RISKOPILOT

Who can act in time

Leadership, staffing and authority behind critical controls

A report for executive committees, boards and site directors on the decisions that determine whether anyone can act when a critical control fails. Four investigations, three instruments, seven decisions reserved for executives and the forms to complete.

RISKOPILOT RESEARCH
CRITICAL CONTROLS SERIES
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ABOUT THIS REPORT

What this is, and what it is not

This report is about the people and decisions behind a critical control. It asks who can act when the control fails, whether that person is free to act, and how long people stay exposed while the organisation makes up its mind.

It offers a method. It reports no field data. Riskopilot has not run the reviews it describes on a client site, and no staffing ratio is proposed, because the research does not support one.

It follows two earlier reports. *Time to act* set out what safety technology can and cannot do for critical controls, and six conditions leaders must create. *Prove it on site* showed how to test one function honestly. This report takes the next question: once a warning is real, who owns the next safe decision?[14]

How to read the labels

FACT A finding from a named source, with its date and scope.

INFERENCE Our reading of what the facts imply.

ILLUSTRATION An invented example or number that explains a method.

RECOMMENDATION What we advise executive committees, boards and site directors to do.

Small gold numbers refer to the source register on pages 39 and 40.

Who it is for

Executive committee members and board members who approve budgets, schedules and contracts. Site and project directors who decide how a shift is covered. HSE and engineering leads who must show that a control was restored.

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SUMMARY FOR EXECUTIVE COMMITTEES

Before you fund another pair of eyes, find out who can act on what they see

Most requests that reach an executive after a serious event ask for more visibility: another supervisor, another observer, another camera. In the four investigations we reread, the warning had already arrived. What was missing was a person with the authority, the competence and the time to act on it.

The decision

RECOMMENDATION Require every request for an additional supervisor, observer or camera to name three things: the protective duty that is uncovered, its deadline, and the person with authority to act. Apply the same test to any proposal to reduce cover.

Why this test

FACT At Texas City in 2005, one board operator ran three units during a start-up, and the supervisor left the site at 10:47 with no replacement. An earlier assessment had recommended a second board operator for start-ups.[1]

FACT In Florida in 2018, cracks in a bridge were documented for 19 days. Five parties could have stopped work or closed the road beneath it. None did.[2]

INFERENCE More observation would have changed neither event. Both needed a named person who was free to act and knew the decision was theirs.

Five findings

1. Research gives no staffing ratio. FACT The UK regulator's staffing method for process plants states that it is not designed to calculate a minimum or optimum number of staff.[5] The one construction study we found describes practice and does not establish a causal minimum.[7]

2. Coverage fails by the interval. INFERENCE A roster that is adequate on average can leave one qualified person owing two exclusive duties for fifteen minutes.

3. Diagnosis and restriction are different jobs. FACT At Chevron Richmond in 2012, people worked at a leak for about 2 hours 40 minutes. Some suggested shutting the unit down. Nobody formally used stop-work authority.[3]

4. A visit that changes nothing does harm. FACT In a randomised study across 19 hospitals, a senior-manager walk-round programme lowered staff ratings of improvement on average.[8]

5. Repair time is the wrong clock. INFERENCE What matters to the person at risk is how long work continued with the control failed or unknown. Few organisations report it.

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SUMMARY FOR EXECUTIVE COMMITTEES

Three instruments, and what each one tells you

EXHIBIT A

What to ask for, who does it and what comes back

INSTRUMENT	QUESTION IT ANSWERS	WHO DOES THE WORK	WHAT COMES BACK TO YOU
1. Duty-coverage review Part 3	On the busiest shift, is every protective duty covered by a qualified person who is free and close enough?	Planner and technical authority, with the trades and a worker representative.	The intervals where a duty is uncovered, and the cheapest way to cover or remove each one.
2. The two clocks Part 4	Were people protected in time, and how long did work continue with the control failed or unknown?	Shift leads keep the record. An independent verifier samples it.	Hours exposed, hours under restriction, and the releases that came before the evidence.
3. Reserved decisions Part 5	Which of your own decisions removed a protective duty, and who owns the consequence?	The executive who signs the budget, schedule or contract.	A signed record of the duty affected, the alternative priced and the shift on which it was checked.

RECOMMENDATION Riskopilot proposal. The instruments are management methods. None has been validated against injury outcomes.

What to sign

RECOMMENDATION A 90–day review at one bounded operation, on its most demanding shift, for one recurring impairment of a critical control. Name the site director as sponsor and the technical authority as verifier. Pay workers and contractors for the time they take part.

A rule that any change to budget, schedule or roster names the protective duty it touches before it takes effect.

A weekly report that separates hours exposed from hours safely stopped.

What to refuse

RECOMMENDATION A staffing request justified by a ratio or a benchmark. Ask which duty, on which shift, at what time.

A deputy who has never been tested with the principal absent.

An impairment extended for a third time without a funded repair date.

A closed action whose only evidence is the signature that closed it.

A contract under which the contractor who stops a job pays for the delay.

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SUMMARY FOR EXECUTIVE COMMITTEES

Ninety days, one operation, one written decision

DAYS	OWNER	WORK	GATE
1 to 15	Site director and a worker representative	Choose one critical activity and one recurring impairment. Map who decides what. Sample nights as well as days.	A signed baseline and a list of decisions nobody owns.
16 to 30	Planner and technical authority	Map duties by interval on the busiest shift, with deputies, travel and simultaneous work. Compare added cover, resequencing and redesign.	An approved change with a fallback and stated hold conditions.
31 to 60	Shift leads and an independent reviewer	Rehearse one absence, one contractor substitution, one system outage and one production dispute. Keep the two clocks.	Any missed duty or unauthorised release restricts the work it concerns.
61 to 90	Executive sponsor	Review cost, verified improvement, what workers report and whether exposure moved to another shift or contractor.	Adopt within limits, redesign, extend or withdraw. Name the owner and the review date.

The first question for the executive committee

RECOMMENDATION Ask for one recent event in which a worker raised a concern and the business changed the schedule, the design or the allocation of resources. Then ask for the field evidence that protection improved.

If none can be traced, commission a joint review of the last three impairments of a critical control.

What this will cost

INFERENCE Planning time, paid participation and one independent reviewer. We give no figure, because we have none that we could defend.

What it cannot tell you

INFERENCE Whether injuries will fall. One operation over 90 days does not have enough events. It can tell you whether a duty was uncovered, whether a deputy could act, and how many hours work continued exposed.

What would change our advice

A controlled study linking a staffing level, or a named authority structure, to serious-injury outcomes in construction, mining or heavy industry. We found none. If one appears, the duty-coverage review should start from its numbers.

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PART 1

The argument and the evidence

Why seeing a hazard and acting on it are different capacities, what the published research can establish about staffing and leadership, and where it stops.

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PART 1 · THE ARGUMENT

Seeing is one capacity. Acting is another

A critical control is an act or an object that must be in place for someone to survive a known hazard. When it fails, three things have to be true within a deadline. Someone knows. Someone is entitled to restrict the work. Someone competent can restore the control.

Three questions that budgets blur

INFERENCE **Who is there?** Headcount, observers, cameras and dashboards all answer this question. It is the easiest to fund and the easiest to count.

Who may act? This is authority: the right to hold a lift, close a road, shut a unit or refuse a release, and the knowledge that the decision is yours tonight.

Who is free and able? This is coverage. A qualified person who is at another work front, asleep after 29 shifts, or twelve minutes away is on the roster and absent from the decision.

INFERENCE Many staffing requests answer the first question when the gap lies in the second or third. That is why they disappoint.

Where this sits in the series

Time to act gave six conditions leaders must create, among them named authority, cover and resources. This report turns three of those conditions into things a director can measure on one shift.[14]

What we mean by the words

Protective duty. A task that must be done by a qualified person at a given place and time for a critical control to hold. Releasing a lift. Verifying an isolation. Keeping a crossing closed.

