Hazira Port: Cost Modelling and Task Sheet

Project Plan

Simulation Tasks

Task ID	Process & Sub-process	Description	Deliverable
S1	Port Layout & Parameters	Survey Hazira Port berth inventory: 11 berths (3 container, 5 general cargo, 3 liquid), channel draft 11 m, yard footprints (open: 80 000 m^2; container yard: 50 ha), and assumed handling rates (25 000 t/day bulk; 30 moves/hr crane).	`Simulation_Assumptions_Hazira`
S2	Berth Occupancy Simulation	Write `simulate_berth_hazira.py`: generate 365 days of berth-level occupancy at 78 % avg utilization, with monsoon dip (–14 % Jul–Sep) and winter peak (+9 % Dec–Feb).	`berth_occupancy_hazira.csv`
S3	Vessel Arrival & Turnaround	Write `simulate_vessels_hazira.py`: simulate 1 200 vessel calls/yr (bulk carriers, container ships, tankers) via Poisson arrivals; service $\mu = 23$ h, $\sigma = 4.5$ h; include 11 % delay events.	`vessel_turnaround_hazira.csv`
S4	Container Move Simulation	Write `simulate_containers_hazira.py`: for each container call (1 500 TEU), simulate load/unload counts (avg 1 400 TEU) and yard moves (2.6 moves/container) using Hazira yard layouts.	`container_moves_hazira.csv`
S5	Crane & RTG Uptime & Downtime	Write `simulate_cranes_hazira.py`: quay cranes 19 h uptime/day with 2×1.2 h downtime; RTGs 15 h uptime with 2×1 h events; model failure interarrival via Weibull($k = 1.7$).	`crane_uptime_hazira.csv`
S6	Gate-Entry Traffic	Write `simulate_gate_hazira.py`: generate 160 trucks/day (Poisson), service $\mu = 11$ min, $\sigma = 2.5$ min; apply peak-hour surge +28 % (08–10 h, 17–19 h); output queue lengths.	`gate_entries_hazira.csv`

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S7	Energy Consumption Profile	Write `simulate_energy_hazira.py`: hourly kWh draw base 6 500; +27 % peak (08–18 h); seasonal ±17 % (summer/winter); add 6 % admin/lighting overhead.	`energy_consumption_hazira.csv`
S8	Maintenance Event Simulation	Write `simulate_maintenance_hazira.py`: inject weekly planned maint. (3.5 h) for cranes/RTGs, plus 3 corrective events/month (4.5 h) across conveyors, lighting, berths; tag equipment IDs.	`maintenance_events_hazira.csv`
S9	Process Catalog & Metric Synthesis	Aggregate S1–S8 outputs into monthly metrics: berth idle hrs, avg vessel turnaround, TEU moves, crane downtime hrs, trucks processed, kWh consumption.	`Process_Metrics_Hazira.xlsx`
S10	Data-Ingestion Scripts	Develop `/data_ingest_hazira/*.py`: ingest all CSVs, enforce schema, merge into consolidated pandas DataFrames, and pickle to `/data_ingest_hazira/*.pkl` for reuse.	`/data_ingest_hazira/*.py & .pkl files`
S11	Data Validation on Simulated Data	Run quality checks: missingness ¡1 %, no invalid zeros, flag outliers (¿3σ), and produce a PDF report summarizing anomalies with charts.	`Data_Quality_Hazira_Report.pd`

Baseline Cost-Model Inputs

Task ID	**Process & Sub-process**	**Description**	**Deliverable**
B1	Compute Unit Costs from Sim	Assign Hazira-specific rates: 5 100/hr quay-crane, 3 600/hr RTG, 550/TEU-day yard, 380/truck entry, 7.8/kWh; document sources, drivers & formulas in `unit_costs_hazira.xlsx`.	`unit_costs_hazira.xlsx`
B2	Build Simulated Cost Model	Create `Cost_Model_Hazira.xlsx` with sheets: Inputs (simulated volumes + unit rates), Process-Map, Cost-Calc (formulae), Summary (annual totals).	`Cost_Model_Hazira.xlsx`

