



BOARD DECISION MANUAL | 2026 EXPANDED EDITION

STEM Investment and Cost-of-Inaction Framework

A board-level field manual for pricing the complete capability system, comparing alternatives and governing the risk of delay.

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For school boards, foundations, companies, development partners and public institutions making consequential STEM investment decisions.

FIELD-TESTED THINKING | PRACTITIONER TEMPLATES | EVIDENCE ANCHORS

What this manual helps you decide

Move from idea to explicit decisions, owners, evidence and next actions.

1	Investment thesis	Price durable capability rather than opening-day equipment.
2	Three-year TCO	Expose acquisition, operating, sustainability and risk costs.
3	Capability per cedi	Compare options using meaningful learner experiences and demonstrated outcomes.
4	Cost of inaction	Make the consequences of delay visible without inventing false precision.
5	Options and procurement	Use risk-adjusted appraisal, functional specifications and stage gates.
6	Board decision pack	Translate evidence into a concise, governable recommendation.

Use the manual as a decision cycle

1 OBSERVE	2 DECIDE	3 ASSIGN	4 REVIEW
Start with the ordinary operating condition, not the launch-day exception.	Record the choice, the alternatives rejected and the assumption carrying the most risk.	Name one accountable owner, the supporting actors and the evidence they must produce.	Set a date and define what evidence will trigger continuation, repair, redesign or stop.

A completed template is not evidence of success. Pair every decision with an observable artefact, a named owner and a scheduled review.

Price capability, not equipment

The cheapest quotation can become the most expensive unused room. The right unit is durable capability per cedi.

LAYER	INCLUDE	BOARD TEST
Learning	Curriculum, progression, projects and assessment	What will learners make and explain?
People	Diagnosis, training, coaching and technical support	Who can operate without the vendor?
Access	Timetable, group size, inclusion and frequency	How often will each learner practise?
Operations	Storage, consumables, repair, licences and replacement	What recurring cost keeps it alive?
Evidence	Utilisation, capability, transfer and review	What decision will each indicator inform?
A credible investment case links every cost to a capability, operating condition, risk control or evidence requirement.		

PRACTITIONER DEPTH

DECISION BRIEF	Convert every line item into the capability or operating condition it protects. Hardware without dosage, prepared people, repair and assessment is inventory rather than educational capacity. Compare complete systems, not supplier baskets.
EVIDENCE TO LEAVE	Require a capability-cost map, three-year operating assumptions, learner-access model, staffing plan, support route and evidence budget before approving acquisition.
FIELD CHALLENGE	Remove the equipment line from the proposal and describe the learning system that remains. Missing people, operations or evidence will become immediately visible.

DECISION GATE

ASSUMPTION	EVIDENCE OWNER	NEXT REVIEW	STOP / SCALE RULE
☐ Named	☐ Assigned	☐ Dated	☐ Recorded

Trace money to meaningful learner experience

Avoid a business case where outputs are expensive objects and benefits are inspirational adjectives.

CHAIN	DECISION QUESTION	EXAMPLE EVIDENCE
Inputs	What money, people, time and assets are committed?	Cost model, staff allocation and inventory
Activities	What repeated learning and support will occur?	Timetable, coaching and maintenance cadence
Outputs	Who receives what dosage and quality?	Unique participants and observation
Capability	What can learners and teachers now do?	Authentic tasks and demonstrations
Transfer	Can they apply it elsewhere?	New-context task and classroom use
Durability	What remains after external support reduces?	Local delivery, budget and operating routines

Value test

For every major cost line, ask which link in the value chain it protects. For every promised benefit, ask which evidence source will make the claim credible.

PRACTITIONER DEPTH

DECISION BRIEF	Value is created through repeated, active learner decisions supported by capable teachers and reliable operations. Count the chain from committed resources to dosage, capability, transfer and durability; do not jump from devices purchased to transformation claimed.
EVIDENCE TO LEAVE	Link each cost to an activity, output, capability indicator, evidence source and review decision. State where attribution is uncertain or shared with other investments.
FIELD CHALLENGE	Choose the largest budget line and follow it to a learner artefact or observed practice. If the connection cannot be demonstrated, test whether the expenditure is enabling, excessive or misplaced.

DECISION GATE

ASSUMPTION	EVIDENCE OWNER	NEXT REVIEW	STOP / SCALE RULE
☐ Named	☐ Assigned	☐ Dated	☐ Recorded

Expose the complete operating requirement

Total cost of ownership includes acquisition, operation, sustainability and risk - not only the supplier invoice.

