



守護百年鐵道

REVIVING A CENTURY-OLD RAILWAY LEGACY

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Image courtesy of / Professor Jyh-Jong Liao and Secretariat

被時間暫停的鐵道

清晨的阿里山，薄霧繚繞在山谷間，一列紅色小火車緩緩駛來。這條蜿蜒於高山之間的森林鐵路，承載著百年歷史，也串聯起無數人的回憶。然而，從 2009 年開始，它飽受風雨摧殘，軌道受損、車站荒蕪、列車停駛，彷彿陷入沉睡，直到一群人投入修復工程，過程中也包括學校的一位老師。這條被凍結在光陰中的鐵道，終於在 2024 年迎來全線復駛。

廖志中曾任土木工程學系教授，退休後現職於校內的防災與水環境研究中心，擔任客座教授。廖老師

The railway frozen in time

At dawn, mist blankets the valleys of Alishan as a red train moves steadily along the tracks. This century-old railway has long been a passage through history, carrying countless memories. However, since 2009, typhoons have battered the railway, leaving tracks damaged, stations abandoned, and trains motionless, as though time had stood still. The railway remained silent until a dedicated team, including a professor from our university, stepped in to restore it. After years of effort, this once-frozen railway finally resumed full operation in 2024.

Professor Jyh-Jong Liao, who previously taught in the Department of Civil Engineering, has retired and now serves as a Visiting Professor at the university's Disaster Prevention and Water Environment Research Center. His steady demeanor and

語氣沉穩，舉手投足間帶著一種長年與山林對話的篤定。談及阿里山林業鐵路的修復，他沒有過多渲染災難的驚心動魄，平淡的口吻彷彿在講述一場漫長的堅持，一場與時間、土地和技術角力的經歷。

崩塌路段、隧道開鑿的評估與監測，每個環節都牽動著這條百年鐵道的未來，而老師的工作似乎不只是修復一條路，更像是在梳理這片山林與人類交通之間的關係。當我坐在他對面，聽著他回憶那些關鍵時刻，似乎可以看到風雨過後，廖老師站在滿目瘡痍的山坡上，審視崩塌的地勢，思索著如何讓這條鐵道再次連接起人與山的情感。

composed presence reflect years of experience working with the land. When discussing the restoration of the Alishan Forest Railway, he did not focus on the devastation caused by the disaster. Instead, his calm tone made it feel as though he was recounting a prolonged effort, a test of endurance against time, nature, and engineering challenges.

Every step of the reconstruction, from assessing landslides to reinforcing tunnels, was crucial to securing the railway's future. Yet, Professor Liao's role went beyond technical restoration. It felt as though he wasn't just rebuilding a railway, but restoring the connection between people and the mountains. As I sat across from him, listening to his reflections, I could almost see it—the hillside scarred by the typhoon, the devastation before him, and the challenge of finding a way to reconnect the railway with the land and the people who rely on it.

阿里山林業鐵路於 1912 年嘉義至二萬平正式完工通車，是一條穿越雲霧、攀登山巒的百年軌道，承載著時間巨輪所推動的歷史足跡。從嘉義平原出發，紅色小火車沿著蜿蜒的鐵道前行，穿過翠綠的茶園與竹林，隨著高度提升，氣溫逐漸下降，景色也發生變化。車窗外，平原農田漸漸被雲霧取代，當列車終於駛入高山車站，空氣中瀰漫著濕潤的森林氣息，這段跨越地貌與時光的旅程，帶領人們進入另一個世外桃源。

阿里山林業鐵路是由農業部林業及自然保育署管理。廖老師也談到自己與政府單位結緣的契機，隨著台灣經濟發展，工程量增加，政府推動不與民爭利政策，鼓勵民間參與大型工程，並將部分設計與監造委託外部單位。為確保工程品質，政府機關開始邀請外部專家學者進行審查。基於此種機緣，廖老師逐步與多個政府單位建立合作關係，投入多項公共工程的規劃設計、施工督導與審查工作，包含修復阿里山林鐵。

「阿里山林鐵在莫拉克颱風來襲的時候幾乎整個都毀掉。」廖老師坐在研究室裡，語氣沉穩地回憶起當年的災後景象。2009 年，莫拉克颱風挾帶

The Alishan Forest Railway was completed in 1912, officially opening for service between Chiayi and Erwanping. For over a century, this railway has wound through misty peaks and climbed towering mountains, carrying the marks of history along its route. The red train departs from the Chiayi plains, following its twisting path through lush tea fields and dense bamboo forests.