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B3	Populate Inputs with Sim Data	In Inputs, link monthly metrics from `Process_Metrics_Hazira.xlsx` and unit rates from `unit_costs_hazira.xlsx` using lookup tables/formulas.	Updated "Inputs" tab
B4	Implement Cost Calculations	On Cost-Calc, apply for each subprocess: • Total_Cost = Metric_Value × Unit_Rate (e.g., quay_crane_hrs × 5 100/hr). • Manually verify one month's results.	Verified formulas in `Cost_Model_Hazira.xlsx`
B5	Validate Sim Baseline Totals	Compare annual Opex (4 800 cr) vs. Hazira Port Authority published Opex; document any variance ¿5 % with root-cause analysis in `Baseline_Validation_Hazira.docx`.	`Baseline_Validation_Hazira.do`

AI Scenario Simulation

Task ID	**Process & Sub-process**	**Description**	**Deliverable**
SC1	Scenario Definition	Define improvement profiles: conservative (+5 % berth turnover, +4 % crane productivity, +3 % gate speed), moderate (+10 %, +8 %, +6 %), aggressive (+20 %, +15 %, +10 %).	`Scenario_Parameters_Hazira.js`
SC2	Metric Adjustment	Write `apply_scenario_hazira.py`: apply each scenario's multipliers to S1–S11 outputs; output adjusted CSVs per scenario.	`Adjusted_Metrics_SC*.csv`
SC3	Cost-Saving Computation	Write `compute_savings_hazira.py`: calculate differential Opex vs. baseline for each scenario; summarize savings by subprocess and total.	`Cost_Savings_Summary_Hazira.x`

Financial Projection & Sensitivity

Task ID	Process & Sub-process	Description	Deliverable
F1	CapEx/OpEx Assumptions	Compile capital cost estimates: 130 cr/quay-crane, 85 cr/RTG, 60 cr/yard upgrade; annual fixed costs: security, admin, dredging; document depreciation & financing terms in assumptions sheet.	`CapEx_OpEx_Assumptions_Hazira`
F2	Cash-Flow Model	Build 5-year Excel model `5yr_CashFlow_Hazira.xlsx` incorporating baseline Opex, scenario savings, depreciation schedules, debt service, and tax.	`5yr_CashFlow_Hazira.xlsx`
F3	ROI/NPV/Payback	On `5yr_CashFlow_Hazira.xlsx`, calculate ROI, NPV (@10 % discount), IRR, and payback period for each scenario; include summary table.	`ROI_NPV_Payback_Hazira.xlsx`
F4	Sensitivity Analysis	Vary unit rates ±20 % and improvement rates ±5pp; produce tornado chart & sensitivity table showing impacts on NPV/IRR.	`Sensitivity_Analysis_Hazira.x`

Reporting & Presentation

Task ID	Process & Sub-process	Description	Deliverable
R1	Draft Report	Compile methodology, assumptions, simulation data, cost-model results, scenario analyses, and appendices into Word doc per Hazira Port Authority template; include executive summary.	`Draft_Report_Hazira.docx`
R2	Visualizations	Design figures: berth occupancy heatmaps, cost breakdown pies, scenario comparison bars, sensitivity tornado; export high-res PNGs.	`Figures_Hazira.zip`
R3	Slide Deck	Develop PowerPoint deck summarizing objectives, methods, key findings, and recommendations; include stakeholder & executive summary slides.	`Presentation_Hazira.pptx`
R4	Internal Review	Distribute report & slides to stakeholders, collect feedback in `Review_Comments_Hazira.xlsx`, and maintain revision log.	`Review_Comments_Hazira.xlsx`

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Task ID	Process & Sub-process	Description	Deliverable
R5	Final Handoff	Incorporate feedback, finalize deliverables, and package report, models, data, and slides into `Hazira_Final_Deliverables.zip` for repository submission.	`Hazira_Final_Deliverables.zip`