

MPBx Research | What the next technology cycle requires from PCBs

Quantitative evidence and modeling methods · Information cutoff: 30 September 2026

Finding: The evidence supports a combination of AI computing/networking demand, higher board complexity, automotive electronics, and manufacturing diversification. It does not establish a predominantly humanoid-robot-driven Thailand investment cycle. Company disclosures establish stated intentions and operating results; they cannot reveal every private investment motive.

This study uses sources from China, Japan, South Korea, Germany, the United States, and an international agency. No Thai publications, BOI statistics, MPBx articles, or Thai investment totals enter the model. Values remain in their original currencies unless a source already reports USD. It is a research pack, not a published MPBx article.

1. How much more PCB?

The working market series is the June 2026 Prismark forecast reproduced in Chinese listed-company filings. It **includes IC package substrates**. These are market estimates and forecasts, not measured future orders. Amounts are annual production/market value, not cumulative spending.

Measure	2025 estimate	2030 forecast	Calculated increase
Global PCB value, including substrates	\$85.836bn	\$144.610bn	\$58.774bn; 68.5%
Global shipment area	About 483m m ²	About 628m m ²	About 145m m ² ; 30.0%
Value excluding IC substrates	\$70.945bn	\$115.000bn	\$44.055bn; 62.1%

Value inputs: [Shengyi H1 2026, pp. 10-11](#). Area endpoints: [WUS H1 2026, printed p. 6 / PDF p. 10](#). Changes and substrate subtraction are our arithmetic. The area estimate is rounded and its complete underlying methodology was not available publicly.

The distinction matters: a 68.5% value increase is not 68.5% more boards. The endpoints imply 11.0% annual value growth and 5.39% annual area growth. Their ratio implies approximately 29.6% greater pooled value per reported square metre by 2030. This is a mixture of product mix, complexity, pricing and possibly FX; it is **not** a forecast that an unchanged board's price rises 29.6%.

2. Which board types absorb the growth?

Technology class	2025, \$bn	2030, \$bn	Added annual value, \$bn	Calculated CAGR
Single/double-sided	8.440	10.344	1.904	4.2%
4-6 layer multilayer	16.706	20.159	3.453	3.8%
8-16 layer multilayer	11.445	18.645	7.200	10.3%
18+ layer multilayer	5.254	19.759	14.505	30.3%
HDI	16.197	30.010	13.813	13.1%
IC package substrates	14.891	29.610	14.719	14.7%
Flexible PCB	12.903	16.083	3.180	4.5%

Endpoints: [Shengyi's reproduced Prismark table, p. 11](#). Calculations: model.py. The 2025 and 2030 segment totals reconcile exactly. The rounded 2026 segment total is \$1m below the published total.

18+ layer boards, HDI and substrates contribute \$43.037bn, or 73.2%, of the projected \$58.774bn increase. This is a technology classification, not an AI-only revenue share. The same products serve several applications. Technology categories and end-market categories are separate views of one market and must never be added together.

The industry opportunity therefore depends on manufacturing capability: lamination cycles, registration, fine lines, vias, low-loss materials, testing, and qualification. Generic square metres alone cannot represent this workload.

3. What are the technology customers preparing for?

End-market indicator	Citable input	Quantitative interpretation
Server and data-storage PCB	\$16.031bn in 2025; 24.8% projected CAGR to 2030	Implies about \$48.53bn in 2030 and \$32.50bn additional annual value
Wired infrastructure PCB	19.0% projected CAGR, 2025-2030	Implies 2.39 times the 2025 value; baseline dollars not supplied here
Mobile-phone PCB	4.5% projected CAGR	Slower growth than infrastructure
Computer PCB	2.9% projected CAGR	Must remain separate from server/storage category
Consumer-electronics PCB	3.7% projected CAGR	No justification for applying AI-server growth to all electronics

Inputs: [Avary September 2026 prospectus, printed p. 21 / PDF p. 22](#), attributing the market data to Prismark. Derived server/storage expansion represents approximately 55.3% of the overall projected market increase. It includes conventional servers and storage; it is not an AI-only estimate. Exponentiating a rounded CAGR gives an approximation, not a separately published endpoint.

