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19th September, 2024

Unlock the power of your data: Enhance safety, reliability and productivity

Data is one of the biggest assets in our organisations, and yet, 73% remains underutilised.

About Empirisys

THE SUNDAY TIMES
Best Places to Work 2023

Founded by Gus Carroll and Pete Sueref in October 2020

We uncover vital intelligence within your existing data.

This hidden data can be refined into unique insights, and then transformed into practical solutions to improve safety, reduce losses and build resilience.

All our AI and machine leaning models are based on academic principles and are transparent and trustworthy.

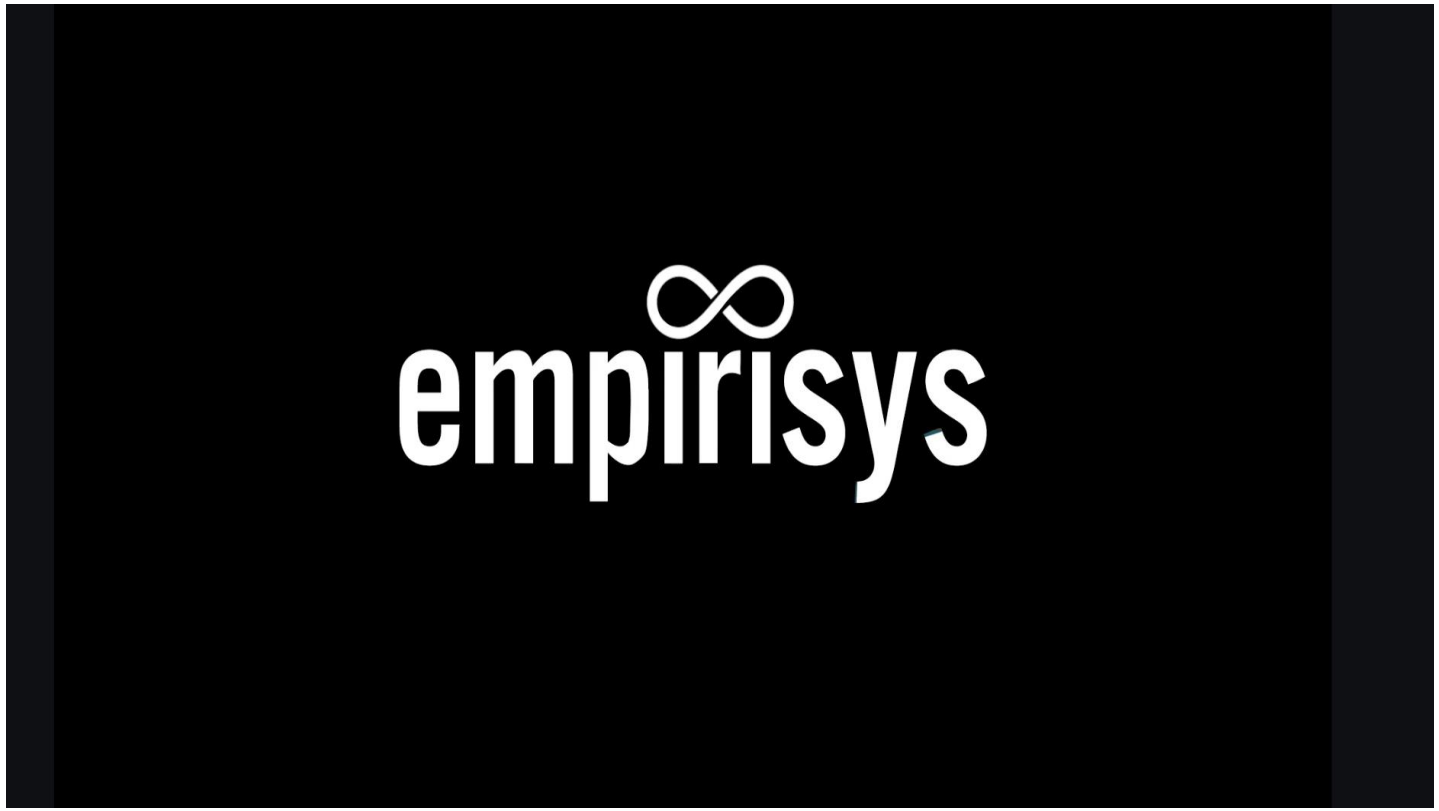
Our technology aims to enhance human endeavour and expertise rather than replace it.

Data Scientists

Process Safety Experts

Software Developers

The Inspiration Behind Our Mission



Dr Nyala Noe
Chief Data Scientist

Through her background in social psychology and computer science, Nyala has developed a particular interest in using networks to make sense of complex data. After completing her PhD at Cardiff University, Nyala started her career as a data scientist and eventually joined Empirisys as one of its founding employees.

Gwilym Rees
Data Scientist

Gwilym holds a BSc in Natural Sciences from Exeter University and began his career in an unexpected field – spending two years as a professional chef before transitioning into data science. He later attained a PgDip in Applied Data and AI at the University of South Wales. Gwilym is passionate about leveraging machine learning and data visualization to drive advancements within the process safety sector.

Roger Berriman
Technical Manager

Roger has a background in Process Safety with over 20 years' experience in operations and high hazard safety management in the chemicals, refining and oil & gas sectors. Roger is a registered Professional Process Safety Engineer, a chartered Chemical Engineer and a member of IChemE.

Agenda

Time	Presentation Title/ themes
14:00 GMT 15:00 CEST	The Data Science Process Dr Nyala Noe| Chief Data Scientist
14:10 GMT 15:10 CEST	Case Study: Enhancing Reliability of an Existing Key Asset Dr Nyala Noe| Chief Data Scientist
14:25 GMT 15:25 CEST	Connecting weak signals and proactively boosting MAH prevention Gwilym Rees | Data Scientist
14:40 GMT 15:40 CEST	Leadership Training Roger Berriman | Technical Manager
14:55 GMT 15:55 CEST	Opportunity for questions (Q&A)

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Presented by: Nyala Noe

The Data Science Process

Transform your biggest asset into your competitive advantage

Why data science?

Understand your existing data

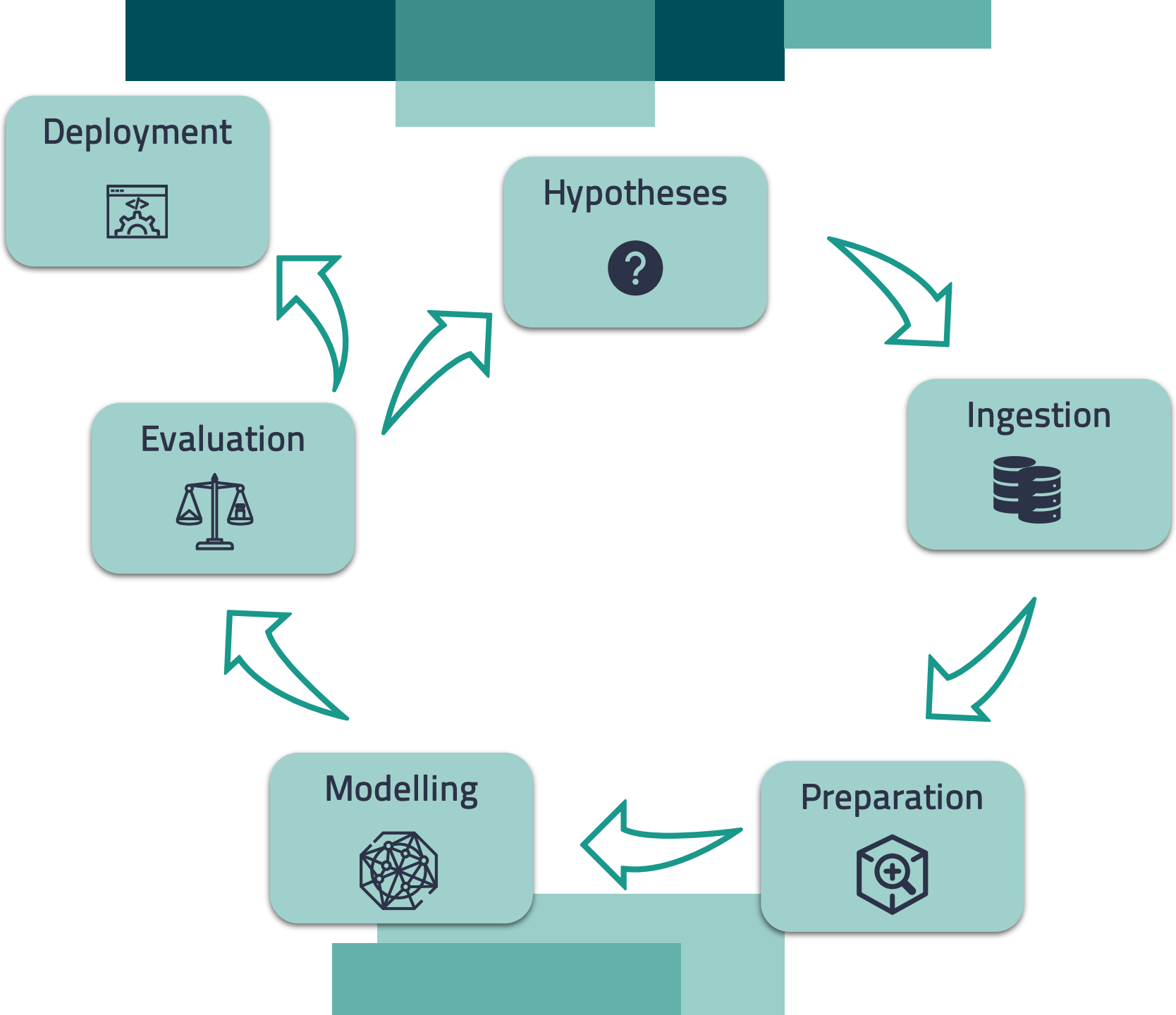
"What can my data tell me that I didn't know about before?"