COST AREA	INCLUDE	SETUP	Y1	Y2	Y3
Space/infrastructure	Power, accessibility, security, storage, work surfaces				
Learning tools	Devices, robotics, electronics, fabrication and safety				
Software/connectivity	Licences, data, hosting, updates and security				
People	Diagnosis, training, coaching, planning time and support				
Operations	Scheduling, inventory, supervision and administration				
Consumables	Components, batteries, materials and safety items				
Maintenance	Repairs, spares, warranty and replacement reserve				
Governance	Safeguarding, privacy, policy and incident response				
Evidence	Baseline, assessment, observation, learning and reporting				
Contingency	Exchange rate, shipping, delay and unplanned support				

Three-year TCO = setup + annual operations + support + maintenance/replacement + governance + measurement + contingency.

PRACTITIONER DEPTH

DECISION BRIEF	Use ranges and scenarios across the useful life of the programme. Include inflation, foreign exchange, shipping, replacement, staff time, support and exit. Separate sunk cost from avoidable future cost when reviewing an existing programme.
EVIDENCE TO LEAVE	Retain supplier assumptions, quantity and price basis, tax and shipping treatment, renewal terms, replacement rates, staff costing method, contingency rationale and scenario calculations.
FIELD CHALLENGE	Recalculate total cost under lower utilisation and higher failure. A proposal that becomes unaffordable under plausible variation requires staged commitment or a different design.

DECISION GATE

ASSUMPTION	EVIDENCE OWNER	NEXT REVIEW	STOP / SCALE RULE
[] Named	[] Assigned	[] Dated	[] Recorded

Make uncertainty auditable

An honest range is more useful than a precise number built on invisible assumptions.

ASSUMPTION	BASE	LOW	HIGH	EVIDENCE / OWNER
Exchange rate and import exposure				
Learners per device or kit				
Sessions per learner per term				
Teacher release and coaching time				
Annual licence/data escalation				
Failure and repair rate				
Useful life and replacement cycle				
Consumable use per session				
Monitoring and evaluation effort				

Sensitivity sequence

Change one assumption at a time. Identify the two variables that move the decision most. Build contractual controls, contingency or a staged pilot around those variables.

PRACTITIONER DEPTH

DECISION BRIEF	A range is useful only when its drivers are visible. Identify the assumptions that change the decision, the evidence that could narrow them and the owner responsible for testing them. Do not hide uncertainty inside a contingency percentage.
EVIDENCE TO LEAVE	Maintain an assumption register with source, confidence, low-base-high values, sensitivity, verification action, owner and deadline. Update the decision model when evidence changes.
FIELD CHALLENGE	Ask which single assumption would cause the recommendation to reverse. Test that variable before negotiating marginal price reductions elsewhere.

DECISION GATE

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Compare cost against meaningful exposure

Cost per registered learner hides dosage, waiting time, equipment access and whether the learner made any consequential decisions.

Meaningful learner experience = a session in which the learner actively designs, codes, builds, tests, debugs, analyses or explains against a defined objective.

METRIC	FORMULA	USE	LIMITATION
Cost per unique learner	TCO / unique learners	Access efficiency	Does not show dosage or quality
Cost per meaningful hour	TCO / active learner-hours	Intensity and utilisation	Needs reliable observation
Cost per capable learner	TCO / learners meeting standard	Outcome efficiency	Depends on credible assessment
Cost per sustained site	TCO / sites continuing after support	Durability	Requires follow-up period

Use a small dashboard of complementary metrics. No single ratio should carry the entire decision.

PRACTITIONER DEPTH

DECISION BRIEF	Cost metrics should reflect active practice and demonstrated capability, not only enrolment. Pair efficiency ratios with quality, equity and durability measures so programmes cannot appear efficient by reducing dosage or excluding learners who need support.
EVIDENCE TO LEAVE	Document the denominator, observation method, active-time rule, capability standard, missing-data treatment and follow-up period for each ratio.
FIELD CHALLENGE	Compare registered learners with learners receiving the intended dosage and those meeting the capability standard. Explain every major drop between the three numbers.

DECISION GATE

ASSUMPTION	EVIDENCE OWNER	NEXT REVIEW	STOP / SCALE RULE
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Model the bottleneck before purchase

A room full of equipment can still deliver very little learner practice.

