



SPRING26 +22ND GCPS

A Joint AIChE and CCPS Meeting

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Houston, TX

**Where Chemical
Engineering
Meets Innovation**



Lessons Learned Implementing PSM in Chemical Startups

**Where Chemical Engineering
Meets Innovation**



Authors



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Over 33 years of experience in specialty chemical, refining, and chemical recycling industries. Extensive career spanning across process safety, engineering, risk management, and environmental, health, and safety (EHS) disciplines. Both corporate and site-specific roles, working across domestic and international operations.



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Over 17 years experience in chemical manufacturing across both site-specific and corporate roles. Background includes environmental engineering, safety engineering, and emergency response, with the past nine years focused primarily on process safety management, risk reduction, and operational governance.



Agenda

- Context & stakes for startups
- Seven challenges we see most often
- Actionable, right-sized solutions
- Key takeaways & Q&A

The 7 Wonders
of the
Ancient
World



Why Startups Face Unique PSM Challenges

- Lean teams, rapid change, limited operating history
- Novel chemistries/equipment → uncertain hazards
- Higher regulatory scrutiny + investor expectations



One serious event can be existential for a startup.

7 Challenges Implementing PSM in Startups vs 7 Wonders of the Ancient World



Challenge # 1:
Customization over
Replication

Great Pyramid of Giza



Challenge # 2:
Insufficient PSI

Hanging Gardens of Babylon



Challenge # 3:
Compressed /
Inadequate
Safety Reviews

Statue of Zeus at Olympia



Challenge # 4:
Scaling Challenges

Temple of Artemis at Ephesus



Challenge # 5:
Employee
Participation and
Safety Culture

Mausoleum at Halicarnassus



Challenge # 6:
Management of
Change (MOC)

Colossus of Rhodes



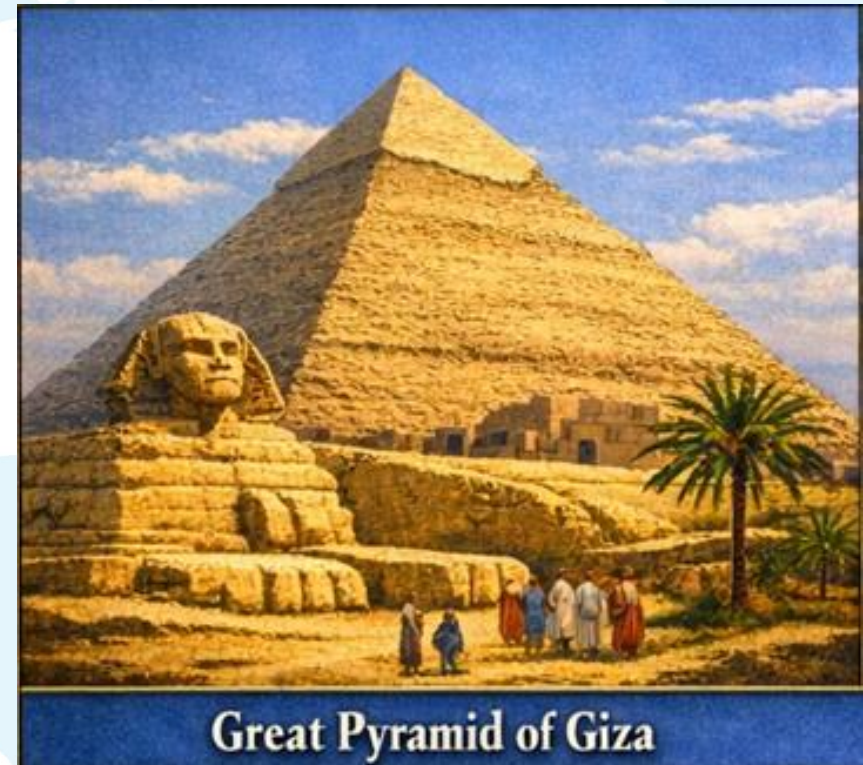
Challenge # 7:
Incident
Investigation

Lighthouse of Alexandria



Challenge #1 - Customization over Replication – Legacy PSM Doesn't Fit Startups

- **Mismatch with Startup Structure** –
Legacy PSM systems assume large teams and stable organizations — not lean, fast-changing startups.
- **Different Risk Tolerance** -
Established companies have broader resilience whereas one significant event can end a startup.
- **Higher Regulatory Scrutiny** -
New technologies + no compliance history = more regulator attention and tighter expectations.
- **Consequences of Misalignment** -
Copy-paste PSM programs create overdocumentation, blind spots, noncompliance, and weaken safety culture.