Follow-through on a specific hypothesis

"Are the trends I am seeing in increased observations around a specific topic genuine?"

Make connections you haven't seen before

"Are trends in maintenance related to process safety events, and if so, how?"


Deployment
Hypotheses
Ingestion
Evaluation
Modelling
Preparation

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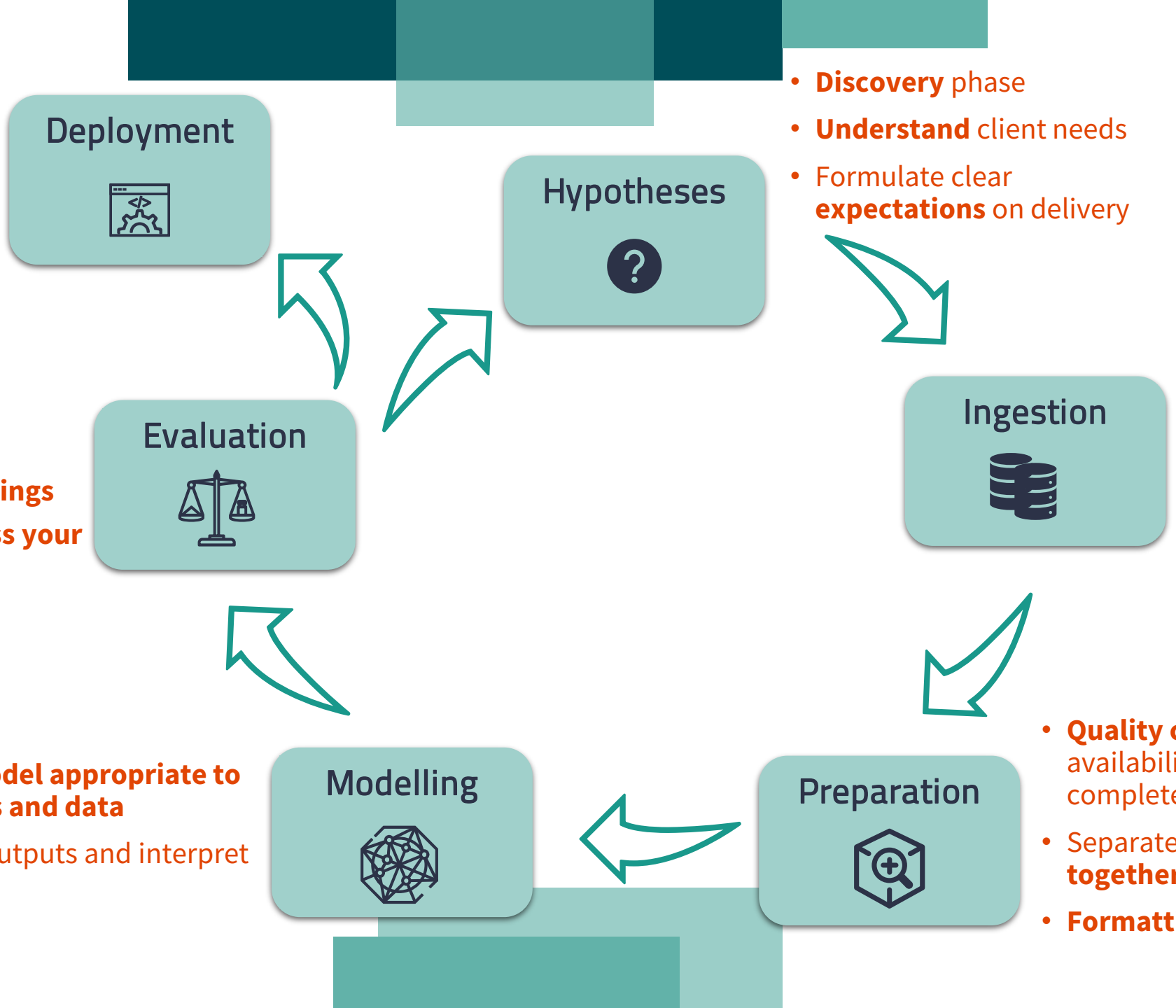

- **Discovery** phase
- **Understand** client needs
- Formulate clear **expectations** on delivery

- Agree on data ingestion **strategy**
- Data can come in many **different formats**
- **Understand** data through dictionaries and SMEs

- **Quality control**: availability, completeness, accuracy
- Separate datasets to **join together**
- **Formatting** data

- **Choose model appropriate to hypothesis and data**
- **Visualise** outputs and interpret them

- **Assess model performance**
- Report on your **findings**
- **Present and discuss your** outputs

- **Test** models and outputs thoroughly
- Write **production-ready** code
- **Engage** with wider teams and/or end users

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Our Typical Data Science Approach

1. In-Depth QCA Assessment

Quality, Completeness, and Availability check of all selected datasets based on pre-determined acceptance criteria. This also includes a review of tools and environments

2. **QCA Stage Gate**

Collaborative agreement on whether to proceed or not

3. Exploratory Data Analysis

Explore selected data, cleanse, transform, and join to create single data lake

Agree meaningful set of hypotheses and explore potential insights

4. Deep Dive

Focus on one (or more) high value outcomes from exploratory stage

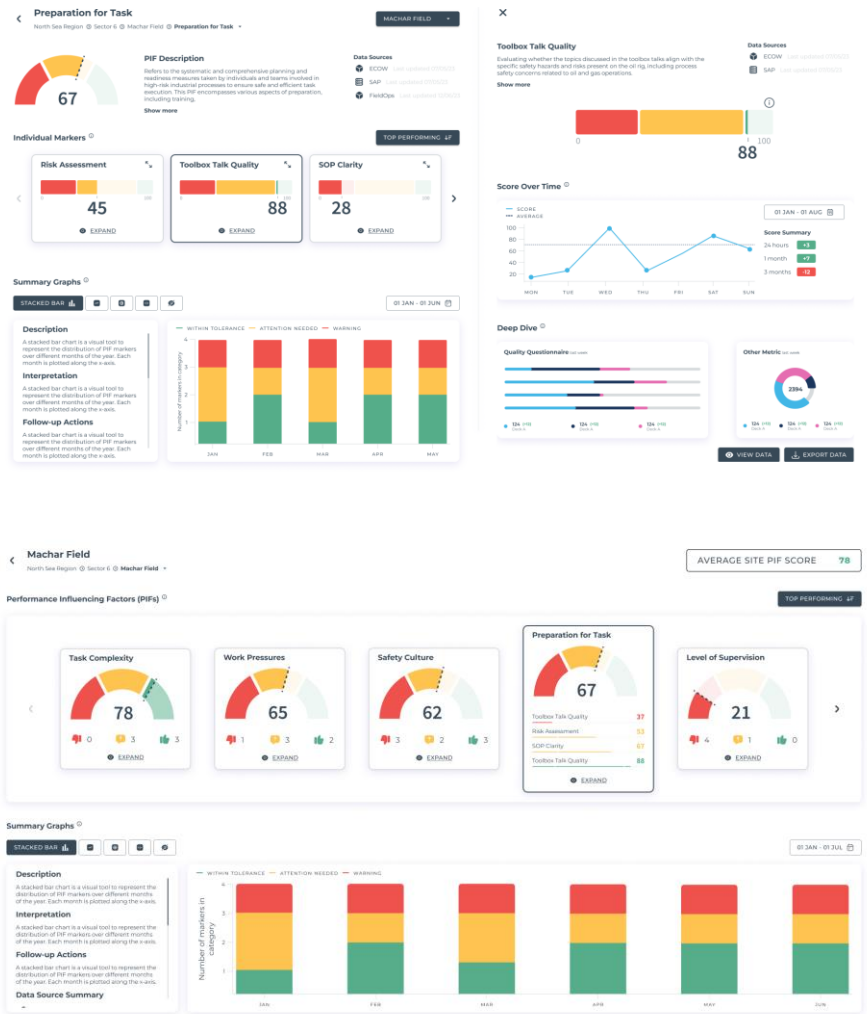
Develop useful and usable output for client (often an interactive dashboard)

