Executive Summary

Purpose. This report consolidates everything we developed about **capital measurement (K)** for Israel's ports and lays out a complete, multi-track blueprint—**Tracks A–D**—to build monthly port-level capital series and the mediator **ln(K/L)** for econometric analysis.

Tracks. - **Track A — Counts Index (physical units):** a transparent, timing-sharp index built from counts and sizes of assets (STS cranes, yard cranes, berth meters×depth, yard area, automation flags). - **Track B — Financial/Accounting (PPE & PIM):** value-weighted capital from financial statements, producing both **real PPE** and **PIM** stocks, with growth-preserving **splice** across accounting breaks. - **Track C — Engineering Capacity/Services:** an engineering-based capacity or services measure derived from asset specs (crane rates, berth productivity, depth constraints) and commissioning milestones. - **Track D — Hybrid/Market & Composite:** (i) hybrid market-based signals (concession values, insurance/book appraisals), (ii) user-cost/shadow-price services, and (iii) **composite K** that blends A–C (e.g., z-score average or PCA).

Why multiple tracks? Each track sees different aspects of capital. **A** nails timing and tangibility; **B** captures value/quality and integrates accounting; **C** captures usable capacity; **D** provides market-based cross-checks and a rigorous way to **combine** signals. Triangulation makes mediation and identification more credible.

Where we stand (Haifa first): We have a curated **raw data table** for Track B (2018–2019, 2020–2021, 2023–2024 annuals; 2022Q1–Q3 interims) capturing PPE, depreciation, and investing cash flows. Next, we finish a few **raw-only extractions** (final 2020 PPE & depn, Q2–Q3 2022 CF & PPE, 2018–2019 Note 8 details). Tracks A & C have designs ready; Track D defines the composite and optional market signals.

Deliverables overview. Monthly K for each track at **port×month**, **ln(K/L)** mediators, QA/META logs, and a composite K.

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1) Economic Rationale, Use in the Thesis, and Identification

1.1 Role of K in port production

Ports transform ship calls and yard operations into container throughput and service quality. **Capital** is multidimensional—civil works (quay, depth), ship-to-shore (STS) cranes, yard equipment, IT/automation. Capital deepening raises productivity and can mediate the effect of **entry/privatization** on outcomes.

1.2 Why several measures of K

- **Data heterogeneity:** Not all sources report the same thing; entrants may be opaque.
- **Conceptual nuance:** Book values (B) vs. usable capacity (C) vs. physical counts (A) vs. market/apparatus (D).

- **Robustness and instruments:** Different tracks supply distinct sources of variation and IV strength (e.g., commissioning dates in A/C; privatization break in B).

1.3 Econometric usage

- **Outcome models:** LP, wait/berth/stay times, throughput.
- **Mediator:** $M_{pt} = \ln(K/L)$ explaining how entry/privatization changes productivity.
- **IV/mediation:** Engineering milestones and scheduled deliveries instrument changes in **K** and **K/L**.

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2) Track A — Counts Index (Physical Units)

Concept. Build a monthly **index of physical capital** using counts/sizes of assets; emphasize **timing** of additions.

Signals (examples). - **STS cranes:** number, outreach class (SPP, SPP+), age bins. - **Yard cranes/RTGs/RMGs:** counts. - **Berth meters × depth factor:** e.g., meters × f(depth), where f(depth≥16m)=1, else 0.8. - **Yard area:** square meters. - **Automation/TOS:** binary or phased multiplier (e.g., +10% if go-live).

Index construction. Let component k have quantity $q_{k,t}$ and weight w_k . A simple Laspeyres-style quantity index:

$$K_t^A = \sum_k w_k \, q_{k,t} \quad \text{rebased to } 2018{=}100.$$

Weights can be: - **Engineering weights** (e.g., contribution to theoretical TEU/hour), or - **Cost shares** (if rough unit costs are known), or - Equal weights with sensitivity bands.

Data needs. Commissioning logs, press releases, engineering dossiers, operator brochures, AIS-backed berth expansions.

Pros/cons. + Excellent timing & transparency. – Ignores valuation quality; needs weights.

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3) Track B — Financial/Accounting (PPE & PIM)

Concept. Use **financial statements** to build a value-weighted capital stock: - **PPE-based stock:** Deflated **net PPE** (book) → monthly path; handle **accounting breaks** via **splice**. - **PIM-based stock:** Deflated **investment** I_t from cash flows or Note 8 additions, accumulate via the capital law of motion.

Key formulas. - Real PPE (annual): $K_y^{PPE,real} = \mathrm{PPE}_y^{nominal} / P_y^K$. Interpolate to months; splice across breaks. - PIM (monthly): $K_t^{PIM} = (1-\delta_m)K_{t-1}^{PIM} + I_t$, with $\delta_m = 1-(1-\delta)^{1/12}$.