Great Pyramid of Giza



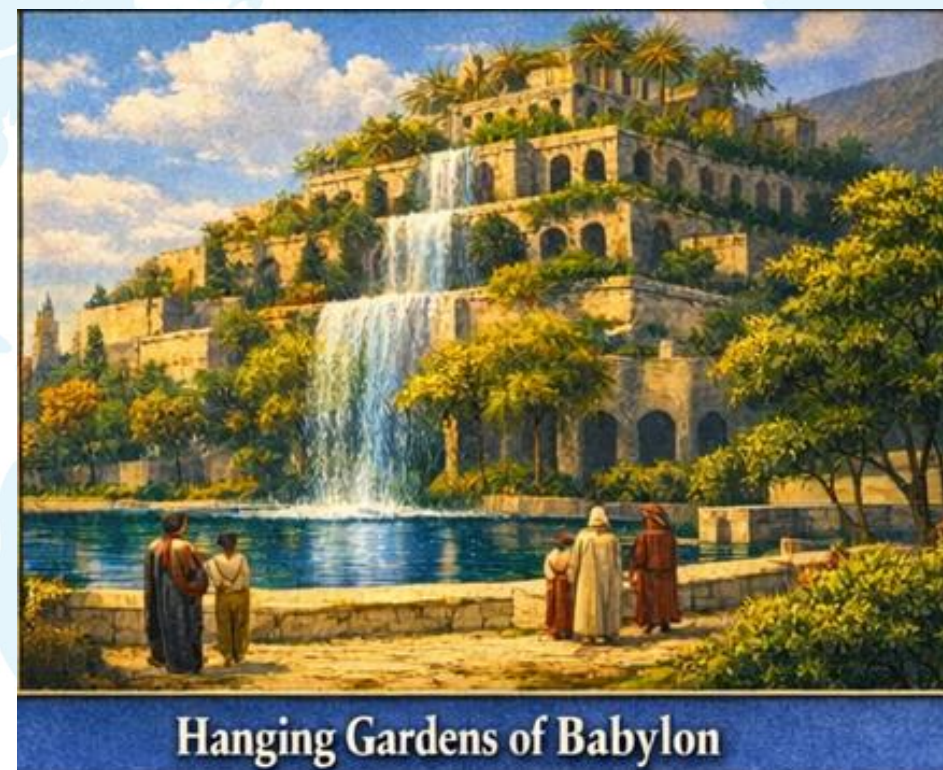
Solution #1 - Scaled, Risk-Based PSM

- **Tailored, Risk-Based PSM**
- **Eliminate Hazards Early**
- **Use External Expertise Strategically**
- **Document Assumptions Clearly**



Challenge #2 - Insufficient PSI – Why It Matters

- Novel chemistry/equipment → real data gaps
- Uncertainty during PHA can miss hazards
- Credibility risks if limits/assumptions aren't explicit



Boldly go where no one has gone before, but be sure to...



