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Research article

Artificial intelligence's networking scalability: ESG value creation and bankability issues

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Appendix A. Notation and variable dictionary

Table A1. Principal notation.

Symbol	Definition	Unit/range
G	Directed weighted multilayer network	—
V	Set of organizational actors	set
L	Set of organizational or stakeholder layers	set
E	Set of intra- and inter-layer links	set
q	Gross effective-coordination index	0–1
ρ	Organizational readiness coefficient	0–1
σ	Strategic resilience coefficient	0–1

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Symbol	Definition	Unit/range
λ_t	Implementation-lag factor in period t	0–1
q^*_t	Realized coordination in period t	0–1
u^R_t	Revenue uplift in period t	percentage
u^c_t	Operating-cost efficiency in period t	percentage
κ	EBITDA-to-operating-cash conversion factor	0–1
FCADS	Free cash flow available for debt service	currency
DSCR	Debt-service coverage ratio	multiple

Appendix B. Sequential computational workflow

Step 1 – Historical financial statements and business plan. Establish the baseline using historical financial statements, the reference business plan, debt schedule, covenant definitions, capital expenditure, and working-capital assumptions.

Step 2 – AI capability and implementation plan. Define the AI initiative, including technology, data, implementation costs, timetable, and expected operational objectives.

Step 3 – Readiness and coordination calibration. Assess organizational readiness, governance, leadership, data quality, workforce capability, and the coordination processes expected to improve.

Step 4 – Operating assumptions. Translate the expected organizational improvements into explicit assumptions for revenues, operating costs, working capital, investments, and implementation costs.

Step 5 – Accounting statements. Convert the operating assumptions into internally consistent projected income statements, balance sheets, and cash-flow statements.

Step 6 – FCADS and lender ratios. Calculate FCADS, DSCR, leverage, liquidity, and debt-service capacity to evaluate bankability.

Step 7 – Scenario, sensitivity, and decision outputs. Compare alternative scenarios, run sensitivity analyses, identify key value drivers and risks, and support investment decisions, lender communication, and future recalibration.

Managerial interpretation. AI creates financial value only when technical capability is successfully implemented, translated into operating improvements, converted into cash flows through accounting, and ultimately strengthens lender-oriented financial performance.