Accounting breaks. Privatizations/revaluations change levels. We create **raw** and **spliced** variants (spliced preserves pre/post growth at a common level).

Data (what we capture raw). PPE net (and when available gross/accum. dep.), Note 8 additions/disposals, CF investing lines, depn expense, revaluation reserves.

Pros/cons. + Value-weighted quality; integrates all asset types. – Can jump at accounting events; coverage for entrants may be thin.

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4) Track C — Engineering Capacity / Services

Concept. Build an **engineering capacity** measure and/or **capital services** directly from specs.

Capacity model (example). For port p in month t:

$$\mathrm{Cap}_{p,t} = \alpha \sum_i \left(c_i^{STS}\, n_{i,t}^{STS} \right) + \beta\,(\text{berth meters}_t \times f(\text{depth})) + \gamma\,\text{yard crane-hours}_t + \zeta\,\text{yard area}_t,$$

where c_i^{STS} is a theoretical moves/hour per crane class, adjusted for availability and utilization windows.

Services variant. Convert capacity to **capital services** using designed availability (e.g., 6,000 hours/year per crane) and utilization factors extracted from operations reports where available.

Data needs. Milestones file (commissioning/retirements), spec sheets, depths and berth meters, crane class capability, automation go-lives.

Pros/cons. + Direct link to operational capability. – Requires engineering assumptions; sensitive to availability/utilization inputs.

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5) Track D — Hybrid/Market & Composite

D1. Market/valuation signals (optional). Concession prices, privatization proceeds, appraisals, insured values, or regulator price base (where available). Use carefully as **benchmarks**, not primary K.

D2. Shadow-price services (user cost). Jorgenson-style services: $S_t = (r_t + \delta)\, K_{t-1}$. Calibrate r_t from market rates, δ from lifetimes; can be applied to B or C stocks.

D3. Composite K (recommended). Combine standardized A, B, C into a single **composite** (z-average or PCA):

$$K_t^{comp} = \sum_v w_v\, z\big(K_t^{(v)}\big), \quad v \in \{A, B, C\},$$

with $\sum w_v = 1$. Sensitivity: equal weights vs. fit-based weights.

Pros/cons. + Diversifies risk of any one method; often improves correlation with outcomes. – Requires careful standardization and documentation.

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6) Israel Implementation — Data, Files, and Contracts

6.1 Current raw (Haifa — Track B)

Captured (annual unless noted): - **2018, 2019:** PPE net; CF investing (fixed assets, intangibles, proceeds). (English 2019 FS.) - **2020:** CF investing from 2021 annual comparatives; **PPE net & depreciation (2020)** to be confirmed from 2020 Hebrew annual pages. - **2021:** PPE net (from 2022-Q1 BS audited column), depreciation, CF investing (from 2022-Q2 table audited column). - **2022:** Q1 PPE net & depn; Q2 **YTD** investing CF; Q3 row scaffolded for YTD CF and PPE net extraction. - **2023, 2024:** PPE gross/accum/net, Note 8 purchases & depn, CF investing, revaluation reserve (2023), receipt from ILA (2024).

Raw table schema (key fields we populate): - Identification: `port, company, period_type, financial_year, period_end_date, report_year, language, currency, units_scale`. - Balance sheet: `ppe_net_nominal`, optional `ppe_gross_nominal`, `accumulated_depreciation_nominal`. - Note 8 flows: `additions_purchases_note_nominal`, `disposals_note_nominal`, `depreciation_expense_note_nominal`. - Cash flows: `acq_fixed_assets_net_cf_nominal`, `purchase_intangibles_cf_nominal`, `proceeds_disposal_fixed_assets_cf`, `investing_grants_or_receipts_cf`. - Equity context: `revaluation_reserve_equity_nominal`, `accounting_basis_note`, `break_or_basis_change_flag`. - Provenance: `source_pdf_filename`, `page_ref_bs/note/cf/equity`, `comments`.

Contracts. Raw table is **as-reported only** (no deflation, no netting beyond what statements state; preserve signs/units). We never overwrite authoritative sources.

6.2 What remains to extract (Haifa, raw-only)

1) **2020 annual:** `ppe_net_nominal (2020)`, `depreciation_expense_note_nominal (2020)` from the Hebrew PDF balance sheet and CF adjustments. 2) **2022 Q2:** Replace derived depn with the **raw CF adjustment**; record `page_ref_cf`. 3) **2022 Q3:** Add YTD **CF investing** and **PPE net** with page refs. 4) **2018–2019 Note 8:** Add `ppe_gross_nominal`, `accumulated_depreciation_nominal`, `additions_purchases_note_nominal`, `disposals_note_nominal` where tables exist in the 2019 English FS.