VARIABLE	INPUT	CALCULATION / QUESTION
Available sessions		Weeks x sessions per week x usable periods
Active stations		Working tools after charging, repair and safety reserve
Group size		How many learners can make decisions at once?
Active fraction		What share of session time is making vs waiting?
Learner dosage		Active hours per learner per term
Capacity constraint		Teacher, timetable, room, tool, power or support?

Board question

Would the next cedi create more capability if spent on additional hardware, teacher coaching, timetable redesign, repair capacity, connectivity, consumables or assessment?

PRACTITIONER DEPTH

DECISION BRIEF	Capacity is constrained by the scarcest combination of timetable, teacher attention, functioning stations, group roles and support. Additional equipment creates value only when it relieves the binding constraint.
EVIDENCE TO LEAVE	Use a capacity model with usable weeks, sessions, downtime, active stations, group size, active fraction, teacher ratio and learner dosage. Validate inputs through observation.
FIELD CHALLENGE	Invest the same hypothetical amount in hardware, coaching and repair capacity. Compare which option produces the greatest increase in meaningful learner-hours.

DECISION GATE

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Record the liabilities created by delay

Do not claim that every delayed programme causes a financial loss. Identify credible consequences, mechanisms and evidence.

INACTION AREA	MECHANISM	EVIDENCE	MATERIALITY
Curriculum gap	Learners receive less practice against intended competencies	Curriculum map and timetable	Low / medium / high
Teacher capability	Uncertainty grows while tools enter informally	Baseline, policy and practice review	Low / medium / high
Equity	Advantage concentrates among learners with private access	Access and participation data	Low / medium / high
Procurement	Reactive purchases create fragmentation and lock-in	Asset and contract review	Low / medium / high
Reputation/trust	Unsafe or low-quality use damages confidence	Incident and stakeholder evidence	Low / medium / high
Opportunity	Partnership, pathway or curriculum windows close	Confirmed deadlines and requirements	Low / medium / high

Discipline

Use cost of inaction to compare timing choices, not to manufacture urgency. Separate verified cost, estimated exposure and qualitative strategic risk.

PRACTITIONER DEPTH

DECISION BRIEF	Cost of inaction is a disciplined comparison of timing choices, not a fear-based number. Describe the consequence, causal mechanism, people affected, evidence and reversibility. Distinguish financial exposure from strategic or social risk.
EVIDENCE TO LEAVE	Create an inaction register with baseline, trigger, time horizon, materiality, evidence confidence, mitigation available during delay and decision date.
FIELD CHALLENGE	Identify one benefit of waiting, such as stronger evidence or lower lock-in, alongside the risks. A balanced record produces a more credible urgency decision.

DECISION GATE

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Compare credible alternatives, including doing less

The decision is rarely technology versus no technology. It is which sequence creates the strongest learning system within constraints.

OPTION	DESCRIPTION	THREE-YEAR TCO	VALUE	RISK	REVERSIBILITY
A	Maintain current model with targeted repair				
B	Teacher capability plus virtual-first pathway				
C	Blended robotics and coding programme				
D	Full physical lab with advanced equipment				
E	Delay with explicit preparation actions				

Appraisal rule

Reject any option that cannot meet the minimum learning, safeguarding or operating standard, regardless of its weighted score.

PRACTITIONER DEPTH

DECISION BRIEF	Options must be materially different and feasible. Include staged, virtual-first, shared-service, repair-current-model and prepare-then-invest alternatives. Apply non-negotiable learning and safeguarding gates before weighted scoring.
EVIDENCE TO LEAVE	For every option record full cost, capability, access, implementation burden, key risks, reversibility, exit path, evidence confidence and conditions for success.
FIELD CHALLENGE	Ask the team that designed the preferred option to present the strongest case for the best alternative. Unchallenged preference is not appraisal.

DECISION GATE

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Weight what matters before seeing vendor proposals

Weights should reflect strategy and context, not be adjusted to make a preferred product win.

CRITERION	WEIGHT	OPTION A	OPTION B	OPTION C	EVIDENCE
Learning relevance and progression	20%				
Teacher and local ownership	15%				
Equity and accessibility	15%				
Operating feasibility	15%				
Safeguarding and governance	10%				
Three-year affordability	10%				
Evidence and measurement	5%				
Interoperability and exit	5%				
Environmental sustainability	5%				

Score 1-4, multiply by weight, then apply red-line gates. Record evidence and confidence beside each score.