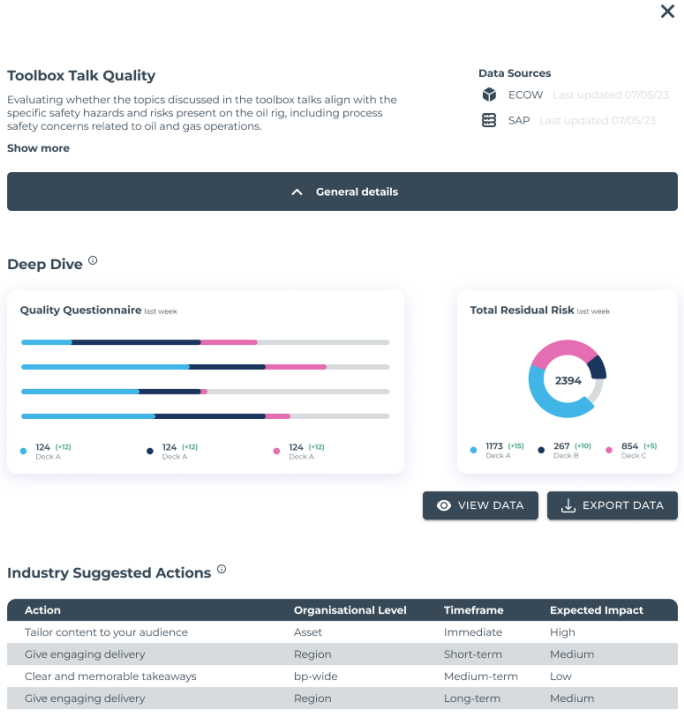
5. Outcome Review

Based on results of Step 4, determine next steps, such as building out the model on new data, etc

Example Outputs

Detect: Performance Influencing Factors – Our Industry tested AI algorithm helps organisations input their data sets to identify performance influencing factors which are often the root cause of safety events. Our dashboard visualisations then help to pinpoint targeted interventions to enhance safety, reliability, and productivity.





Action	Organisational Level	Timeframe	Expected Impact
Tailor content to your audience	Asset	Immediate	High
Give engaging delivery	Region	Short-term	Medium
Clear and memorable takeaways	bp-wide	Medium-term	Low
Give engaging delivery	Region	Long-term	Medium

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Presented by: Nyala Noë

Case Study: Enhancing Reliability of an Existing Key Asset

Using data science and process safety leadership training

Challenges to address

Challenge: the management team overseeing the asset performs continuous improvement to:

- Safety
- Health and Environment
- Reliability
- Production

In addition to the existing and well-established approaches to successfully manage these areas, can the latest innovations in data science also be applied to yield even greater outcomes?

Asset reliability improvements evident in post-intervention

1. Setup multi-disciplinary team of data scientists, subject-matter experts, and engineers
2. Data evidence to pinpoint areas for improvement
3. Targeted plan to address identified areas

Number of unplanned outages reduced by over half

Improvements in several key systems

Engagement of the whole operating team, setting them up for success

A partnership for success

Our client's asset management has:

- extensive experience
- a strong and diverse workforce
- wide range of accumulated operating data

Could Data Science enhance their operating decisions?

Empirisys' belief that changing culture is fundamental to creating the conditions that enable safer, better performing, and more sustainable businesses to evolve.

These goals can be achieved with a more data driven approach which we champion.

Working as one team

- Project Leader (FT): Ensure the smooth running of the project and connecting the right people
- Data Scientists (FT): gather, prepare, and analyse data
- SCRUM Master (PT): facilitate the team working together
- Subject-Matter Experts (PT): Interpret, validate, and review results
- Senior Managers (PT): Validate results and action them

Empirisys Team

Andrew Gibson

Subject-Matter Expert, chartered engineer

Darren Oliver

Subject-Matter Expert, safety leadership

Gus Carroll

Subject-Matter Expert, CEO

Dr Nyala Noë

Data Science, CDO

Approach

1. Set objective: set what problem needs to be addressed

Example: Understand the effect of operator experience on asset reliability

2. Gather data: gather any data relevant to the objective

Example: reliability and training/competence data of asset personnel

3. Analyse evidence: analyse the gathered data for patterns and anomalies

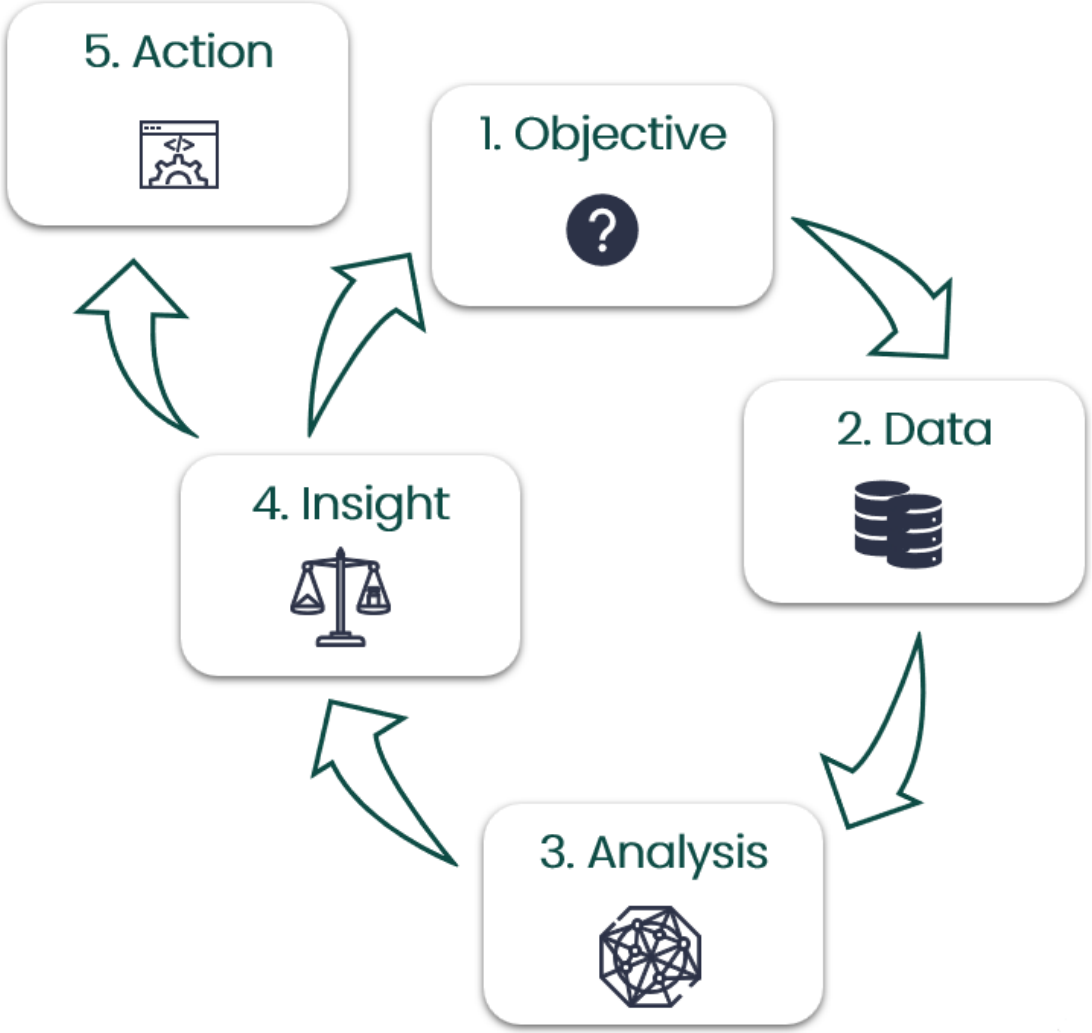
Example: trends in experience levels over time

4. Gain insight: root cause analysis of trend

Example: small but consistent experience drift over time

5. Derive action: use data evidence to derive a meaningful solution

Example: focused effort on coaching



Working as one team to respond to the challenge

1. Weekly stand-ups to share progress and change direction if needed

2. Iterative analysis that could react quickly to new questions as they emerged

3. Regular reviews with Subject-Matter Experts to make sure data insights make sense

Combining different datasets for a complete picture

What is the history of the asset and how did that influence its current state?

Historic data
- Trends
- Anomalies
- Forecasting

Gained understanding of the current trends at the asset

What is the current state of the asset and its people?

Operational data
- Plant
- Process
- People

Identified issues around processes, loss of experience, and where work was focused

How do the people feel about their asset and its current state?