Physical interpretation: computing boards, switch/network boards, accelerator modules, memory/storage interconnects and power-delivery boards are connected demand channels. They should be mapped into complete systems before counting PCB content to prevent counting the same module twice.

4. Why Thailand? Evidence from the investing parents

Parent and source	Disclosed evidence	What it supports
Shengyi Electronics, China	Its 2023 decision describes overseas customer orders, trade-policy exposure, comparative land/building/labour/tax costs and the developing supplier base	Location diversification and manufacturing economics, in the company's own assessment
Shennan Circuits, China	Original project budget RMB1.27418bn; rationale explicitly addresses international customers and global supply capability	Overseas supply expansion; the budget is not realized sales
CMK, Japan	September 2022 plan: approximately JPY25bn phase-one investment; double HDI capacity; up to four times original capacity if expanded fully	A documented automotive/CASE rationale predating this investment wave's present AI narrative
WUS, China	H1 2026: over 90% of overseas customers in the Thai data-communications division had completed certification; original capacity essentially full; boards up to 30 layers in volume production for 400G switches and AI servers	Direct evidence of customer-qualified computing/network production, rather than an uncommissioned project announcement

Sources: [Shengyi original decision, pp. 1-3](#); [Shennan original decision, pp. 1-2](#); [CMK original plan](#); [WUS interim report, printed pp. 9-10](#).

Inference: Thailand can gain output from both growing worldwide consumption and customers reallocating where existing demand is manufactured. Those are different effects. These disclosures do not support assigning a precise percentage of Thailand's investment to AI, tariffs, or robotics.

A factory's announced equipment capability also does not establish its future product mix. Customer qualification, yielded output and repeat orders are stronger evidence than capacity announcements.

5. Cross-checks from Japan, Korea and Germany

Company	Period and measurement	What the number does and does not establish
Samsung Electro-Mechanics, South Korea	Package Solution Q2 revenue: KRW564.6bn in 2025 to KRW771.6bn in 2026, +36.7% calculated	Supports a substrate demand upswing; exclude cameras and MLCC revenue from PCB demand
Meiko, Japan	AI-server PCB sales: JPY7.3bn FY2025 actual; JPY17bn FY2026 and JPY60bn FY2028 in its May 2026 plan	A supplier growth plan, not a forecast for every PCB company; its FY2025 ended March 2026
CMK, Japan	Year ended March 2026: mobility 89.3% of sales; operating profit down 26.8%	Thailand exposure need not be primarily AI, and sales growth need not translate into profit growth
Schweizer Electronic, Germany	H1 2026 revenue EUR92.1m, +11.9%; EBITDA EUR0.2m	Demand growth can coexist with a roughly 0.2% EBITDA margin

Sources: [Samsung Q2 2025](#), [Q2 2026](#); [Meiko May briefing, pp. 5 and 10](#); [CMK 2026 report, pp. 2-3](#); [Schweizer H1 release](#).

Meiko says its plan uses customer forecasts; that does not mean firm orders. Its expansion in Vietnam also shows that Thailand competes with other production locations. [Meiko management Q&A](#).

6. Robotics: quantify the missing coefficient

The German-based IFR reports 603,000 industrial robot installations in 2025 and forecasts 806,000 in 2029. Its separate humanoid coverage reports about 7,000 full-size units above 140cm sold in 2025. These are different populations, not additive categories of a single validated total. [IFR presentation, pp. 9 and 32](#); [industrial outlook](#); [humanoid scope](#).

The missing parameter is **bare-board content per robot**, excluding chips, motors, complete control electronics and assembly charges. Without comparable teardown/BOM data, assigning a global robot-PCB market value would be speculative.

Volume reference	Bare-board content per unit required for a \$1bn annual PCB market
603,000 industrial installations, 2025 reported	\$1,658
806,000 industrial installations, 2029 forecast	\$1,241
Approximately 7,000 full-size humanoids, 2025 reported	\$142,857

This is threshold arithmetic: \$1bn divided by annual units. It is not an estimate of actual board content or a forecast of humanoid adoption. It illustrates the scale of evidence needed before attributing today's large factory investment cycle to humanoids.