Exclusive duty. A protective duty that cannot be shared with another task in the same interval.

Restriction. A verified state in which nobody is exposed to the failed control: the job held, the area closed, the machine locked.

Release. The recorded decision, by a person with authority, that work may resume.

Exposed time. Time during which work continued with a critical control failed or its state unknown.

> **The test this report applies**
>
> For any warning that matters: name the person who must act, show that they are entitled to, show that they were free to, and state how long people remained exposed. If one of the four cannot be shown, that is the finding.

Critical control is used as in the Riskopilot critical control health method.[13]

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PART 1 · THE EVIDENCE

What the research can establish, and where it stops

We looked for evidence on three questions: how many people, what leaders should do at the workface, and how to tell whether a control is in place. The evidence is thin on the first, cautionary on the second and practical on the third.

EXHIBIT 1

Six sources, what each supports and its limit

SOURCE	DESIGN AND SETTING	WHAT IT SUPPORTS	LIMIT
Brabazon and Conlin, 2001, for the UK regulator [5]	Assessment method. Process plants.	Test staffing against credible abnormal scenarios: can the team detect, diagnose and recover in time? Eight decision trees and a set of rating ladders.	Not designed to give a minimum number. A failed assessment does not by itself mean adding staff.
UK regulator, staffing guidance [6]	Guidance. Major-hazard sites.	Staffing changes often arrive with reorganisation. Assess before and after the change.	Process industries. Construction adds travel, changing layouts and several employers.
Awolusi, Marks and Vereen, 2017 [7]	Survey of safety personnel. US construction firms.	Firms employ more safety staff than cross-industry guides suggest.	Descriptive. Riskier projects may hire more advisers, so a ratio cannot be read as a cause. Sample size not visible to us.
Tucker and Singer, 2015 [8]	Randomised field study. 19 hospitals, 56 work areas, 18 months.	A walk-round programme lowered perceived improvement on average. Results were better where senior managers took responsibility for fixing problems.	Hospitals. The outcome is staff perception.
Zohar and Polachek, 2014 [9]	Randomised field study. One manufacturing plant.	Feedback to supervisors on their daily talk improved safety behaviour and audit scores.	One plant. Not serious injuries.
UK regulator, indicator guidance [12]	Guidance.	Pair evidence that a control is active with evidence that it failed.	Indicator design, not staffing.

FACT Findings as reported by the authors. Sources 8 and 9 were read for *Time to act*.

INFERENCE **What follows.** No study we found links a staffing level to serious-injury outcomes in construction or mining. A method that tests cover against scenarios is defensible. A ratio is not.

INFERENCE **How we use investigations.** The four cases in Part 2 show how authority and cover failed in a specific chain of events. They cannot say how often this happens, or what one more supervisor would have changed elsewhere.

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PART 2

Four investigations

Three events in which the warning was present and nobody with authority acted in time, and one in which an authority acted before the outcome was certain. Each is read from the official report, with what it can and cannot prove.

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PART 2 · TEXAS CITY, 23 MARCH 2005

One operator, three units, and a supervisor who had to leave

Fifteen people died and 180 were injured when a distillation tower overfilled during the restart of a refinery unit.[1] The technical cause is well known. The staffing record is less often read.

What the record shows

FACT During the start-up, one board operator was responsible for three units from a central control room. An earlier assessment had recommended an additional board operator for start-ups of this unit. None was assigned.[1]

FACT The operators had worked 12–hour shifts for 29 or more consecutive days. The investigators judged them likely to be fatigued.[1]

FACT At 10:47 the supervisor left the refinery for a family emergency. No supervisor or technically trained person replaced him. The explosion came at about 13:20, 153 minutes later.[1]

FACT The company had set budget-cut targets of 25% in 1999 and a further 25% in 2005. The central training department had fallen from 28 staff to eight.[1]

FACT The investigators found that the board of directors did not provide effective oversight of major-accident prevention, and that no member was responsible for assessing it.[1]

Reading it as coverage

INFERENCE Three protective duties were owed during that start-up: watching the tower, supervising a non-routine operation and being fit to do either. On the day, the first was shared with two other units, the second had no replacement after 10:47 and the third had been eroded over a month.

INFERENCE Each gap traces to a decision taken away from the control room: a roster, a recommendation not acted on, an absence with no deputy, a budget.

What it cannot prove

INFERENCE The report does not show that a second operator would have prevented the explosion. Instrument failures and the placement of trailers also mattered. It shows that the people who could have noticed were fewer, more tired and less supervised than the company's own assessment advised.

The question for an executive

When you approved the last reduction, which shift lost which duty? If the paper does not say, the decision was made without knowing.

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PART 2 · FLORIDA BRIDGE, 15 MARCH 2018

19 days of cracks, five parties, an open road

A pedestrian bridge under construction fell onto an eight-lane road in Miami. One bridge worker and five people in vehicles died. Ten were injured.[2] We cited this case in *Time to act* for shared authority. Here we read its timeline.

The timeline

FACT **23 to 25 February.** Formwork is removed. Cracking is first documented. On 24 February the crew hears a cracking sound and records a crack at the node that later failed.[2]

10 March. The span is moved onto its piers and one member is detensioned. Cracking becomes markedly worse.

13 and 14 March. The design engineer's emails and a voicemail say the cracks are not a safety issue.

15 March, 09:00. A meeting of the university, the contractor, the state transport department and the inspection firm. The engineer of record says there is no safety concern.

15 March, 13:46. The bridge falls while a crew retensions the member. Two lanes were closed. Six were open.[2]

What the investigators found

FACT Probable cause: errors in the design calculations. An inadequate peer review contributed. Contributing to the severity: the failure of five named parties to stop work and close the road once cracking reached unacceptable levels.[2]

Reading it as authority

INFERENCE Three functions were in play: diagnosing the structure, stopping the work and closing the road. The investigators found that each of the five parties could have stopped the work or had the road closed.[2] Each could see the cracks. Each deferred to the designer's diagnosis.

INFERENCE The diagnosis was wrong, and the investigators note that the engineer did not obtain an independent review of the remedial plan.[2] A restriction did not require the diagnosis to be settled. It required someone to decide that an unexplained crack over live traffic was reason enough.

What it cannot prove

INFERENCE That any one party knew the bridge would fall. The calculation that explains the cracks came after the collapse. The lesson concerns who may restrict while experts disagree. It does not concern foresight.

> **The question for a project director**
>
> If the designer says a defect is safe and your site lead is not sure, who closes the area tonight, and have they ever done it?

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PART 2 · CHEVRON RICHMOND, 6 AUGUST 2012

2 hours 40 minutes at a leak

A corroded pipe in a crude unit leaked, then ruptured. Nineteen employees were engulfed in the vapour cloud and escaped. Six had minor injuries. About 15,000 people nearby sought medical treatment in the following weeks.[3]

The interval

FACT **About 15:50.** An operator finds the leak.[3]

About 16:07. The refinery fire department arrives. Around 40 people gather. A hot zone is marked.

About 17:00. The shift team leader orders the feed reduced.

After 17:00. The group considers a clamp, then decides to remove insulation to see the leak. The leak worsens. Managers decide to shut the unit down, which takes hours.

About 18:30. A vapour cloud forms and ignites before the shutdown is complete.[3]

What the investigators found

FACT On the day, the refinery had no leak response guidance or formal protocol for operators, managers or responders. Some people at the scene were uncomfortable and suggested shutting the unit down. Nobody formally invoked stop-work authority. The protocol written afterwards would require a shutdown for a similar leak.[3]

Reading it as two jobs

INFERENCE For 160 minutes the organisation did one job, diagnosis, and did it with energy. Forty people were present. The second job, restricting exposure while the diagnosis ran, had no owner and no rule.

