Optimal
ENGINEERING EXCELLENCE
LTD

OEE-MAN-001 · Issue 1.0
September 2026
Strategic & Reliability Register

A RELIABILITY ENGINEERING MANIFESTO FOR UK MANUFACTURING

The Preservation Mandate

Why the next decade of British industrial margin will be earned by engineering failure out of existing assets — not by replacing them — and the operating model that delivers it.

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STRATEGIC SUBMISSION

01	02	03	04	05
Preserve function	Eradicate root cause	Engineer out human error	Treat energy as a diagnostic	Triage ruthlessly

THE PRESERVATION MANDATE

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METHODOLOGY	Reliability-Centred Maintenance (RCM2) · Forensic Root Cause Analysis · Whole-Life Cost and Energy Diagnostics · Systems Thermodynamics
SUBJECT	The UK continuous-manufacturing base — FMCG, pharmaceutical, food and automated distribution — across the 2027–2031 energy and capability transition
READER	Plant and engineering leadership · Chief Financial Officers · Boards · Capital and joint-venture partners · Recruiters

EPISTEMIC STATUS

Two kinds of claim sit in this document and are kept deliberately apart. **Engineering claims** — failure mechanisms, protection timings, measured case-study outcomes, standards — are stated as fact and traceable. **Macro-energy claims** — the EROI decline, the 2029 convergence window, hardware inflation — are structural, pattern-based analysis, stated at the confidence actually held: a directional thesis with named indicators, not proven science. Section 12 tests what happens to the recommendations if the thesis is wrong. The short answer: they still pay.

SECTION 01

The Position

HEADLINE POSITION

UK manufacturing has run for decades on a reactive model — throw labour at breakdowns, pay overtime, swap like-for-like, repeat. That model was only ever affordable because energy, capital and skilled fitters were cheap and plentiful. All three are now scarce at once. The operating response is not more engineers or newer assets; it is a smaller, sharper reliability function that eradicates root causes, engineers human error out of the installation, reads energy draw as an early-warning signal, and concentrates scarce skill on the assets that actually carry the business. A single decision of this kind, documented in Section 5, cut repair time by roughly 75% and extended asset life by an estimated 300% for a single-digit-percent cost premium. Applied systematically across a site — and across a sector — the same logic converts engineering from a cost centre into the primary protector of margin.

This manifesto sets out the engineering vision behind Optimal: Engineering Excellence Ltd. It is written to be read by three audiences at once: the plant or engineering leader who needs the mechanism, the finance director who needs the return, and the partner or investor who needs to know whether the capability is real, repeatable and scalable. Each will find their answer in a specific place — the method in Sections 3–6, the resilience architecture in Section 7, the organisational and commercial case in Sections 8–10.

1.1 The value proposition, in four lines

For	What Optimal delivers
The plant	Increasing MTBF, reducing MTTR, and engineering out repetitive breakdowns so they are closed permanently rather than repaired repeatedly.
The finance function	Lower whole-life cost of ownership, a smaller reactive overtime bill, and capital spent where criticality justifies it — not by calendar habit.
The board	Continuous processes that ride through grid disturbance, a workforce structure that no longer rewards breakdowns, and EBITDA insulated from energy volatility.
The partner / investor	A codified, standards-aligned method (BS ISO 55000, RCM2, FMEA) that transfers between sites and sectors — capability that scales beyond one engineer.

1.2 Why this is a no-regret position

The strongest objection to any energy-crisis thesis is that the crisis may arrive later, softer, or differently than forecast. The recommendations here are built to survive that objection. Root-cause eradication, error-proofed installation and criticality-led maintenance pay back on today's breakdown costs alone; the 2029 resilience case is upside layered on top, not the foundation. A client who never experiences the convergence still keeps the MTBF gain, the MTTR gain and the lower overtime bill.

SECTION 02

The Operating Environment

Stripped of the usual productivity rhetoric, the UK manufacturing base faces a simple systems problem: the three inputs that made reactive maintenance affordable — cheap energy, cheap capital replacement, and a deep pool of experienced fitters — are degrading simultaneously. Each pressure alone is manageable. Together they compound — and they hand a durable cost advantage to the operators who re-engineer first.

