

出國報告（出國類別：參與研討會及參訪）

## 參加東京都水道局主辦之2023年 亞洲自來水人力資源發展網路會議

服務機關：台灣自來水股份有限公司

姓名職稱：陳昭賢 組長

吳宸安 工程師

派赴國家/地區：日本/東京

出國期間：112年10月19日至10月20日

報告日期：112年11月 14 日

# 摘要

本報告為 112 年 10 月 18 日起至 112 年 10 月 21 日止，台灣自來水公司參加「第十六屆亞洲自來水事業人力資源網絡會議」及參訪相關設施之紀錄，內容包含亞洲自來水事業人力資源網絡會議介紹、會議行程安排、研討會發表內容、參訪內容說明、以及參訪心得與建議等項目。

本屆會議由東京都水道局主辦，其他參加單位包括韓國水資源公社 (Korea Water Resources Corporation)、韓國首爾市水務局 (The Office of Waterworks, Seoul Metropolitan Government、泰國都會水務局MWA、越南建設部第二建設協會HCC、臺北自來水事業處、孟加拉達卡水資部DWASA、及台灣自來水公司等共 7 個單位之代表人員現場或視訊與會。

本屆會議討論主題有二，分別為「推動供水韌性之人力發展 (Human Resources Development for Enhancing water supply Resilience)」及「維持高標準符合規章意識的行動 (Actions to Maintain a High Level of Compliance Awareness)」，並由主辦單位安排參訪東京都水科學博物館、2023 年國際水協展覽會、及東京都水道局訓練及技術發展中心。

# 目 次

壹、亞洲自來水事業人力資源網絡（A1-HRD）會議簡介及目的.....	3
貳、議程安排.....	4
參、研討主題說明.....	9
肆、參訪心得及建議 .....	16
伍、附錄（本屆會議台水公司發表內容） .....	18

## 壹、亞洲自來水事業人力資源網絡（A1-HRD）會議簡介及目的

亞洲自來水事業人力資源網絡(Asian Waterworks Utilities Network of Human Resources Development)係由亞洲各國(城市)自來水事業所組成之人力資源發展組織，目的為促進亞洲各國(城市)自來水事業之人才培育及專業技能交流。該組織由東京都水道局(The Bureau of Waterworks, Tokyo Metropolitan Government)於2007年發起，並以英文全名各單字第一個字母簡稱為A1(WUN)-HRD，自許成為亞洲第一之人力資源發展組織。

目前成員除了東京都水道局外，尚有韓國水資源公社(Korea Water Resources Corporation)、韓國首爾市水務局(The Office of Waterworks, Seoul Metropolitan Government)、泰國都會水務局(Metropolitan Waterworks Authority)、越南建設部第二建設協會(College of Construction No.2, Vietnam Government)、臺北自來水事業處、孟加拉達卡水資部DWASA、及台灣自來水公司。

A1-HRD 除每年向會員發行4次刊物(Newspaper)外，各年度由不同會員國家(城市)輪流舉辦會議，請各會員針對會議主題分享有關人力資源發展及各項專業技術之經驗，會議中針對不同自來水事業運作方針互相討論及檢討，希望透過國際經驗交流與分享，提升各自來水事業專業技術水準及管理知能。

**A1-HRD Newsletter**  
Vol. 39  
August, 2023  
Asian Waterworks Utilities Network of Human Resources Development

Hello everyone.  
After three consecutive years of online meetings, a face-to-face meeting will finally be held in Tokyo this October. For those who have difficulty in coming to Tokyo, an online meeting is also being prepared, which means we will organize a hybrid meeting. We really look forward to seeing you in Tokyo and online.

**The 16<sup>th</sup> meeting is coming soon!!**

Meeting Schedule (Tentative)  
Day 1, Thursday 19<sup>th</sup> October, 2023  
13:00-14:30 Opening Ceremony at Tokyo Water Science Museum  
Opening Remarks, Introduction of Each Utility  
Commemorative Item Exchange, Group Photo  
14:30-17:00 Tour of Waterworks Exhibition (Suiko-ten) at Tokyo Big Sight  
18:00-20:00 Visit to Observatory in Tokyo Metropolitan Government (TMG) Building  
Reception party in TMG building  
Day 2, Friday 20<sup>th</sup> October, 2023 at Training and Technical Development Center  
9:30-12:00 Experiential Training  
13:00-17:00 Presentation and Discussion (Hybrid meeting!!)  
Theme1: Human Resources Development for Enhancing Water Supply Resilience  
Theme2: Actions to Maintain a High Level of Compliance Awareness

**125 anniversary of the Bureau of Waterworks, TMG**  
Since the waterworks in Tokyo started to supply water from the Yodobashi purification plant in 1898 as a modern waterworks, we have been working for securing water resources, improving and expanding our facilities in order to supply a consistent, stable and clean water. As a result, the waterworks in Tokyo today has evolved into one of the largest facilities in the world with the highest level of technology.

I am renewed for 125 anniversary!

