Visualize and Manage Process Safety Risk in Operations
Practical Case Studies
Simon Jones and Abhilash Menon, Sphera Solutions
Introductions

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# Visualize and Manage Process Safety Risk in Operations: Practical Case Studies

## OUTLINE

| CHALLENGE | Are our facilities getting any safer? Where should we focus?  
Lessons from 2020 survey of Process Safety professionals |
|-----------|-------------------------------------------------------------|
| OPPORTUNITY | Industry 4.0 and Digital Twins  
Connecting process safety to the frontline |
| CASE STUDIES | Practical application of Barrier Health Models to surface systemic risks  
Delivering real-time risk view of all activity & critical equipment status for a major Middle East refinery |
| DEVELOPMENT | Evolving the model to focusing on major hazard risk – dynamic risk pathways  
A maturity model – setting out your path forward |

**Q&A - throughout**
GOOD INTENTIONS

Companies take safety seriously...

- 88% Say safety is part of corporate value structures
- 78% Continuously monitor safety performance
- 60% Are striving to reduce operational and Major Accident Hazard (MAH) risk exposure

... but risk insights are lacking.

- 49% Are unaware of their vulnerability to major hazard risk
- Only 37% Can proactively manage process safety
GOOD INTENTIONS

Companies take safety seriously...

88% Say safety is part of corporate value structures

78% Continuously monitor safety performance

60% Are striving to reduce operational and Major Accident Hazard (MAH) risk exposure

... but gaps exist between intent and reality.

81% Say there are gaps between process safety intent and reality

58% Say risk changes during periodic process safety review periods
FIGURE 1. EPSC BENCHMARK RESULTS OF 2019 INCIDENT ROOT CAUSES (ON CA 1000 CLASSIFIED PROCESS SAFETY CASES)

PROCESS SAFETY INCIDENT CAUSES

- DESIGN: 14%
- INTEGRITY: 35%
- OPERATIONAL: 51%
EPSC Process Safety Fundamentals
## Components of a Safety Management System Over the Asset Lifecycle

<table>
<thead>
<tr>
<th>Design Phase</th>
<th>Detailed Design</th>
<th>Operational Phase</th>
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<tbody>
<tr>
<td><strong>Hazard Mgmt Process</strong></td>
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<tr>
<td>Design Intent</td>
<td>Process Hazard Analysis</td>
<td>Periodic PHA revalidation</td>
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<td><em>Process Hazard Analysis</em></td>
<td>Bowtie Diagrams</td>
<td>Barrier Model</td>
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<td><em>HAZID's / ENVIDs</em></td>
<td>Safety Critical Elements</td>
<td>Maintenance, Inspection, Verification</td>
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<tr>
<td><strong>Design Safety Case</strong></td>
<td>Risk Register</td>
<td>Risk Assessment - PTW</td>
</tr>
<tr>
<td><em>Develop Initial Risk Register</em></td>
<td>Risk Modelling (RAM) - acceptability</td>
<td>Operational Controls &amp; Procedures</td>
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<tr>
<td><em>Probability Modelling</em></td>
<td>Critical Tasks and Activities</td>
<td></td>
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<tr>
<td><em>Preliminary Quantitative Risk calculations (acceptability)</em></td>
<td>Controls &amp; Procedures</td>
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<td><strong>Detailed Design Safety Case</strong></td>
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<td>2-3 Years</td>
<td>3-5 Years</td>
<td>0 to 40+ Years</td>
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What’s in a KPI?

THE BOARDROOM

- **82%** of Safety Critical maintenance is achieved
- **79%** of staff have up-to-date competency training
- Currently achieving **89%** of plan attainment

THE SUPERVISOR

- **18%** of Safety Critical maintenance is overdue
- **21%** of staff need training – but where are the gaps?
- **11%** of the plan has not been attained

THE FRONTLINE

- The gas detector is out of service on unit
- Unaware of major hazards on the unit; emergency scenarios / drills
- He needs to perform tasks faster to achieve plan attainment target

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Digitization in service of safe operations?

A true view of the operational reality by extracting, translating and aggregating the data from sensors, systems and human activity

Common currency for disparate data

Unlocks meaningful relationships, previously unseen

Provides a realistic view of the operational reality

SHOWS IN REAL-TIME
- What’s happening
- When it’s happening
- Where it’s happening
- What’s driving the risk

Integrated workflows ensure safe & efficient, consistent execution
2020 Process Safety & Operational Risk Mgmt Survey

Boldly going where no organization could go before

Top digital twin benefits

- Safer operations: 52%
- Plantwide productivity performance: 43%
- Safer, more efficient shutdowns & turnarounds: 35%

3x growth in digital twin adoption
Close the gaps: Operational Risk Management Digital Twin

The “Physical” Asset

The “ORM Digital Twin”

Improve Operational Decision-making

Understand

Predict

Act

Monitor
Close the gaps: Operational Risk Management Digital Twin

The “Physical” Asset

- Process Safety Critical Equipment status
- Overdue Safety Critical Maintenance
- Inspections
- Permitted Activity
- Operations Activity
- MoC
- Deviations
- Inhibits


the “ORM Digital Twin”

A true digital twin is a virtual counterpart of a real object, which enables other software, systems and operators to interact with it rather than directly, bypassing the real object.

A digital twins must include:
- A model of the physical object
- Data generated by the object
- Unique one-to-one correspondence with the physical object
- The ability to monitor the object

**Improve Operational Decision-making**

- **Understand** how equipment status and activity all come together to impact cumulative risk
- **Predict** cumulative risk on the plant today & in the future
- **Pro-Actively** manage productivity against risk
- **Monitor** the operational risk status of the asset
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Q&A - throughout
CASE STUDY

Objectives

• Close the loop between operations, maintenance and engineering

• Right information at the right time to make the right decisions.