6.3 Ashdod & Eilat (Track B raw plan)

- **Ashdod Port Co.**: scrape annuals from Gov Companies Authority and APC site; same fields as Haifa; pay attention to any revaluation/policy changes.
- **Eilat Port Co.**: collect baseline PPE, any annuals; if sparseness persists, Eilat can be retained as auxiliary port in models.

6.4 Track A raw plan

- Build `Data/K_proxy/assets_counts.tsv` with dated counts and sizes. Columns: `port, date, sts_count, sts_class_spp, yard_cranes, berth_meters, depth_m, yard_area_m2, automation_flag, notes`. All values **as observed** with exact commissioning dates.

6.5 Track C raw plan

- Finalize `Data/K_proxy/assets_milestones.tsv` with one row per asset event (terminal, asset_type, spec_qty, unit, spec_detail, in_service_date, retire_date). Keep **raw specs**; services mapping happens later.

6.6 Track D raw plan

- `Data/K_proxy/market_signals.tsv` (optional): concession fees, appraisals, insured values; include source links & units.

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7) Transformation Blueprints (What We Will Do Later in Code)

(No computation now; this section documents what the code will do once raw is complete.)

7.1 Track B transforms

- **Deflation:** join monthly CBS deflator; compute `PPE_real`, `I_real`.
- **Monthly path:** interpolate within year; apply commissioning re-weighting where available.
- **Break splice:** construct `K_PPE_real_raw` and `K_PPE_real_spliced`.
- **PIM:** build `K_PIM_stock_{low,central,high}`; optional `K_services`.

7.2 Track A transforms

- Normalize components; apply weights; produce index (2018=100) and level proxy if cost weights are available.

7.3 Track C transforms

- Map specs to designed moves/hour and availability; sum to monthly capacity/services; rebase to index.

7.4 Track D transforms

- Construct composite `K_comp` = z-average of A, B (spliced), C; PCA as a check. Compute `ln(K/L)` mediators for all variants.

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8) QA and Diagnostics

Coverage & keys: completeness across months (2018–2024), uniqueness per `port,year,month`.

Internal consistency: - Track B: reconcile Note 8 additions vs CF acquisitions; depn expense vs implied δK . - Track A/C: commissioning dates line up with TEU/LP movements.

Breaks: raw vs spliced PPE overlay; report level gap.

Sensitivity: deflator choices; δ bands; weights in Track A and C.

Mediator sanity: finite ln(K/L); outlier months inspected.

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9) Status Checkpoint (Now) and Next Actions

Status (Haifa, Track B raw): substantial coverage in place (2018–2019, 2021, 2023–2024 annuals; 2022 Q1 & Q2 CF; Q3 scaffolded). **Pending:** 2020 PPE & depn; 2022 Q2 raw depn; 2022 Q3 YTD CF & PPE net; 2018–2019 Note 8 details.

Status (Tracks A, C): schemas/design set; raw-collection to proceed via milestones and counts.

Immediate next actions (raw-only): 1. Extract **2020 PPE net & depn** from 2020 annual (Hebrew) and append to raw TSV. 2. Replace Q2-2022 **derived** depn with the **raw** CF adjustment; extract **Q3-2022 YTD** investing CF and PPE net. 3. Add **2018–2019 Note 8** (gross, accum., additions, disposals) to raw TSV. 4. Spin up **Track A** counts TSV and **Track C** milestones TSV from dossiers and press logs.

Then: lock raw tables → proceed to code for K (Tracks A–C) and **ln(K/L)** mediators; stand up QA & META logs.

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10) Appendices

A. Suggested column dictionaries (raw tables). - *Financials raw (Track B):* see §6.1 schema. - *Counts raw (Track A):* `port, date, sts_count, sts_outreach_class, yard_cranes, berth_meters, depth_m, yard_area_m2, automation_flag, notes`. - *Milestones raw (Track C):* `port, terminal, asset_type, spec_qty, unit, spec_detail, in_service_date, retire_date, source`. - *Market raw (Track D):* `port, date, type, value_nominal, currency, units, source`.

B. Naming & keys. Canonical `Ashdod`, `Haifa`, `Eilat` for ports; terminals: `Ashdod-Legacy`, `Ashdod-HCT`, `Haifa-Legacy`, `Haifa-Bayport`.

C. Files & outputs (future). `Data/K_proxy/K_B_monthly_port.tsv`, `Data/K_proxy/Mediator_K_over_L.tsv`, META JSON, QA TSV.

D. Risks & mitigations. Entrant opacity → rely on Track C; accounting breaks → splice; deflators/rates → sensitivity bands; identification → milestone IVs.

Bottom line. This document is the full blueprint for **K measurement** via **Tracks A–D** in Israel's ports. We finish the last raw extractions, then run the code to generate monthly K and $\ln(K/L)$ with complete QA and robustness across tracks.