Solution #2 - Balance Speed with Rigor

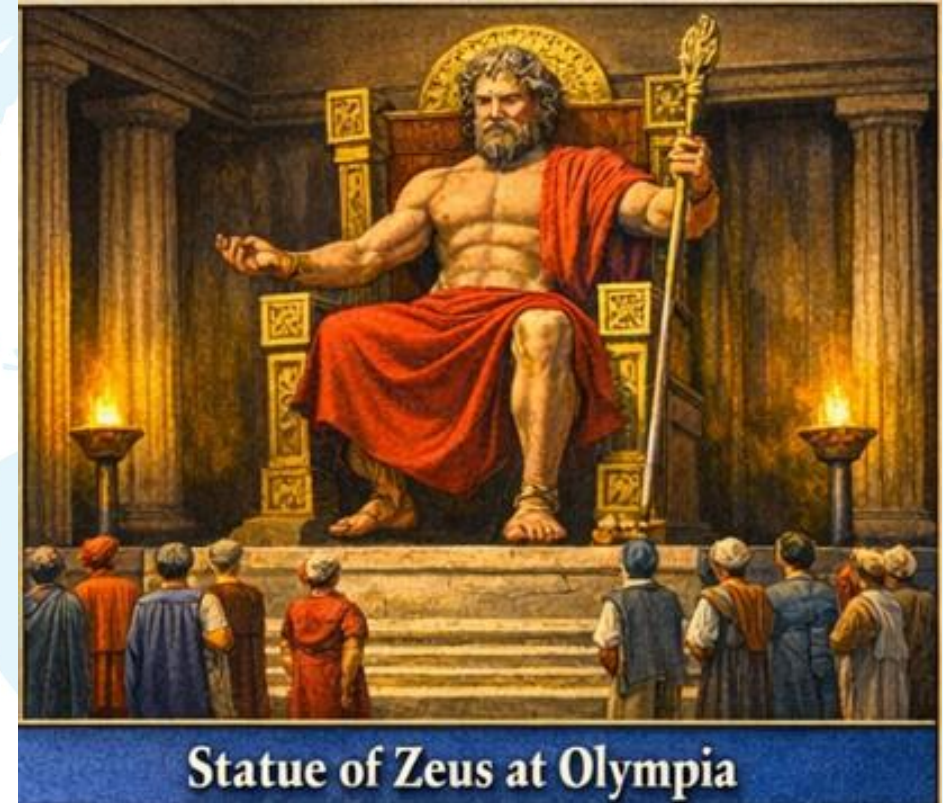
- **Leverage Analogous Data**
- **Engage External Expertise**
- **Iterative Hazard Reviews**
- **Pilot Testing and Modeling**
- **Document Uncertainty Transparently**

**Forge ahead safely, because recklessness is not innovation—
it's a liability.**



Challenge #3 - Inadequate/Compressed Safety Reviews

- Short-cut PHAs to 'hit milestones'
- Assume packaged units are already reviewed
- Rushed sessions miss integration/site hazards



Statue of Zeus at Olympia



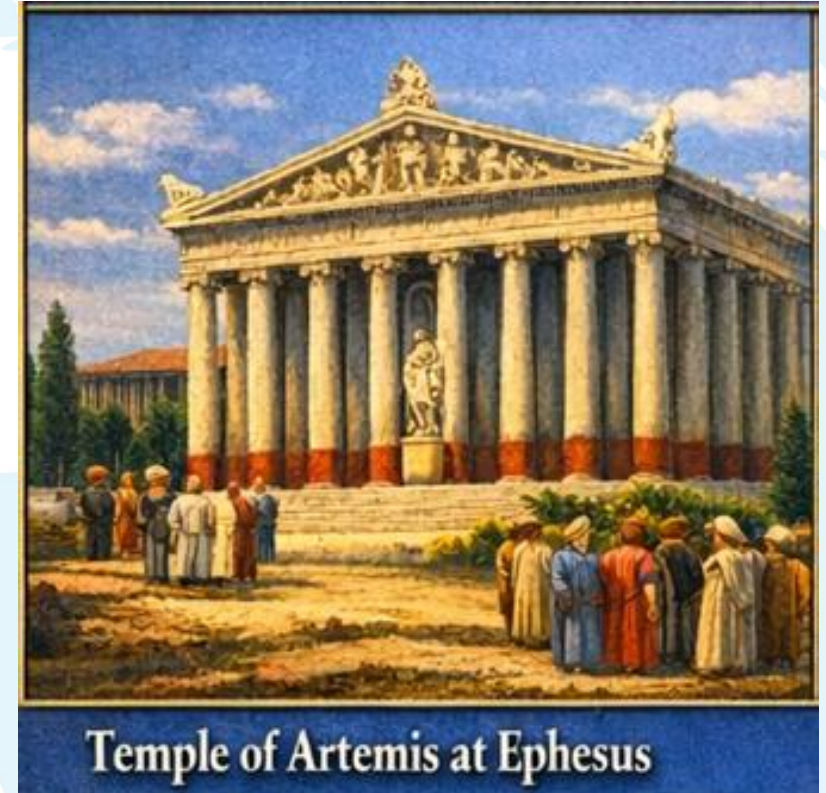
Solution #3 - Early, Frequent, Right-Sized Reviews