• Create intelligent integration of disparate data from vendors, systems, sensors, and human-derived activity to radically improve end to end operations.

ORM Digital Twin in Action

Very large NOC

“Greenfield” site

Big digital vision

ACTIVITY

Maintenance
EPTW
Operations Activities
MoC
Other Activities

OPERATIONAL RISK MANAGEMENT
DIGITAL TWIN

ASSET & EQUIPMENT STATUS

Historians
APM
Inspections
EHS and more...

THE CUMULATIVE IMPACT
OF RISK ON THE
OPERATIONAL REALITY.

 Integrations

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Case Study: Data Sources

Management of Change (MoC)

- Equipment
- People & Process

Process Safety
Critical Equipment

Data Historian / APM system integration

ORM Digital Twin

Understand

Predict

Act

Monitor

Activity Management

Permitted Activity
e.g. Hot work, Breaking containment, CSE, Isolations, etc.

Operations Activity
e.g. Routines, non-permitted activity, process sampling, gas tests, start-ups, etc.

- Exceptions
- OPS Rounds integration
- EAM integration
- Overdue maintenance
- Inspection status
- SCE Maintenance
- SCE Inspections

Deviation & Inhibit Management

Manually recorded deviations

Inhibited equipment

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Case Study: Making Risk Visible by Location

Fundamental Barrier Grouping Model

- Maintain Structure
- Process Containment
- Ignition Control
- Detection Systems
- Protection Systems
- Shutdown Systems
- Emergency Response
- Life Saving

Operational Risk Management Software data mapping

Data generated by vertical, functional silos and systems

- Overdue Maintenance
- Overdue Inspections
- Planned Maintenance
- High Risk Jobs
- Failed Inspections
- Field Observations
- Management of Change
- Incident reports
- Critical Equipment Status
- Audit findings
- Shift competence gaps
- IOW Deviations

Reference: IOGP - 544
Three Screens. One Operational Reality.

Know what’s happening, where it’s happening and what’s driving the risk
Location: See the Risk on Your Assets

Easily see how the risk profile changes from shift to shift.

Icons, shape and colour indicate activity, type, state and risk levels.

Easily pan & zoom.
Risk: Dynamic Risk Visualization

In real-time, on the next shift, tomorrow, and beyond.

Understand the hour-by-hour impact of cumulative risk by major hazard event.

See the real-time health of the impacted barriers.

Click to reveal the details of equipment health and deviations.

See how equipment health and deviations impact process safety barriers.

Navigate from shift-to-shift to see the evolution of process safety barrier impact & cumulative risk.
Time: Understand the Impact on the Schedule

Navigate from shift-to-shift to see the evolution of process safety barrier impact and cumulative risk.

Understand what is contributing to risk on the shift.

Understand the risk level on each shift.

See SIMOPS and safety conflicts.
The Technical Safety Challenge

“...court reports from several accidents such as Bhopal, Flixborough, Zeebrugge, and Chernobyl demonstrate that they have not been caused by a coincidence of independent failures and human errors, but by a systematic migration of organizational behavior toward accident under the influence of pressure toward cost-effectiveness in an aggressive, competitive environment.”


Complex systems migrate toward states of high risk but often we don’t realize it until something bad happens...
Major Loss Event and Scenario-specific Defined Barriers

THREAT / CAUSE

Hardware

Event

Hardware

Human

Hardware

Human

CONSEQUENCE

Hardware Barriers
Safety System Integrity

Human Barriers
Operating Discipline

Management System Elements
Supports Hardware & Human Barriers

Standardization of barrier definitions

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Dynamic Risk Pathways

Real Time View of Safeguarding Barrier Status

Policies and procedures

Real-time capture of risk related data

Complex operating environment

Intelligent translation & mapping

Operators trying to connect the dots

Emerging Risk Pathways allow for early intervention
PHAs are conducted. Audits & LOPC Incidents reported & Lessons. KPIs established & tracked. Audits & LOPC Incidents reported & Lessons. KPIs established & tracked.

Process safety system supports barrier management. Critical Barriers and assurance tasks defined. Deviation RA process for non-conformances. Barrier management system provides a near real-time risk view of status of critical barriers and planned work by location to support frontline decision-making.

Barrier management system provides a near real-time risk view of status of critical barriers and planned work by location to support frontline decision-making.

Organizations have access to real-time visibility of barrier impairments with comprehensive tracking of critical equipment, assurance processes and operational data. Risk visualizations based on barrier impact for defined Major Accident Hazard scenarios for assets.

49% are unaware of MAH risk vulnerability.

Source: Sphera 2020 Survey on Process Safety and Operational Risk Management
Key themes and conclusions

Seize the opportunity to rethink safety and risk management in operations – **key takeaways:**

- **Improve the resilience of our assets using digital tools to drive effective, compliant business processes.**
- **Uncover the process safety-related data sources in asset application environment today.**
- **Connect these disparate data sources to the frontline to provide dynamic, real-time risk insight to support practical decision making.**

There are gaps between process safety intent and what happens at the frontline – the dynamic nature of frontline operations is a challenge.
Reaching Operational and Financial Goals Requires an Integrated Approach to Risk Management

Optimize across the enterprise
- Corporate performance reporting
- Sustainable global growth
- Investor and public relations

Power your decisions
- Team and site performance
- Regulatory compliance
- Employee and environmental safety
Operationalize, Scale, & Optimize Integrated Risk Management
with our purpose-built solutions supported by information, innovation & insights
Sphera Delivers Integrated Risk Management Around the Globe

1 million+ Individual Users
8000+ Customers
100+ Countries
1000+ Colleagues

Headquarters
Sales Center
Development Center

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References and contacts for follow-up


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