As it ascends, the air grows cooler, and the landscape transforms: farmlands disappear into drifting fog, giving way to towering trees. When the train finally reaches the high-altitude station, the crisp mountain air is filled with the scent of damp earth and pine. This journey, spanning both landscapes and time, transports travelers into a world that feels untouched and timeless.

The Alishan Forest Railway is managed by the Forestry and Nature Conservation Agency (FANCA) under the Ministry of Agriculture. During our conversation, Professor Liao explained how he first began collaborating with government agencies.

As Taiwan's economy grew, infrastructure projects expanded. To prevent competition with the private sector, the government encouraged private companies to undertake large-scale projects and outsourced portions of the design and construction. To ensure quality, agencies began inviting external experts to review plans and oversee implementation. This opened the door for Professor Liao's collaboration with multiple government departments, where he contributed to planning, supervision, and project reviews, including the restoration of the Alishan Forest Railway.

"The Alishan Railway was nearly destroyed when Typhoon Morakot struck," Professor Liao recalled, his voice steady as he reflected on



After Typhoon Morakot, the team carefully made their way along the mountainside to assess the damage

莫拉克颱風後勘災，
團隊在山坡小心的前行

驚人的雨量席捲阿里山山區，短短數日內降下超過兩千毫米豪雨，山洪夾帶巨石與泥沙狂瀉而下，沖刷著原本穩固的鐵道路基。老師看著桌上的林鐵地圖，手指向二萬平的位置：「那裡有個二萬平車站，當時的災損名稱就叫做『二萬平大規模崩塌』，一個約 130 公頃的山坡整片走掉。」

山坡在連續降雨中無聲鬆動，隨著一聲轟然巨響，大地像是被撕裂般向下傾瀉，大片林木、岩石與泥土如洪流般傾瀉而下，吞噬沿線鐵道。老師的話語間沒有誇張的渲染，卻能讓人身歷其境般地感受當時的驚人景象。

the aftermath. In 2009, the typhoon brought relentless rainfall to the mountain region, dumping over 2,000 millimeters of rain within days. Floodwaters surged through the valleys, carrying boulders and debris that tore through the once-stable railway foundation.

Examining a railway map, Professor Liao pointed to a spot and said, "Right here—Erwanping Station. The disaster was officially classified as a 'major landslide at Erwanping.' Over 130 hectares of mountainside collapsed, completely reshaping the landscape."

Days of unrelenting rain had weakened the slopes until, with a thunderous roar, they gave way. A massive wave of trees, rocks, and soil crashed downward, swallowing the railway in an instant. Without any embellishment, his words alone painted a stark picture of the devastation.

Professor Liao discusses restoration plans with his team.

廖老師 (右三) 與團隊討論修復規劃



Professor Jyh-Jong Liao
廖志中教授





After Typhoon Dujuan struck, the tunnel was damaged by landslides and debris.

杜鵑颱風來襲後，隧道因土石受損

喚醒沉睡的鐵道

「莫拉克颱風來襲後，造成阿里山林鐵因災害受損停駛，直到修復工程逐步展開。」廖老師回憶道，他就是從那時候開始參與的。林業及自然保育署分階段先修復了嘉義至竹崎較低海拔及阿里山國家森林遊樂區內的鐵道路段，接著開始進行位於屏遮那站與二萬平站間第 46 號隧道的新建工程，這條隧道取代原本位於地質不穩定的既有路線，亦是林鐵全線最長的隧道，但也因此需詳細調查評估重新整建，才能讓列車安全通行。

廖老師的工作涵蓋現場勘查、評選顧問公司、審查設計方案，確保隧道修復計畫的可行性與安全性。

「從一開始，我就協助林業及自然保育署找合適的顧問公司，並審查設計方案，確保工程能順利推進。」

隨著整體修復工程穩步推進，原訂於 2015 年全面恢復通車。然而，就在這場歷經多年的復原工作即將完成時，杜鵑颱風突襲阿里山，強降雨再次重創

Waking the slumbering railway

"After Typhoon Morakot, the Alishan Forest Railway suffered extensive damage and was forced to suspend operations until restoration efforts gradually got underway," Professor Liao recalled. That was when he became involved. The Forestry and Nature Conservation Agency (FANCA) first prioritized the repair of lower-altitude sections between Chiayi and Zhuqi, as well as tracks within the Alishan National Forest Recreation Area. They then moved on to constructing a new Tunnel No. 46 between Pingzhena and Erwanping stations. This tunnel replaced a previously unstable section of the railway and became the longest tunnel on the entire line. However, due to its complexity, a detailed survey and evaluation were required before reconstruction could proceed to ensure safe train passage.