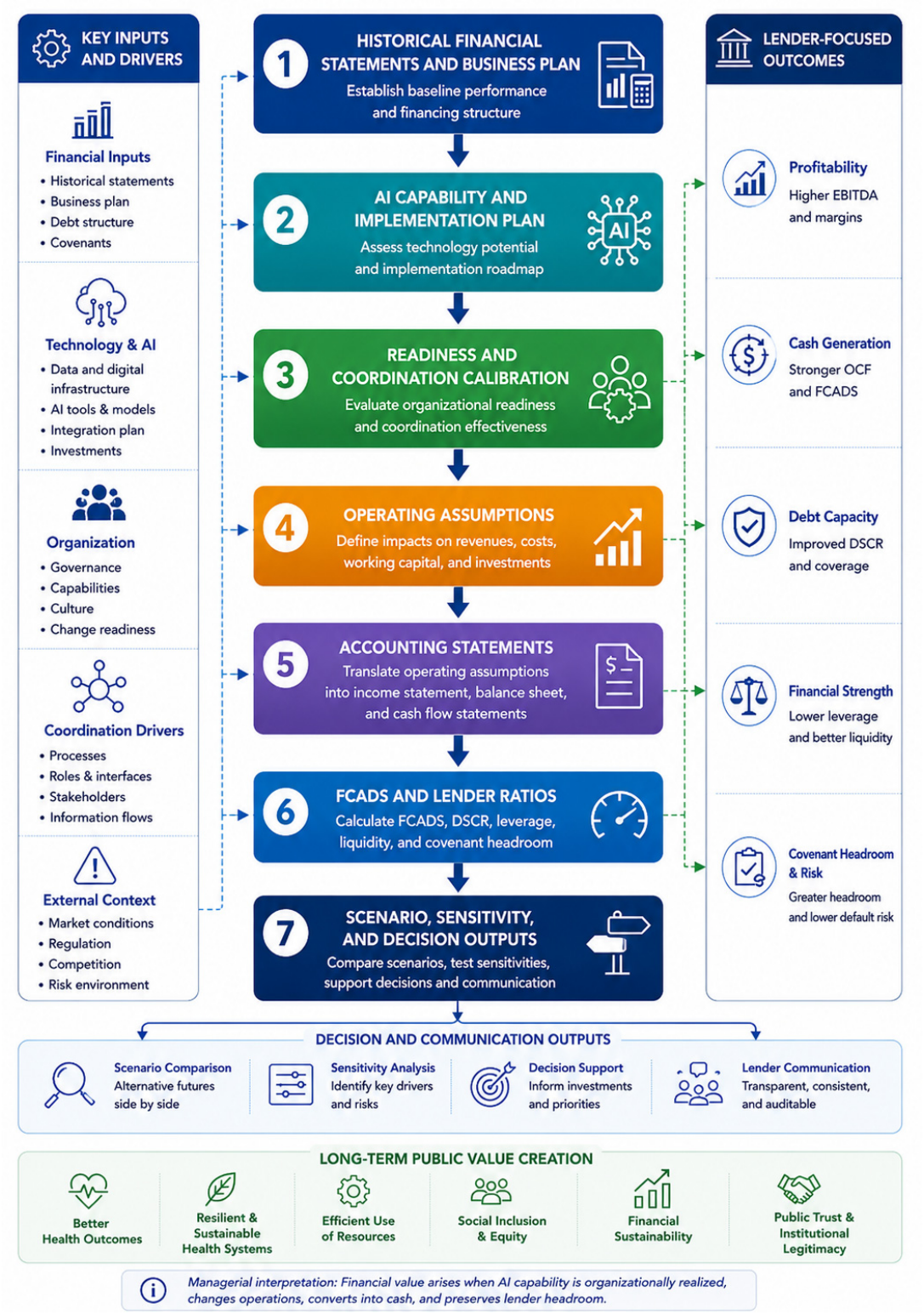


Figure A.1. Sequential computational workflow (Source: Authors' conceptualization and prompt; graphical rendering produced using OpenAI).

Appendix C. Calibration protocol

C.1 Financial information

Reconcile at least three historical periods, where available. Required items include income statements, balance sheets, cash-flow statements, debt schedules, maintenance and growth CapEx, cash taxes, covenant definitions, and the reference business plan.

C.2 Operational information

Relevant indicators may include production or service volumes, conversion rates, forecast error, process completion time, rework, stockouts, inventory turnover, procurement performance, customer response time, and exception frequency.

C.3 Organizational evidence

Governance documents, implementation plans, process ownership, training records, user-adoption evidence, data-quality assessments, internal controls, cyber-risk reviews, and structured interviews should support readiness.

C.4 Calibration discipline

Parameters should be expressed as ranges where uncertainty is material. Management estimates should be distinguished from observed metrics, contractual evidence, benchmark information, and independent validation.

C.5 Reconciliation

Every operating assumption must map to a financial-statement line. Revenue and cost effects must not overlap; one-off implementation expenditure must be separated from recurring OpEx; and working-capital effects must not be counted again within the cash-conversion factor.

Appendix D. Scenario construction

D.1 Baseline

Represents the reference plan without incremental AI-related operating effects. Existing digital initiatives embedded in the plan should not be added again.

D.2 Moderate operating improvement (Scenario B)

Assumes moderate operating improvements supported by identifiable process changes and adequate readiness. Benefits emerge progressively and are capped.

D.3 Strong operating improvement (Scenario C)

Tests a stronger but still bounded operating transformation. It should not be treated as a forecast or added to separate overlapping benefits.

D.4 Implementation friction (Scenario D)

Combines weak realization, delayed benefits, temporary operating duplication, implementation CapEx, and working-capital absorption. It is designed to expose trough-year financing risk.

D.5 Macro stress extension

A firm-specific model may combine implementation friction with lower demand, higher interest rates, supplier disruption, or inflation. The external shock should remain separate from the AI implementation assumptions.

Appendix E. Sensitivity and robustness procedures

Sensitivity analysis should vary one parameter at a time to identify marginal influence and then combine the most material parameters in two-dimensional grids. At minimum, the analysis should cover organizational readiness, implementation lag, revenue uplift, recurring cost efficiency, implementation CapEx, working-capital absorption, cash conversion, debt service, and financing cost.

Break-even analysis should identify the minimum operating improvement required to preserve the DSCR covenant and minimum liquidity after implementation costs. Where the baseline has limited debt-service capacity, the analysis should focus on the initial transition period rather than only on steady-state outcomes.

Robustness is strengthened when multiple evidence sources support the same assumption. Reconcile process logs, management interviews, contractual data, audit evidence, and external benchmarks rather than averaging them mechanically.

Add stochastic analysis when probability distributions can be justified. In the absence of credible distributions, transparent deterministic ranges are preferable to false precision.

Appendix F. Replication checklist

- Baseline financial statements and business plan reconciled.
- Revenue, OpEx, EBITDA, FCADS, debt service, and covenant definitions documented.
- Each AI initiative assigned to a process owner.
- Operational KPI and affected accounting line identified.
- Gross technical capability distinguished from realized organizational benefit.
- Readiness, resilience, and implementation lag documented.
- Implementation CapEx, recurring OpEx, and working-capital effects separated.
- AI operating effects separated from ESG credibility and financing effects.
- Scenario assumptions identified as observed, contractual, benchmarked, or managerial.
- Trough-year liquidity and debt-service capacity reported.
- Sensitivity and break-even analyses completed.
- All calculations reproducible from disclosed inputs.



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