Suitaki-kun: a mascot character of Bureau of Waterworks, TMG

**Photo Gallery of the Bureau of Waterworks, TMG**

Revitalized water source forest because of our efforts  
Photo on the left: 90 years ago, photo on the right: current

Intake towers in Murayama-shimo reservoir  
One of the sightseeing spots of the Bureau

Tokyo Water Science Museum  
Venue of Opening Ceremony on Day 1

Training and Technical Development Center  
Venue of Day 2

**We are honored to welcome you to Tokyo in our 125<sup>th</sup> anniversary year!!**

圖一：A1-HRD 2023年第39期刊物邀請及主題邀稿

## 貳、議程安排

本次會議於 112年10月19日至10月20 日於日本舉行，由東京都水道局主辦，除主辦單位外，尚有韓國水資源公社、韓國首爾市水務局、泰國都會水務局、越南建設部第二建設協會、臺北自來水事業處、孟加拉達卡水資部DWASA、及台灣自來水公司，共計 6 個國家 8 個自來水事業機構(含訓練研究機構)，合計 21 人參加會議。

表一、第十六屆亞洲自來水事業人力資源網絡會議議程表

**The 16<sup>th</sup> A1-HRD Meeting Program (Tentative)**  
**19<sup>th</sup> and 20<sup>th</sup> October, 2023**  
**Bureau of Waterworks, Tokyo Metropolitan Government (BWT)**

Day 1 Thursday 19 <sup>th</sup> October, 2023 Venues: Tokyo Water Science Museum, Tokyo Big Sight		
Time	Program	Remarks
12:30	Meeting up at Tokyo Water Science Museum	Please come to the venue by 12:30
13:00~14:30	Opening Ceremony -Opening Remarks -Introduction of Each Utility -Commemorative Item Exchange -Group Photo	Simultaneous Interpretation Service for the Ceremony (English ⇄ Japanese)
14:30~ around 17:00	Tour of Waterworks Exhibition ( <i>Suido-ten</i> ) 14:30-14:45 move to Tokyo Big Sight 17:00-18:00 move to Tokyo Metropolitan Government (TMG) building	Interpretation support by BWT staff (English ⇄ Japanese) BWT offers transportation
18:00~20:00	Visit to Observatory in TMG building Reception party in TMG building	Complimentary for participants from abroad
20:00~	Move to hotel	A Hotel in Shinjuku
Day 2 Friday 20 <sup>th</sup> October, 2023 Venue: Training and Technical Development Center		
Time	Program	Remarks
8:30	Meeting up at hotel lobby and move to Training and Technical Development Center	BWT offers transportation
9:30~12:00	Experiential Training -Training Field Tour -Virtual Reality Training Course Experience	For your safety, please wear flat shoes
12:00~13:00	Lunch time	Complimentary for participants from abroad
13:00~17:00	Presentation and Discussion(*) -Welcome Remarks -Introduction of Participants -2024 A1-HRD Theme Announcement -2025 A1-HRD Host Announcement -Presentation Theme 1: Human Resources Development for Enhancing Water Supply Resilience Theme 2: Actions to Maintain a High Level of Compliance Awareness	Coffee Break will be held during the session
17:00~17:15	Group Photo	-
End of Program		

\*Presentation and Discussion Session will be held in a hybrid format using the on-site venue and an online conference system. The order of presentations will be announced in due course.