Professor Liao played a crucial role in the process, conducting on-site assessments, evaluating consulting firms, and reviewing design proposals to ensure the feasibility and safety of the tunnel project. "From the very beginning, I helped FANCA select the right consultants and review their designs to keep the project moving forward," he explained.

As the restoration work steadily progressed, full service was originally scheduled to resume in 2015. However, just as years of effort were about to pay off, Typhoon Dujuan struck Alishan.

部分路段，導致隧道坍塌、軌道受損，列車重返鐵道的目標再度變得遙遙無期。

「2015 年，杜鵑颱風來了。」廖老師搖搖頭，回憶起那場風災的衝擊，這次是十字路站到屏遮那站之間的 42 號隧道，發生兩處大崩塌，總長 55 公尺。

「我記得當時剛從日本開研討會回來，隔天晚上就接到林業及自然保育署一位技正的電話，問我是否能與他們一起上山看工程。」隔天一早，他們從嘉義高鐵站出發，搭車上山，再換乘簡易台車進入災區。廖老師接著描述當時看到災損的震撼，「明隧道被砸毀，幾公尺大的岩塊從數百公尺高處垮落，連基礎都被掏空，整個隧道變成了一個大缺口，連路基都沒了。」

這場災害迫使修復及復駛計畫重新調整。廖老師分析崩塌原因，並協助團隊制定修復方向，從可行性評估、設計到施工，全面規劃。這項修復工程歷時九年，從 2015 年災損到 2024 年全線通車，經歷了無數次測量、規劃與修正，才讓這條重要的鐵道得以重見天日。

The restoration of Tunnel No. 42 represents a significant milestone toward full line operation.

42 號隧道完成修復



Intense rainfall once again inflicted severe damage on parts of the railway, causing tunnel collapses and track destruction. The long-awaited return of the trains was once again pushed further into the future.

"Then came Typhoon Dujuan in 2015," Professor Liao said, shaking his head as he recalled the impact. This time, the damage occurred between Shizilu and Pingzhena Stations, where Tunnel No. 42 suffered two major collapses, leaving a total of 55 meters of destruction.

"I remember just returning from a conference in Japan when I received a call late at night from a technical specialist at the Forestry and Nature Conservation Agency. He asked if I could join them the next day to assess the damage in the mountains," Professor Liao recalled.

Early the next morning, the team departed from Chiayi High-Speed Rail Station and made their way up the mountain. Professor Liao described the devastation he saw. "The open-air tunnel was completely destroyed. Massive boulders, several meters in size, had tumbled down from hundreds of meters above, wiping out the foundation. The entire tunnel was torn apart, leaving a gaping hole, with no trace of the railway bed remaining."

The extent of the destruction required a complete reassessment of the restoration and reopening plans. Professor Liao analyzed the causes of the collapse and worked closely with the team to determine the best course of action, overseeing the process from feasibility studies and design to construction. The restoration project spanned nine years, from the disaster in 2015 to the full reopening of the railway in 2024. After extensive surveys, planning adjustments, and continuous refinements, this vital railway was finally revived.



Chushan Station
after restoration

修復完成的祝山車站



守護鐵道的路上，那些不可或缺的事

「這段時間，我主要負責規劃工程步驟，參與選商與圖面審查。」廖老師語氣輕描淡寫，但這些決策攸關整條鐵道的安全與未來。除了技術指導，廖老師也著重人才培育。他笑著說，「我一直是在做老師的工作啦。」在這次工程中，他帶領年輕工程師與林業及自然保育署團隊，從規劃、設計到發包與監督，建立完整的工程管理概念。他也培訓顧問公司團隊，讓碩士與技師背景的專業人員，真正學會調查、分析與設計，為未來的工程做好準備。