INFERENCE This is the clearest published example we know of the gap between the two. A stop-work card in every pocket did not fill it. A rule written in advance, with a named person to apply it, would have.

What it cannot prove

INFERENCE That the interval was a safe window anyone could have counted on. It was reconstructed afterwards. Nobody at the pipe knew when it would fail. That is the reason to restrict first and diagnose from a distance.

> **The question for an operations director**
>
> For your three worst credible leaks, structural warnings or abnormal readings: who restricts the area, on what trigger, without waiting for the expert?

Times are from the investigation report, which notes that the video clock may be about five minutes out.[3]

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PART 2 · OROVILLE DAM, FEBRUARY 2017

An order given before the outcome was certain

The fourth case is different. The long history is one of failure. The last decision is one of authority used in time. Both lessons are needed, and they should not be confused.

What happened

FACT **7 February.** A section of the main spillway chute at Oroville dam in California fails during releases. Erosion follows.[4]

About 11 February. With the reservoir rising, water flows over the emergency spillway for the first time in the dam's history.

12 February. The hillside below the emergency spillway erodes rapidly towards its crest. Staff fear the crest structure could be undermined, releasing the reservoir. An evacuation of about 188,000 people downstream is ordered.[4]

What the investigators found

FACT No single root cause. A long-term systemic failure involving the owner, regulators and industry practice. The owner's dam safety programme was immature, lacked clear executive accountability and relied too heavily on regulators. Once the emergency spillway was allowed to overtop, the forensic team describes the evacuation order as a necessary precaution.[4]

Reading the last decision

INFERENCE On 12 February nobody could say whether the crest would hold. The engineering question was open. The order was given anyway, by an authority entitled to give it, and it applied to a very large number of people.

INFERENCE Set beside the bridge and the refinery, this is what the missing decision looks like when it is taken: a restriction that does not wait for the diagnosis.

What it cannot prove

INFERENCE The order does not vindicate what came before. The same report finds decades of missed chances to intervene. Nor can anyone say how many injuries the evacuation prevented. The 188,000 are the people covered by the order.

INFERENCE And a public evacuation is not a site hold. The structure transfers, the scale does not: an identifiable authority, a trigger short of certainty, and a way to confirm that people have in fact moved.

The question for a site director

Where your work borders the public, who can order people out, and have you tested that call with them?

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PART 2 · READING THE FOUR TOGETHER

The warning arrived. The decision had no owner

EXHIBIT 2

Four events on the same four questions

EVENT	WHAT WAS KNOWN	WHO COULD RESTRICT	INTERVAL	WHAT DECIDED THE OUTCOME
Texas City[1]	A recommendation for a second board operator at start-ups.	The supervisor, who left at 10:47 with no deputy.	153 minutes from his departure to the explosion.	Cover removed by roster, absence and budget.
Florida bridge[2]	Documented cracks that grew.	Five parties. None did.	19 days from the recorded crack to collapse.	Restriction made to wait for diagnosis.
Chevron Richmond[3]	A leak in a hot hydrocarbon line.	Anyone, by policy. Nobody, in practice.	About 160 minutes from discovery to ignition.	No rule and no owner for restriction.
Oroville[4]	Rapid erosion towards a spillway crest.	A public authority, which did.	Hours, on 12 February.	An order given before certainty.

FACT Facts from the official reports cited. INFERENCE The last column is our reading. Four cases chosen by us are not a sample.

Three patterns

INFERENCE **The person was on the roster and absent from the decision.** Shared across three units, away with no deputy, or one of forty at a leak.

Restriction waited for diagnosis. Where experts were still working, exposure continued. Where an authority restricted first, it ended.

The cause sat upstream. Budgets, rosters, contracts and the absence of a rule were set by people who were not on site on the day.

Guarding against hindsight

INFERENCE Every interval in Exhibit 2 was measured after the event. On the day, nobody knew how long they had. We do not claim that people should have foreseen the outcome.

The claim is narrower. In three of the four, no named person held the decision to restrict, with a trigger that did not depend on knowing the outcome. That is a design fault, and it can be found before anything happens.

RECOMMENDATION Parts 3 to 5 give three ways to look for it.

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PART 3

Instrument 1: the duty-coverage review

How to build a roster from the protective duties the work requires, test it on the busiest interval, and choose between hiring, resequencing and redesign.

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PART 3 · METHOD

Build the roster from the duties

The usual staffing question is how many people a site of this size should have. The useful one is which protective duties this shift owes, and whether a qualified person is free to perform each of them at the time it falls due.

1. List the protective duties

RECOMMENDATION For each work front, write down the decision being protected, the role and competence it needs, the place, the duration, the deadline for a response and whether the duty is exclusive. Include rescue cover, abnormal operation and handover. Check legal, contractual and manufacturer requirements locally before comparing options.

2. Test the busiest interval

RECOMMENDATION Cut the shift at every change of task, place or availability. In each interval, count the people who are qualified and in fact free. Leave out anyone committed elsewhere, absent, on a break without relief, or barred because the duty needs independence. Add travel, communication and preparation time. Count each named person once.

INFERENCE An average over the shift hides the fifteen minutes that matter.

3. Stress the plan

RECOMMENDATION Replay four conditions on paper, then on site: a night shift, a contractor substitution, an alarm while the supervisor is at the other work front, and one critical absence. Compare the time needed to reach a safe state with the deadline. Where travel or divided attention leaves cover in doubt, restrict the work until it has been checked.

4. Choose the intervention

RECOMMENDATION Page 18 sets out the choice. In short: add or redeploy people when a duty is uncovered, resequence when the overlap is avoidable, redesign when exposure would remain under perfect observation, and fund maintenance when repair is what holds things up.

Where the method comes from

FACT The UK regulator's staffing method for process plants tests whether a team can detect, diagnose and recover from defined scenarios in time, and says plainly that it does not compute a minimum number.[5] INFERENCE We have adapted the idea for sites where people travel between work fronts and several employers share the ground. The adaptation is ours and is untested.

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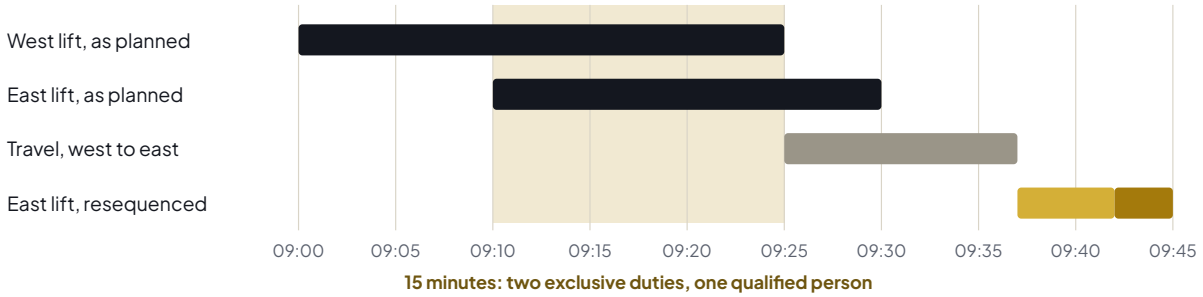
PART 3 · WORKED EXAMPLE

Two lifts and one qualified supervisor

ILLUSTRATION An invented morning on a building site. Two crane lifts each need the exclusive attention of a supervisor authorised to release the load. The site has one. A safety adviser is present and has no authority to release a lift.

EXHIBIT 3

Fifteen minutes the roster did not show



15 minutes: two exclusive duties, one qualified person

Grey: 12 minutes of travel. Light gold: 5-minute briefing from 09:37. Dark gold: earliest safe start of the east lift, 09:42. All times invented.

ILLUSTRATION Illustration. Times recomputed when this report was built.

