APEX RELIABILITY ENGINEERING

Reliability Pilot Business Case Template

A fill-in workbook for one reliability or RCM pilot funding request, written for plant and maintenance managers preparing a case for finance approval.

Prepared by		**Date**	
Plant / site		**Version**	
Pilot scope (asset, line or failure-mode group)		**Approver**	

Quickstart

1. **Pick one pilot.** One asset, line, or group of failure modes, with a named owner. Not a plant-wide program.
2. **Gather evidence first (Section 2).** Count events from a named source over a stated period. If the data is not good enough, stop and rebaseline (Section 2.4) instead of estimating around the gap.
3. **Build the cost of one event (Section 3)** from unrecoverable contribution margin plus event costs. Agree the dollars-per-hour figure with finance before you use it.
4. **Compare real options (Section 4)** and record low, base, and high assumptions with their evidence (Section 5).
5. **Do the arithmetic (Section 6)** by hand, in your own spreadsheet, or with the free RCM ROI calculator at https://apexreng.com/funding/rcm-roi-calculator/. Write the results in the tables.
6. **Plan delivery, measures, and decision gates (Sections 7–8)**, then get an independent check and sign-off (Section 9).
7. **Write the one-page memo (Section 1) last.** It summarizes the rest; finance reads it first.

What this file is, and is not

- **Fillable PDF.** Type in the blank cells and lines and tick the boxes. Open it in Adobe Acrobat Reader or another viewer with full PDF form support, then use Save or Save As to keep entries; some browser previews may not save them. **No macros, scripts, or automatic calculation.**
- Text in gray brackets, like *[this]*, is an instruction. Replace or delete it before you send the case.
- Appendix A is a **synthetic worked example** to show the arithmetic. Its numbers are not plant data, benchmarks, or typical results. Do not copy them into your case.
- This template is educational. It is not financial, investment, insurance, or legal advice. It does not guarantee funding approval, savings, uptime, payback, or any other outcome. A well-built case may conclude that the pilot should not be funded; that is a valid result.

Notation used throughout

Symbol	Meaning	Symbol	Meaning
n	Number of events counted in the observation period	r_f	Assumed fractional reduction in event frequency (0–1)
T	Observation period in years of comparable operation	r_s	Assumed fractional reduction in cost per event (0–1)
λ = n / T	Event frequency, events per year	A	Avoided loss per year = ALE − ALE_after
D	Unrecoverable downtime cost, $ per hour	C_0	One-time (upfront) cost, spent at time 0
H	Downtime hours per event	R	Recurring cost per year
F	Fixed event costs per event, $ (repair, parts, freight…)	N	Net annual benefit = A − R
S = D × H + F	Severity: cost of one event, $	i, Y	Discount (hurdle) rate per year; horizon in years
ALE = λ × S	Expected annual loss, $ per year		

1. Executive funding memo (one page)

[Complete this page last. Keep it to one page. Lead with the base case and put the low case beside it. Every figure here must trace to a table in Sections 2–6.]

Field	Entry
To / From / Date	
Decision requested	☐ Approve ☐ Approve with conditions ☐ Decline Decision needed by: _____
Amount requested	One-time: $_____ Recurring: $_____ per year Horizon: ____ years
What the money buys	*[Pilot scope: asset/line, failure modes, activities, duration]*
Accountable owner	*[Name, role]*
Why now	*[Evidence, not urgency words: recent events, trend, upcoming window, cost of waiting]*
Evidence and data quality	*[Events counted (n), period (T), source; main data gaps (Section 2)]*
Baseline expected annual loss	Low $_____ Base $_____ High $_____ (Section 3.3)
Avoided loss per year	Low $_____ Base $_____ High $_____ (Section 6.3)
Net annual benefit / payback / NPV	Base: N $_____/yr Payback _____ months NPV $_____ Low: N $_____/yr Payback _____ months NPV $_____
Assumptions a skeptic should test	1. 2. 3.
How we will know	*[Measures, measurement period, review date (Section 7)]*
Decision gates	*[Accept / revise / stop criteria and who decides (Section 8.1)]*
Main risks and downside	*[What happens in the low case; does it meet the financial floor?]*

Statement to keep in the memo: These figures are estimates from the inputs and assumptions stated in this case. They are not a guarantee of savings, uptime, or payback, and approval is at the discretion of the approver named above.

2. Current problem: scope and evidence

2.1 Scope

Item	Entry
Site, line, and asset(s) with tag numbers	
Failure modes or event types in scope	
Explicitly out of scope	
Operating context (shifts, duty, product mix, recent changes)	
Is this asset a production constraint? Evidence?	

