QUICK REFERENCE · RISK ASSESSMENT · CQE · CSSBB · CMBB

TWO QUESTIONS SORT EVERY RISK TOOL

Top-down vs. bottom-up, proactive vs. reactive: find any tool on one map.

Q1 Which way do you dig? From the bad outcome down, or from the parts up?

Q2 When do you dig? Before anything fails, or after it already has?

← TOP-DOWN · DEDUCTIVE (outcome → causes) | MIDDLE-OUT | (cause → effects) BOTTOM-UP · INDUCTIVE →

PROACTIVE · BEFORE

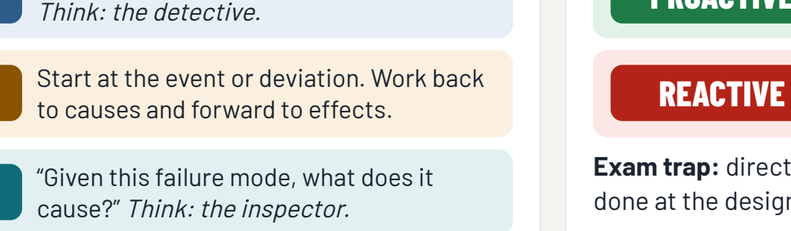
DESIGN-STAGE DETECTIVE WORK

FAULT TREE ANALYSIS · DESIGN

Pick one feared top event ("pipe ruptures"). Trace it down through AND / OR gates to basic causes, before anything has failed.

+ HAZAN: PUT NUMBERS ON IT

MINI FAULT TREE



AND = two failures together. One-at-a-time FMEA can miss it.

MIDDLE-OUT

HAZOP

Guide word + parameter = deviation. Back to causes, forward to effects.

BOW-TIE

Causes + barriers ← event → consequences + barriers

THE INSPECTOR'S HOME TURF

FMEA / FMECA

Every failure mode, every step → effect. Rate S, O, D.

HACCP

Hazards step by step, then critical control points.

PHA

Early hazard scan of each part of a new system.

WHAT-IF / SWIFT

"What if…?" prompts at each step. Lighter than FMEA.

HAZID — THE FIRST SCAN · BEFORE HAZOP

Hazard identification: a broad scan of a layout or concept, including how systems affect each other.

EVENT TREE (ETA)

Inductive: forward from one event

THE FAILURE HAPPENS

REACTIVE · AFTER

THE INVESTIGATION ZONE

5-WHY

Ask "why?" until you reach a fixable root cause.

FISHBONE

Brainstorm causes on 6M bones back to the defect.

FAULT TREE · INVESTIGATION

Same tool as above, used after an incident to test which combinations of causes could explain it.

CAPA / 8D

Not an analysis tool: the loop that uses RCA, fixes the cause and updates the FMEA.

FMEA UPDATE

A field failure becomes a new failure mode in the FMEA: a reactive use of a proactive tool.

↺ LESSONS FEED BACK

ALMOST EMPTY: BOTTOM-UP TOOLS ARE BUILT FOR "BEFORE"

Q1 · WHICH WAY? direction

TOP-DOWN "Given this bad outcome, what causes it?" *Think: the detective.*

MIDDLE-OUT Start at the event or deviation. Work back to causes and forward to effects.

BOTTOM-UP "Given this failure mode, what does it cause?" *Think: the inspector.*

Q2 · WHEN? timing

PROACTIVE Before failure. Find and treat risks in design, launch and change.

REACTIVE After failure. Find the root cause, fix it, stop it coming back.

Exam trap: direction ≠ timing. FTA is top-down, yet it is often done at the design stage.

USE BOTH blind spots cancel out

Top-down misses causes nobody put in the tree. **Bottom-up** misses combinations of failures.

PFMEA EVERY STEP + **FTA** THE BIG ONE

Pipe rupture study: PFMEA across the rolling and finishing line, plus a fault tree for the rupture itself.

HAZOP GUIDE WORDS guide word + parameter = deviation

NO / NONE	MORE	LESS	AS WELL AS	PART OF	REVERSE	OTHER THAN
No flow	Higher flow	Lower flow	Flow + contaminant	Part of the mix	Backflow	Wrong material

1 · CAUSES? What makes it happen?

2 · CONSEQUENCES? What happens next?

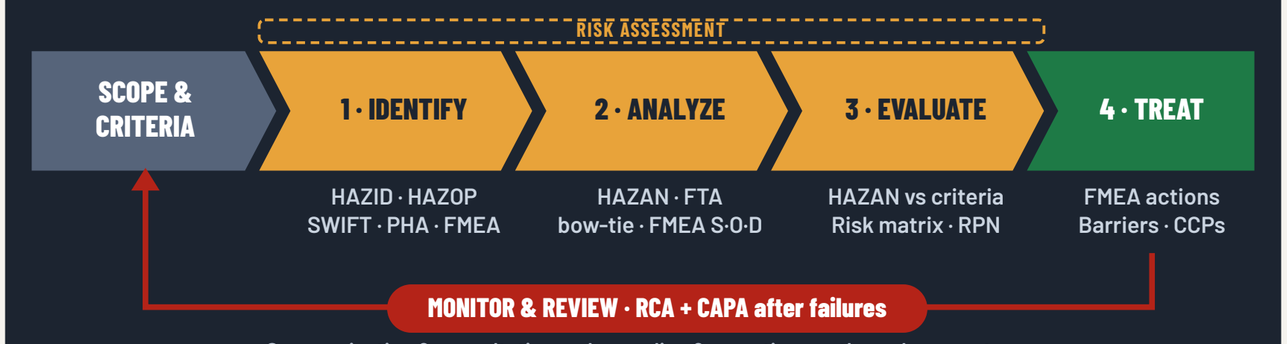
3 · SAFEGUARDS? Alarms, interlocks, relief

4 · ACTION? Is it enough?

HAZID (layout) → HAZOP (P&ID) → HAZAN (size it) **HAZOP identifies, HAZAN assesses.**

For continuous processes: caster cooling water, EAF off-gas, ladle argon. For final pipe inspection, use PFMEA.

WHERE THEY FIT IN ISO 31000 ISO 31000:2018, clause 6



Communication & consultation and recording & reporting run through every step.

IEC 31010:2019 is ISO 31000's companion catalogue of these techniques. ISO 31000:2018 is current; a revision is in progress.

EXAM TIPS · CQE · CSSBB · CMBB

1. **Known failure? Go top-down. Blank page? Go bottom-up.**
2. **FTA is deductive** (AND / OR gates). **Event tree** is inductive.
3. **Bow-tie** = fault tree (left) + event tree (right) around one top event.
4. FMEA's weak spot: **combination failures**. Pair it with FTA.
5. **HAZOP** works node by node on a P&ID. Sources file it both ways.
6. **5-Why and fishbone are reactive**: they need a problem first.
7. **HAZID → HAZOP → HAZAN**: find hazards on the layout, then the P&ID, then size the big ones.

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