IFR's service-robot presentation states that its sample covers 238 of 1,001 producers, is not extrapolated to the entire industry and varies each year. Do not train a longitudinal forecast by blindly joining successive service-robot survey totals. [IFR methodology, p. 28](#).

7. Modeling method for a defensible independent forecast

A. Bottom-up demand by hardware architecture

For application a, system design j, technology k and year t:

Good PCB area[a,k,t] = $\sum_j (\text{Annual system shipments}[a,j,t] \times \text{Boards per system}[a,j,k,t] \times \text{Finished board area}[j,k,t])$

PCB value[t] = $\sum_{(a,k)} (\text{Good PCB area}[a,k,t] \times \text{Realized price per good square metre}[a,k,t])$

Use generation-specific designs: server motherboards, accelerator carriers, switches and power boards separately. Record whether shipment counts mean racks, trays, servers or accelerators. Include IC substrates only in a separate compatible series. Count replacement hardware as shipments; do not multiply installed stock by new-unit content every year.

For stock data: New shipments = Increase in operating stock + Retirements, with separate repair-board demand. Estimate retirement curves from installed cohorts rather than assuming every machine is replaced at the same age.

Needed inputs: hardware shipments, measured board count and dimensions, technical specifications, and verified realized pricing. This pack does not invent those missing inputs.

B. Convert demand to production workload

Gross panel area required = Good finished area / (Panel nesting efficiency × Final good-board yield)

Layer-area = $\sum (\text{Good area} \times \text{Copper-layer count})$

Layer-area is an engineering workload proxy, not a complete capacity measure. Laser drilling, sequential lamination, plating and electrical test can be the binding constraint. For each process, model available machine-hours versus hours required per qualified design. Do not apply an extra yield factor to a capacity figure already stated as good finished output.

C. Separate Thailand's share gain from global demand growth

For a consistently defined product class, let global market be G and Thailand production share be s:

Change in Thailand output = $s_0 \times \text{Change in G} + G_0 \times \text{Change in s} + \text{Change in G} \times \text{Change in s}$

The terms identify worldwide growth, geographic relocation, and their interaction. This identity applies to area or value only if both sides use the same definition and unit. It does not estimate Thailand's share by itself.

Build a factory panel from parent-company disclosures: product class, installed capacity, start date, customer certification, utilization, yield, realized sales, expansion and retirement. Separate overseas replacement capacity from net new capacity. Enforce demand constraints: aggregate production cannot exceed qualified sell-through plus a separately modeled inventory change.

No Thailand-wide numerical output forecast is issued here because a complete comparable, non-Thai-source capacity and sales census has not been assembled.

D. Treat financial-market signals as leading indicators

Use quarterly customer hardware purchases, issuer order intake, inventory days, utilization and capital spending to explain subsequent board shipments. Keep data-centre land, buildings, leases and power equipment out of a direct PCB-spending conversion.

The IEA projects data-centre electricity consumption from 485TWh in 2025 to 950TWh in 2030. This is a useful capacity-consistency check, not a 95.9% PCB-volume forecast. Hardware power, utilization, efficiency and replacement rates can all change. [IEA 2026 executive summary](#).

Candidate short-horizon model:

Change in $\log(\text{PCB shipments}[t])$ = intercept + lagged shipment growth + distributed lags of hardware demand + inventory correction + product-mix controls + error

Fit on a consistent quarterly panel; preserve the publication date of each input to avoid using information unavailable at the forecast date. Select lag structure and regularization using rolling-origin validation. Compare against seasonal-naïve and simple trend forecasts. Report out-of-sample MAE/WAPE, directional accuracy, and interval coverage. Use time-block resampling for serial dependence; do not label arbitrary scenario bands as 95% confidence intervals.

Status: this econometric model has not been fitted or backtested. The delivered Python script reconciles cited forecasts and computes derived quantities. It is not a trained prediction model.