Option A. Sequence

The west lift ends at 09:25. Travel takes 12 minutes, so the supervisor reaches the east lift at 09:37. A start planned for 09:40 leaves 3 minutes. If the briefing needs 5, the plan fails by 2. The earliest honest start is 09:42.

RECOMMENDATION Walk the route and time the briefing before approving the new start.

Option B. Cover

Assign a second authorised supervisor to the east lift, with a separately verified signaller and relief where needed.

INFERENCE This settles the conflict over one person. It does not show that the two lifts can safely run at once. Check shared access and overlapping load paths.

Option C. Remove

Change the delivery or assembly sequence so that the east lift happens at another stage.

INFERENCE Compare the disruption with the cost of option B. A camera on both lifts would show two areas and leave one person owing two immediate decisions.

RECOMMENDATION **Record why the chosen option covers the duties.** The adviser cannot fill the gap, and the weekly headcount would never have shown it. The interval 09:10 to 09:25 appears only when duties are mapped against the clock.

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PART 3 · CHOOSING

What the review found decides what you fund

The same symptom, a hazard seen late or not acted on, has at least five causes. Each calls for a different purchase. Asking which one applies is the whole value of the review.

EXHIBIT 4

From finding to intervention

IF THE REVIEW FINDS	FUND THIS	BEFORE YOU DO	IT WILL NOT HELP IF
A protective duty with no qualified person free in the interval.	A qualified person, hired or redeployed, with relief.	Confirm the duty is exclusive and the overlap cannot be moved.	The person lacks authority to act.
Two exclusive duties that overlap by plan.	Resequencing.	Price the delay against added cover.	The programme reintroduces the overlap next week.
Exposure that would remain even if everyone watched perfectly.	Redesign: segregation, a barrier, a different method.	Compare with the conventional option, as in *Prove it on site*.[14]	The redesign moves the exposure to another crew.
A hazard seen in time and no one entitled to restrict.	Delegated authority, written and rehearsed.	Test the deputy with the principal absent.	The contract penalises whoever stops.
A restriction held correctly while repair waits.	Maintenance: parts, access, competent labour.	Separate hours exposed from hours stopped.	The repair is closed on paper and not verified.
A hazard nobody saw, in a place nobody could have been.	Observation or monitoring, as an advisory layer.	Pilot it against the conventional option.[14]	No one is assigned to act on what it shows.

RECOMMENDATION Riskopilot proposal. Only the last row is a visibility problem.

Reductions pass the same test

RECOMMENDATION A proposal to remove a post, merge two roles or lengthen a shift is a change to protective cover. Run it through steps 1 to 3 before it takes effect, and record which duty moves to whom.

FACT The UK regulator observes that staffing changes commonly arrive with reorganisation, and asks for assessment before and after.[6]

Remote support

RECOMMENDATION A remote expert or control room can advise. Count it as cover only where local action, a fallback and the timing have been demonstrated on that site, at night.

INFERENCE Texas City had a central control room. The question was how much one person in it was asked to watch.[1]

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PART 3 · HANDOVER, DEPUTIES AND CONTRACTORS

Three places where cover disappears without anyone deciding

A duty-coverage review looks hardest at three moments: when a shift changes, when the named person is away, and when the work belongs to another employer.

Shift change

FACT The UK regulator reports that many accidents have followed failures of communication at handover, most of them involving planned maintenance. It cites the Piper Alpha inquiry and a 1983 discharge at Sellafield among its examples.[10]

FACT Its guidance asks for a face-to-face, two-way exchange, spoken and written, with the incoming person checking the information before taking over. It flags handovers during maintenance, between shift and day staff, and between operations and maintenance as higher risk.[10]

RECOMMENDATION At handover, the outgoing lead states every impaired control, every live restriction and who holds each. The incoming lead repeats them. If custody of a restriction is uncertain, the job stays on hold.

RECOMMENDATION Give the handover paid overlap. A handover done in the car park is a planning decision.

The deputy

INFERENCE At Texas City the supervisor's absence was nobody's fault. The absence of a deputy was a design.[1]

RECOMMENDATION For each exclusive duty, name a deputy with the same competence and the same authority. Test the deputy by rehearsal with the principal removed. An untested deputy leaves the duty uncovered.

The other employer

FACT US regulator guidance asks that workers employed by contractors, subcontractors and agencies take part in the site's safety arrangements, and notes that fear of retaliation suppresses participation.[11]

RECOMMENDATION Map duties across every employer on the work front. Where a duty sits with a subcontractor, check that its person has authority over the other trades, or name who has.

INFERENCE The Florida bridge had five organisations and no single holder of the decision to close the road.[2]

> **A quick test.** Pick tonight's shift. For one critical control, ask who can restrict the work at 03:00, who can restore it and who can release it. Three names, or the gap.

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PART 4

Instrument 2: the two clocks

A way to record one decision episode so that anyone can check whether people were protected in time, whether the control was restored, and who released the work.

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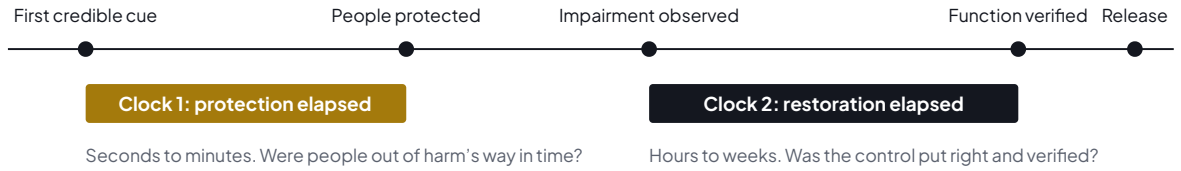
PART 4 · METHOD

Two clocks, kept apart

An alarm can arrive, a crew can respond and a work order can close while nobody can say whether people were out of harm's way in time. Most systems time the repair. We propose timing two other things and never merging them.

EXHIBIT 5

What each clock starts on



During Clock 2, report separately the time under a verified restriction and the time work continued exposed.
Release is a third record, signed by the person with authority. A clock with a missing end is open. A clock with missing evidence is unknown.

RECOMMENDATION Riskopilot proposal, developed from the paired-indicator approach in the UK regulator's guidance.[12]

Clock 1. Protection

RECOMMENDATION From the first credible warning to the observed protected state: the vehicle stopped, the area clear, the job held. It needs two admissible end points and independent evidence of the physical condition.

If people were already separated throughout, say what kept them apart and mark the clock as not applicable.

Clock 2. Restoration

RECOMMENDATION From the first supported observation that the control was impaired to a competent functional check on the same asset, defect and scope. Record the restriction in force during that time and any gap in it.

Exposed time

RECOMMENDATION Within Clock 2, split the hours into those under a verified restriction and those in which work continued. Report the second number.

ILLUSTRATION An impairment open for 31 hours, 26 of them with the conveyor locked out, is 5 hours of exposed time. A stopped job waiting for parts and a running job waiting for parts call for different decisions.

Release

RECOMMENDATION A separate record: the conditions met, the decision, the time and the authorised person. A release logged before the required evidence is a disputed release.

Open and unknown

RECOMMENDATION Open means an end event is still awaited. Unknown means the evidence cannot establish a fact or a time. Write both down. Neither is a pass.

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PART 4 · READING THE CLOCKS

Timely, late or undetermined

When seconds matter, a time is only as good as the clock that took it. The rule below stops a measurement error from being read as a margin.

The rule

RECOMMENDATION Let D be the latest acceptable time for the protected state, set in advance by the technical authority. Let T be the observed time. Let U be the total approved uncertainty on the comparison. Use one time origin and one unit.