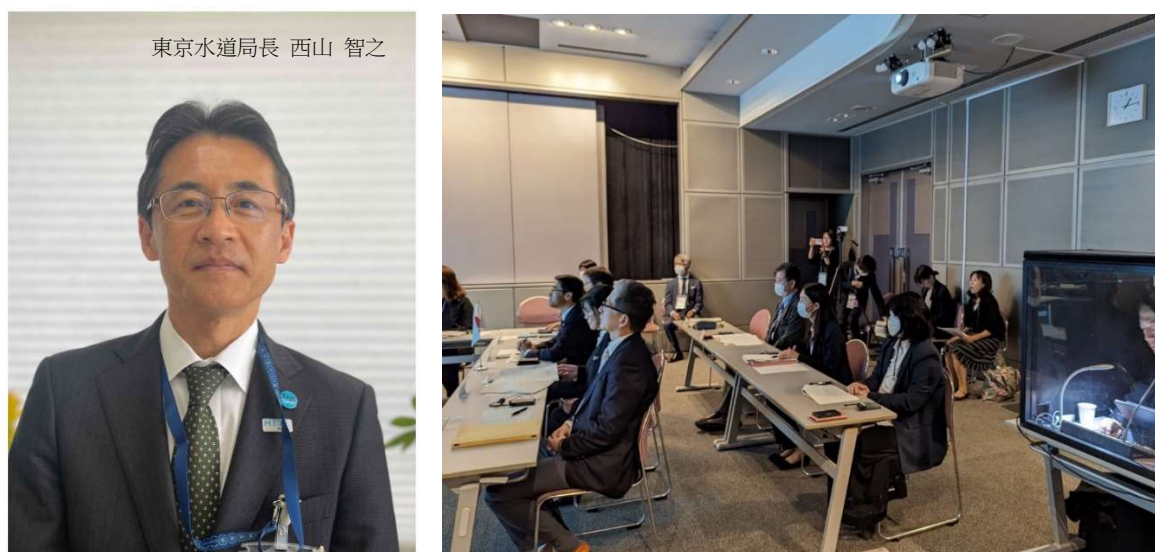


## 16<sup>th</sup> Meeting at Training and Technical Development Center

Organization	Department	Position	Name	Participation
Seoul Waterworks Authority, Seoul Metropolitan Government	Education & Cooperation Division	Manager	YOU Yoonjeong	Onsite
	Safety Management & Investigation Division	Manager	IN Chemin	Onsite
Taiwan Water Corporation	Planning Section, Public Works Department	Sector Chief	CHEN Jao-Shyan	Onsite
	Southern Region Engineering Office	hydraulic engineer	WU Chen-An	Onsite
	Professional Training Center	System Coordinator	LIU Li-Wei	online
Taipei Water Department	-	Senior Specialist	SHIH Chia-Lin	Onsite
	Technical Division	Executive Engineer	HUANG Chin-Ling	Onsite
Dhaka Water Supply and Sewerage Authority	Local Government Division	Secretary	Muhammad Ibrahim	Onsite
	-	Managing Director & CEO	Taqsem A Khan	Onsite
	Finance	Deputy Managing Director	Akhtaruzzaman	Onsite
	-	Executive Engineer	Mohammad Badrul	Onsite
Bureau of Waterworks Tokyo Metropolitan Government	Personnel Division	Senior Director	FUNAKAWA Katsuyoshi	Onsite
	Training and Technical Development Center	Senior Director	FUKUJU Yoko	Onsite
	Training and Technical Development Center	Director	SUZUKI Chieko	Onsite
	Training and Technical Development Center	Director	YAMAMOTO Yoichi	Onsite
K-water	Doctor SEOK Kwan-soo, and seven others			online
Metropolitan Waterworks Authority	Director KONGKASEM Chumpon, and 10 others			online
Ho Chi Minh City College of Construction	Rector NGUYEN Ba Khiem, and three others			online
Tokyo Water Co., Ltd	Training Section	Director	HIGUCHI Kensuke	Onsite
	Misono office	Director	TAKADA Manabu	Onsite
	Pipe Planning	Deputy Director	HARAGUCHI Kenichiro	Onsite

圖二：參加人員名單

會議第一天(10月19日)前往隸屬東京都水道局管理之東京都水科學館(Tokyo Water Science Museum)，首先由東京都水道局局長致詞，再由各與會人員代表自我介紹及互贈紀念品，並於館外進行團體拍照留念。



圖三：主辦東京水道局及開幕現場會場現況



東京都水道局致詞



台灣自來水公司介紹



參加人員合影

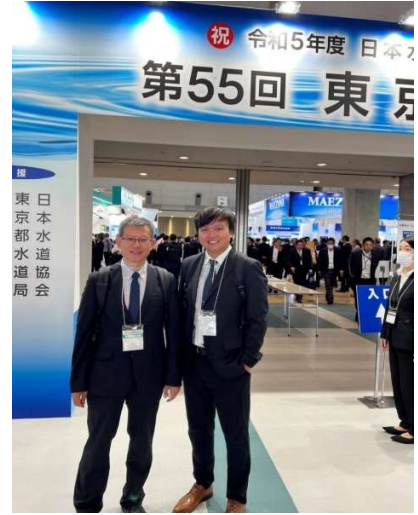
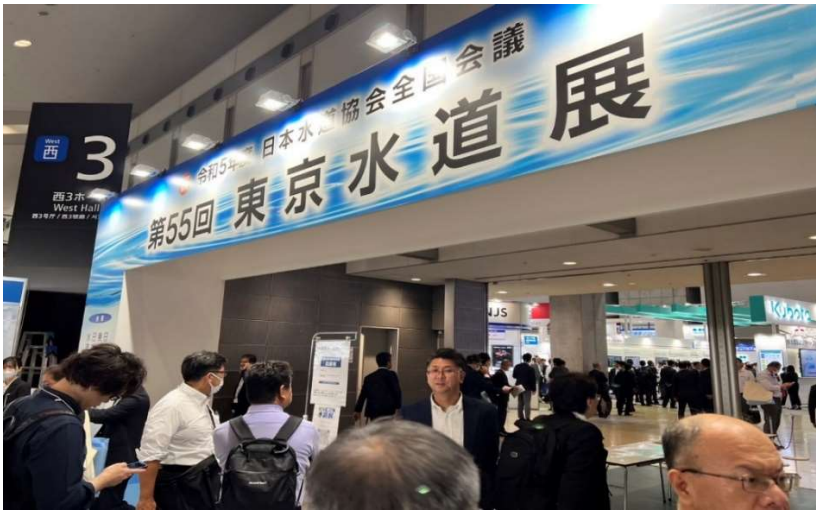


交換紀念品(台灣與日本)

圖四:各單位介紹報告及交換紀念品

接著，由主辦單位簡介東京都自來水事業發展過程及水科學館，並由館方導覽人員帶領下，參觀館內館內設施。參觀結束後，主辦單位帶領與會人員前往本屆2023東京水道展參觀。





圖五：東京水道展現場



圖六：新產品(快濾R0模及內視鏡機器人)