2.2 Failure evidence

Use one event definition for the whole period (for example, “unplanned stop longer than 15 minutes” — set your own). T is the time the asset ran in comparable duty, in years.

Failure mode / event type	Data source	Period (from–to)	T (yr)	n	λ = n/T	Data quality notes

- Small counts mean wide uncertainty. For example, four events in two years supports a rate somewhere between roughly 0.7 and 4.6 per year at 90% confidence (Poisson interval; method at https://apexreng.com/funding/risk-quantification-method/). Report the interval with λ.
- Do not substitute a handbook or “industry” rate unless you can cite the specific source. Zero events observed does not mean zero risk.

2.3 Data gaps

Gap	Effect on estimate (over / under / unknown)	How it will be closed	Owner	By when

2.4 When there is not enough data: stop or rebaseline

> Do not build a savings case if any of these is true: no defensible event count for the scope; the observation period does not cover a normal operating cycle; the event definition or recording practice changed mid-period; finance will not accept any downtime cost figure; or the dominant failure mode cannot be separated from others.
>
> **Instead:** propose a short, low-cost data-collection period with a defined event log, an agreed $/hour, and a date to return with a case. Present it as a request to measure, not as a savings estimate.

3. Baseline: cost per event and expected annual loss

3.1 Unrecoverable downtime cost per hour (D)

Use contribution margin on output that is truly lost, not gross revenue and not output that will be made up later. If finance already has an accepted figure, use it and cite it. Working guide: https://apexreng.com/funding/downtime-cost-per-hour/

Line	Item	Basis / source	Value
a	Contribution margin per unit ($/unit) — price minus variable cost		
b	Output rate of the constrained line (units/hour)		
c	Unrecoverable share of lost output (0–100%)		
d	Lost margin per hour = a × b × c		
e	Idle labor per hour (people × loaded rate) — only if paid and not redeployed		
f	Other incremental time-based costs per hour		
D	**Downtime cost per hour = d + e + f** (or finance-agreed figure: $_____ , source/date _____)		

Avoid double counting

- **Revenue is not loss.** Gross revenue includes material and variable costs that are not spent while the line is stopped.
- **Recovered output:** if lost units are made up on overtime or later shifts, count the recovery cost (overtime premium, expediting) in F, and do not also count their margin in D.
- **Repair labor and parts** go in F once. Do not also include them in D or in a separate “maintenance savings” line.
- **Scrap and rework:** count committed material and processing cost once, in F.
- **One stop, several assets:** count line downtime once, at the line level. Watch shared spares and common utilities in roll-ups.

3.2 Fixed event costs per event (F)

Cost item (per event)	Basis / source	$ per event
Internal repair labor		
Contractor / mobilization		
Parts, materials, expedited freight		
Scrap, rework, cleanup		
Recovery overtime premium (if output is recovered)		
Other (describe)		
Total F		

3.3 Baseline expected annual loss by failure mode

Failure mode	λ (/yr)	H (h/event)	D ($/h)	F ($)	S = D×H + F	ALE = λ × S
Total (sum of modes)						

Add ALE across modes; do not average them. If one event belongs to two modes, count it once. Record low/base/high values of λ, H, D, and F in Section 5.

4. Options considered

[Status quo is a real option with a real cost: the baseline ALE continues. Do not make it a straw man. A broader program is often better decided after pilot evidence exists.]

Item	A. Status quo	B. Targeted pilot	C. Broader program
Description			
Scope			
One-time cost C_0	*[$0, or note any]*		
Recurring cost R per year			
Expected ALE after (base)	*[= baseline ALE]*		
Time to first evidence	*[n/a]*		
Main risk			
Why chosen / not chosen			

5. Assumptions: low, base, and high

> **Frequency and severity reductions multiply; they do not add**
>
> $ALE_{after} = \lambda \times (1 - r_f) \times S \times (1 - r_s) = ALE \times (1 - r_f) \times (1 - r_s)$
>
> Example: $r_f = 25\%$ and $r_s = 20\%$ give a combined reduction of $1 - 0.75 \times 0.80 =$ **40%**, not 45%.

Assumption	Low	Base	High	Evidence / source	Confidence (H/M/L)
Event frequency λ (/yr)					
Hours per event H					
Downtime cost D ($/h)					
Fixed event cost F ($)					
Frequency reduction r_f (%)					
Severity reduction r_s (%)					
One-time cost C_0 ($)					
Recurring cost R ($/yr)					
Discount rate i (%) / horizon Y (yr)					
Benefit ramp by year (if used)					

- Reductions are assumptions, not promises. If you cannot name evidence for a reduction, keep it out of the base case.
- The **low case** should be one you would defend in a skeptical review, not a token haircut. The base case should not be the high case relabeled. Costs usually run higher in the low case.
- Use the same horizon and discount rate across options; use finance's hurdle rate, not one picked to make the case work.

