CAREER PATH

CBTC Engineer Learning Roadmap

CBTCBOOK.COM
V1.0 · SEPTEMBER 2026
CHUNJUN (FRANCISCO) WANG

Where the discipline is actually entered, what to do in the first five years, and where the paths diverge afterwards — with the reading that compresses the learning curve.

Stage 0 · Getting in

ROUTE	WHAT TRANSFERS	WHERE IT LEADS FIRST
Electrical engineering	Real-time systems, digital communications, control theory, reliability engineering. The most common starting point.	Vendor onboard or wayside engineering.
Computer engineering / CS	Safety-critical embedded code, OS internals, distributed-system failure reasoning. Software is now the dominant cost driver.	Vendor software and integration teams.
Mechanical / transportation	Control-systems concentration plus operational context.	Agency operations and performance ownership.
Lateral entry	Automotive, aerospace, medical devices, telecom. Safety-critical discipline transfers; domain knowledge is taught.	Wherever a hiring manager recognizes the pattern.

A master's helps but is not required. The strongest signal in a junior résumé is a thesis or capstone on a real safety-critical system — embedded, automotive, medical, aerospace — not a higher GPA.

Stage 1 · The first job

ENTRY POINT	FIRST 18 MONTHS LOOK LIKE	TRADE-OFF
Vendor	Writing test procedures, executing factory acceptance tests, supporting commissioning. Siemens, Alstom, Hitachi Rail and the specialists.	Deepest product competency, narrowest early view of the railway.
Transit agency	Monitoring performance, investigating incidents, vendor reviews, RAMS support. MTA NYCT, BART, WMATA, SFMTA, MARTA, HART.	Operational reality first; slower to build design depth.
Consultancy	Procurement and program support. STV, WSP, AECOM, HDR, HNTB, Jacobs.	Broad exposure across agencies; less hands-on engineering.

Stage 2 · Before year five, go and do all five

- ☐ **Run a full factory acceptance test** for a subsystem — procedure written by you, failure modes characterized. This is where you learn what the system does as opposed to what the requirements say it does.
- ☐ **Work a revenue cutover in the field.** There is no substitute for being on the line at 2 a.m. when a cutover is going badly and the recovery has to happen anyway.
- ☐ **Read one IEEE 1474 standard and one IEC 62290 standard end to end.** Not excerpts. The standards are the industry's shared vocabulary, and clause-level fluency changes how you are treated in a room.
- ☐ **Take one revenue-service incident to a determined root cause.** Deployed behavior under stress is rarely what FAT predicted.
- ☐ **Spend an assignment with the operations control center.** The system looks different from the dispatcher's seat, and that view is missing from every design-side career.

Stage 3 · The mid-career fork (years 5–15)

TRACK	WHERE IT GOES	WHAT IT COSTS
Technical	Senior systems engineer writing safety cases; principal onboard engineer owning VOBC architecture; chief commissioning engineer running cutovers.	Nothing, if depth is what you want. Well compensated and durable.
Program management	Owning schedule, budget, customer and the stage gates from RFP to revenue service.	Different skills — risk, contracts, stakeholders — and less time in the engineering.
Agency / consultancy	From "engineer at the vendor" to "engineer working with the vendor."	Same skill, different side of the contract. Prior vendor time is what makes it credible.

Where competency actually comes from

Engineering school — fundamentals; no CBTC. **Vendor new-hire training** — product competency.

AREMA · APTA · TSI — industry practice and continuing education.

On-the-job apprenticeship — the part no course replaces. **Standards, read directly** — the shared vocabulary.

US pay bands, 2026

ROLE	BASE	NOTE
Entry, vendor	\$80k–110k	Total compensation includes benefits and any project incentives.
Entry, agency	\$75k–95k	Lower base, stronger benefits and pension contributions that partly close the gap.
Senior, vendor	\$115k–160k	Total compensation runs higher in a major metro; cutover commissioning often carries spot incentives.
Senior / chief, agency	\$105k–140k	Equivalent senior systems or chief engineer role.
Context	~\$111k	BLS median for electrical engineers generally; 75th percentile near \$140k, 90th above \$170k.

The reading list

#	WORK	WHY
1	Pachl, *Railway Operation and Control* (4th ed.)	The operating principles everything else assumes.
2	Theeg & Vlasenko (eds.), *Railway Signalling and Interlocking* (3rd ed.)	The reference for what CBTC replaced and still interfaces with.
3	IEEE Std 1474.1 / .2 / .3 / .4	Performance, functional and test requirements. Read one end to end.
4	IEC 62290 series	Functional architecture and the GoA definitions.
5	Storey, *Safety-Critical Computer Systems*	Why SIL 4 is a design posture, not a certificate.
6	Hartong, Goel & Wijesekera on CBTC	Academic framing of the architecture.
7	FTA, *CBTC Implementation Guidance*	The US federal view a program will be measured against.
8	TCRP Report 163 — Transit Capacity and QoS Manual	Where capacity claims get checked.
9	Wang, *Communications-Based Train Control*, Vols. 1–2	The US-context reference these sheets are cut from.
10	APTA Rail and IEEE/ASME Joint Rail conference proceedings	Where current practice is reported before it reaches books.

Sequence that actually works. Pachl first, for operating context. Then one IEEE 1474 standard, slowly, with the manuscript alongside it. Then Storey, once you have seen a real safety case. The conference proceedings become useful only after you have a project to compare them against — reading them first produces opinions without a foundation under them.

Compiled by Chunjun (Francisco) Wang from the career and competency articles on cbtcbook.com and twenty years of building and hiring CBTC engineering teams. Pay bands are 2026 US figures for the named role and employer type; they are base salary unless total compensation is stated, and vary sharply by metro.

FREE TO USE AND SHARE WITH ATTRIBUTION.