晚間於東京都廳北展望室舉行歡迎餐會，主辦單位同時安排與會人員及東京都水道局員工一同參加，各國人員互動熱絡。





圖七：東京都廳及北展望室

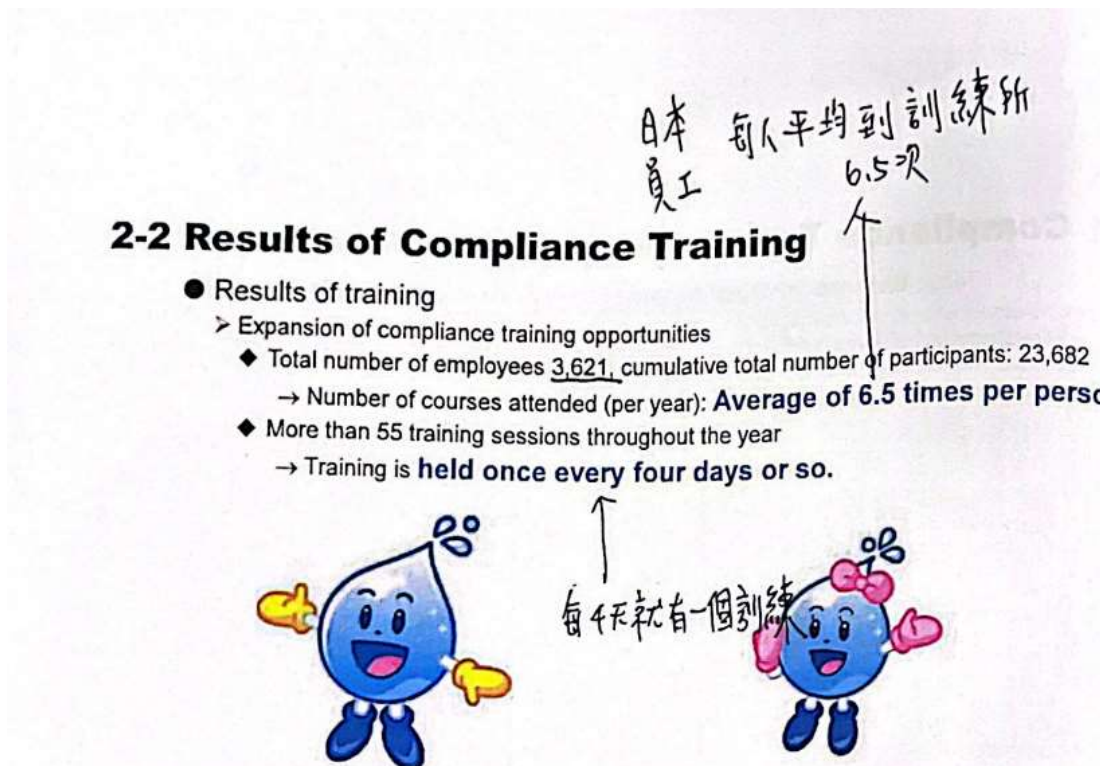
第二天(10月20日)上午於東京都水道局訓練中心進行主題討論，各自來水事業機構就本次會議主題一「推動供水韌性之人力發展 (Human Resources Development for Enhancing water supply Resilience)」及主題二「如何應對高標準規章下警訊 (Actions to Maintain a High Level of Compliance Awareness)」依序進行簡報發表及提問。台灣自來水公司以「主題一:推動供水韌性之人力發展」作為主題，介紹台灣自來水公司利用E - Training系統及實際人員教育訓練來面對氣候變遷以提升供水韌性。於簡報完畢開放提問時，與會人員對於台灣自來水公司海水淡化開發水源及海洋潮汐高差變化是否會影響取水非常感興趣，並進一步詢問內容及細節。各國簡報結束後，決議明年第 17屆仍由東京都水道局舉辦，原則採線上方式辦理。

## 參、研討主題說明

本屆會議主題為主題一「推動供水韌性之人力發展（Human Resources Development for Enhancing water supply Resilience）」及主題二「如何應對高標準規章下警訊（Actions to Maintain a High Level of Compliance Awareness）」，茲以日本東京都水道局、子公司TOKYO WATER及韓國水資源公社就所發表之內容值得借鏡學習之處，爰摘述如下：

### 一、東京都水道局

(一)東京都水道局為有效解決了人口增加之用水需求、原水汙染及漏水率問題，近年加強對於內部員工訓練，遠高於其他國家訓練頻率值得借鏡。



圖八：每位員工平均一年6.5次到受訓中心學習，平均每4天就有一個訓練。

(二)該局為培育具有國際觀及科技新知應用員工，聘請業界專業人才建立模組，協助培訓員工應用VR技術在職業安全衛生訓練上。親自體驗後更能實際明白職業安全預防的重要性。




圖九:採用VR 結合職業安全訓練，模擬操作應用

(三)經詢問東京都水道局員工5年資歷離職率，查日本員工幾乎選定一家公司後就很少會離職，其中參加受訓僅5%會無法達到平均一年6.5次到受訓中心學習，能夠有如此密集投資，其中歸咎於公司須建立員工向心力及視人力為資產培養。

Japan.  
離職率

Challenge (1)  
About 5% of the employees miss out on training programs.  
..... Encourage those who have not completed the courses to take them, utilizing technology such as introducing e-learning, and expanding opportunities for telework to create an environment that makes it easy to take classes anytime, anywhere.

Challenge (2)  
Further liaison with the group companies is necessary  
.....Promote the sharing of new needs through exchanges and information sharing between the training sections of the Bureau of Waterworks and Tokyo Water Co., Ltd. Joli will be further promoted.