6. Costs and financial results

6.1 One-time and recurring costs

Cost item	One-time C_0 ($)	Recurring R ($/yr)	Source / quote	Who budgets it
Analysis / facilitation				
Internal team time (hours × loaded rate)				
Training				
Spares, monitoring equipment, software				
Added or changed PM / PdM task labor				
Production time needed for pilot work (at D)				
Contingency				
Total				

6.2 Formulas

Avoided loss A = ALE − ALE_after **Net annual benefit** N = A − R

Simple payback (months) = $C_0 \div N \times 12$, only when N > 0.

- If N ≤ 0, payback is **undefined**: write “not reached on these assumptions”, never a number.
- If $C_0 = 0$ and N > 0, payback is immediate. The case then rests on whether N is real and R is the only cost.

Net present value NPV = $-C_0 + \Sigma$ (t = 1 to Y) N_t ÷ (1 + i)^t — C_0 at time 0; N_t at the end of year t. With a ramp, N_t = A × ramp_t − R.

Probability weighting: if you use probabilities, attach documented weights to separately defined outcome scenarios (e.g., benefit levels, cost overruns), weight those cash flows, then compute NPV, or show low/base/high NPVs side by side. Do not multiply the whole NPV by an unsupported “success probability”: it also shrinks C_0, which is spent whether or not the pilot works.

6.3 Results

Metric	Low	Base	High
Baseline ALE ($/yr)			
ALE after ($/yr)			
Avoided loss A ($/yr)			
Recurring cost R ($/yr)			
Net annual benefit N ($/yr)			
One-time cost C_0 ($)			
Simple payback (months, or “not reached”)			
NPV (Y = ____ yr, i = ____ %) ($)			

6.4 Sensitivity and financial floor

Input moved (one at a time)	Change tested	Base NPV after change	Does NPV change sign?
Downtime cost D	*[e.g., ±20%]*		
Reduction r_f or r_s (each separately)			
One-time cost C_0			
Event frequency λ (interval bounds)			

Financial floor (from finance policy, e.g., NPV ≥ 0 in the low case or a maximum payback): _____ .
Low case meets floor? ☐ Yes ☐ No. If no, say so in the memo; do not adjust inputs until it passes.

7. Pilot delivery and measurement plan

7.1 Schedule and production windows

Phase / activity	Start	End	Production window or downtime needed	Owner
Confirm baseline and event log				
Analysis sessions (RCM / FMEA / RCA)				
Implement task or design changes				
Measurement period				
Review and gate decision				

7.2 Roles (RACI: R does the work, A is accountable, one per row; C consulted; I informed)

Activity	R	A	C	I
Baseline data and $/hour agreement with finance				
Analysis sessions				
Implement changes				
Schedule production windows				
Safety review / management of change				
Measurement and reporting				
Gate decision				

> **Safety and required work**
>
> Safety-, environmental-, and regulatory-required work is **never deferred** to fit the pilot schedule or to improve its numbers. Task changes go through your site's safety review and management-of-change process. The pilot does not remove or extend safety-critical tasks without that review.

7.3 Measures

Measure	Leading / lagging	Definition and data source	Baseline	Expected	Review frequency
[e.g., tasks done on time]	Leading				
[e.g., findings acted on]	Leading				
[e.g., events in scope]	Lagging				
[e.g., hours per event]	Lagging				

7.4 Measurement period, normalization, and causality

- **Set the period before the pilot starts.** Expected events in the window = λ × window length. At λ = 2 per year, a 3-month window expects 0.5 events, too few to tell change from chance. Lean on leading measures early.
- **Normalize** lagging results per operating hour or per unit produced, and log changes in duty, product mix, staffing, and other projects.
- **Observation is not proof of cause.** A before/after difference shows association; other changes can explain it. Report what else changed, and compare with a similar asset outside the pilot if one exists.

Measurement period (from – to)		**Normalization basis**	
Comparison asset (if any)		**Review date**	

8. Decision gates, risks, and counterarguments

8.1 Decision gates

Gate	When	Accept (continue / expand) if	Revise if	Stop if	Decider
0. Data readiness	Before funding				
1. Implementation complete					
2. End of measurement					

8.2 Risks and counterarguments

[Write the strongest objection a skeptic would raise, then your answer. Leave in any you cannot answer.]