2.1 Unplanned downtime is getting more expensive

Siemens' *True Cost of Downtime 2024* estimates that unplanned downtime now costs the world's 500 largest companies around **11% of annual revenue**, and that a typical large plant loses **27 hours a month** to it — more than a full day's production. In FMCG a lost hour averages around **$36,000**; in automotive it exceeds $2 million. Cost per incident is rising even as incident frequency falls, because every stoppage now carries dearer energy, parts and labour. Inside a UK food, drink or consumer-goods plant this rarely shows as a single line in the accounts. It is spread across overtime, emergency freight, scrapped batches and missed retailer service levels — which is exactly why it persists.

2.2 The skills base is eroding faster than it is being replaced

Make UK estimates the sector loses around **£6 billion of output a year** to unfilled vacancies and digital capability gaps, and reports that only **2% of manufacturers** have AI or predictive maintenance widely embedded — most initiatives stall at pilot, with skills shortages the most-cited barrier. The joint RS / IMechE *Industry in Motion* research found fewer than a third of maintenance professionals confident their function operates at high maturity, with maintenance data quality a pervasive concern. The practical consequence on a factory floor is that complex installations are increasingly performed by less experienced hands — and every failure mode that depends on a fitter's “feel” becomes a recurring one.

2.3 The energy floor is moving

The net energy available to industrial economies — the **Energy Return on Investment (EROI)** — has compressed from the mid-twentieth-century levels of 20:1 and above toward a global average in the region of 10–15:1, with the marginal unconventional barrel lower still, and useful-stage estimates (after conversion losses) lower again. Estimates vary materially with method and system boundary. The structural point does not: when less surplus energy is available, waste that was once absorbed by margin becomes visible as cost. This is the thesis carried through Jordan Watson's wider work, and it frames — but does not carry — the engineering case.

Pressure	Mechanism	Plant-floor consequence
North Sea inflection	Declining domestic gas output increases exposure to international LNG pricing and grid balancing cost.	Every kWh wasted by a worn gearbox or a restart spike costs more each year.
Critical-mineral deficit	Copper, lithium and cobalt demand from electrification mandates outpaces mining capacity.	Switchgear, drives and inverters inflate in price and lead time; replacement becomes slower and dearer than preservation.
Renewables retirement wave	Late-2000s wind and solar assets reach end of life during the same window.	Transient supply-side constraint; more frequent power-quality events at the site incomer.
Skills erosion	Veteran technicians retire faster than apprentices mature.	Installation error rises; MTBF compresses on any task that depends on tacit skill.

Table 2.1 — *The convergence ("triple squeeze" plus skills). The first three rows are forward-looking structural analysis; the author's working window for their overlap is mid-2029. Leading indicators to watch: copper/lithium forward spreads, true system LCOE including firming, and the pace of UK SMR final investment decisions.*

SECTION 03

The Doctrine

Six principles govern every Optimal engagement. They are not slogans; each one changes a specific decision on the plant floor, and each is anchored in an established engineering lineage rather than presented as a new invention.

I Preserve function, not equipment

From Nowlan and Heap's airline work to John Moubray's **RCM2**: the object of maintenance is the function the asset performs in its operating context. That reframing decides which assets get monitored, which get overhauled, and which are allowed to run to failure — and it is what stops scarce labour being spent evenly on unequal risks.

II Failure is a system property

Every recurring failure has a physical mechanism and an enabling condition. Forensic **root cause analysis** traces both — with named instruments, timestamps and material properties — so the fix closes the failure mode permanently. Blame is excluded by design: internal reports address mechanism and fix, never individuals.

III Engineer out human error

The skills gap will not be trained away in time. **Poka-Yoke** (mistake-proofing) and **Design for Reliability** remove the possibility of the error instead — specifying hardware whose correct installation does not depend on rare tacit skill. This is skill neutralisation: protecting the plant from the labour market.