圖十：參加受訓僅5%採用E-Learnig及其他機會方式加強補足。



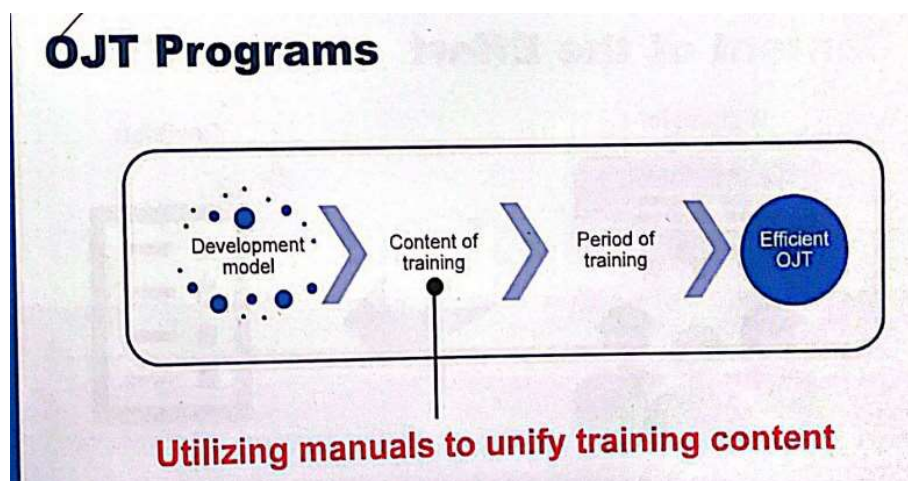
## 二、東京水道局之子公司TOKYO WATER

(一) 東京水道局控股80%成立之子公司TOKYO WATER為從事技術及海外拓展部門，擁有第一線的技術並為公司推廣國際化建立第一線窗口。



圖十一：母公司及子公司關係圖

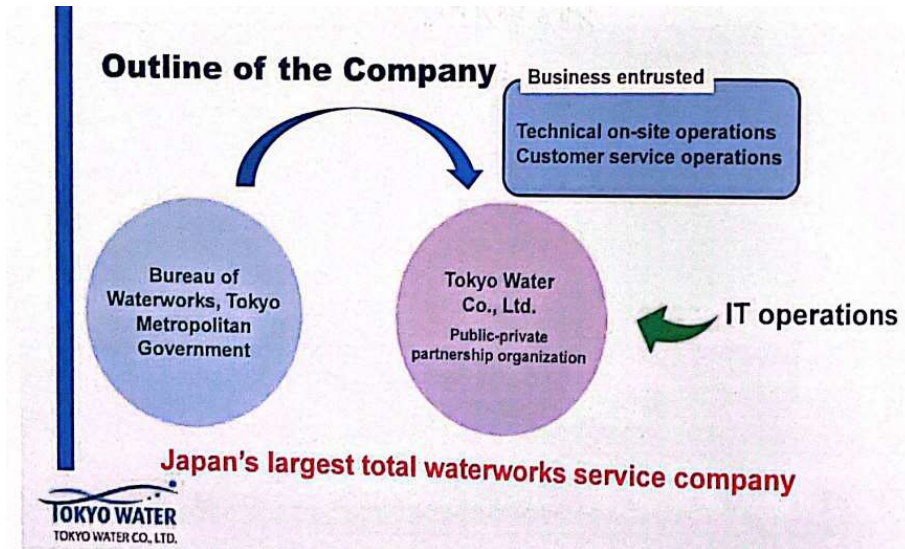
(二) TOKYO WATER的技術培養重視師徒制度，建立OJT制度(ON JOB TRAINNING)在職訓練，不僅提供學費及獎學金外，也提供許多誘因。



圖十二：在職訓練架構圖

(三)其他國家未來可考慮成立子公司借鏡，更多角化經營。





圖十三: 技術轉移架構圖及技術留用方式

(四) TOKYO WATER 實務基礎訓練，重視經驗累積及親自參與，而非教科書上理論。

### Practical Training

OJT field

Valve operations

Drawing the wiring diagram of a circuit  
(Output the valve opening signal to the valve opening degree detection device)

Variable resistance  
0 Ω to 500 Ω

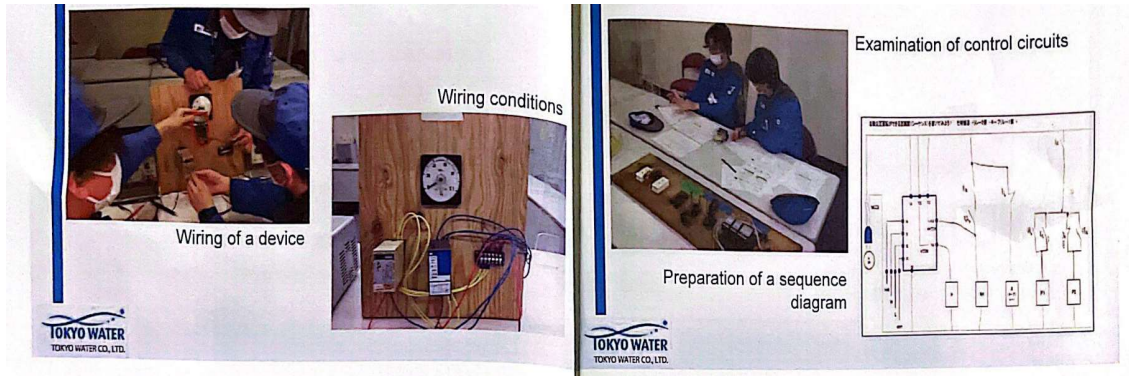
WH1-DC-16A/R1  
Input: DC 4 mA to 20 mA  
Output: DC 1 V to 5 V  
DC 100 V

MES310-P-A  
Input: 0 Ω to 500 Ω  
Output: DC 4 mA to 20 mA  
DC 100 V

Potentiometer  
0 Ω to 500 Ω

### Deepen understanding through experience.

- Experience from design to operation.
- Learn functions and roles through experience.