IF	THEN
T + U is at or below D	**Timely.** State the reserve, D minus (T + U).
T minus U is above D	**Late.**
Anything in between	**Undetermined.** The interval crosses the deadline.
Time evidence missing or on incompatible clocks	**Unknown.**

Three readings

ILLUSTRATION With D at 10 seconds and U at 1 second: a protected state observed at 7 seconds is timely, with a reserve of 2 seconds. One observed at 9.5 seconds is undetermined. One observed at 12 seconds is late.

RECOMMENDATION Undetermined and unknown count against acceptance. They are never averaged into the passes.

Which end point

RECOMMENDATION Time the physical state, not the acknowledgement. A driver pressing a button and a vehicle at rest are different events. If the site sets a deadline for issuing a command, first account for the full physical response time, and do not count the same allowance twice.

Independent evidence

RECOMMENDATION Two screens that copy one detector are one source. For each record, keep the original, its owner, its clock and evidence that the clocks agree. Keep disagreements. Give each new observation its own reference.

The worker's record

RECOMMENDATION A worker or contractor can attach a contrary observation to the same trace and is told what was done with it. Originals, times and changes are preserved.

FACT US regulator guidance asks employers to give workers a way to raise concerns without fear and to let any worker request a temporary halt to work they believe is unsafe.[11]

> **Why this matters to an executive committee.** A dashboard that shows 100% of alarms acknowledged has timed the wrong end point.

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PART 4 · WORKED TRACE A

An alert at a delivery gate

ILLUSTRATION An invented replay on a closed course, using a surrogate in place of a person. It follows the delivery-gate dossier in *Prove it on site*.[14] Every time and allowance below is made up for the exercise.

EXHIBIT 6

Four original records and what each can establish

RECORD	WHAT IT SHOWS	WHAT IT CANNOT SHOW
G1. Reference video, independent of the camera under test	At 0 seconds the surrogate enters the marked approach. At 7 seconds the vehicle is at rest with separation intact.	Why the driver stopped.
G2. Event log of the camera under test	Detection and cab warning at 2 seconds.	That the vehicle stopped. The log holds no confirmation of a stop.
G3. Radio recording	The marshal calls a hold at 5 seconds.	Which cue prompted the call.
G4. Exercise design	Latest acceptable protected state: 10 seconds. Combined timing allowance: 1 second.	Anything beyond this exercise.

Reading the clocks

ILLUSTRATION Clock 1 reads 7 seconds from the first independently observed cue. With the allowance, 7 + 1 is below 10, so protection was timely with 2 seconds in reserve.

No impairment of the physical control was established, so Clock 2 does not apply. No release was requested.

What can be claimed

INFERENCE The combined arrangement of camera, marshal and driver protected the surrogate in time, once.

What cannot

INFERENCE That the camera caused the stop. G2 shows a warning and G3 shows an instruction. The marshal may have seen the surrogate first.

That the arrangement is reliable. One replay says nothing about poor light, occlusion, a relief marshal or another site.

What changes the funding decision

RECOMMENDATION Compare the same demand under three options: the present layout, a practical segregation of vehicles and people, and the camera as an added layer. If segregation removes the conflict, fund the layout.

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PART 4 · WORKED TRACE B

A repaired conveyor at shift change

ILLUSTRATION An invented night-shift exercise. A conveyor guard and its interlock have been repaired. The incoming supervisor has four records and must decide whether the conveyor may run.

EXHIBIT 7

Four records at 02:00

RECORD	TIME	WHAT THE INCOMING SUPERVISOR CAN ESTABLISH
Work order	01:40	Repair recorded as complete. No functional check for release is recorded.
Shift note	01:46	The outgoing operator notes that the functional check is outstanding. This leaves the result unknown. It does not show a failed test.
Duty roster	01:55	The usual verifier is unavailable. Whether competent relief exists has to be found out.
Handover	02:00	The incoming supervisor keeps the restriction in place. Nothing in the four records shows when people first reached a protected state.

Reading the clocks

ILLUSTRATION Clock 1 is unknown. Clock 2 is open, and its start is unknown too, because no record shows when the impairment was first observed. Operations has recorded a hold.

INFERENCE "Repair complete" neither starts nor stops a clock. It is a statement about work done, and the control has not been shown to function.

What can change the hold

RECOMMENDATION A competent person checks the required function on the right asset and scope. The supervisor deals with any objection, confirms the other local conditions and records the release.

What the executive learns

INFERENCE Three things that a closed work order would have hidden. The verifier's role has no relief on nights. The repair system lets a job close without its functional check. And nobody recorded when the guard was first found defective, so exposed time cannot be stated.

RECOMMENDATION Each has an owner above the shift: the roster, the maintenance system and the reporting rule. Name them and set a date.

If an automated assistant is involved

Software can display the four records and escalate to the duty supervisor. It cannot confirm a physical restriction. That still needs the crew, under the site procedure. A later report in this series covers the governance of such agents.

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PART 5

Instrument 3: decisions reserved for executives

Seven decisions that remove protective cover when taken carelessly, the record each one should leave, and the routines and rehearsals that keep authority real.

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PART 5 · RESERVED DECISIONS

Seven decisions that should never be delegated by default

Each of these looks commercial or administrative. Each can remove a protective duty from a shift without anyone on that shift being asked. We propose that the named executive signs a short record for each.

EXHIBIT 8

Decisions 1 to 4

DECISION AND OWNER	BEFORE DECIDING	PROOF AFTERWARDS	BASIS
1. Approve a budget cut Executive committee and finance director	Compare the spending assumptions with the actual roster, spares and overdue repairs. Ask which jobs must stop if the money goes. Obtain an independent view of the remaining exposure and a priced alternative.	Trace the decision to one affected shift. If a required duty has gone, restore cover or restrict the work before the budget takes effect.	FACT Texas City: resource and oversight findings. [1]
2. Accelerate the schedule Project director	Freeze the original sequence. Walk the proposed overlap, travel and emergency cover with the trades. Price resequencing and added qualified cover.	Witness the busiest interval. A programme that gives one person two exclusive duties at once stays on hold.	RECOMMENDATION Proposed stress test, from the method on page 16.
3. Extend an impairment Operations director	Require an expiry, the people exposed, the restriction in force, what is new since the last extension and a funded repair date.	Sample the workface at expiry. Close only when restoration is shown on the next comparable job. A third extension goes to the budget holder.	RECOMMENDATION Proposed, informed by indicator guidance. [12]
4. Wait for technical certainty Site director and engineering authority	Delegate the authority to restrict separately from the duty to diagnose. Arrange independent review where engineering judgement is contested.	Rehearse a night-shift dispute. Check that the area was in fact cleared by the local deadline, and review the evidence used to reopen.	FACT Florida bridge and Chevron Richmond. [2, 3] INFERENCE Oroville shows the alternative. [4]

INFERENCE **What the four have in common.** The person deciding is far from the shift, the effect arrives weeks later, and nothing in the paperwork connects the two.

RECOMMENDATION **The record.** Form 3 on page 36 has one line that does most of the work: “Protective duty affected, and who now covers it.” A blank there is the finding.

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PART 5 · RESERVED DECISIONS

Three more, and the test they share

EXHIBIT 9

Decisions 5 to 7

DECISION AND OWNER	BEFORE DECIDING	PROOF AFTERWARDS	BASIS
5. Let the contractor absorb the cost of a stop Commercial director	Before award, agree standby, dispute and reporting terms. Say in the contract who pays when a job is held for a safety reason.	After a real hold, review invoices, pay and future work allocation, with confidential input from workers. Investigate adverse changes independently. Protect personal data.	RECOMMENDATION Proposed, informed by guidance on worker participation.[11]
6. Buy more visibility Executive sponsor	Trace three recent critical findings to the point of greatest delay. Was it lack of observation, of a qualified response, of authority or of repair resources?	Fund the constraint that binds. Compare exposed time at a comparable volume of work.	RECOMMENDATION Diagnostic. No general staffing effect is established.[5, 7]
7. Accept administrative closure Operations manager and independent verifier	Pick a signed closure. Identify the mechanism behind the original failure.	Revisit an equivalent task after the original verifier has moved on. Record the actual condition of the control and the worker's account. If the failure returns, reopen and fund a systemic correction.	RECOMMENDATION Proposed field test.

