site setup. Therefore, not only was the loss of lost government's image, but also the increased obstruction to landfill recovery and setup.

(4) Environmental aspect:

Table 2. Damage facilities of landfills on natural disaster (1986-2000).

Landfill facility	Damage no.						
	Herb	Winnie	Zeb	921 earthquake	Kai-tak	Bilis	Total (%)
Storage facility	19	1	7	5	1	1	34 (34)
Synthetic liner	12		2				14 (14)
Storm water collection and drainage system	5		1	1			7 (7)
Leachate collection and drainage system	2		1				3 (3)
Methane collection and emission system	3		1				4 (4)
Leachate Treatment system peripheral facility	3		3	2			8 (8)
Road structure	16		1				17 (17)
Manages facility	3						3 (3)
Dust screen	2						2 (2)
Fences	1		4				5 (5)
Weighing facilities			1				1 (1)
Heavy mechanic plant			2				2 (2)

① The natural disasters caused severe damages of the main constructions and access roads to the landfills, so that the waste disposal could not be carried out from the landfills. The day after Zeb Typhoon attacked, three hundred tons of waste was cleaned. It was twice as much as it was in a normal day. Because the landfills were destroyed, the waste pile-up increased rapidly. It revealed the severity of waste disposal problem following destruction of the landfills.

② Impact on traffic and sanitation: Because of the traffic obstruction and delay, municipal waste could not be transported timely to the landfills for disposal. It is piled up along the streets, so that pathogens started to breed and affected seriously the public health.

③ Effects of ecological degradation and environmental appearance: Waste from the collapse of landfills caused secondary pollutions, resulting in contamination of the rivers, groundwater and soils.

④ The usage life of landfill sites became shortened: After the landfill incidents, the landfills could no longer recovery any more and were forced to close down earlier than their normal usage life.

3. The Items and Degrees of Damaged Facilities in the Landfills

From 1996 to 2000, six natural disasters had damaged landfill facilities. Damage of the storage facilities (retaining walls) were the most serious, 34%. Road structures (17%) were the second serious, and the rest were synthetic liners (waterproof cloths, 14%), leachate treatment facilities (8%), storm water collections and drainage systems (7%), fences (5%), methane gas collections and emission systems (4%), leachate collections and drainage systems (3%), management facilities (3%), dust screens (2%), heavy mechanic plants (2%), and weighing facilities (1%) (Table 2). From these data, we can clearly see that seventy percent of those damages were of the main constructions after those natural disasters. They severely affect waste disposal capacity of the landfills. Depending on the damage degree of the storage facilities (retaining walls), the collapse, crack, incline and wash out of the foundation of retaining walls occurred to seriously affect the safety and also to cause secondary pollutions. Although there are retaining structures including mounds, snake cages, slope protection devises, soil retaining walls and etc . , the set up of the

Table 3. The effect of landfill damage in typhoon (1996-2000).

Name of typhoon (Issue/Relieves time)	Landfill		Climate data[1]	
	Damage no.	Damage items	Vmax (m/s)	Rainfull[2] (mm/in 24 hr)
Herb (0729/2320 - 0801/2320, 1996)	38	66	53 (intense)	203
Winnie (0817/0520 - 0819/0300, 1997)	1	1	43 (moderate)	156
Zeb (1013/2020 - 1017/0245, 1998)	18	23	55(intense)	201
Kai-tak (0708/0545 - 0709/2305, 2000)	1	1	35 (moderate)	196
Bilis (0821/1445 - 0823/2005, 2000)	1	1	53 (intense)	179

1) Source of typhoon data: Central Weather Bureau.
2) Day of precipitation on transits area of typhoon.

landfills in Taiwan have been the major items on the list that are frequently vulnerable to natural disasters. They are also the major causes of human casualties, so that better design, management and maintenance should be strengthened.

4. Study of the Damage Factors Resulted from Natural Disasters

(1) Regional distribution of typhoons: Based on the statistic data between 1996 and 2000, landfill incidents resulted from five typhoons were related to strong winds and heavy rainfalls. The heavier the rainfalls were, the more incidents and damaged items were. The damages were worse especially for those landfills located on or coast or riverside. Among all typhoons hitting Taiwan, Herb Typhoon caused the most serious damages. Different degrees of damages were caused in 38 sanitary landfill sites and 37 waste piling sites. It was 28% of the landfills damaged during Herb typhoon. There were also 18 sanitary landfill sites damaged by Zeb Typhoon. The data showed that the intense typhoons brought serious damages to the landfill sites. Moderate typhoons could also cause damages, and even human casualties (Table 3). They are worth of our effort on strengthening preventions. From our data described above, we found that heavy rainfalls from typhoons caused soil to become loose and then get washed away. They also can lead to the collapse of retaining walls. In addition, strong winds may erode the foundations of coastal jetties and result in human casualty.