- Tiered reviews at key scale milestones
- Integrate with agile iterations
- Avoid oversimplification; document assumptions & actions



Challenge #4 - Scaling Challenges - What Changes at Scale

- Heat removal
- Mixing regimes
- Control lag appears
- Process mode shifts
- Mechanical realities emerge
- Relief behavior changes (e.g., foaming, two-phase flow, faster gas generation)
- Equipment \neq glassware



Temple of Artemis at Ephesus



Solution #4 - Plan Flexibility & Stepwise Learning

- Design in ports, bypasses, clean-out access, safe access ports
- Set safe limits early; verify at each scale
- Plan manual/degraded modes; train and drill
- Scale in stages with learn → pause → adjust between scales

Yesterday's success does not guarantee tomorrow's safety.



Solution #5 - Lean, Agile Participation

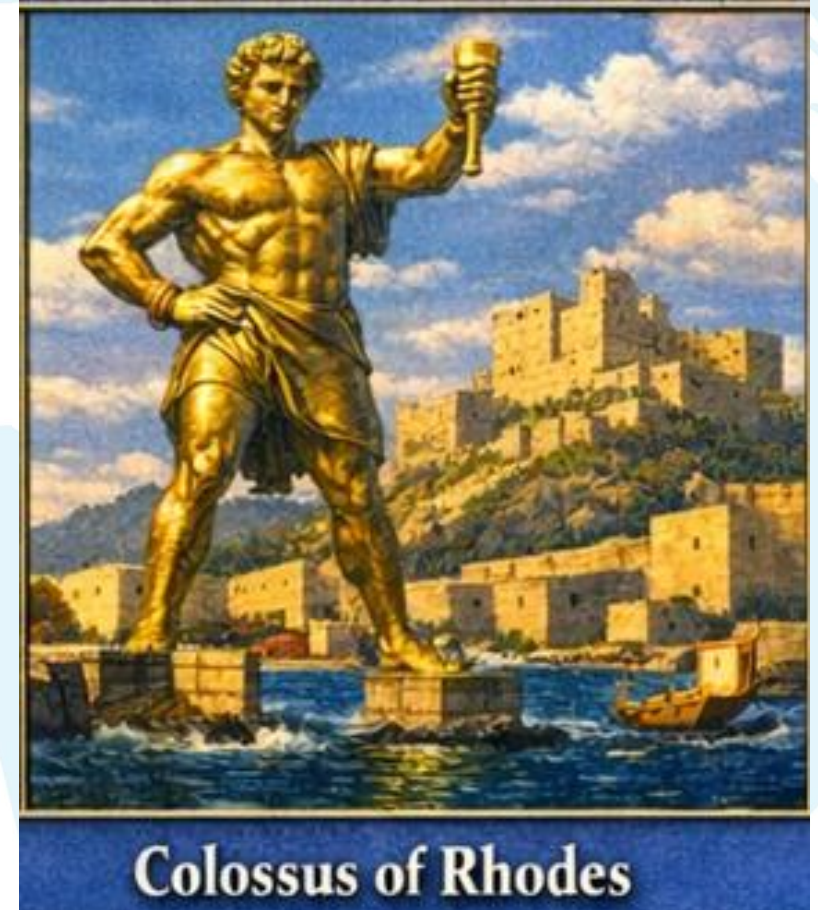
- One-page plan; growth triggers pre-defined
- Frontline in PHA/MOC/incidents (use temporary stand-ins early)
- Simple reporting with visible feedback (**truth in action**)
- Lightweight evidence dossier for regulators/investors