The shared test

RECOMMENDATION For any of the seven, the executive should be able to answer four questions in writing before signing.

Which protective duty does this touch? Named by task, place and shift.

Who covers it afterwards? A person and a deputy.

What was the alternative, and what did it cost?

On which shift will someone check? A date and a name outside the line that proposed the change.

Why sign at all

INFERENCE A signature does not make a decision right. It makes the decision visible and attaches it to a person who can be asked about it later. At Texas City, the investigators found that the board had no member responsible for assessing major-accident prevention.[1]

The risk in this proposal

INFERENCE Records can become ritual. If the form is completed after the decision, or by someone who has not seen the shift, it adds paper and removes nothing. Page 38 takes this objection seriously.

> **A rule of thumb.** If a decision record takes more than one page or more than one hour, it is being written for an auditor.

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PART 5 · WHEN A WORKER STOPS A CRITICAL JOB

Who absorbs the delay, and who may restart

We argued earlier in this series that if a worker has to stop the job, a leader's decision has already failed. It will still happen. What the organisation does in the next hour decides whether it happens again.

Five minutes before release

ILLUSTRATION An agency worker notices that the indicator on an excavator attachment does not look right. The shift manager holds the task, secures the area and tells dispatch what other work can continue.

RECOMMENDATION The worker is paid for the time spent raising and explaining the concern. Other crews using the same family of equipment are told.

Who absorbs the delay

RECOMMENDATION The project director owns the effect on the schedule. Commercial management records the standby and applies the contract as written. Procurement should have agreed fair terms for reporting, standby and disputes before award.

INFERENCE A supervisor cannot promise protection to someone who stops a job if procurement later penalises the contractor for every hold.

The legal floor

FACT International and European instruments protect a worker who withdraws from serious and imminent danger from undue consequences.[15, 16] INFERENCE They say nothing about who restarts, or who pays the contractor.

Who may restore and release

RECOMMENDATION Engineering establishes the correct configuration and how the manufacturer says it should be checked. An authorised person verifies the condition in the field. The operational authority releases the work, communicates the release and records any objection the worker still has.

RECOMMENDATION A manager who wants an early restart uses the same route.

What the chief executive asks the next day

RECOMMENDATION Which decision prevented exposure? Did anyone lose pay, access or future work? Did another crew inherit the risk? Which purchase, maintenance or schedule decision created the doubt in the first place?

Assign a funded correction and check it on the next comparable job.

FACT US regulator guidance asks employers to let any worker request a temporary halt, and warns that fear of retaliation reduces reporting.[11]

> **One number worth tracking.** Stops raised by contractor and agency workers, as a share of all stops. If it is near zero on a site where they do most of the hazardous work, ask why.

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PART 5 · THE LEADERSHIP VISIT

Turn a visit into a management decision

Visits are popular and their effect is rarely tested. The best trial we know of found that a visiting programme made things worse on average, and better where managers took ownership of what they heard. [8]

What the trial found

FACT Nineteen hospitals were randomly chosen to run an 18–month programme in which senior managers observed front-line work, asked for improvement ideas and worked with staff to resolve them. Fifty-six work areas took part. On average, the programme lowered staff ratings of performance improvement. Areas that prioritised problems that were easy to solve did better. So did those where senior managers took responsibility for the fix. [8]

INFERENCE The setting is hospitals and the outcome is perception. The mechanism is plausible anywhere: a visit raises an expectation, and an unmet expectation costs trust.

Before the visit

RECOMMENDATION Choose a high-exposure task from the current plan, including one reported as normal. Bring the latest defect or change that affects it. Arrange to speak with a worker without the immediate supervisor answering for the crew. Provide interpretation on paid time if needed.

At the task

RECOMMENDATION Ask the worker to show the protective condition as it is now, to explain the last change, and to say who could stop and restore the work on nights. Compare the account with the physical arrangement and with the outgoing shift's record. Act at once on uncontrolled exposure, under the local procedure.

After the visit

RECOMMENDATION Leave with four things: one operating owner, an agreed temporary restriction, the authority for a permanent correction, and a date for feedback to the person who spoke. Ask an independent verifier to revisit the next comparable task.

Avoid the count

INFERENCE A target for the number of visits invites quick tours of low-risk areas. Count instead the recurring exposures removed and the long-standing defects brought to light.

RECOMMENDATION Check whether reporting fell after a contractor was challenged. A rise in concerns can be a sign of trust. Independent observation helps tell the difference.

> **The test of a visit.** One month later, can the worker you spoke to say what changed?

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PART 5 · GOVERNANCE

Six routines, each with a decision owner

Authority that exists only in an organisation chart is not exercised at 03:00. These six meetings already exist on most sites. What we add is the evidence each must see and the decision it must be able to take.

EXHIBIT 10

Forum, evidence and consequence

FORUM AND OWNER	EVIDENCE REQUIRED	DECISION OR CONSEQUENCE
Tender and award Commercial director	Safety-critical competencies named. Paid induction. Who responds to defects. Who pays for standby.	Reject a bid that promises supervision without naming cover and relief.
Mobilisation or change Project director	A walk of the shared interfaces with every employer. Authorisation for the current stage only.	Hold the start where ownership is uncertain, drawings are out of date or the fallback is untested.
Daily planning Construction or operations manager	Concurrent work fronts, travel and exclusive duties on the busiest shift.	Resequence or provide competent cover before release.
Shift handover Outgoing and incoming leads	Live jobs, impaired controls and who holds each restriction. The incoming lead repeats them. [10]	Uncertain custody keeps the job on hold.
Weekly defect review Operations and maintenance leads	For each impairment, hours exposed and hours under restriction. Repeat failures.	Escalate parts, access and funding constraints to the site director.
Monthly executive review Executive sponsor	One record reported as normal and one recent restart, each compared with field evidence. [12]	Release capital, restrict work or commission independent verification. Record the decision.

RECOMMENDATION Riskopilot proposal. Adapt titles to your organisation. Keep the last column.

INFERENCE **Why the last column matters.** A forum that can only note a problem will be bypassed by anyone who needs a decision.

RECOMMENDATION **Sampling a normal record.** The monthly review should look at something reported as fine. Problems that are already red have an audience.

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PART 5 · REHEARSAL

Rehearse with the decision-maker removed

A deputy, a contract clause and an escalation route are all claims until they are tried. The cheapest test is a tabletop exercise in which the person who usually decides is told to stay silent.

How to run one

RECOMMENDATION Take one critical control and one realistic pressure. Gather the real roles, including the contractor and a worker representative. Remove the primary decision-maker. Start a clock.

Record four things: who held delegated authority, who absorbed the delay, the time at which exposure ended, and what evidence was still missing at release.

RECOMMENDATION An exercise that ends with a telephone call to the absent principal has found the gap.

What it is not

INFERENCE It does not test equipment, and nobody is exposed to anything. The staged challenges for technology are in *Prove it on site*, where challenge E covers the human handover.[14]

Four scripts to start from

ILLUSTRATION **The delivery target.** A booked delivery window is about to be missed at a gate where vehicles cross a walkway. Who changes the booking or funds segregation, and does the marshal keep the crossing closed meanwhile?

ILLUSTRATION **The overrunning shutdown.** A night maintenance job on a conveyor overruns into a planned feeder test. Who pays for a qualified overlap or delays the test?

ILLUSTRATION **The absent designer.** A movement warning arrives on temporary works and the designer cannot be reached. Who orders people out, and who decides they may return?

ILLUSTRATION **The reassigned rescue team.** The rescue cover named on a confined-space permit has been sent elsewhere. Who postpones the entry?