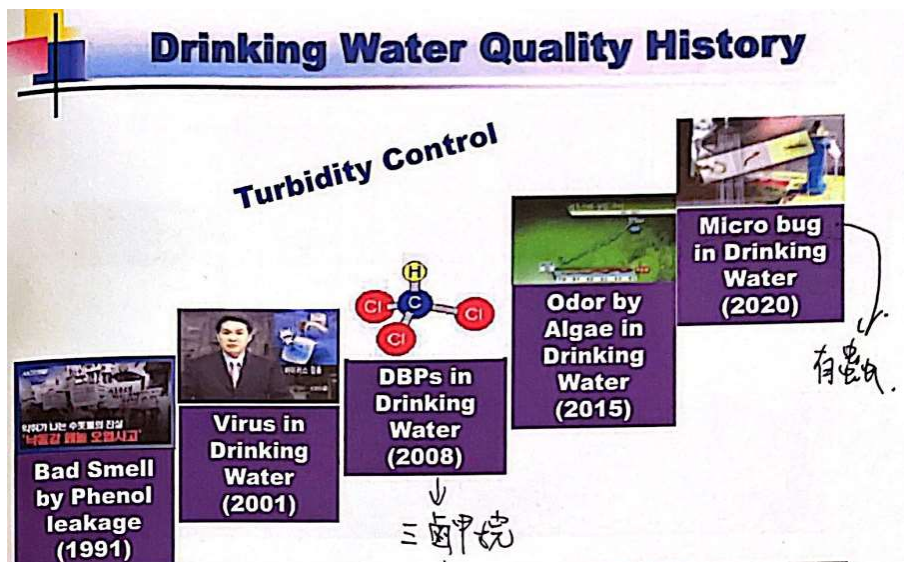


圖十四:現場繪圖及操作

### 三、韓國水資源公社(K-water)

(一)韓國水資源公社(K-water)為韓國最主要之水管理國有公司，從水源整治、水壩建設及營運、自來水設施建設、營運至汙水處理等各階段水源管理，均為該公司經營內容。K-water 通過50多年的水資源專業經驗及技術，配合韓國政府擴展公營事業國際發展之政策，向全世界各國提供關於整個水循環過程的“全水解決方案”(Total Water Solution)。例如參與國外水力發電工程興建計畫、提供智慧水資源管理計畫(Smart Water Management Projects)等方案，協助海外國家建設水資源基礎建設並改善人民生活品質。

(二)探討近年面臨的水質問題(三鹵甲烷及微生物問題)




圖十五:韓國面臨的五大風險









(三)其中微生物問題造成韓國人民用水恐慌，故特別介紹以供其他國家應對：

## Latest Water Quality Issues

### Micro bug (Kironomus Larva)

- Activated Carbon Filtration in Incheon Metropolitan City('20)
- Water supply pipeline in Jeju City('20)
- Size : average 2.2mm
- Activity : Anti bug screen, Water treatment process



 인천(경) 양동양 조판	 제주(경) 양동양 조판	 인천(경) 양동양 조판	 제주(경) 양동양 조판
 인천(경) 양동양 조판	 제주(경) 양동양 조판	 인천(경) 양동양 조판	 제주(경) 양동양 조판

圖十六:微生物入侵飲用水





達卡水資部DWASA



越南建設部第二建設協會HCC



台灣自來水公司簡報發表



同步視訊討論



研討會後合影



其他國家對台灣簡報詢答

圖十七：研討會過程照片



## 肆、參訪心得及建議

### 一、 耐震型接頭 GX：

日本因地震所造成之管線損害日益嚴重，積極研發耐震型接頭，包括 NS 型及更新之 GX 型。台灣自來水管線管材均沿襲日本規格，目前普遍採用之 K 型接頭即日本早期之接頭。台灣目前因 NS 型因進口且價格高，尚屬試辦方式辦理，惟日本方面在管徑 400mm 以下均已使用 GX 型，可見使用優良接頭的落差相當大。考量將停水所造成的外部成本納入修漏成本中，採用優良管材接頭的成本，可能是一個較佳的先期投資方式。建議台灣自來水公司及臺北自來水事業處，適時參採日本最新耐震型接頭，制定管材規範逐步擴大引進使用，當使用量有一定規模市場，鼓勵台灣管材商洽日商技術移轉至本地生產，以逐步降低成本擴大使用。