- Areas of strength
- Areas of opportunity
- Emotions

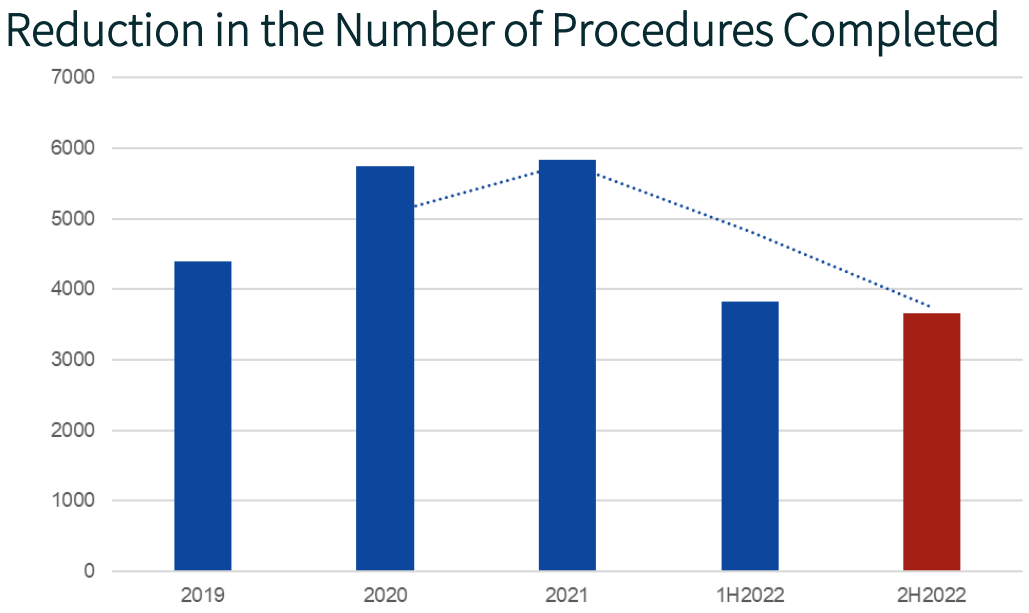
Identified issues around culture and psychological safety at the asset

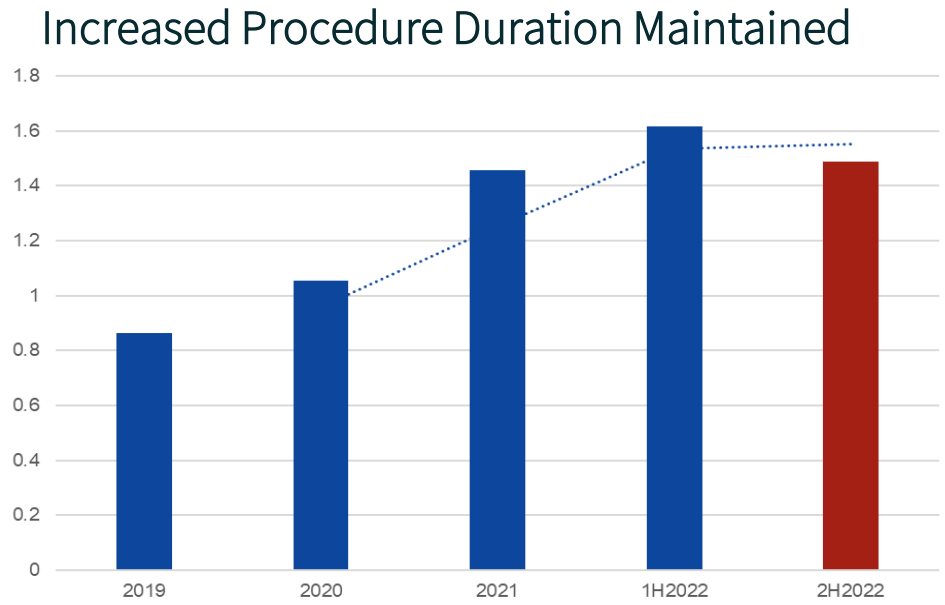
Actioning the findings

Details on Intervention: rationalize operator surveillance processes.

Approach: SME team reviewed the value of the current list of procedures.

Result: one third of procedures removed, allowing more time for other activities.



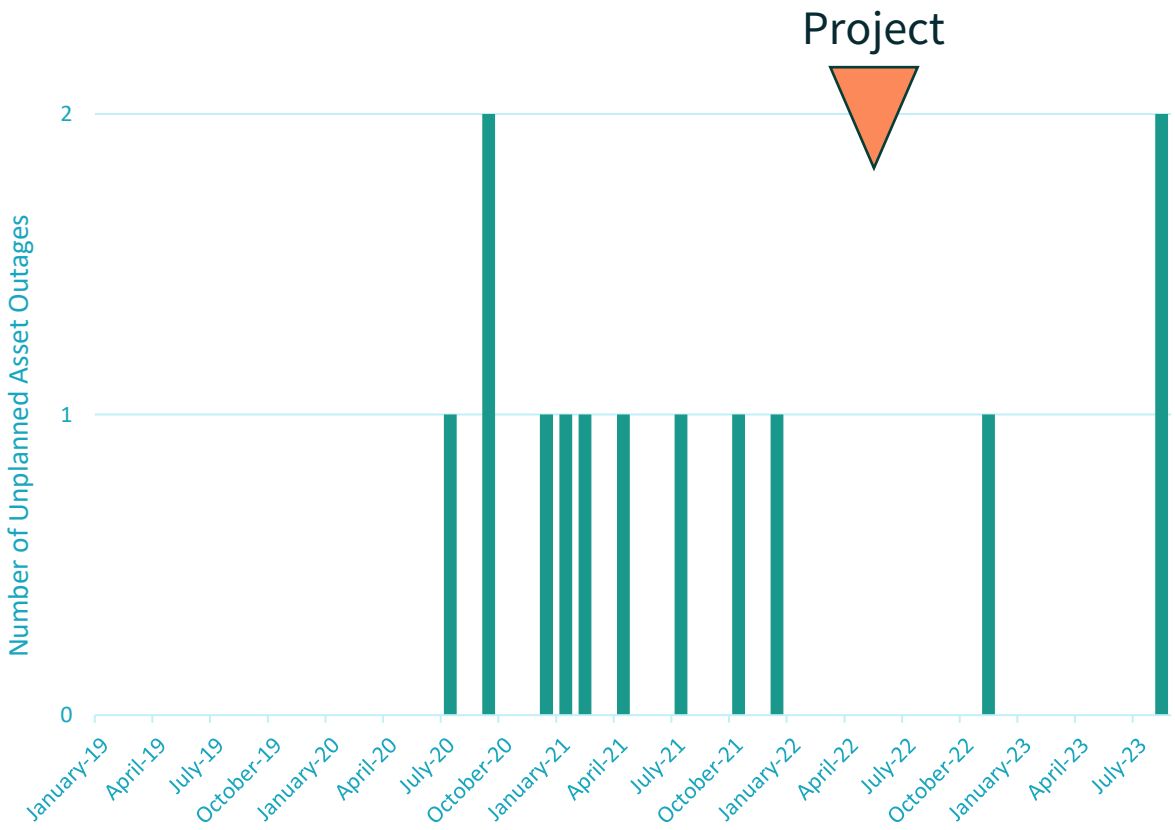


Actioning the findings

Details on Intervention: improve culture at the asset through coaching intervention

Approach: Empirisys provided leadership coaching to the management team

Result: shift in culture at the asset which is reflected in an improved performance



Winning Factors

- Strong support from asset manager
- Team collaboration and transparency
- Efficient and wide-ranging data access
- Data science platform that enabled quick analysis
- Frequent touchpoints with relevant subject-matter experts
- Intervention to directly address the outcomes of the analysis

Seamless collaboration and implementing actions informed by data evidence ensured success

Poll Question

What do you believe is the most significant hurdle to enhancing asset reliability?

a. Insufficient proactive maintenance and inspection programs
b. Difficulty implementing real-time monitoring technologies
c. Challenges in ensuring data quality for decision-making
d. Gaps in training and competency of operational staff
e. Other- Please specify in the chat

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Presented by: Gwilym Rees

Enhanced Hardware Barrier Model

Addressing major accident hazards effectively

Summary

Objective: Create useful insight from existing operational data to support decision making to manage risk