IV Energy is a diagnostic signal

A degrading machine draws more power to do the same work — friction, misalignment, cavitation and bearing fatigue all show up on the meter before they show up as noise. **Energy-Centred Maintenance** turns kWh-per-unit into an early-warning probe, and ties reliability directly to BS EN ISO 14001 and carbon commitments.

V Triage ruthlessly

Universal maintenance is no longer affordable. **Asset criticality ranking** concentrates predictive technology, spares and senior skill on the Tier-1 assets that halt production or carry safety and environmental consequence — and deliberately accepts run-to-failure on the periphery where that is cheaper.

VI Reliability needs authority

When reliability reports into the function measured on today's uptime, today's uptime always wins. The long-term improvement mandate needs its own budget line and lateral stop authority — the organisational design set out in Section 8.

Skill neutralisation: protecting the plant from the labour market.

SECTION 04

The Method

Physical assets drift toward their lowest-energy state — a broken one — unless organised maintenance effort is injected. The **Maintenance Entropy Reduction Protocol** is Optimal's sequence for injecting that effort at the lowest possible cost. It is aligned throughout with **BS ISO 55000**, which reframes the task from repairing broken assets to managing whole asset lifecycles against risk, cost and performance.

01	02	03	04	05	06
Criticality	Failure profile	FMEA & P-F interval	Condition monitoring	CMMS workflow	Design-out

4.1 Asset criticality ranking

Every asset is scored on three dimensions: **production impact** (does its failure stop the line or a redundant sub-process?), **safety and environmental consequence** (arc flash, chemical release, statutory breach) and **cost of failure** (secondary damage and replacement lead time). High scorers become Tier-1 critical assets and receive predictive monitoring, held spares and priority capital. Low scorers — a redundant office HVAC unit, a non-essential local conveyor — are deliberately run to failure, provided spares are cheap and on the shelf. Spending diagnostic effort on them is waste.

4.2 Why calendar maintenance fails most assets

The foundational RCM finding, from Nowlan and Heap's 1978 study for United Airlines and the US Department of Defense, is that most failures are not age-related. Only three of six observed failure patterns — covering roughly 11% of components — show a wear-out zone where a time-based overhaul helps. For the other 89%, a scheduled teardown adds cost and introduces infant-mortality risk without reducing failure. Condition monitoring is the only rational strategy for them.

Pattern	Conditional probability of failure over life	Share	Best strategy
A	Bathtub — infant mortality, constant, then wear-out	4%	Age-based possible
B	Constant, then pronounced wear-out	2%	Age-based possible
C	Gradually increasing, no clear wear-out age	5%	Condition-based
D	Low when new, rising quickly to constant	7%	Condition-based

Pattern	Conditional probability of failure over life	Share	Best strategy
E	Constant — random throughout life	14%	Condition-based
F	**Infant mortality, then constant**	**68%**	**Condition-based; avoid intrusive overhaul**

Table 4.1 — *Failure patterns, Nowlan & Heap (1978). Industrial populations differ from civil aircraft, but the direction of the finding has held across sectors.*

4.3 FMEA and the P-F interval

For each critical asset, a **Failure Mode and Effects Analysis** maps how it fails, what warning it gives, and what that failure costs the wider system. The output is not a spreadsheet for an audit file — it directly sets which sensor is fitted, which spare is held, and how often data is sampled.

FMEA parameter	Question	Decision it drives
Failure mode	What is the degradation mechanism — bearing fatigue, insulation breakdown, fretting, corrosion?	Which monitoring technology can see it (vibration, thermal, acoustic, electrical).
Failure effect	What physically happens — seizure, rupture, trip?	Which spares, tooling and routing minimise MTTR.
Failure consequence	What does the wider system lose — line, batch, compliance, safety?	Urgency; safety and environmental consequences override production schedules.
P-F interval	How long between a detectable potential failure (P) and functional failure (F)?	Inspection frequency — a four-week P-F interval demands at least weekly sampling.