廖老師不只關注修復，更推動長期監測機制。「鐵道也需要體檢，就像人要定期健康檢查一樣。」他建議林業及自然保育署引進光學雷達 (LIDAR)，透過高精度測量掌握地形變化，預測潛在風險，並制定優先修復計畫。阿里山林鐵在恢復全線通車後再遇凱米颱風來襲，但只停駛一個月進行小規模土石、倒樹清理及環境整理即恢復營運，就是這套機制發揮了作用。

訪談尾聲，廖老師也謙虛地說，他覺得他做對了一件事，不只是讓這條歷經風雨的鐵路恢復運行，也讓年輕工程師與官員在過程中成長。「我一直告訴

What truly matters in restoring the railway?

"During this period, my main responsibilities included planning the construction process, selecting contractors, and reviewing design plans," Professor Liao said in a matter-of-fact tone. However, these decisions were critical to the safety and future of the railway. In addition to providing technical guidance, he placed great emphasis on mentoring the next generation of engineers. With a smile, he added, "At the end of the day, I'm still a teacher."

Throughout the project, he led young engineers and the Forestry and Nature Conservation Agency (FANCA) team, guiding them through planning, design, procurement, and supervision while helping them develop a comprehensive understanding of railway project management. He also trained consulting firm personnel, ensuring that professionals with master's degrees and engineering certifications gained hands-on experience in surveying, analysis, and design, preparing them for future infrastructure projects.

Professor Liao's contributions extended beyond restoration. He also championed the need for a long-term monitoring system. "A railway needs regular checkups, just like people need medical examinations," he said. He recommended that FANCA implement Light Detection and Ranging (LIDAR) technology to conduct high-precision measurements, track terrain changes, predict potential risks, and establish priority repair plans.

After the railway was fully reopened, Typhoon Gaemi struck. With this monitoring system in place, the impact was minimized. Train services were suspended for only a month to allow for minor debris removal, fallen tree clearance, and environmental

他們，工程不能只停留在發現問題，而是要不斷尋找解決方法。阿里山鐵路的修復從來不是一條平坦的路，颱風、坍方、資源不足，每一步都充滿挑戰，但關鍵在於如何推動工程持續向前，讓鐵路真正穩定運行，而不是停留在原地。」

我覺得這不是謙虛，而是廖老師確實做到了。他不只讓鐵道重新運行，也讓一群年輕工程師在挑戰中成長，帶著解決問題的能力，讓這條鐵路在風雨後依然屹立。在全線通車感恩典禮中，廖老師獲賴清德總統頒發阿里山林鐵全線通車感謝狀。

如今，紅色小火車再次穿梭於山巒之間，鳴笛聲迴盪在雲霧之中，彷彿訴說著這條鐵道經歷的重重考驗。廖老師與團隊並非創造奇蹟，而是一步一腳印解決問題，讓這條鐵道在風雨摧折後仍能穩定前行。或許沒有 100 分的解決方案，但這條曾被大自然吞噬的鐵道，終於在技術、毅力與不懈實踐中，再次連結起人與山林的情感。■

restoration before resuming. This demonstrated the system's effectiveness.

As the interview drew to a close, Professor Liao reflected on what he took the most pride in—not just restoring a railway battered by storms, but guiding young engineers and officials through the process, helping them grow. "I always tell them that engineering isn't just about identifying problems; it's about finding solutions. The restoration of the Alishan Railway was never a smooth journey. Typhoons, landslides, and limited resources posed constant challenges. The key was to keep moving forward, ensuring the railway could operate safely rather than remain in limbo."

He spoke with humility, as if his role was just a small part of a larger effort. However, this was more than modesty. It was the reality of what he had achieved. Restoring the railway was only one part of his accomplishment. A new generation of engineers also emerged, equipped with the skills and mindset to take on future challenges. At the ceremony celebrating the full reopening, President Lai Ching-te presented Professor Liao with a certificate of appreciation in recognition of his contributions to the project.

Today, the red train winds through the mountains once more, its whistle echoing through the mist as if telling the story of all the challenges this railway has overcome. Professor Liao and his team did not perform miracles. They tackled each challenge step by step, ensuring the railway continued moving forward despite the hardships. There may never be a perfect solution, but through skill, perseverance, and relentless effort, this railway, which was once nearly lost to nature, has once again become a bridge between people and the mountains.