Challenge #6 - MOC - Managing Change When Nothing Is Static

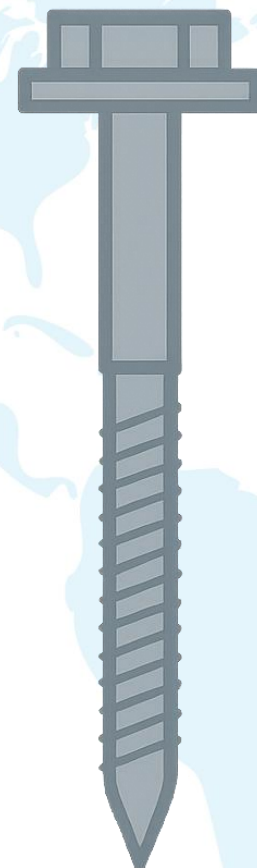
- Unrecognized changes are the main risk
- Project scope vs. operational MOC must be distinct
- Over-processing stalls; under-processing risks catastrophe





Solution #6 - Simplify & Clarify MOC

- Triage by hazard:
full / targeted / RIK
- Publish boundary:
project change vs. operational MOC
- Train what is / isn't MOC with
concrete examples



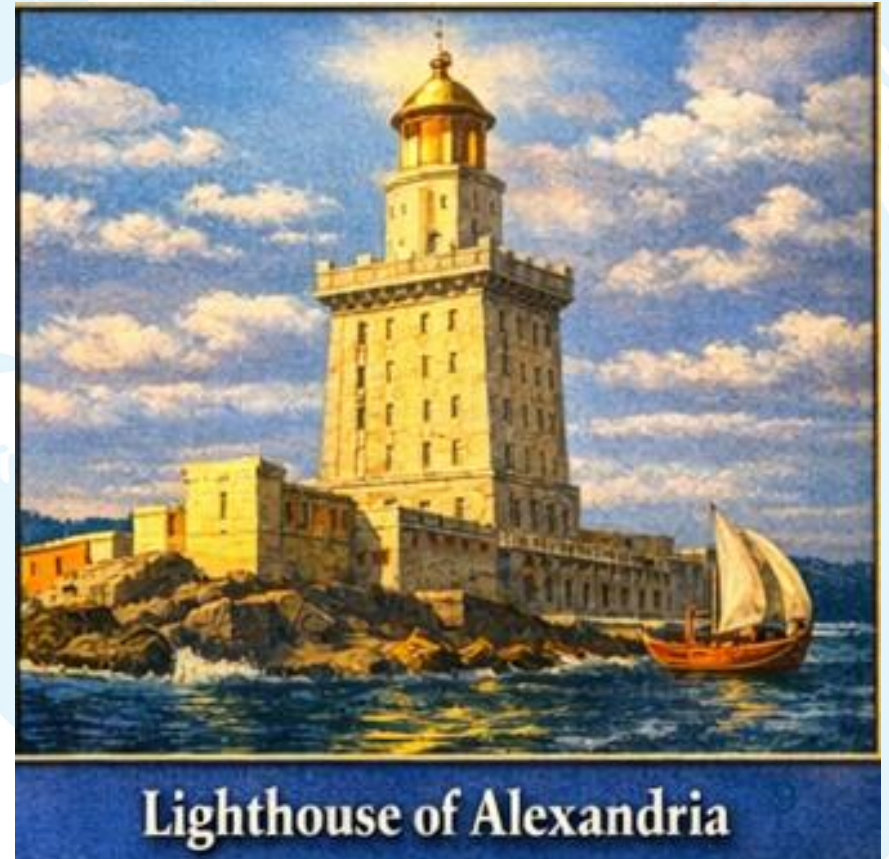
**MOC IS THE
ANCHOR BOLT
— IT DOESN'T
STOP THE
EARTHQUAKE,
BUT IT KEEPS
THE STRUCTURE
STANDING**



Challenge #7 - Incident Investigation - Right-Sizing

- Lean orgs can't deep-dive everything
- Near misses show early drift—capture them
- Clear tiers prevent over/under-reaction

**A lighthouse only helps if the light is on —
and right-sized investigations keep that
light shining.**



Lighthouse of Alexandria



Solution #7 - Tiered Investigations

- Tier 1: quick fix for minor/obvious causes
- Tier 2: short-form + simple RCA for moderate/repeat
- Tier 3: full RCA + cross-functional team; bring external SMEs as needed
- Define triggers; communicate lessons fast

A lighthouse guides by shining only what you need — enough to warn you and focused enough to help you steer clear.