4.4 Condition monitoring on the critical few

Vibration signature analysis detects bearing, alignment and gear degradation typically weeks ahead of failure. **Thermography** finds loose terminations and failing insulation in MCCs, transformers and switchgear before they become arc-flash or fire events. **Acoustic emission** hears inadequate lubrication and early cavitation. Fused through anomaly-detection models, these become a continuous auditor on each Tier-1 asset — allowing planned, graceful shutdowns instead of hard stops, cold restarts and collateral damage downstream.

4.5 The CMMS as nervous system

Sensor data is worthless unless it becomes work. A properly structured **CMMS** links a detected anomaly to an automatic work order, reserved OEM parts, the correct schematics and the isolation procedure — removing the administrative latency that inflates MTTR. Its failure codes and repair durations are also the evidence base for every later design decision. Poor data in yields poor decisions out; data discipline is therefore part of the method, not an IT project.

4.6 Design-out: the step most programmes skip

Maintenance can only preserve reliability up to the limit of the original design; it cannot add it. The final step feeds root-cause evidence back into procurement and redesign — **Design for Reliability** and **whole-life costing** — so the next purchase is chosen on total cost of ownership, not lowest initial price. This is where recurring failures stop recurring, and it is where the largest returns sit, as the next section shows.

SECTION 05

Proof of Mechanism

Case: UK FMCG high-torque cookhouse agitator. A critical batch-mixing agitator (SEW DRN100L6/LN, 1.5 kW gearmotor on a KF77 gearbox) suffered recurring catastrophic failure. Root cause analysis established that a **non-manufacturer-specified interference fit** had led to keyway wallowing and fretting corrosion, ultimately destroying the motor, the gearbox and the agitator shaft together.

Dimension	Option 1 — Like-for-like KF77 swap	Option 2 — KAF77 TorqLOC upgrade
Shaft interface	Keyed interference fit; damaged shaft sent away to be welded and re-machined to tight tolerance.	Keyless hollow shaft with shrink-disc clamp; uniform 360° grip, no precision machining.
Skill dependency	High — success relies on an experienced fitter's “feel” for the fit.	Low — right-first-time installation by a single technician of baseline skill.
Failure mode	Unchanged; any fitting error reproduces fretting and repeat failure.	Eliminated; wear returns to the OEM design baseline.
Cost	Baseline, low thousands of pounds — recurring.	≈ 5% premium over baseline — once.

Table 5.1 — *Replacement options compared.*

−75%
MTTR
Stoppage turnaround from ≈ 6 hours to ≈ 1.5 hours.

≈ +300%
MTBF (PROJECTED)
Repeating swap loop replaced by a permanent design.

≈ 5%
CAPITAL PREMIUM
Single-digit uplift on a low-thousands purchase.

The third return is the one that does not show on a work order: **skill neutralisation**. By removing the high-precision fit, the upgrade stopped consuming the site's scarcest resource — experienced fitter time — and closed an entire class of installation error. The intervention became the blueprint for upgrading every high-torque keyed

agitator gearbox on site, and subsequently across the group.

THE SYSTEMS POINT

One decision improves one process. The same decision rule, applied to every recurring failure on a site, compounds into a step change in availability, energy intensity and labour demand. Applied across a national manufacturing base, it becomes an efficiency gain that requires no additional fuel.

SECTION 06

The Measurement Framework

A reliability programme that cannot prove itself to site leadership will be cut at the first budget round. The KPI set below is chosen so that every metric maps to a decision and to a pound figure — and so that energy, which conventional OEE treats as free, is counted.

Metric	What it proves	Direction / benchmark
MTBF	Frequency of loss; rising MTBF proves root-cause fixes are holding.	Up, per critical asset
MTTR	Severity of loss; spares, diagnostics and design ergonomics.	Down
OEE	Availability × Performance × Quality — what output is being lost.	World-class ≈ 85% (90 / 95 / 99)
OEEE	OEE with an environmental factor — energy and emissions per good unit.	> 70% good; > 85% excellent
Maintenance cost % ERV	How much capital an ageing asset is bleeding versus replacing it.	Commonly benchmarked ≈ 2–3% for best-in-class
kWh per unit output	Asset-level energy intensity; an upward trend is often the first sign of internal wear.	Flat or down; alarm on drift
Upgrade return	Lifecycle energy, labour and spares saved by a design change versus its capital cost.	Evaluated on whole-life, not CAPEX