E. Test whether demand becomes profitable growth

Operating profit = Revenue × Contribution margin – Fixed operating costs – Depreciation

Cash flow proxy = Operating cash flow – Cash purchases of long-lived assets

Incremental ROIC = Incremental after-tax operating profit / Average incremental invested capital

Discount forecast free cash flow using explicitly estimated financing costs; use enterprise value and debt only after matching valuation dates. Stock-price appreciation is not a direct measurement of PCB demand.

A concrete counter-check: WUS H1 2026 reported RMB1.151bn operating cash flow and approximately RMB3.602bn long-lived-asset purchases, giving a roughly **RMB2.45bn negative cash-flow proxy**, despite reported profit growth. This is not an audited company-defined free-cash-flow measure. [WUS printed pp. 9 and 11](#).

Shennan specifically discloses the burden of depreciation, limited initial output and longer overseas customer qualification during Thailand's ramp. An announced factory therefore requires a cash and qualification schedule, not just a revenue multiple. [Shennan H1 2026, p. 23](#).

8. Source discrepancies and limits

1. **Forecast versions:** Prismark's public page says \$123.3bn in 2030; the June 2026 forecast cited in dated issuer filings says approximately \$144.61bn. The difference is about 17.3%. Keep both versions; do not average them or call them a statistical confidence range. [Prismark public summary](#); [Avary source date, PDF p. 21](#). 2. **Source arithmetic:** Shengyi's 18+ layer row gives \$5.254bn and \$9.406bn for 2025/2026 but prints 72.8% growth. The endpoints calculate to 79.0%, matching WUS's table. Preserve endpoints and flag the printed rate. 3. **Area wording:** WUS gives 483m to 628m m² and approximately 5.4% CAGR, then mentions 5.8% in the adjacent sentence. The endpoint-derived CAGR is 5.39%; the model uses that. 4. **Rounding:** the 2030 technology rows sum to the published \$144.610bn total. For 2026 the rows sum to \$101.953bn versus a published \$101.954bn; retain the published total and disclose the \$1m rounding difference. 5. **Dependence:** three issuers quoting Prismark are not three independent market forecasts. Their own operating results provide different evidence, but their market-size tables share an origin. 6. **Scope:** no accepted public global BOM establishes PCB dollars per humanoid, AI rack, or robot. No physical board-count forecast is issued without design-area information. No uncited percentage is assigned to motives behind Thailand investment. 7. **Time and incentives:** interim figures can be unaudited; investment and fundraising presentations contain management forecasts. Meiko's dated plan is an example of stated intent, not a claim that its targets remain unchanged at every later date.

9. Delivered data and reproducibility

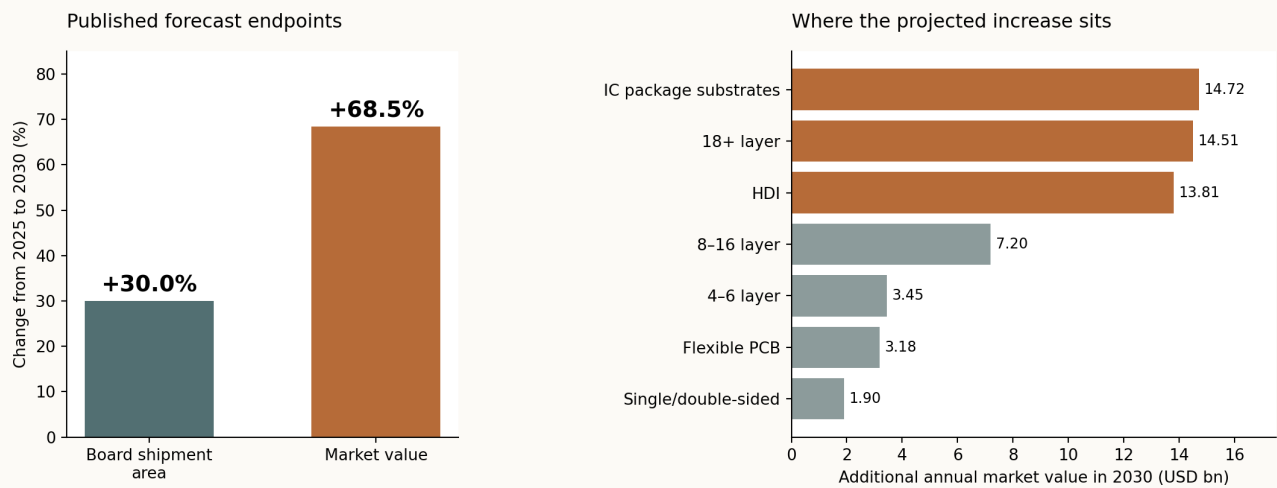
- inputs.json: cited baseline and forecast inputs, with periods and scope.
- sources.csv: 18 non-Thai sources, original links, publication dates and page locators.
- global_forecast.csv: published annual market series, 2025–2030.
- technology_model.csv: technology breakdown and recalculated growth.
- robot_thresholds.csv: sourced volumes and derived break-even scale comparisons.
- model.py and results.json: reproducible calculations, no paid API or hidden fit.
- Two chart sets in PDF, SVG and PNG; source PDFs retained for audit with SHA-256 hashes.