RECOMMENDATION Each script names a pressure, a decision and a cost. Write your own from last month's disputes.

> **Scoring.** Pass: a named person with authority restricted the work, on the stated trigger, within the deadline, without the principal. Anything else is a finding with an owner. Form 4 on page 37 records it.

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PART 5 · DOING IT

The 90-day plan in detail

One operation, one recurring impairment, one sponsor. The aim is a written decision and a short list of duties that now have owners.

EXHIBIT 11

Four windows, with the form used in each

DAYS	OWNER	WORK	GATE	FORM
1 to 15	Site director, worker representative	Select one critical activity and its most demanding shift. Map the chain of decisions from warning to release. Cost the existing restriction. Sample nights.	Baseline signed. Unowned decisions listed.	1
16 to 30	Planner, technical authority	Map duties by interval, with deputies, travel and simultaneous operations. Compare cover, resequencing and redesign.	A change approved, with fallback and hold conditions.	1, 3
31 to 60	Shift leads, independent reviewer	Rehearse one absence, one substitution, one outage and one dispute. Keep a trace for every impairment of the chosen control.	A missed duty or unauthorised release restricts the work.	2, 4
61 to 90	Executive sponsor	Review cost, exposed hours before and after at comparable volume, what workers say and whether exposure moved elsewhere.	Adopt within limits, redesign, extend or withdraw.	3

RECOMMENDATION Riskopilot proposal. No site has yet reported results from this plan to us.

What to count

RECOMMENDATION Intervals with an uncovered exclusive duty, before and after. Hours exposed and hours restricted per impairment. Releases logged before their evidence. Rehearsals passed without the principal. Stops raised by contractors.

INFERENCE None of these is an injury rate. Each can move in 90 days.

What would make us stop

RECOMMENDATION Evidence that the review moved exposure to another shift or employer. Records being completed after the fact. A fall in reported concerns once the review began.

RECOMMENDATION Any of these goes to the sponsor that week, and the review pauses until it is understood.

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PART 6

Forms to complete

Four blank pages to print or fill in on screen: the duty-coverage sheet, the protection trace, the executive decision record and the rehearsal record.

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PART 6 · FORM 1

Duty-coverage sheet

One sheet per shift reviewed. Start a new row at every change of task, place or availability. Count each named person once per interval. Copy the page as needed.

Site, area, date and shift	
Reviewed by Planner, technical authority, worker representative	

FROM, TO	WORK FRONT	PROTECTIVE DUTY	COMPETENCE AND AUTHORITY NEEDED	EXCLUSIVE?	NAMED PERSON	COMMITTED ELSEWHERE?	TRAVEL AND PREP, MIN	DEPUTY	COVERED?

Intervals with an uncovered duty	
Option chosen for each Cover, resequence, redesign, authority, maintenance	
Stress replays done Night, substitution, alarm at the other front, absence	

Planner	Technical authority	Worker representative
Name, signature, date	Name, signature, date	Name, signature, date

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PART 6 · FORM 2

Protection trace

One trace per decision episode: one job, one control, one challenge. Reuse it at shift change, including when the decision is to keep a restriction. Attach original records.

1. Identity Trace reference, place, task, asset, shift, control, expected protected state, owner. Time origin	
2. Demand What required the control to act. First credible cue and its independent source. Confirmed, absent or unknown	
3. Response Observation, interpretation, communication, authorised action and physical outcome, each with source and time	
Clock 1. Protection elapsed From, to, evidence. Deadline D, uncertainty U. Timely, late, undetermined or unknown	
4. Impairment Failed or suspect function. Earliest supported evidence. Functional test and verifier	
Clock 2. Restoration elapsed From, to. Hours under verified restriction. Hours exposed. Open or unknown	
5. Release Conditions met, decision, time, authorised person. Disputed if logged before the evidence	
6. Recurrence Manager with budget or schedule authority, remedy, due date, next comparable task, who will check	
Contrary observation From a worker or contractor, and what was done with it	

Shift lead	Verifier	Release authority
Name, signature, date	Name, signature, date	Name, signature, date

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PART 6 · FORM 3

Executive decision record

One page, completed before the decision takes effect, for any of the seven reserved decisions on pages 26 and 27. If it takes more than an hour, it is being written for the wrong reader.

Decision Budget, schedule, impairment extension, technical uncertainty, contract terms, visibility, closure	
Operation, shifts and employers affected	
Protective duty affected, and who now covers it Task, place, shift. Person and deputy	
Independent view of the remaining exposure Who gave it	
Alternative considered, and its cost	
Restriction or fallback if cover cannot be shown	
Shift on which this will be checked Date, and a name outside the proposing line	
Result of the check Duty covered, uncovered or moved elsewhere	
Decision reopened? Yes or no, date, reason	

Deciding executive	Technical authority	Independent checker
Name, signature, date	Name, signature, date	Name, signature, date

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PART 6 · FORM 4

Rehearsal record

One page per tabletop exercise. The usual decision-maker attends and stays silent. Nobody is exposed to any hazard.

Control, pressure and script	
Roles present Include contractor and worker representative	
Decision-maker removed Name and role	
Who held delegated authority Was it written before the exercise?	
Trigger used to restrict Did it depend on a diagnosis?	
Time from cue to restriction Against the stated deadline	
Who absorbed the delay Schedule, cost, contract	
Evidence missing at release	
Result Pass, or finding with owner and date	

Pass: a named person with authority restricted the work, on the stated trigger, within the deadline, without the principal.

Facilitator	Deputy tested	Sponsor
Name, signature, date	Name, signature, date	Name, signature, date

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LIMITS

What would change this report

The argument rests on four investigations, a small body of research and our own reasoning. These are the findings that would move it.

IF THIS APPEARED	WE WOULD CHANGE
A controlled study linking a staffing level to serious-injury outcomes in construction, mining or heavy industry.	Start the duty-coverage review from its numbers and treat our method as a supplement.
A field evaluation of duty-coverage reviews or of the two clocks, with outcomes independently measured.	Report it, including what did not work, and revise the forms.
Evidence that named single-point authority delays action more often than it speeds it.	Reconsider Part 5 in favour of shared authority with a default to restrict.
A replication of the walk-round trial in heavy industry with a different result.	Revise page 29.
A site willing to publish its 90–day review.	Add it as a worked case.

The strongest case against this report

"Four disasters chosen after the fact prove nothing." They prove nothing about frequency, and we say so. They show a mechanism that can be looked for in advance. A site that finds no uncovered duty and no unowned decision has lost a few days of planning time.

"Naming one person concentrates blame and slows everyone else down." A real risk. That is why the report asks for a deputy, a default to restrict, and a contract that does not punish whoever stops. Authority without those is a liability handed to one individual.

"Exposed time will be gamed like every other indicator." It will, if it carries a target. Use it to choose where to look, sample it independently and never attach a bonus to it.

"This is more paper for supervisors who are already stretched." Three of the four forms are completed by planners and executives. The fourth, the trace, replaces the note a shift lead already writes.

"Sometimes the answer really is more people." Yes. Exhibit 4 says when. The report objects to hiring before knowing which duty the new person will hold.

Limits of the evidence

INFERENCE Three cases are from the United States, in refining, civil construction and dams. The research on leadership visits is from hospitals. Transfer to your sector is a judgement. Legal duties differ by country and are not covered here.

Limits of the method

INFERENCE The three instruments are proposals. Riskopilot has not run them on a client site and no outcome data exist. The worked examples are invented and every number in them is marked.

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SOURCES

Source register

Every source was chosen in this order of preference: official investigations and regulators, peer-reviewed research, then established institutions. The right-hand column states what we read, when, and any limit on it. No supplier or consultancy material is cited.