Table 6.1 — *Core KPI set. OEE reveals what output is lost; MTBF how often; MTTR for how long.*

6.1 The Six Big Losses, counted in energy

A line at 60% OEE is dissipating 40% of the energy, labour and capital put into it as idle time, scrap and heat. Much of the UK's legacy base operates in that range. A ten-point OEE gain across a site is additional capacity that requires no additional fuel.

OEE factor	Loss	Energy consequence
Availability	**Unplanned breakdowns**	Zero useful work while base load, lighting and auxiliaries keep drawing; frequent secondary damage.
Availability	**Setup & adjustment**	Extended shifts to recover volume raise total facility load.
Performance	**Minor stoppages**	Repeated motor starts; inrush current spikes and insulation stress.
Performance	**Reduced speed**	Baseline power for reduced output — higher kWh per unit.
Quality	**Production defects**	All embodied energy and material lost; rework doubles the input for no gain.
Quality	**Start-up rejects**	Pure loss before stable production is reached.

6.2 Why OEEE changes the conversation

Under conventional OEE, a machine with chronic micro-stops that hits quota through overtime registers only a time loss. Under **Overall Environmental Equipment Effectiveness** (Domingo & Aguado), the restart spikes and the extra hours of base load are counted too. That is the metric that lets a finance director see reliability and energy cost as one line — and it is the metric Optimal proposes as the basis for energy-tariff and subsidy conversations (Section 11).

SECTION 07

Resilience Architecture

Reliability does not stop at the gearbox. For continuous processes — active CIP loops, biological filling, extrusion — the most expensive single failure is often not mechanical at all: it is a **cascaded plant dropout** caused by a grid disturbance lasting a fraction of a second. The resilience architecture below is drawn from Optimal's Functional Design Specification for high-speed island-mode microgrids.

7.1 The sub-cycle constraint

Conventional vacuum circuit breakers clear in **30–50 ms**. Process PLCs and variable speed drives typically ride through only **15–20 ms** on DC-bus capacitance. The gap is the dropout. Closing it requires the site's point of common coupling to decouple faster than the drives can notice.

Layer	Specification	Critical figure
PCC switchgear	**Solid-State Circuit Breakers (SSCBs)** or hybrid solid-state/mechanical breakers on the main incomer; G99 settings configured for intentional islanding.	**< 4 ms decoupling**
Energy storage	BESS with **Grid-Forming (GFM)** voltage-source inverters using Virtual Synchronous Generator control to establish the 400 V / 50 Hz reference instantly.	≥ 150% overload for 60 s
Control network	**IEC 61850 GOOSE** messaging on redundant PLC pairs; polling protocols (Modbus TCP, standard Profinet) are too slow for the protection layer.	Event-driven, not polled
Load shedding	Pre-programmed **High-Speed Load Shedding** to balance the island before the BESS trips on under-frequency or over-current.	10–15 ms after PCC opens

Table 7.1 — *Island-mode architecture summary (FDS, Optimal: Engineering Excellence Ltd).*

7.2 Profitability-indexed load shedding

Static shedding lists are written years in advance and reflect wiring, not value. The microgrid controller understands amps, volts and state of charge; the MES understands SKUs, batch value and margin — and in most plants the two never talk. Bridging them with **MQTT Sparkplug B** or OPC UA lets the controller read the live £/kW yield of every line and shed the least valuable load first.

