Zen and the Art of Commuter Rail Operations: Taiwan Railways Administration's Design, Operations, and Philosophy

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通勤列車運轉的藝術：台灣鐵路管理局的系統設計，作業，與哲學

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Abstract

This paper offers a review of ideas and practices making Taiwan Railways Administration (TRA) unique and distinctively different to North American commuter railroads, based on two weeks' field observation, published sources, authors' cultural knowledge, and discussions with locals. Unlike most transit systems, TRA accommodates different trip purposes and train types on shared railway infrastructure, covering areas with varying traffic densities, travel needs, and geographic features. As an importer of railway technology, to meet diverse requirements, and because of incremental and stop-gap measures devised in response to capital budget restrictions, TRA has needed to embrace, operate, and maintain a wide assortment of different standards and procedures. This willingness to accept outside designs and consider functionality/cost/simplicity trade-offs when addressing specific needs resulted in constantly varying daily routines for management, staff, and customers. In turn, it may have cultivated expectations of learning curves with new technologies and continuous training requirements, apparently resulting in higher skill levels and a more nimble workforce that contributes to overall higher reliability, tolerance of changes, and nuanced operations tailored to maximize railway effectiveness. These observations suggest further research needs for commuter rail authorities: Can infrastructure and schedules be designed with better cost-flexibility tradeoffs? Should train priorities be explicit in public schedules? What is an appropriate level of standardization? Is technology better thought of as workplace assistance and not functional replacement for employees? Embracing diversity in engineering and operating solutions could reduce investment costs yet improve effectiveness by requiring humans to think on their feet.

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Further Research for Commuter Railroads

- *Designing to Expect Disciplined Operations:* TRA's infrastructure is not foolproof. Employees have to "get it right the first time".
- *Scheduling for Priority and Reliability:* Schedules and plant require en-route "checkpoints" and absorb uncontrollable disruptions.
- *Empowering Local Supervision with System Responsibility:* Effective use is made of constrained infrastructure through significant on-site supervision, teamwork, peer camaraderie, communication, and hands-on operations.
- *Appropriate Standardization:* Standardization efforts are tempered by local adaptations and procurement policy. Tolerating some diversity and using off-the-shelf products may reduce costs and improve effectiveness.
- *Technology as Workplace Assistance, not Functional Replacement:* Automation is accomplished without compromising employees' skills or flexibility. Machines enable employees to perform better, faster, or to multi-task.
- *Prioritizing Investment Based on Technology Characteristics:* TRA's projects are ranked by each technology's specific impacts on operations.
- *Fare Control Automation:* Taiwan implemented faregates to improve passenger throughputs rather than to remove human presence.
- *Metropolitan Terminals:* Taipei's downtown tunnel offers insight into how such projects can be environmentally and politically justified.
- *Integrated Transportation Planning:* TRA's seamless passenger experience across jurisdictions demonstrate effective island-wide strategic planning.

Simple, robust, single-purpose machines with a multi-skilled, multi-tasking workforce make TRA a successful yet flexible commuter railroad.

Underground urban trackage and run-through services make efficient use of assets and available track capacity. An Italian *Società Costruzioni Industriali Milano* (SOCIMI) EMU300 trainset is being prepared at the Qidu carbarn.

Taipei Main Station's less-crowded underground platform with a *British Rail Engineering Limited* (BREL) EMU100, delivered in 1978 for the original Taiwan West Coast Mainline Electrification programme.

Taoyuan commuters wait for the South African *Union Carriage & Wagon* EMU400 to Qidu. To support metropolitan growth, Banqiao yard moved west to Shulin, and Nankang yard east to Qidu, extending through-running operations.

TRA purchased six sets of *Hitachi* 8-car 130 km/h tilting trains, based on *JR Kyushu*'s 885-series design, for US$85 million, to provide accelerated East Coast services. Locally called "Taroko trains" after the mountain gorge.

An empty unit coal train with an American *Electro-Motive Division* (EMD) G12 (TRA R20-class) locomotive is stored on Taoyuan's bypass track, likely recently returned from the Linkou coal-fired power plant.

TRA's infrastructure designs are targeted towards scheduled movements. The South Korean *Daewoo* EMU500 commuter unit is being prepared on Hsinchu's middle track while an intercity train departs.

The express train with streamlined orange E1000 locomotive is passing a blue local train using outside bypass tracks at Kueishan (Turtle Mountain) station on the Yilan Line.

Train terminations and transfers occur at interchanges where double island platforms and full crossovers are provided. The Japanese *Tokyu* DR3000 DMU is departing from Shulin station, using crossovers for yard access.