Phase 1

- Mapped performance standards (SECEs) to MAHs using the AOC safety case

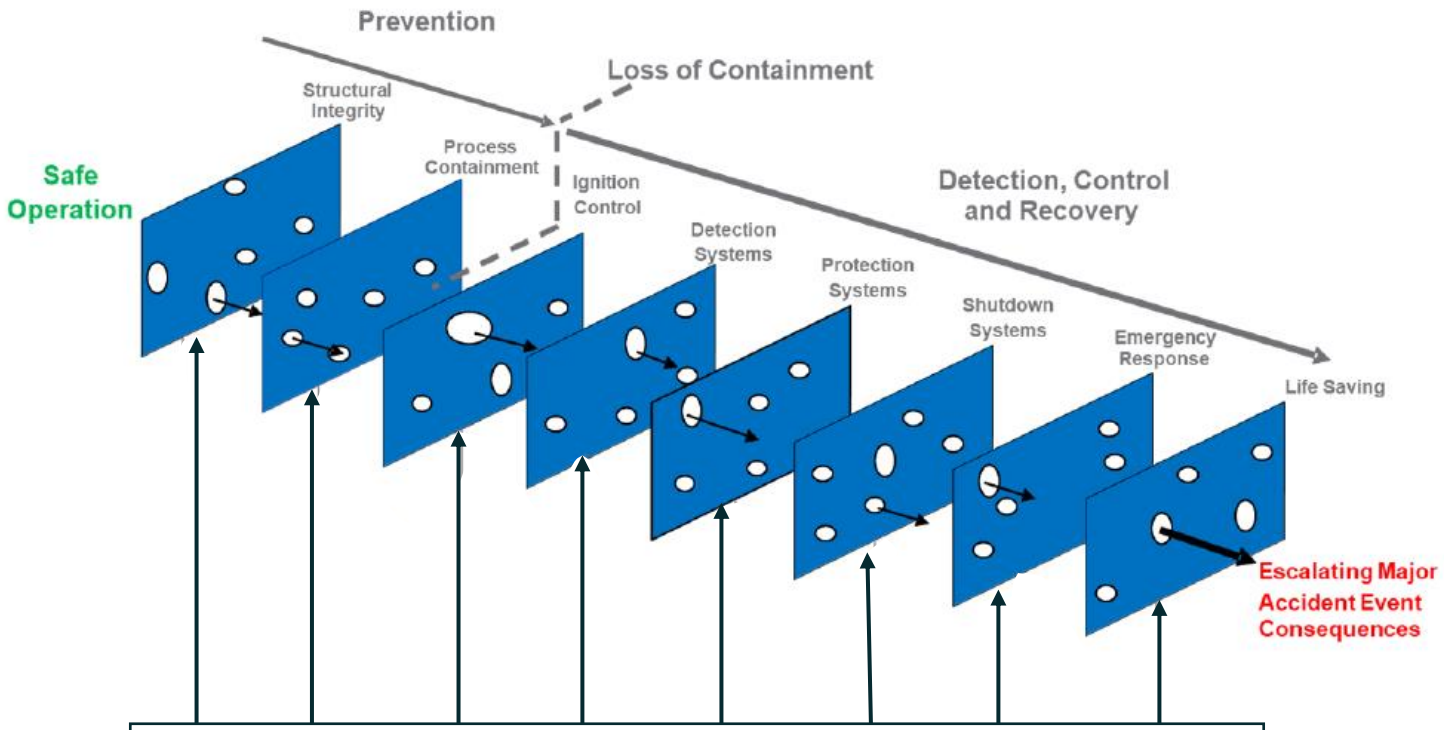
Phase 2 – Proof of Concept

- Mapped equipment to a subset of the above SECEs and MAHs
- Established risk criteria for each PSPI
- Power BI dashboard

Introduction

The Underlying Concept & Current Situation

The Underlying Concept



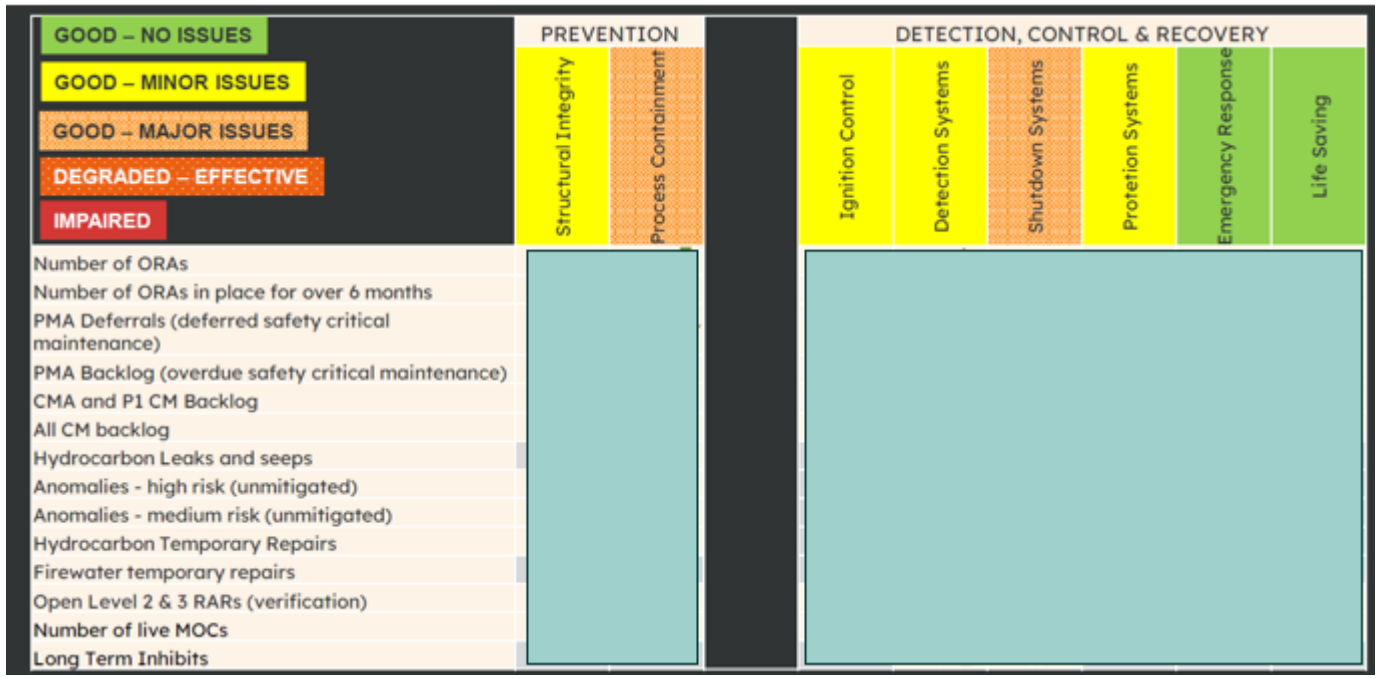
Hardware Barriers Managed via Performance Standards

- Management of process safety requires understanding of the status of:
  - People
  - Process
  - Plant
- Understand vulnerabilities to people via AOC's competence management processes
- Proxy indicators (existing PSPIs) are used to measure the integrity and vulnerability of:
  - Hardware barriers and the Performance Standards (SECEs)[1] used to manage them
  - Major Accident Hazards and their related QRA events[2]

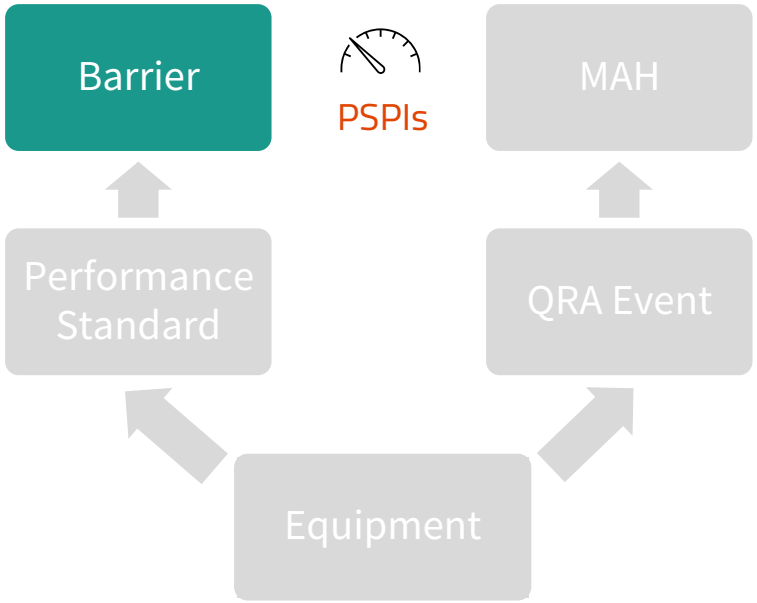
[1] A set of assurance tasks which comprise part of a barrier

[2] Scenarios which can lead to the MAH, identified via the quantitative risk assessment (QRA)