Two-hour grid anomaly	Static system	Profitability-indexed system
Decision	Sheds Line 2 — high-margin, mid-CIP — because it was designated Priority 2 years earlier.	Queries MES, promotes Line 2 to Priority 1, sheds idle low-margin Line 5.
Outcome	**≈ £150k product loss + ≈ 8 h CIP recovery**	**No product loss; continuous run maintained**

Table 7.2 — *Illustrative operational scenario; figures are modelled, not measured.*

7.3 Graceful degradation, not blind tripping

Opening a feeder on an active caustic wash causes equipment damage and hours of recovery. Instead, the controller issues a GOOSE *Safe State Request*; the line PLC stops dosing, purges pipework, closes isolation valves and returns *Ready to Shed*. A hard T_{max} watchdog trips the feeder regardless if the local PLC hangs — protecting the whole microgrid from one line's failure. Operators see this on an ISA-101 high-performance HMI in which colour is reserved for abnormal states.

7.4 Thermal decoupling and the strategic spares store

Process heat up to around 120 °C can move behind the meter via **high-temperature industrial heat pumps**, with **phase-change thermal storage** decoupling steam generation from grid events, and on-site anaerobic digestion converting high-COD effluent to biomethane for backup generation. On spares, obsolete and single-source PLCs

are stripped out, and just-in-time holding of long-lead items — large-frame VSDs, IEC 61850 switchgear, contactors — is replaced by a front-loaded **Strategic Resilience Store** sized by criticality, not habit.

SECTION 08

The Organisational Model

The era of scaling engineering by hiring more reactive fixers is over. Flat-rate salaries plus 20–25% chronic overtime create a **breakdown-reward culture**: the function is paid most when the plant performs worst. The replacement is a leaner, more analytical department in which a small reliability node sets asset strategy and a multi-skilled workforce executes it — a smaller, better-paid team running a larger, more complex facility.

8.1 A bifurcated leadership matrix

	Engineering Director — "Run"	Principal Reliability & OpEx Strategist — "Improve"
Focus	Immediate availability, safety compliance, shift roster, physical hardware delivery.	36-month efficiency trajectory, IT/OT integration, energy-indexed OEE, MTBF extension.
Budget	Operational MRO — spares, payroll, routine OEM servicing.	Dedicated efficiency and energy CapEx/OpEx fund.
Authority	Line management of the engineering workforce.	Lateral stop authority — can hold a teardown to preserve root-cause evidence.
Reports to	Plant General Manager	Plant General Manager

Table 8.1 — *Separating the run mandate from the improve mandate removes the structural incentive to trade tomorrow's reliability for today's uptime.*

8.2 An OPEX-neutral competency-banded structure

Capping overtime at 5% and converting shift managers into working Shift Reliability Leads funds Tier-1 market salaries — competitive with the largest FMCG employers — while reducing total cost. Modelled on a 30-headcount continuous-process site:

Role	Heads	Base salary
Engineering Director	1	£120,000
Principal Reliability Strategist	1	£80,000
IT/OT & Microgrid SMEs	3	£95,000
Shift Reliability Leads	4	£85,000
Band 3 Technicians (Systems / HV)	4	£75,000
Band 2 Technicians (Multi-skilled)	8	£58,000
Band 1 Technicians (Mechanical fitters)	6	£50,000
Apprentices	3	£35,000
Modelled total OPEX vs legacy £2,262,750	**30**	**£2,069,450**

Table 8.2 — *Illustrative model. Frees ≈ £193,000 a year while funding IT/OT and microgrid specialists and removing reliance on agency contractors.*

8.3 The 36-month upskilling pipeline

STAGE 1

Substation automation and IEC 61850 GOOSE network diagnostics

STAGE 2

HV Authorised Person certification; GFM inverter and VSG training

STAGE 3

High-temperature heat pump and phase-change thermal storage maintenance

SECTION 09

The Engagement Model

Optimal: Engineering Excellence Ltd operates in high-consequence, highly regulated environments — FMCG, pharmaceutical, food and automated national distribution — where an engineering error surfaces in a boardroom, an insurance claim or a tribunal, not only in a missed shift target. Engagements take one of four forms.