Risk or counterargument	Effect on the case	Response / mitigation	Owner
Event counts are small or the history is short			
Downtime cost overstated (some output recoverable)			
Reduction assumptions lack evidence			
Team time competes with production work			
Improvement could come from other changes			
Recurring costs not budgeted after the pilot			

> **No forced favorable case.** If the low case misses the financial floor or NPV changes sign under one reasonable input change, state it plainly in the memo and let the decision-maker weigh it.

9. Review, sign-off, and checklist

9.1 Review and sign-off

Role	Name	Review focus	Signature	Date
Prepared by (maintenance / reliability)		Evidence, scope, plan		
Independent arithmetic check		Every formula and total		
Plant / operations manager		Production windows, $/hour		
Finance reviewer		Costs, rate, horizon, floor		
Safety / EHS reviewer		Required work, MOC		
Approver		Decision		

9.2 Pre-submission checklist

- ☐ One pilot; scope bounded; out-of-scope items listed.
- ☐ Every count has a source, period T, and one event definition; the interval on λ is reported.
- ☐ Data gaps listed with the direction of their effect; stop/rebaseline test (2.4) passed.
- ☐ D built from unrecoverable contribution margin, or a cited finance-agreed figure; double-counting list checked.
- ☐ Frequency and severity reductions combined by multiplication.
- ☐ Low/base/high assumptions each have evidence and a confidence rating.
- ☐ One-time and recurring costs separated; N = A − R; payback shown as “not reached” where N ≤ 0.
- ☐ NPV states C_0 at time 0, i, Y, and any ramp; no whole-NPV probability scaling.
- ☐ Sensitivity done; sign changes and the financial floor result reported.
- ☐ Safety-required work unaffected; measures, period, normalization, and gates defined.
- ☐ Appendix A synthetic example deleted, or clearly kept separate from plant figures.

9.3 Questions finance is likely to ask

Question	Our answer
Where does the $/hour come from, and who agreed it?	
Is the lost output really unrecoverable?	
How many events is λ based on, over what period?	
What does the low case show, and does it meet the floor?	
Which costs recur after the pilot, and who budgets them?	
What does waiting a year (status quo) cost?	
How will we know it worked, and what else could explain a change?	
What would make us stop?	

Appendix A. Synthetic worked example (not plant data)

SYNTHETIC EXAMPLE. Every number on this page is invented to show the arithmetic. It is not client data, a benchmark, or a typical or expected result. Keep it separate from your figures, or delete this appendix before you submit the case.

Step	Calculation	Result
Frequency	n = 4 events in T = 2 years; λ = 4 ÷ 2	2 events / yr
Uncertainty on λ	90% Poisson interval: $\chi^2(0.05; 8) \div 4$ to $\chi^2(0.95; 10) \div 4$	≈ 0.68 to 4.58 / yr
Severity	S = 6 h × $1,500/h + $3,000 fixed = $9,000 + $3,000	$12,000 per event
Baseline loss	ALE = λ × S = 2 × $12,000	$24,000 / yr
After pilot (base)	r_f = 25%, r_s = 20%: $24,000 × 0.75 × 0.80	$14,400 / yr
Avoided loss	A = $24,000 − $14,400 (combined reduction 40%, not 45%)	$9,600 / yr
Costs (illustrative)	C_0 = $10,000 one-time; R = $2,000 per year	—
Net annual benefit	N = $9,600 − $2,000	$7,600 / yr
Simple payback	$10,000 ÷ $7,600 × 12	≈ 15.8 months
NPV, flat benefit	−$10,000 + $7,600 × 3.7908 (5-yr annuity factor at 10%)	≈ $18,810
NPV, with ramp	Ramp 25% / 75% / 100% / 100% / 100%: N_t = $400, $5,200, $7,600, $7,600, $7,600	≈ $10,281

Same example, low / base / high (5 years, 10%, flat benefit, same costs)

Case	r_f / r_s	ALE after	Avoided A	Net N	Payback	NPV
Low	10% / 10%	$19,440	$4,560	$2,560	≈ 46.9 mo	≈ −$296
Base	25% / 20%	$14,400	$9,600	$7,600	≈ 15.8 mo	≈ $18,810
High	40% / 40%	$8,640	$15,360	$13,360	≈ 9.0 mo	≈ $40,645

What the example shows: the low case has a slightly negative NPV, so the sign changes within the stated range. A memo would say so. With only n = 4 events, the 90% interval on λ runs from about 0.7 to 4.6 per year, so ALE itself is uncertain. Payback above is steady-state; the ramp lengthens it. If R were $9,600 or more, N would be zero or negative and payback would be “not reached”.

Reduction values 10/25/40% (frequency) and 10/20/40% (severity) match the illustrative starting values in the RCM ROI calculator; they are examples, not recommendations.

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