QUICK REFERENCE · RISK ASSESSMENT · CQE · CSSBB · CMBB

TOP-DOWN VS BOTTOM-UP

Which way are you digging? Start from the bad outcome, or start from the parts.

THE ONE QUESTION

Do you already know the bad outcome you fear? Dig **down** to its causes. Starting from a blank page? Walk **up** from every part and step.

DEDUCTIVE · OUTCOME → CAUSES

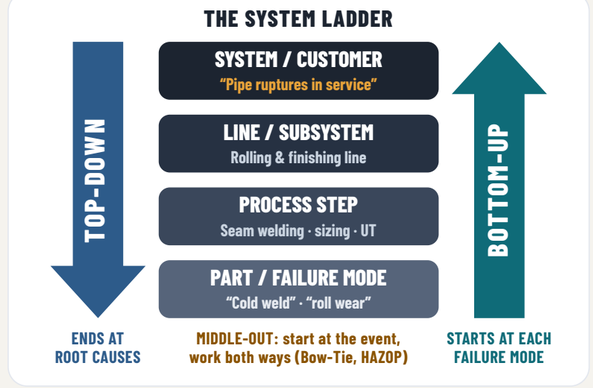
TOP-DOWN

"Given this bad outcome, what could cause it?"

Steel mill example: "Why did this heat fail its Charpy test?" "Why was this pipe rejected at final inspection?"

THINK: THE DETECTIVE

Start at the scene of the crime. Work backward to the culprit.



INDUCTIVE · CAUSE → EFFECTS

BOTTOM-UP

"Given this failure mode, what could it cause?"

Steel mill example: "If the sizing-mill rolls wear, what does the customer see?" Ask it for every step on the line.

THINK: THE INSPECTOR

Check every part, one by one. Ask what each failure would break.

MEET THE TOOLS

Green = proactive (before failure) · Red = reactive (after failure)

TOP-DOWN — OUTCOME → CAUSES

FAULT TREE ANALYSIS

Start with one top event ("pipe ruptures"). Branch down through **AND / OR gates** to basic causes.

PROACTIVE · REACTIVE

ROOT CAUSE ANALYSIS

5-Why and **Fishbone (Ishikawa)**: start from the defect you saw, work back to the root cause.

REACTIVE

MIDDLE-OUT — EVENT → BOTH WAYS

BOW-TIE ANALYSIS

Top event in the knot. Causes + prevention barriers on the left; consequences + recovery barriers on the right.

PROACTIVE

HAZOP

Guide word + parameter = deviation ("no flow"). Work back to causes, forward to consequences.

PROACTIVE · FILED BOTH WAYS

BOTTOM-UP — CAUSE → EFFECTS

FMEA / FMECA

Every failure mode of every step: effect on the next level up, then the customer.

PROACTIVE

HACCP

Step by step: find each hazard, then set critical control points and limits.

PROACTIVE

PHA

Preliminary Hazard Analysis: an early scan of hazards for each part of a new system.

PROACTIVE

HAZID

Hazard identification: a broad first scan of a layout or concept, and how systems interact.

PROACTIVE

WHAT-IF / SWIFT

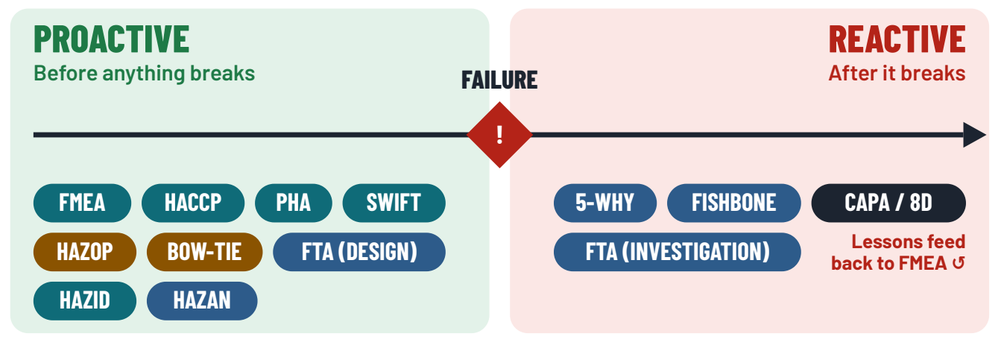
Structured "What if…?" prompts at each step. Lighter and faster than FMEA.

PROACTIVE

SIDE BY SIDE

	TOP-DOWN	BOTTOM-UP
START POINT	A defined bad outcome	A part, step or failure mode
DIRECTION	Outcome → causes	Cause → effects
LOGIC	**Deductive**	**Inductive**
BLIND SPOT	Causes nobody put in the tree	Combinations and interactions between parts
BEST FOR	One known or feared failure	Full coverage before failures happen
PAIRS WITH	RCA, CAPA, 8D	DFMEA, PFMEA action plans

PROACTIVE OR REACTIVE?