Service line	Scope	Typical output
Interim turnaround leadership	Time-boxed authority to restructure an engineering function, reset asset strategy and lock in capital decisions ahead of market inflation.	Handover-ready roadmap; restructured team; procurement locked
Forensic failure investigation	Evidence-led root cause analysis of complex failed systems, with ruled-out mechanisms eliminated on physical grounds and, where required, formal data requests to third parties.	RCA / FIR reports; ECRs; supplier data requests
Reliability strategy	Criticality ranking, FMEA, condition-monitoring design, CMMS structure and KPI framework to BS ISO 55000.	RCM strategy; KPI baseline; spares policy
Resilience & energy advisory	Functional design for island-mode microgrids, MES-to-SCADA integration and board-level capital justification.	FDS; HMI specification; CFO business case

9.1 The six-month turnaround mandate

Months 1–2 AUDIT	Forensic hardware and failure-history audit; criticality ranking; freeze legacy CapEx pending review; establish the Strategic Resilience Store.
Months 3–4 LOCK-IN	Issue the FDS; execute fixed-price OEM contracts for SSCBs and GFM storage; stand up the MES-to-SCADA framework.
Months 5–6 RESTRUCTURE	Roll out the competency-banded structure and power-quality RCA procedure; hand the optimised roadmap to the permanent Principal Reliability Strategist.

9.2 How Optimal reports

Every report passes an audience gate before it is written. **Site reports** carry full technical depth on mechanism, evidence and fix, but no fault attribution, no named owners and no imposed deadlines — failure is treated as a system property, which keeps shop-floor teams candid.

Forensic reports — for insurers, solicitors, supplier recovery or tribunal — apply a stricter evidentiary standard: every claim traced to a named instrument, timestamp or document; liability stated plainly, with the opposing party's likely defence stated honestly. The investigation is evidence-led, not conclusion-led.

An engineering error surfaces in a boardroom, an insurance claim or a tribunal — not only in a missed shift target.

SECTION 10

The Value Ledger

Specialist interim leadership is normally booked as overhead. Modelled correctly, it behaves as a capital-protection instrument. The illustrative case below is a six-month mandate (130 billable days at £1,200/day) on a continuous-process site with a £4,000,000 infrastructure modernisation programme.

Category	Outlay	Return	Basis
Interim leadership, 6 months	(£156,000)	–	130 days × £1,200
Procurement front-loading	–	+£1,000,000	25% modelled switchgear/inverter escalation avoided on £4M
Cascaded dropout prevention	–	+£300,000	Two avoided line dropouts, 2029–31
Workforce restructure	–	+£193,000	Annual; recurs each year
Margin stabilisation	–	Unquantified	Profitability-indexed shedding under rationing
Consolidated (first year)	**(£156,000)**	**+£1,493,000**	**Net £1,337,000 · ≈ 8.6× net return**

Table 10.1 — *Illustrative deployment ledger. The procurement line depends on the hardware-inflation thesis; the restructure line does not. Site-specific figures replace these at audit.*

≈ 8.6×

NET RETURN, YEAR ONE

Net £1,337,000 on a one-off £156,000 outlay (illustrative ledger).

£193k

RECURRING EACH YEAR

The workforce restructure alone — independent of the energy thesis.

< 10 mo

PAYBACK, THESIS WRONG

No procurement arbitrage, no grid event — the restructure still pays.

SENSITIVITY — IF THE THESIS IS WRONG

Remove the procurement arbitrage entirely and assume no grid event ever occurs. The restructure alone returns £193,000 a year against a one-off £156,000 — payback inside ten months — before counting a single MTBF or MTTR improvement from the reliability programme itself.

SECTION 11

The National Scale

The UK's ten-year infrastructure strategy commits around **£725 billion**, with delivery overseen by the National Infrastructure and Service Transformation Authority (NISTA). NISTA can enforce a procurement pipeline; it cannot, on its own, enforce a reliability culture. Capital deployed into plants that still run to failure will be consumed by the same friction. Three protocols would change that.

PROTOCOL **A**

RCM before release of funds

No capital for new critical infrastructure without a costed reliability-centred maintenance plan and FMEA documentation, with condition monitoring designed in from day one.

PROTOCOL **B**

MTBF and MTTR as contractual KPIs

Operators drawing on public industrial funding report MTBF and MTTR through standardised CMMS data; sustained MTBF compression or MTTR inflation triggers an engineering intervention, not a larger budget.