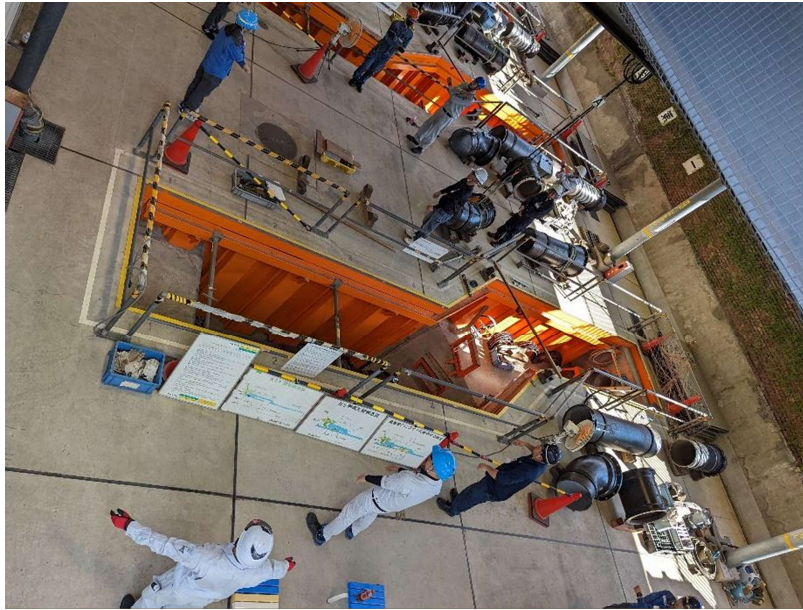
圖十八:耐震接頭NS及GX型

### 二、 不斷水工法:

國內自來水管線改接、施設制水閥、蝶閥、或汰換，大部分仍使用傳統停水斷管施工方式，不僅用戶停水的外部成本大增，停水時間所造成的收益減少、民眾抱怨及洗排水的浪費，更是自來水事業持續需要面對的困境。而日本目前都使用不斷水工法，對民眾供水品質及穩定大幅提升，亦符合節能減碳潮流之工法。臺北自來水事業處自 92 年引進，目前每年皆辦理一定金額的契約使用，惟台灣自來水公司除部分試辦案外，尚未大量採用。未來如能將此工法納入標準施工作業，將逐步降低成本，或吸引國內自行研發在地不斷水施作工法，提升自來水技術。

### 三、 訓練場地：

東京都水道局管線裝接施工訓練場地，模擬開挖後管溝設置，讓受訓人員在受限空間實地操作，如何吊送管件直至管溝內，調整管件角度在管溝內裝接，及押圈螺栓施作等，可作為台灣自來水事業後續興建訓練場地參考。

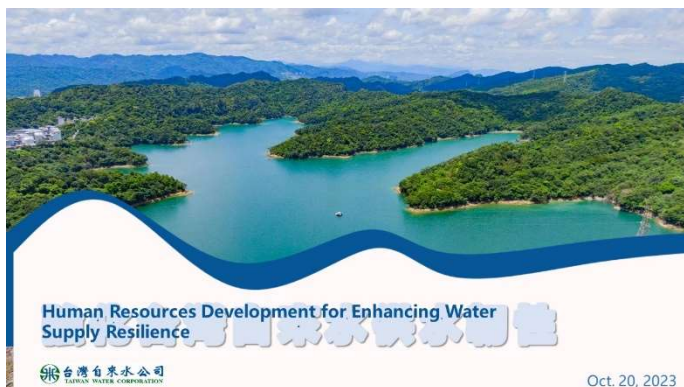


圖十九:模擬管溝訓練場地

#### 四、 孔蓋不下地：

為解決人孔蓋凸起導致道路不平整的情況，台灣目前孔蓋「原則下地，例外不下地」。惟詢日本自來水事業，無法理解台灣為何要將維生系統孔蓋下地，因此日本道路上孔蓋均無下地狀況。人孔蓋一旦下地，就無法隨時定期做預防性的巡檢、調查及維護，若發生緊急狀況需操作使用，將造成無法使用的窘境。另火災發生時如需短時間調度大量用水，需緊急開起或關閉該區域周圍的制水閥，以有效將水量輸送至火災鄰近的消防栓。台灣路權單位所擔心的是人孔蓋與周邊路面常有高低不同，影響交通安全，其問題是出在道路的維護，因人孔蓋及框座高低是可調整的，道路刨鋪時將孔蓋高度配合調整至鋪設厚度，後續道路 AC 或 PC 鋪設注意四周回填的平整及不可下陷，就不致產生落差。因此，建議應從道路鋪修整合確實管理，而非採人孔蓋下地。

## 伍、附錄（本屆會議台水公司發表內容）

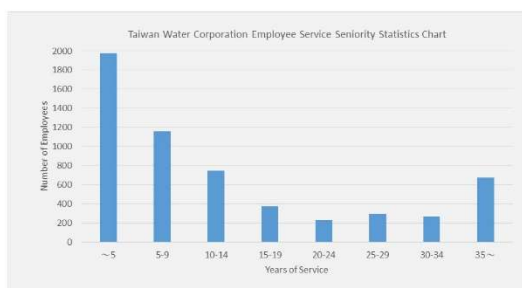


OUTLINE

- ONE Foreword
- TWO Taiwan Water Supply Risk Types
- THREE Enhancing Water Supply Resilience
- FOUR How to Respond to Human Resource Development
- FIVE Conclusion



### Labor Force M-Shaped Polarization





## Taiwan Water Supply Risk Types

- Drought: Response Measures for a Century-Long Drought



- ❑ Extraction of Groundwater at Construction Sites
- ❑ Subsurface Water Recharge
- ❑ Backup Pipeline
- ❑ Mobile Water Purification Unit
- ❑ Digging Drought-Resistant Wells

## Taiwan Water Supply Risk Types

- Earthquake



On September 18, 2011, a magnitude 6.8 earthquake struck the Chihshang area in Taitung, Taiwan, resulting in leaks in some of the water supply network's electrical equipment and pipelines in the affected area.