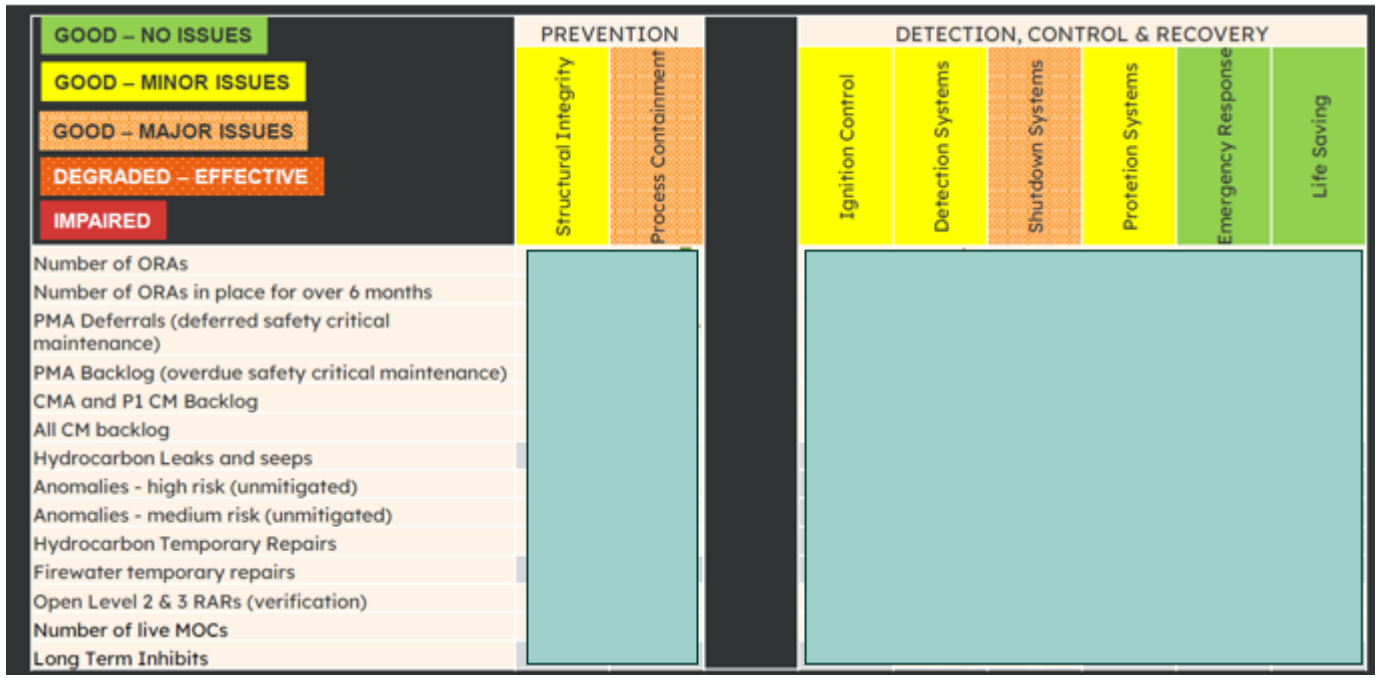
Current Situation



- AOC monitors PSPIs
- However, current PSPI monitoring is at a very aggregated level
- We want to build onto existing approach to create much more granularity and insight



Current Situation



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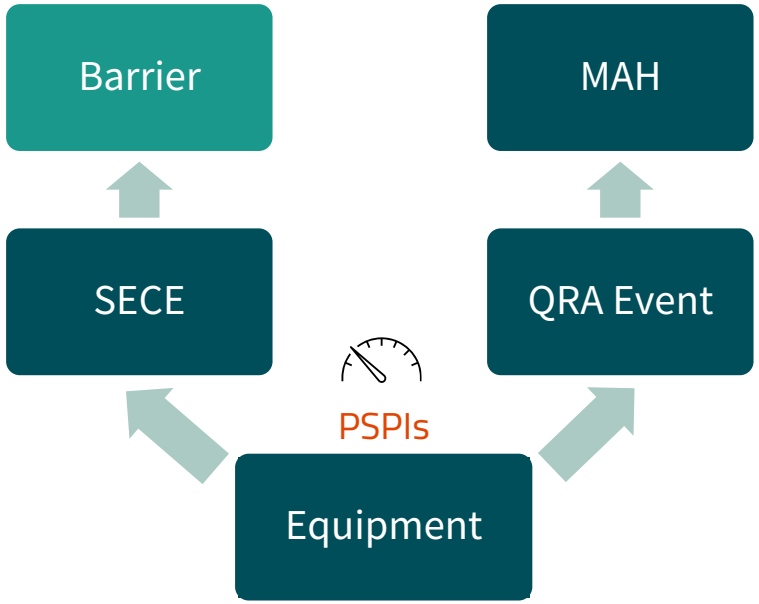

PoC Barrier Model

Deliverables and Scope

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PoC Deliverables

The PoC Barrier Model project was split into 5 primary deliverables

1. Equipment Mapping

Map equipment to SECEs and QRA Events

2. Data Quality Analysis

Verify the quality, completeness, and availability of PSPI data sources

3. Risk Criteria

Establish 'RAG' risk criteria for each PSPI

4. Data Model

Build a scalable, efficient data model

5. Data Visualization

Visualise insights from the barrier model in a Power BI dashboard

Start: Apr 2024

End: May 2024

PoC Scope: Barriers & SECEs

LOSS OF CONTAINMENT

PREVENTATIVE BARRIERS		DETECTION & CONTROL BARRIERS				EMERGENCY RESPONSE	
STRUCTURAL INTEGRITY	PROCESS CONTAINMENT	IGNITION CONTROL	DETECTION SYSTEMS	PROTECTION SYSTEMS	SHUTDOWN SYSTEMS	EMERGENCY RESPONSE	LIFE SAVING
Subsea / vessel hull structures	Topside pressure systems eqpt	Hazardous area ventilation	Fire & gas detection	Deluge system	ESD system	Temporary refuge	Personal survival equipmrnt
Topside structures	Rotating eqpt	Non-hazardous area ventilation		Fire & explosion protection	Plant blowdoan	Escape & evacuation routes	Rescue facilities
Heavy lift cranes and mech handling eqpt	Rotating eqpt (turrent swivels)	Certified electrical equipment		Helideck foam system	Operational well isolation	Emergency & escape lighting	Lifeboats / TEMPSCs
Bilge, ballast & cargo systems	Relief protection	Blanker & purge systems		Firewater pumps	Riser ESDVs	Communication systems	Tertiary means of escape
Mooring systems	Operational well containment / isolation	Earth bonding		Firewater ring main	Process ESDVs	UPS	
	Hazardous open drains	Miscellaneous ignition control		Paasive fire protection	Subsea isolation valves (SSIVs)	Helicopter facilities	
	Tanker loading systems	Flare gas combustion		Gaseous fire protection systems		Emergency power supply	
				Sprinkler systems			
				Fixed foam systems			
				Navigation aids			
				Collision avoidance system			
				Metocean data gathering system			

"Dynamic" SECEs

- "Dynamic" SECEs are those which are likely to fluctuate on a frequent e.g. daily basis
- "Static" SECEs can be integrated in a future iteration
- Equipment to SECE mapping obtained from maintenance data source

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PoC Scope: MAHs & QRA Events

MAH	QRA Event	QRA Event Description
MAH-3 Jet Fire or Explosion from Swivel Stack	A11	Swivel Area Release From First Stage Separator A Inlet Line
	A12	Swivel Area Release From First Stage Separator B Inlet Line
	A32	Swivel Area Gas Release from Export Gas Line
MAH-5 Jet Fire or Explosion from Gas Treatment and Compression	A26	Gas Release from HP Compressor/Suction Scrubber
	A28	Gas Release from Fuel Gas System / Distribution
	A29	Gas Release from Gas Scrubbers and TEG Contactor
	A49	Gas Release from Export Gas Metering / Export Gas Cooler

- Equipment to QRA Event mapping obtained via Process & Implementation Diagrams (P&IDs) from the Fire & Explosion Analysis

PoC Scope: PSPIs

PSPI Type	Green Threshold	Amber Threshold	Red Threshold
Anomalies - High Risk (Unmitigated)			
Anomalies - Medium Risk (Unmitigated)			
Firewater & Hydrocarbon Temporary Repairs			
Long-Term Inhibits			
ORAs	0	1	2
PMA Backlog			
PMA Deferrals			

- Risk criteria: tolerance levels ('thresholds') for the count of a particular type of PSPI e.g., the number of Preventative Maintenance Assurance (PMA) Backlog work orders.
- Defined at the SECE level
- Used to flag PSPIs (for a particular SECE) as low, medium, or high risk