PRACTITIONER DEPTH

DECISION BRIEF	Agree weights and red lines before commercial proposals create attachment. Score evidence strength separately from option performance; a high score supported by weak claims should not outrank a moderate score supported by observed proof.
EVIDENCE TO LEAVE	Keep the approved criteria, weight rationale, scorer notes, evidence references, confidence rating, moderation record and sensitivity analysis.
FIELD CHALLENGE	Change the two most disputed weights within a plausible range. If the winner changes easily, present the decision as contingent rather than certain.

DECISION GATE

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Specify functions and outcomes before brands

Functional requirements preserve competition and make vendor claims testable.

REQUIREMENT	ACCEPTANCE TEST	CONTRACT EVIDENCE
Learning	Representative learners complete defined task	Demonstration against rubric
Offline/low bandwidth	Core workflow survives outage	Observed failure test
Shared access	Group roles and session capacity work	Classroom simulation
Support	Fault is logged, escalated and resolved	Service levels and named route
Data and safety	Export, deletion, controls and incident route work	Policy, data map and test
Interoperability	Content/data move in documented format	Export sample and API/file specification
Exit	Institution can leave without losing essential work	Exit assistance and deletion confirmation

World Bank guidance on devices for education emphasises total cost of ownership and the importance of operating and sustainability costs, not only acquisition.

PRACTITIONER DEPTH

DECISION BRIEF	Requirements should describe the learning, operating and governance result and an acceptance test. Avoid specifications copied from a preferred vendor unless interoperability or safety evidence makes them essential.
EVIDENCE TO LEAVE	Include representative-user tests, service levels, data and deletion terms, accessibility, offline behaviour, export format, documentation, training evidence, warranty, exit assistance and remedies.
FIELD CHALLENGE	Give the brief to a credible alternative supplier. If only one product can respond because of unnecessary feature language, revise the specification or justify the restriction.

DECISION GATE

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Release capital as evidence improves

Staged commitment limits downside and creates leverage for learning and vendor performance.

GATE	QUESTION	REQUIRED EVIDENCE	DECISION
0. Concept	Is there a defined capability problem?	Problem, beneficiaries and strategic fit	Explore / stop
1. Design	Can the model work in context?	Diagnostic, options and TCO	Prepare / redesign
2. Readiness	Are people, operations and controls ready?	Rehearsal, runbook and policy	Pilot / pause
3. Pilot	Did the model produce credible learning?	Capability, equity, incidents and cost	Repair / stop
4. Institutional	Can local ownership sustain quality?	Second delivery, budget and support	Scale / continue

Release conditions

Condition	_____
Evidence required	_____
Owner	_____
Deadline	_____

PRACTITIONER DEPTH

DECISION BRIEF	Stage gates align irreversible spending with increasing confidence. Early funds should purchase diagnosis, rehearsal and evidence; later funds should expand only after learning, safety, ownership and recurring affordability are demonstrated.
EVIDENCE TO LEAVE	For each gate record release amount, required evidence, independent reviewer, conditions, stop rights, remediation period and the decision authority.
FIELD CHALLENGE	Define failure before the pilot starts. If every outcome can be reinterpreted as success, the gate cannot protect the investment.

DECISION GATE

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Why the lower quote can lose

Fictional example: two proposals for a three-year school robotics programme.

FACTOR	PROPOSAL A	PROPOSAL B	DECISION EFFECT
Opening price	Lower; hardware-heavy	Higher; includes coaching and spares	A appears cheaper
Teacher capability	One initial workshop	Rehearsal, coaching and second-teacher pathway	B protects local ownership
Maintenance	Return-to-vendor, unclear turnaround	Local spares and service levels	B protects utilisation
Licensing/data	Low first year, renewal uncertain	Three-year terms and export specified	B reduces exposure
Evidence	Attendance and photos	Capability task, observation and durability review	B supports governance

The board should compare three-year capability and risk, not opening price. Proposal A may still win - but only after complete costs and operating conditions are made visible.

PRACTITIONER DEPTH

DECISION BRIEF	The worked comparison illustrates how omitted coaching, maintenance, renewals and evidence reappear as downtime, dependence and unplanned cost. A higher opening price can still be inferior; the deciding question is risk-adjusted capability over time.
EVIDENCE TO LEAVE	Rebuild both offers into a common three-year cost and evidence template. Mark exclusions, assumptions, service levels, useful life, learner dosage and exit conditions.
FIELD CHALLENGE	Ask each supplier to price the other proposal's omitted functions. The comparison becomes fairer when scope, not headline price, is standardised.