Water suspension period: 5 days  
Number of affected households: 4,963 households



## Enhancing Water Supply Resilience

- Expand Sources of Income
- Reduce Consumption
- Management
- Backup
- Environmental Sustainability

## Enhancing Water Supply Resilience

- Expand Sources of Income (1/2)

✓ **Subsurface Water** Due to its clean water quality, stable water quantity, small development scope, and minimal environmental impact, it is suitable for use as a regular and backup water source.

✓ **Drought-Resistant** A total of 41 wells have been completed and integrated into the tap water system, with abundant groundwater and no risk of subsidence, such as Taichung and Pingtung.

✓ **Seawater Desalination** It possesses advantages such as being unaffected by drought, having a short construction timeline, offering great capacity for expansion, and requiring a small footprint. Taiwan is surrounded by the sea on all sides, and its seawater resources are abundant.

✓ **Surface Water Replacing Groundwater** The artificial lake is used for water storage and supply to provide a stable surface water quantity as an alternative water source to reduce groundwater extraction in the area."

## Enhancing Water Supply Resilience

- Expand Sources of Income (2/2)

### ✓ Seawater Desalination in Taiwan Island

吉貝 regions -- Due to a decrease in the output of groundwater from deep wells and a slight salinization phenomenon in the water quality, the water quality remains unsatisfactory even after treatment. Therefore, a 600-ton seawater desalination plant will be constructed in Island. It is expected to be completed and operational for water supply by the year 2024."



## 6000CMD RO+UF Seawater Desalination system



Utilize aerial photography technology for real-time monitoring



### Seawater Intake Project



Engineering needs to constantly progress in response to environmental changes

### Enhancing Water Supply Resilience

- Reduce Consumption



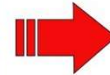
### How to Respond to Human Resource Development

### How to Respond to Human Resource Development

- Goal Changing -- Limited Water Resources



**BEFORE**  
Determine Supply Quantity Based on Demand



**NOW**  
Determine Provision Based on Limited Supply

### How to Respond to Human Resource Development

- Goal Changing -- Limited Water Resources  
The water intake volume has significant changes due to tides and will adjust the water pressure accordingly.  
(受潮汐取水量變化大·所能提供水壓配合調整)



### How to Respond to Human Resource Development

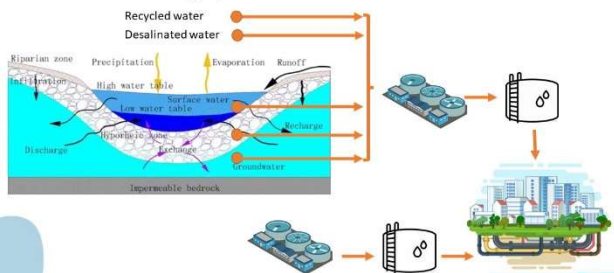
- Goal Changing -- Optimized Manufacturing → Stable Water Pressure Control



Control the Average Water Pressure Under 1.5 kgf/cm<sup>2</sup>

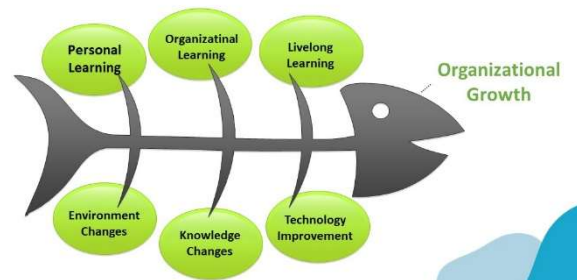
## How to Respond to Human Resource Development

- Diverse Water Supply Model



## How to Respond to Human Resource Development

- E-learning system (1/2)



## How to Respond to Human Resource Development

- E-learning system (2/2)



## How to Respond to Human Resource Development

- Practical Operation Education



Expertise From Experienced Manager



Set SOP & Regular Inspection

## How to Respond to Human Resource Development

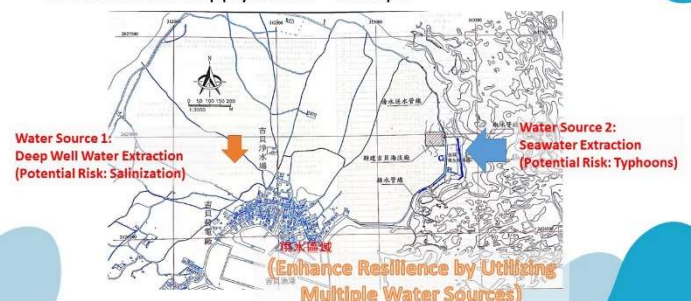
- Practical Operation Education



The only strategy to face an ever-changing future is to enhance adaptability. Just like seashells →

## How to Respond to Human Resource Development

- Diverse Water Supply Model - example





## Conclusion

### Conclusion



"In response to climate change, HRD (Human Resource Development) needs to be more flexible to enhance water supply resilience



Utilizing technological advancements to reduce labor-intensive work and address labor shortage issues



Individuals and organizations should recognize that continuous learning is necessary to face future uncertainties