TRA's operating practices may be labour intensive, but resulting service quality is high: stationmasters' controls feature departure bells, schedule simplifiers, and "good to go" plungers (left); Hsinchu's stationmaster (right).

Jingtong station is the terminus of the Pingsi tourist branch. TRA stations often feature decorative plants that are painstakingly maintained. Train crews are immaculately dressed in blue and white uniforms.

With the train safely immobilized, the commuter EMU's operator and relief operator exchange pleasantries on Yilan's departure track prior to changing ends and returning to Hsinchu via Taipei.

On long distance trains, cleaners move through the train while in-service to collect trash from passengers (left); Sandiaoling's stationmaster exchanging tokens (movement authorities) with Pingsi branch's operator (right).

TRA's fare control occurs at origin, destination, and en-route. Conductors use portable thermal ticket printers to sell onboard fares. 50% penalty fare applies for those failing to purchase tickets before arriving at destination.

A delay machine prints proof-of-delay receipts showing recent train delays. Delays are typically limited to five to ten minutes. Train 1015 was delayed only 27 minutes despite requiring substitute equipment.

Hsinchu's exit-only control area (unpaid side) has modern faregates and volunteer customer assistance staff. TRA volunteers are a mixture of retired railway employees, student interns, and members of the public.

Suao (left) and Yilan (right) on the East Coast still have traditional slam gate fare control areas reliant on manual ticket examination. Nonetheless, electronic noticeboards provide real-time customer information.

Advance-purchase ticket machines have touch screens, reservations, and credit card capabilities (left); commuter ticket machines are simple and robust prepaid-card and cash-only receipt printers (right).

Valid on TRA for local trips, Taipei Metro's EasyCard are also accepted at convenience stores like *Family Mart*. Smartcard payments are allowed for low-value non-transportation items, like Hong Kong's Octopus Card.

To maximize passenger throughput, separate ticket windows provide train information, today's tickets, and advance/commutation tickets. The Buddhist monk is purchasing daily tickets at Hsinchu station, skipping long queues.

Like the Long Island Rail Road, Taiwan has its own versions of the "Dashing Commuters". Underpasses are provided for access to island platforms. TRA had recycled old rails for constructing station canopies since the 1950s.

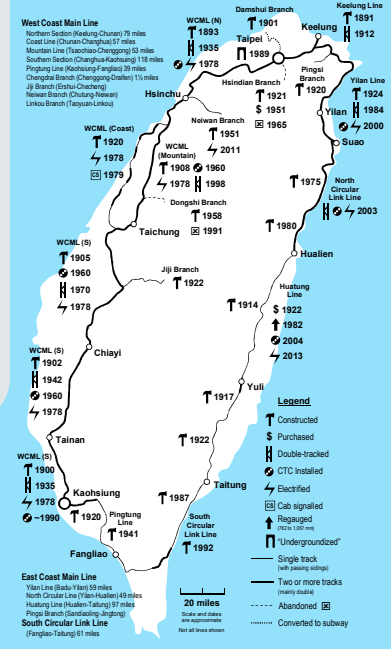
Rueifang station's platform showcase a variety of customer friendly devices: schedule poster box, dot-matrix displays, lighted bilingual signage with icons, security cameras, partially-sighted features, and of course potted plants.

Onboard information system (top) from a newer EMU700 identifies prior stop (Wudu), next stop (Baifu), and following stop (Qidu); flexible scrolling display from older push-pull sets are similar to platform displays (bottom).

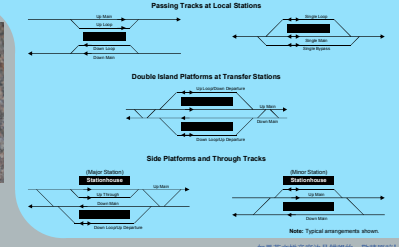
Many principal stations now have bilingual Solari-type "flippy-flippies" or LCD screen departure boards. Delays as short as one minute late are immediately posted.

An authentic TRA bento box ("駅弁" or "便當"), offered for sale to passing trains. Originated in Japan but now ubiquitous throughout Asia, each region offers its own local flavour.

Taiwan Railways Administration Historical Route Map (Unofficial)



TRA's Typical Track Arrangements



Note: English transliterations of station names reflect (where available) those in TRA's passenger rail timetables, which shows a mixture of Wade-Giles (historical and popular usage, particularly outside Taipei), Tongyong Pinyin (former standard), and Hanyu Pinyin (current official standard).

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