Power BI Dashboard

Demonstration

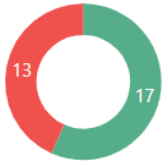
Barrier Integrity

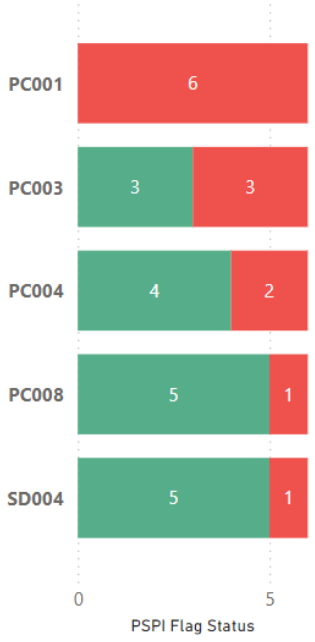
MAH: All

QRA Event: All

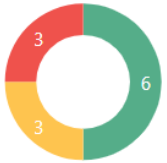
PSPI Type: All

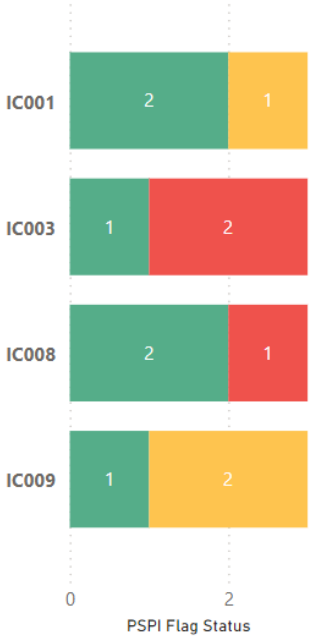
Process Containment



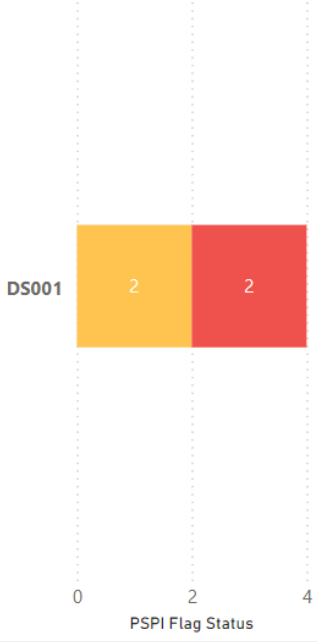


Ignition Control

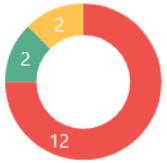


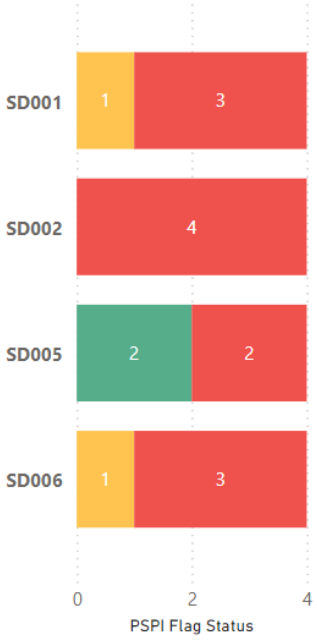


Detection Systems

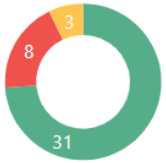


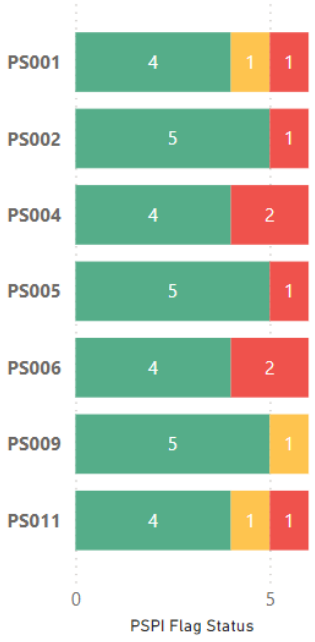
Suppression Devices





Protection Systems



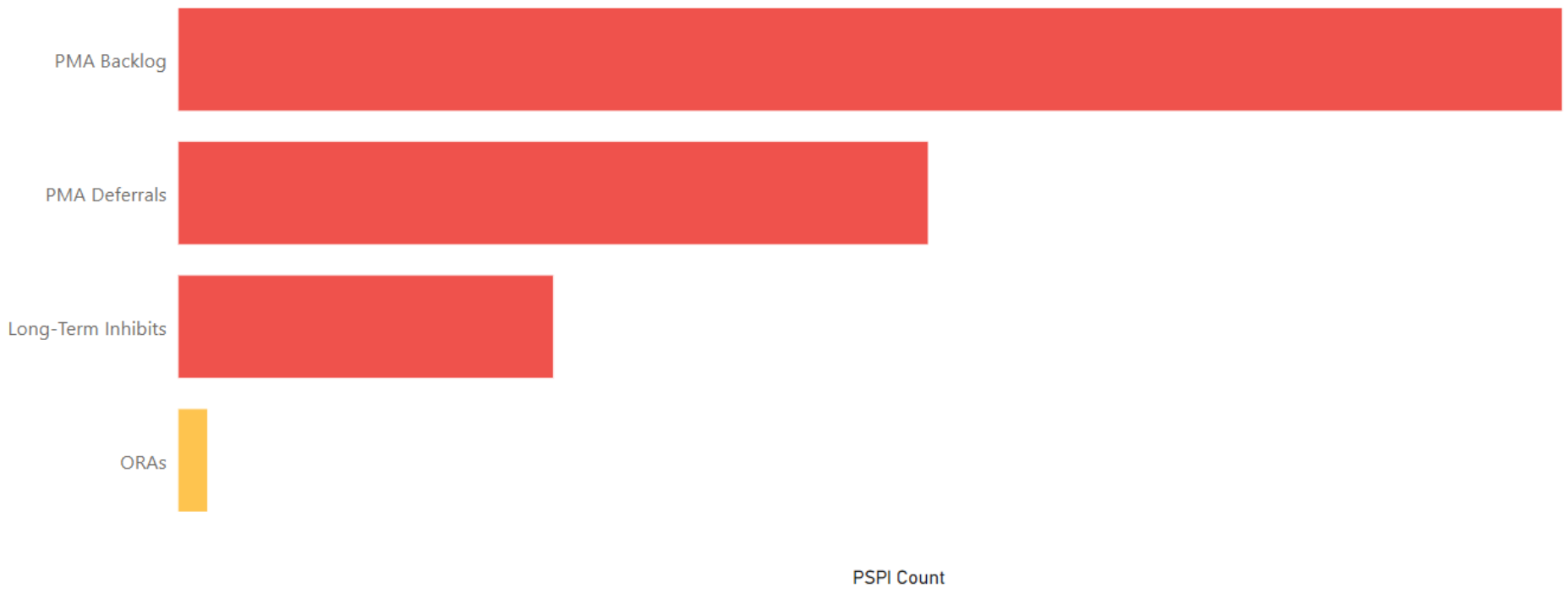


SECE

MAH	QRA Event	Equipment Category
All	All	All

SECE	PSPI Type	Green Threshold	Amber Threshold	Red Threshold
SD006 Process ESDVs	ORAs	0	1	2

Actual PSPI Count by PSPI Type



Operational Risk Assessments

MAH
All

QRA Event
All

Equipment Category
All

SECE
SD006 Process ESDVs

ORA Level
All

ORA Residual Risk
All

Actual PSPI Count

ORAs

Tag	PSPI Count
Total	

Affected Area / Module(s)	ORA Description	ORA Level	ORA Residual Risk	ORA Title	PSPI Instance ID	Start Date

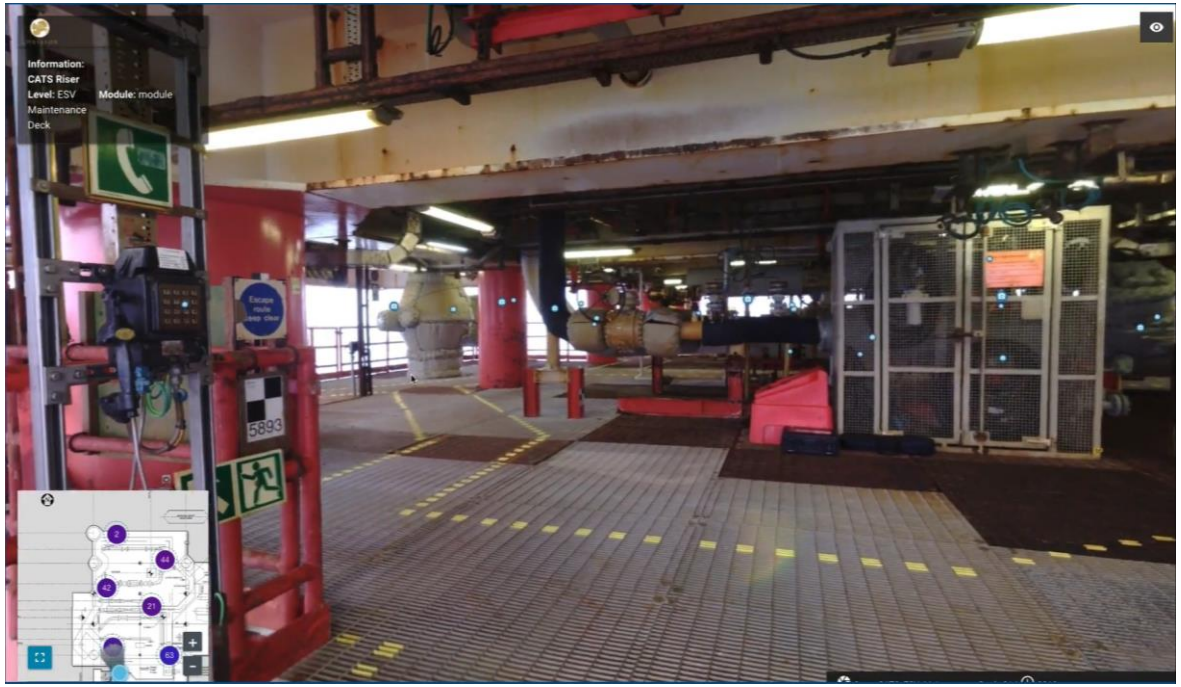
Further Work

Scale Up & Integration with Digital Twin View

Scale Up

- Mapping of SECEs to MAHs / from the AOC safety case has already been completed for a more comprehensive scope
- Pending AOC approval, can scale the enhanced barrier model to a larger portion of the FPSO