(2) Geographic distribution of seismic: As the result of 921 earthquake in Taiwan, we found that earthquakes of magnitude scale 5 and over damaged landfill sites, most of which were located in the earthquake fault. The stronger the earthquake magnitude was, the more damages in the landfills had. The damages occurred mainly on the retaining walls (Table 4).

5. Potential Hazard Analysis of Waste Landfill Sites

(1) Geographic and regional distribution of the damaged landfill sites: Most of the damaged landfill sites resulted from the natural disasters were located on hillside, 60%, 21% of which were located on coast or riverside, and 19% on plain. In the landfills located on the hillside, damages of the main constructions were the worst, especially the storage facilities and the synthetic liner structures. For the landfills located on coast or riverside, the damages to the peripheral constructions were more serious than the other structures. For example, the damages of the ocean jetties of Ba Do Zi landfill site were about seventy meters.

(2) Usage life: The usage lives of most of the damaged landfill sites, 40.3%, were four to six years. Of those sites, 31.4% lasted one to three years, 14.9% seven to nine years, and 11.9% were over ten years. However, 1.5% of those damaged sites were still under construction when the disasters struck. The data showed that natural disasters could damage landfill sites under construction, in operation or in closure. For the usage life, the longer usage life or the deeper filled depth or the larger filled quantity was, the more severe the damage were. In those situations, it was more difficult for recovery and more costly as well.

(3) Time of landfill damage occurred: Of the landfill disasters known, 95.5% occurred during a typhoon attack , 1.5% occurred be -

Table 4. The effect of landfill damage in 921-earthquake disaster (1999).

Landfill site	Landfill		Magnitude
	Damage facility	Site position	
Hsinchu County Jubei City	Retainer wall chap	Neighborhood of fault zone	5
Taichung County Shinshe Shiang	Retainer wall chap	Fault zone	6
Taichung County Dungshr Jen	Retainer wall chap	Fault zone	6
Taichung County Dali City	Sewage treatment plant damage	Fault zone	6
YunlinCounty Yuke Jen	Retainer wall chap	Neighborhood of fault zone	6
Chiai County Juchi Shiang	Sewage treatment plant damage	Neighborhood of fault zone	5
Chiai County Putz City	Retainer wall chap	Neighborhood of fault zone	5
Chiai County Minshung Shiang	Rain water drain system chap	Neighborhood of fault zone	5

fore a typhoon attack, and another 3.0% occurred after a typhoon attack. The tragedy of nine deaths and 18 injured, as described above, happened before and after typhoon attacks, caused by the collapse of landfill sites. It frequently occurred on holidays because people tended to stay home during a typhoon attack, and also because of people and government's carelessness before and after a typhoon attack. Damage continued even before the rescue task was established or after it was dismissed. The capability of the government's emergency response to incidents was the main factor of a successful rescue task. The landfill incidents could be minimized depending on how the government managed crises by utilizing rescue manpower, machinery, facilities, vehicles dispatching and dynamic capability.

6. Recovery Functions

After the landfills were recovered from the damages, the facilities could continue their waste disposal function. However, because the damages were accumulative and chain reactive, the risk factors (or conditions) and potential disasters still could exist even after the landfills were recovered. Therefore, enhanced maintenances and preventives in normal days is far more important than repairing the hardware after disasters strike us. From the data we collected in this study, there is an urgent need of having regulations, administrating enforcements, engineering technologies, supervising and auditing systems reviewed for disaster prevention, emergency response and function recovery. Because the damages occurred to the landfills were accumulative and chain reactive, a complete system including site selection, investigation and analysis, planning and design, engineering quality, operation management and maintenance, closure and improvement should be established step by step for disaster preventions. Certainly, supervising capacity must be strengthened as well.

CONCLUSIONS

1. To the point of time, natural disasters still lead to huge damages of sanitary landfills or piling sites, which are either under construction, in use or in closure. The landfill incidents will continue to occur before, during or after natural disasters.
2. The landfill incidents or piling site incidents cause direct losses and indirect losses. Direct losses include loss of lives, such as human casualties, and properties and economic losses, such as landfills destructions, buildings, vehicles, roads, compensation expenses, and recovery fees. Indirect losses include severe influences on the society, traffic, psychologies and environments such as the safety of local residences, public sanitations, traffic blocks, government images, pubic protests, inabilities to dispose wastes, secondary pollutions, damages on ecological systems and environmental appearances, and reductions of the landfills usage life.
3. Natural disasters inflict damages on main structures and peripheral engineering, and they will impact on waste disposal in the short or in the long term. Depending on the extent of the dam-

age of storage facilities (retaining walls), collapse, crack, and incline of the foundation of retaining walls can get washed out, affecting the safety and leading to secondary pollutions.