DIRECTION ≠ TIMING **Exam trap:** top-down does not mean reactive. FTA is top-down and is often done at the **design** stage. Ask two questions: *which way?* and *before or after?*

HAZOP GUIDE WORDS (guide, not "guild")

GUIDE WORD + PARAMETER = DEVIATION → E.G. MORE + PRESSURE = "HIGH PRESSURE"

NO / NONE	MORE	LESS	AS WELL AS	PART OF	REVERSE	OTHER THAN
No flow	Higher flow than design	Lower flow than design	Flow + a contaminant	Only part of the mix flows	Backflow	Wrong material flows

HAZID (layout) → HAZOP (P&ID) → HAZAN (size the big ones) HAZOP identifies, HAZAN assesses (Kletz)

1 · CAUSES? What could make it happen?

2 · CONSEQUENCES? What happens downstream?

3 · SAFEGUARDS? Alarms, interlocks, relief valves

4 · ACTION? Is the safeguard enough?

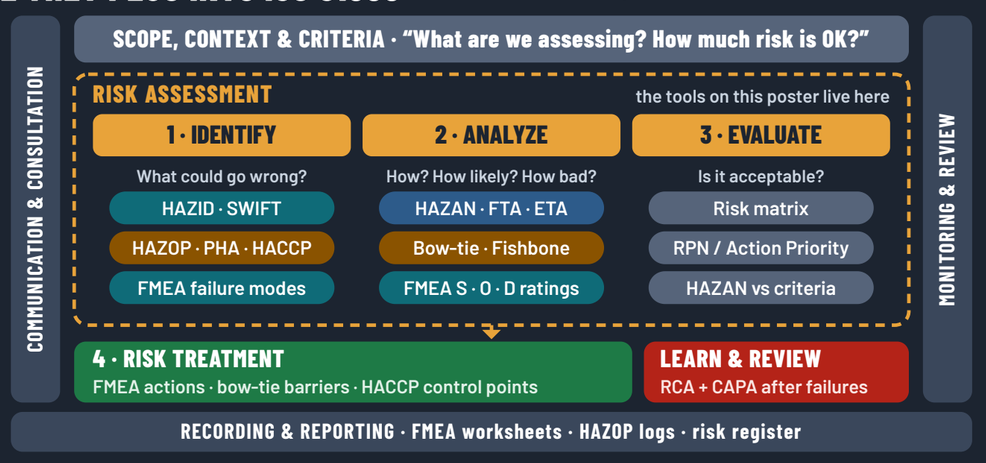
DEVIATION	CAUSE	CONSEQUENCE	SAFEGUARD / ACTION
NO + Flow	Mould cooling-water pump trips	Shell too thin, breakout risk at the caster	Low-flow alarm, standby pump, emergency water supply

Node: caster mould cooling water. A made-up example.

Built for continuous processes (flow, pressure, temperature, level, composition). Steel plant fits: caster cooling water, EAF off-gas, ladle argon stirring. Final pipe inspection? Use PFMEA. Batch steps add **early/late, before/after, faster/slower**.

WHERE THEY PLUG INTO ISO 31000

ISO 31000:2018 risk process (clause 6)

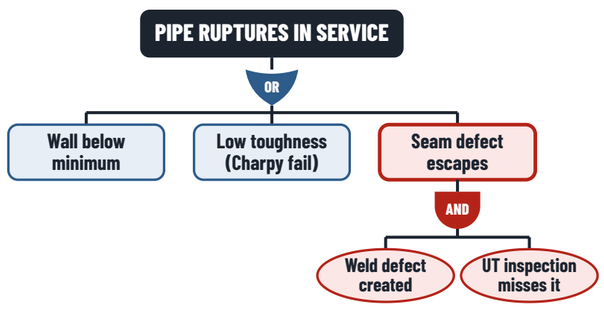


ISO 31000 sets the process. Its companion, IEC 31010:2019, is the catalogue of techniques. Proactive tools feed steps 1–4; reactive tools feed monitoring & review, which updates the assessment. ISO 31000:2018 is current; a revision is in progress.

USE BOTH: A PIPE-RUPTURE STUDY

A made-up example

TOP-DOWN · FAULT TREE



AND gate = two things fail together. One-at-a-time FMEA can miss this.

BOTTOM-UP · PFMEA ROW

STEP	FAILURE MODE	EFFECT	S
ERW seam welding	Cold weld (lack of fusion)	Leak or rupture in hydrotest / service	10
CAUSE · CONTROL		**O**	**D**
Low heat input · online UT of the seam		3	4

Repeat this row for **every step** on the rolling and finishing line. That is FMEA's strength: nothing gets skipped.

PFMEA EVERY STEP + FTA THE BIG ONE

EXAM TIPS

CQE · CSSBB · CMBB

1. **Known failure? Go top-down. Blank page? Go bottom-up.**
2. **FTA is deductive** and uses AND / OR gates. **Event tree** is inductive: forward from an initiating event.
3. **Bow-tie** = a fault tree (left) + an event tree (right) around one top event.
4. FMEA's weak spot: **combination and interaction failures**. Fix it by pairing with FTA.
5. **HAZOP** = guide words × parameters, node by node on a P&ID. Sources file it as top-down *and* bottom-up; it really works out from the deviation.
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 put numbers on the big ones.

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