Run python3 model.py from this folder. The calculation inputs are static and reproducible. The script checks category reconciliation, numeric validity and key derived identities. Python's standard library handles the calculations; matplotlib generates the charts.

Research conclusion: the measurable preparation is for a larger, more demanding computing/networking infrastructure market and geographically diversified supply, alongside continuing automotive demand. The defensible working forecast is about 30% additional global shipment area by 2030 within the cited forecast, with much faster growth in advanced-board value. A Thailand-specific output forecast and an independent econometric forecast require the additional datasets identified above.

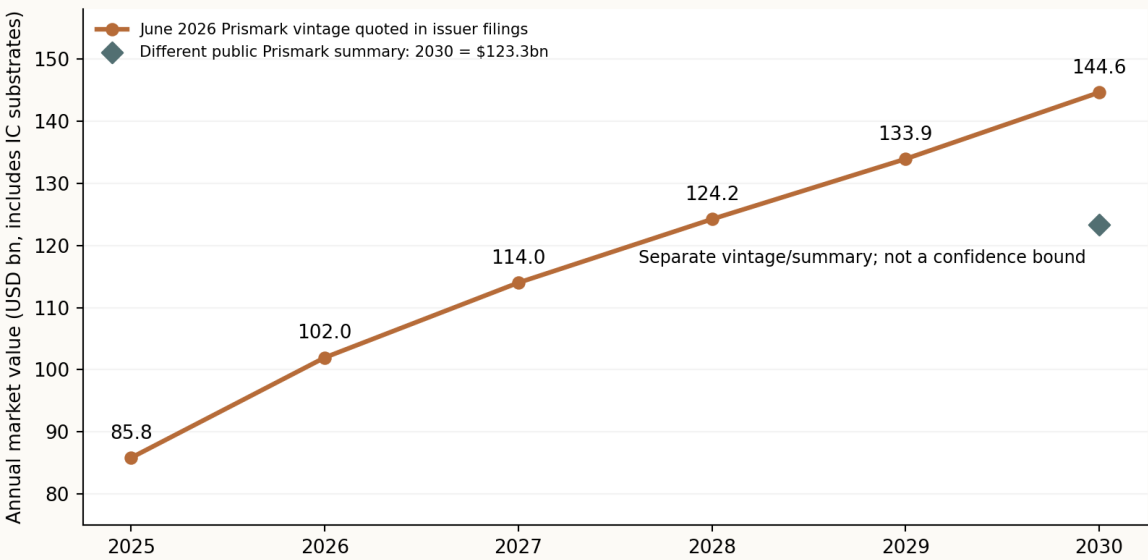
Quantitative exhibits

PCB demand to 2030: more area, much more complexity



Forecasts, not realized demand. Technology classes include IC substrates; they are not end-market categories.
Sources: Prismark as reproduced in Shengyi Electronics H1 2026, pp. 10-11; WUS H1 2026, printed p. 6. Cutoff: 30 Sep 2026.

Global PCB market: keep forecast vintages separate



2025 is a market estimate; 2026-2030 are forecasts. Source: Shengyi H1 2026, pp. 10-11; prismark.com/what-s-new.