PROTOCOL **C**

An OEEE threshold for industrial support

Industrial energy support and tariff relief are weighted toward operators demonstrating strong OEEE — rewarding those that convert energy into output efficiently, and exposing those that do not.

Make UK estimates that widespread digitalisation could add around **£150 billion** to UK GDP by 2035. The binding constraint is not technology but execution capability — the exact capability a reliability-led engineering function builds. Reliability engineering does not reverse the decline in net energy. What it does is put the most direct mechanical lever available into the hands of operators: more useful output from the asset base the country already owns, and time bought for the transition to what comes next.

The binding constraint is not technology but execution capability.

SECTION 12

Strategic Failure Modes

A manifesto that does not test itself is marketing. The same FMEA discipline applied to a gearbox is applied here to the argument.

Failure mode	Strongest version of the objection	Mitigation built into the model
Convergence arrives late or diffuse	Mineral supply responds, gas prices ease, and 2029 passes without a step change.	Core programme is justified on present-day breakdown cost (Section 10 sensitivity). Resilience spend is staged against the named leading indicators.
EROI figures contested	Estimates vary widely with boundary and method; point values are not settled science.	Thesis is framed as direction, not a point forecast. No recommendation depends on a specific EROI value.
Case study does not generalise	One agitator is one data point; the 300% life figure is a projection.	The transferable asset is the decision rule, not the number. Every site programme is baselined and measured against its own MTBF/MTTR.
Organisational resistance	Overtime cuts and flattened management meet union and cultural pushback; key staff leave.	Higher base pay offsets lost overtime; banding offers visible progression. Change is sequenced after trust is earned on early reliability wins.
Data quality blocks RCM	CMMS histories are incomplete; FMEA built on bad data misdirects effort.	The audit phase rebuilds the failure history before any strategy is set. Data discipline is a deliverable.
Key-person dependency	An interim-led turnaround can decay once the interim leaves.	The mandate ends with a permanent Improve role, a codified method and standards-based KPIs — designed to outlive the engagement.

SECTION 13

The Author and Directive

Jordan Charles Watson, IEng is a professionally registered Incorporated Engineer and the Director and sole principal of Optimal: Engineering Excellence Ltd. His background spans FMCG manufacturing, automated distribution logistics and turnaround reliability engineering, working with regional managers and directors in Tier-1, highly regulated operations. His technical core is UK industrial reliability engineering, Reliability-Centred Maintenance, strategic planning for engineering functions and forensic diagnosis of complex failed systems.

Alongside client work he has spent two years building a body of analysis on energy return on investment and systems thermodynamics — the same pattern-recognition applied at plant level, aimed at a larger and slower-moving system. That work is published through strategic reports, an essay series, and the manuscript *The Universal Equation of Civilisation*.

SUMMARY DIRECTIVE

Stop scaling engineering with labour and start scaling it with method. Rank assets by criticality, close recurring failure modes at source, remove skill-dependent installation risk, read energy as a diagnostic, and give reliability its own budget and authority. The core programme pays on today's breakdown costs. The resilience programme should be decided in 2027, while hardware can still be bought at pre-inflation prices and before the 2029 window narrows the options.

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ENGAGEMENT BASIS

Interim turnaround and engineering leadership
Forensic failure investigation and RCA
Reliability and resilience advisory
Outside IR35

Sources

Figures cited in the text are drawn from the following, grouped by the section they support.

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Prepared by Jordan Watson — Optimal: Engineering Excellence Ltd. Illustrative financial figures are modelled, not audited, and are replaced by site-specific data at engagement. Forward-looking energy and market analysis is structural and directional, not a forecast guarantee.

THE DOCTRINE OF PRESERVATION ENGINEERING

Scale engineering with method, not labour.

I Preserve function, not equipment

II Failure is a system property

III Engineer out human error

IV Energy is a diagnostic signal

V Triage ruthlessly

VI Reliability needs authority

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OEE-MAN-001 · Issue 1.0 · September 2026
For clients, partners and capital investors