4. Damaged landfill sites resulted from natural disasters are mostly located on the hillside. Some sites are located on the coast or riverside, and few are located on the plains. According to our data, damages done to the main constructions of the landfills located on the hillside were the most serious, especially the storage facilities and synthetic liner structures. For the landfills located on the coast or riverside, the damages done to the peripheral constructions were more serious than to the other structures.
5. The damage factors of landfill incidents include typhoon and rainfall intensity and earthquake magnitude. The potential hazard factors of landfill sites include location, geographic distribution, usage life, landfill depth (height), landfill capacity, and timing of the accident.
6. At the damaged landfill sites, damages were accumulative and chain reactive, however, the potential hazard factors still existed. Therefore, our date strongly suggest to enhance the monitoring and periodical safety check to avoid re-occurrence of such disastrous events.

REFERENCES

1. Bureau of Central Weather Website (website: http://www.cwb.gov.tw/) (2000).
2. Environmental Protection Administration, "Garbage Disposal Condition Season Report," (1999).
3. Taiwan Province Environmental Protection, "Taiwan Province Locates the Mountainous Area Waste Sanitary Landfill Comprehensive Physical Examination Implements Plans," (1999).
4. Environmental Protection Administration, "Waste Landfill Safe Assessment and Set Up the Geography Information System in Taiwan Area," (1999).
5. Taiwan Province Environmental Protection Bureau, "Criteria of Setting Waste Sanitary Landfill Facility- Related Law Compile of General Waste Processing Landfill (fourth edition)," (1997).
6. Gou, S. H. and J. I. Den, "Review of Waste Sanitary Landfill Operation Management Stage," Proceeding of First Conference on Waste Cleanup and Disposal Practice, Environmental protection Administration, Executive Yuan and Department of Environmental Protection, Taipei City Government, Taipei, March 3-4, pp. 191-206 (1998).
7. Lin, W. J., "Sanzukou Waste Sanitary Landfill Operation and Management," Ibid., pp. 181-189 (1998).
8. Chen, L. J., Zhang, H. Z. and H. Y. Huang, "Perspection on Waste Sanitary Landfill Engineering Technology," Ibid., pp. 147-158 (1998).
9. Chen, L. J., Zhang, H. Z. and H. Y. Huang, "Present Situation and the Correlation Measure on Taiwan Province Garbage Disposal," Ibid., pp. 263-275 (1998).
10. Xie, Y. X. and F. Q. Lou, "Study on Waste Sanitary Landfill Engineering Assessment and Technology Standard," Proceeding of 12th Waste Management Technology Conference, Tamkang Umiversity, Taipei, December 6-7, pp.129-135(1997).
11. Japanese Academic Society, "Harms and Strengthen of Waste Final Disposal Site on Earthquake in South of the Hyogo County," Summarize of Waste Speech on the Earthquake Disaster, pp. 40-50 (1996).

Discussions of this paper may appear in the discussion section of a future issue. All discussions should be submitted to the Editor-in-chief within six months.

Manuscript Received: December 3, 2001
Revision Received: April 17, 2002
and Accepted: April 22, 2002

天然災害對廢棄物掩埋場災損之影響與危害分析

黃 基 森

行政院環境保護署

關鍵詞： 天然災害、掩埋場

摘 要

1998年調查結果，台灣地區使用中垃圾掩埋場共計272座，半數以上位於易遭天災之山坡地及海邊或河岸地區。在1996-2000年間，掩埋場災變造成人員傷亡的直接損失，同時也間接造成對經濟、環境、社會及生態的負面效應。

六次天災造成掩埋場之設施損毀，七成屬於主體工程，其中以貯存結構物-擋土牆最爲嚴重，佔34%，依序爲道路工程（17%）、阻水結構物-不透水布（14%）、滲出水處理設施（8%）及雨水集排系統（7%）。依天然災害的氣象及地質統計顯示，掩埋場災害因子包括颱風及其雨量強度、地震強度。颱風及其雨量強度愈大造成掩埋場災損數目及設施項目愈多。921地震結果，震度五級（含）以上可造成掩埋場災損，均分布於斷層區或附近，以擋土牆損害爲主。

災損之掩埋場以位於山坡地者最多佔60%；其次爲海邊（河岸）佔21%；平地佔19%。施工中、使用中及已封閉之場址皆有災害發生。在颱風發布前、發生時及解除後均有掩埋場發生災變。而掩埋場災害潛勢因子包括掩埋場之地理位置、地域分布、使用年限、掩埋深（高）度、垃圾掩埋量及災變發生時間。發生災變之掩埋場其災損具累積性及連鎖性，復舊後潛在危害因素仍然存在。因此，平時加強維護及預防災害措施比災後硬體維修更重要。