NO.	SOURCE	TYPE, ACCESS AND LIMITS
1	US Chemical Safety and Hazard Investigation Board (2007). Refinery explosion and fire, BP Texas City, March 23, 2005. Investigation report 2005–04–I-TX. https://www.csb.gov/bp-america-texas-city-refinery-explosion/	Official investigation. Sections 1 to 3 of the report and the Board's case page read on 19 November 2026. Casualties confirmed on both. Staffing details rest on the report.
2	US National Transportation Safety Board (2019). Pedestrian bridge collapse over SW 8th Street, Miami, Florida, March 15, 2018. Highway Accident Report NTSB/HAR-19/02, and its illustrated digest SPC-20–02. https://www.ntsb.gov/investigations/pages/hwy18mh009.aspx	Official investigation. Investigation page and digest read on 19 November 2026. Probable cause confirmed in trade press coverage of the board meeting.
3	US Chemical Safety and Hazard Investigation Board (2015). Chevron Richmond refinery pipe rupture and fire, August 6, 2012. Final investigation report 2012–03–I-CA. https://www.csb.gov/assets/1/17/Chevron_Final_Investigation_Report_2015-01-28.pdf	Official investigation. Sections 1 to 3 read on 19 November 2026. Casualty and treatment figures confirmed in the Board's news releases. Times are approximate in the report.
4	Independent Forensic Team (2018). Oroville dam spillway incident. Report of 5 January 2018, as summarised in the Association of State Dam Safety Officials case study. https://damfailures.org/case-study/oroville-dam-california-2017	Independent investigation. Case study and extracts of the report summary read on 19 November 2026. The full 584–page report was not opened. Evacuation figure confirmed in press coverage of the report.
5	Brabazon, P. and Conlin, H. (2001). Assessing the safety of staffing arrangements for process operations in the chemical and allied industries. Contract Research Report 348/2001, for the UK Health and Safety Executive. https://www.sintef.no/globalassets/project/hfc/documents/hse-2001-hse-staffing-method.pdf	Research report commissioned by a regulator. First part read in a hosted copy on 19 November 2026. Data older than three years. The method remains the regulator's reference.
6	UK Health and Safety Executive. Staffing levels. Human factors topic guidance. https://www.hse.gov.uk/humanfactors/topics/staffing-levels.htm	Regulator guidance. Read on 19 November 2026.
7	Awolusi, I., Marks, E. and Vereen, S. (2017). Qualifications and staffing requirements of safety personnel in construction. *Practice Periodical on Structural Design and Construction* 22(4). doi:10.1061/(ASCE)SC.1943–5576.0000328. https://ascelibrary.com/doi/10.1061/%28ASCE%29SC.1943-5576.0000328	Peer-reviewed survey. Abstract read. Sample size not visible to us. Single source.
8	Tucker, A. and Singer, S. (2015). The effectiveness of management-by-walking-around: a randomized field study. *Production and Operations Management* 24(2), 253 to 271. doi:10.1111/poms.12226. https://core.ac.uk/download/28948587.pdf	Peer-reviewed randomised field study, hospitals. Open-access manuscript read in full for *Time to act*. Abstract re-read on 19 November 2026.

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SOURCES

NO.	SOURCE	TYPE, ACCESS AND LIMITS
9	Zohar, D. and Polachek, T. (2014). Discourse-based intervention for modifying supervisory communication as leverage for safety climate and performance improvement: a randomized field study. *Journal of Applied Psychology* 99(1), 113 to 124. doi:10.1037/a0034096. https://doi.org/10.1037/a0034096	Peer-reviewed randomised field study. Abstract read for *Time to act*. Not re-opened.
10	UK Health and Safety Executive. Shift handover. Human factors topic guidance. https://www.hse.gov.uk/humanfactors/topics/shift-handover.htm	Regulator guidance. Read on 19 November 2026.
11	US Occupational Safety and Health Administration. Recommended practices for safety and health programs: worker participation. https://www.osha.gov/safety-management/worker-participation	Regulator guidance, not a legal requirement. Read on 19 November 2026.
12	UK Health and Safety Executive (2006). Developing process safety indicators: a step-by-step guide for chemical and major hazard industries. HSG254. https://www.hse.gov.uk/pubns/priced/hsg254.pdf	Regulator guidance. Read for *Time to act*. Not re-opened.
13	Hounkpati, B. (2026). Critical control health (CCHI): methodology proposal, and The CCHI rollout playbook. Riskopilot. https://riskopilot.com/riskolabs	Riskopilot's own method.
14	Hounkpati, B. (2026). Time to act: what technology can and cannot add to critical controls. And: Prove it on site: a field manual for piloting safety technology against critical controls. Riskopilot Research. https://riskopilot.com/riskolabs	Riskopilot's own reports, earlier in this series.
15	International Labour Organization (1981). Occupational Safety and Health Convention, No. 155. Articles 13 and 19(f). https://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO::P12100_ILO_CODE:C155	International treaty. Legal effect depends on ratification and national law. Read for *Time to act*. Not re-opened.
16	Council Directive 89/391/EEC of 12 June 1989 on measures to encourage improvements in the safety and health of workers at work. Article 8(3) to 8(5). https://eur-lex.europa.eu/eli/dir/1989/391/2008-12-11	EU law, applied through national legislation. Read for *Time to act*. Not re-opened.

How the cases were chosen

We looked for events with a public official investigation in which the report itself addresses who could have restricted the work and when. Texas City and the Florida bridge were already in *Time to act*. Chevron Richmond and Oroville were added for this report. Four cases selected by the authors illustrate a mechanism. They are not a sample and support no statement about frequency.

Sources we looked for and did not find

A controlled study of staffing levels and serious-injury outcomes in construction or mining. A published evaluation of delegated stop or restriction authority. A trial of leadership visits in heavy industry. If you know of one, write to contact@riskopilot.com.

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VERIFICATION, AUTHOR AND LICENCE

Verification note

Confirmed in two independent sources

- Texas City: 15 deaths, 180 injured (source 1, report and case page).
- Florida bridge: probable cause, five parties, six deaths (source 2, investigation page, digest and press coverage).
- Chevron Richmond: 19 employees engulfed, about 15,000 people sought treatment (source 3 and the Board's releases).
- Oroville: evacuation of about 188,000 people (source 4 and press coverage of the report).
- Walk-round trial: 19 hospitals, 56 work areas, negative average effect (source 8, manuscript and repository abstract).

Resting on a single source

- Texas City staffing details: three units, the 10:47 departure, 29 or more consecutive shifts, the 25% targets, training staff from 28 to eight (source 1).
- The Florida bridge timeline (source 2, digest).
- The Chevron Richmond timeline and the stop-work finding (source 3).
- Oroville organisational findings (source 4, read as a case study and summary extracts).
- The staffing method (source 5) and the construction survey (source 7).
- Regulator guidance (sources 6, 10, 11, 12).

Could not be verified, and handled accordingly

- Who signed the Oroville evacuation order. The report text we read does not name the official, so we do not.
- Any outcome from a duty-coverage review or a protection trace. None exists.
- The cost of a 90–day review. No figure is given.

Calculations

The intervals of 19 days, 160 minutes and 153 minutes, the lift example and the three timeliness readings were recomputed when this document was built. Worked examples are invented.

About the author

Bruno Hounkpati is a CEO and former VP HSE. He is the author of the Riskopilot critical control health method (CCHI) and its rollout playbook.

About Riskopilot

Riskopilot helps organisations in high-hazard industries investigate incidents and verify the controls that prevent fatal ones. Riskolabs is where its methods are published and tested in the open.

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Important

This report is general information. It is not engineering, legal or regulatory advice. Staffing, authority and release arrangements for actual work are set by the duty holder under local law and approved procedures. Accounts of past events summarise the official reports cited and make no finding about any person or organisation beyond them. Worked numbers marked as illustrations are invented.

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