DECISION GATE

ASSUMPTION	EVIDENCE OWNER	NEXT REVIEW	STOP / SCALE RULE
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Write the decision in one page

A strong board paper separates evidence, judgement, uncertainty and conditions.

Decision requested	_____
Capability and beneficiaries	_____
Recommended option and why	_____
Three-year cost range	_____
Principal risks and controls	_____
Evidence confidence	_____
Conditions before release	_____
Owner and next review	_____

Board challenge questions

What must be true for this recommendation to work? Which assumption is least certain? Who bears recurring cost? What is the exit route? What would cause us to stop? What will we know in 90 days that we do not know now?

PRACTITIONER DEPTH

DECISION BRIEF	A board paper should make the decision, rationale, uncertainty and conditions legible without hiding analysis. Put detailed models in appendices, but ensure every material risk and assumption is visible in the recommendation.
EVIDENCE TO LEAVE	Attach the options appraisal, cost model, assumption register, risk record, due-diligence evidence and draft release conditions. Record dissent and conflicts of interest.
FIELD CHALLENGE	Ask a reviewer unfamiliar with the project to state the decision, principal trade-off and stop condition after one reading. If they cannot, simplify the paper.

DECISION GATE

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Evidence anchors and further reading

The frameworks translate public guidance and implementation evidence into practical decision tools.

SOURCE	RESOURCE	ADDRESS
Ghana Ministry of Education	Education Strategic Plan 2018-2030 (2018)	https://moe.gov.gh/edge/content/uploads/2019/05/Education-Strategic%20Plan-2018-2030.pdf
NaCCA	Secondary Education Curriculum (2025)	https://nacca.gov.gh/secondary-education-curriculum/
UNESCO GEM Report	Technology in education: A tool on whose terms? (2023)	https://gem-report-2023.unesco.org/
UNICEF Innocenti	Digital Learning, Real Classrooms: Implementation Research in Ghana (2025)	https://www.unicef.org/innocenti/reports/digital-learning-real-classrooms
African Union	Continental Education Strategy for Africa 2026-2035 (2025)	https://static.au.int/en/documents/20250616/continental-education-strategy-africa-2026-2035
World Bank	Devices for Education Knowledge Pack (2025)	https://documents1.worldbank.org/curated/en/099916207092523135/pdf/IDU-88a5de28-77c9-40f7-a841-9d425cdc505d.pdf

Use these sources as starting points. Confirm current law, policy, curriculum and regulator guidance before making consequential institutional decisions. This manual is an implementation aid, not legal, financial or safeguarding advice.

Evidence quality protocol

CHECK	QUESTION	RECORD
Currency	Is the source still current for the decision date, jurisdiction and learner group?	Version, publication date and date checked
Authority	Is it primary guidance, independent research, implementation evidence or vendor material?	Source type and responsible institution
Fit	Do its assumptions match the school, infrastructure, language, staffing and safeguarding context?	Transfer limits and local verification needed
Use	Which decision does this source inform, and what would cause that decision to change?	Decision link, owner and review trigger

Invest in capability that can operate, improve and endure

A practical contribution to stronger AI, coding, robotics and STEM education systems in Ghana and Africa.

The value of a framework is not the elegance of its diagram. It is the quality of the decisions, routines and learning that it makes possible.

About Jonathan Kennedy Sowah

Jonathan is a Ghanaian AI engineer and K-12 STEM systems builder working across robotics, coding, applied artificial intelligence, teacher development and context-aware education technology. His wider portfolio has reached 25,000+ learners, trained 2,500+ educators and engaged 100+ schools. KodeVR has more than 10,000 active learners.

He works with schools, governments, companies and development partners to turn high-visibility technology ambitions into practical learning systems that can operate under real African conditions.

Use this work responsibly

Adapt the tools to the programme, participants, institution and regulatory context. Record assumptions. Seek qualified technical, legal, safeguarding, financial and evaluation review where the decision requires it.

Before commissioning implementation support

QUESTION	A STRONG ANSWER SHOULD NAME
What capability must remain after the engagement?	The learner, teacher and institutional behaviours that should continue without external supervision.
What conditions shape delivery?	The ordinary timetable, infrastructure, language, safeguarding, procurement and maintenance realities.
How will quality be governed?	Decision owners, evidence definitions, review cadence, repair route and stop-or-scale thresholds.
What will the institution inherit?	Reusable learning assets, local capability, documented routines, data rights and an affordable continuity plan.

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