Integrating with Digital Twin Views



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Poll Question

What do you think is the biggest challenge in developing a process safety hardware barrier model?

a. Integrating data from existing systems
b. Communicating the insight in a way that drives decision-making
c. Quality/availability of data
d. Training staff/adapting current PSPI review procedures to adopt a (new) Power BI tool
e. Other- Please specify in the chat

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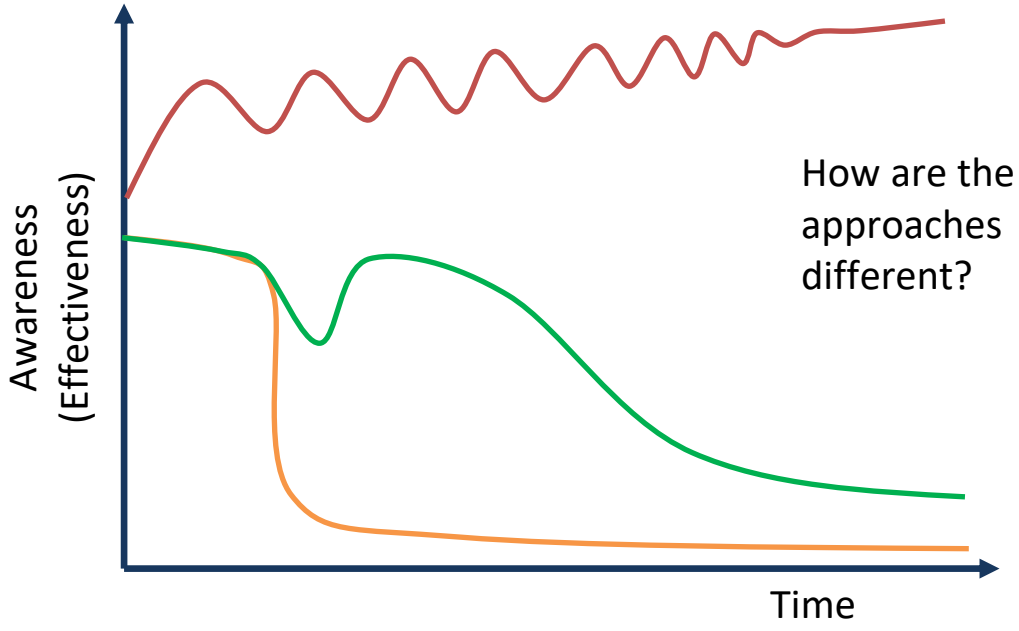
Presented by: Roger Berriman

Process Safety Leadership Training

“Is It all About Training?”

Process Safety Training Impact

- The approach to raising awareness of major accident hazards and process safety management arrangements can vary considerably between industries for approach and effectiveness
- Organisational risk awareness, regulations, cultures and leadership values will all affect both the design and commitment to an effective training program
- The level of awareness (or competence) over time can vary considerably



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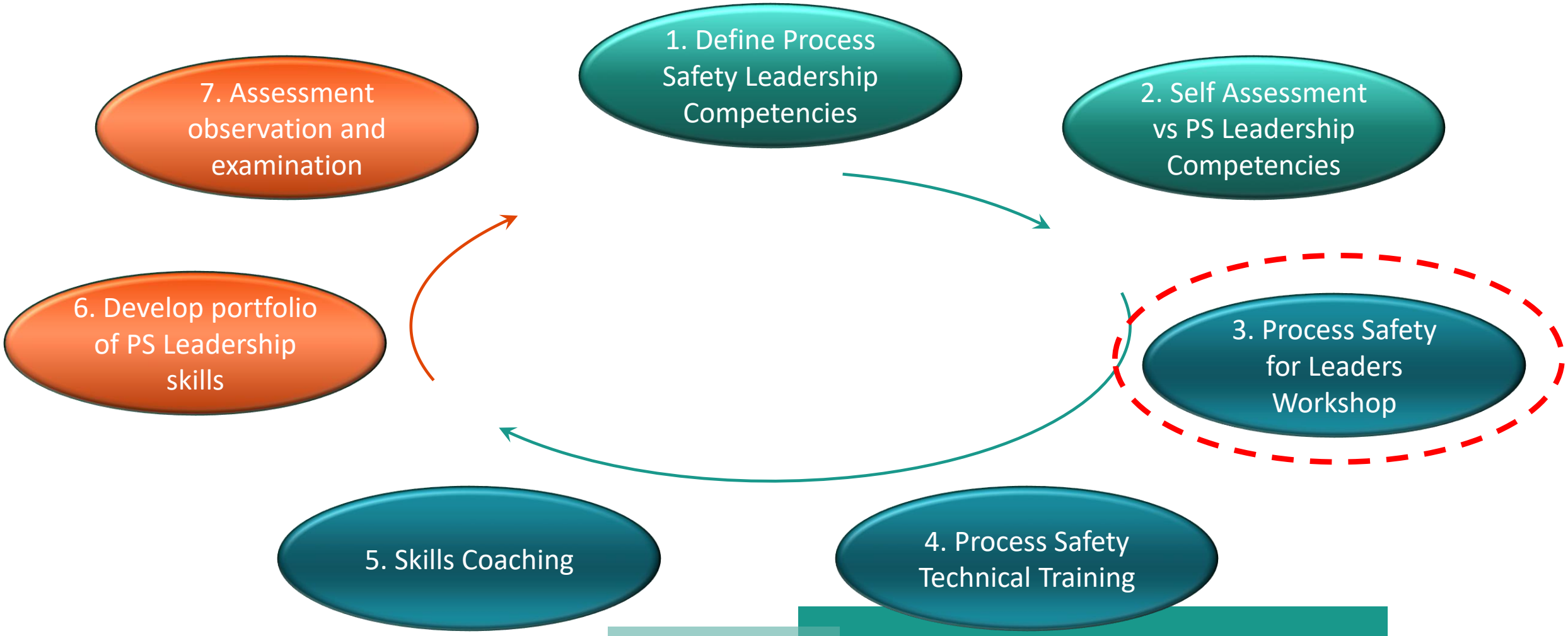
Process Safety (Training) Leadership

- Key purpose is to embed process safety leadership concepts, principles and behaviours.
- The program must bring Process Safety to life.
- A typical Empirisys program comprises the following elements:
  - Executive & Site Leadership Team –Process Safety Leadership workshop, supporting Leaders and managers to deliver a consistent message and understanding about Process Safety Leadership.
  - Functional Support & Engineering Delivery Teams –Process Safety Awareness workshop, supporting core functions to understand their role with respect to Process Safety
  - Supervisors and Front-line Workers –Process Safety Management fundamentals workshop, sharing key messages, language and toolkit (consistent message from control room to boardroom approach).
- The following slides set out a recommended approach

Process Safety for Leaders

Competency Assessment Life Cycle



Executive Board & Site Leadership Team

Outcomes:

- Objective is to ensure that all leaders and managers understand process safety with respect to their responsibilities, relevant legislation, facility hazards and industry relevant case study examples
- Understand why Major Accidents happen and the fundamentals of process safety management
- Creation of a common language and simple tool kit to ensure consistent management of Process Safety
- Introduction to Process Safety Leadership Principles, use of bowtie diagrams, management of safety critical barriers
- Owning Process Safety – your role as a Leader / Manager

Delivery:

- Specialised training centre: e.g. DNV's Spadeadam, Research & Testing Facility in Cumbria to include demonstration of pool fire, vapour cloud explosion and jet fire(s)
- Local training centre: Inclusion of actors/role play to analyse major incidents

Process Safety For Leaders Workshop (1)

DNV Spadeadam Research & Testing Facility

RAF Spadeadam, Cumbria

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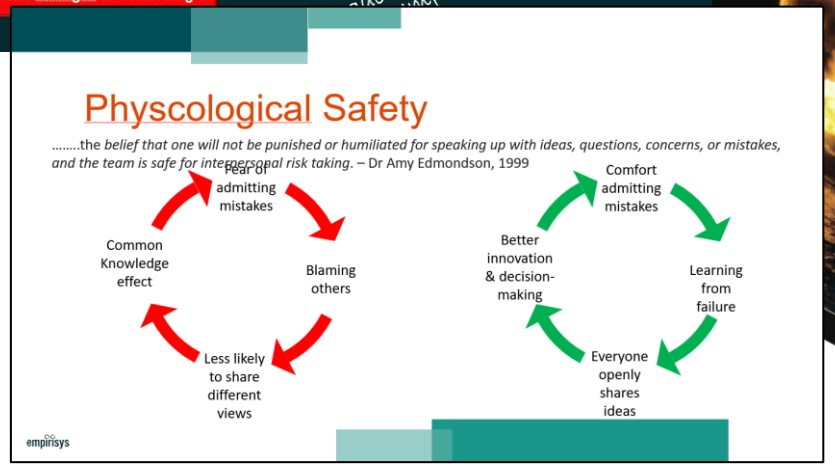
Process Safety For Leaders Workshop (2)

- Workshop facilitated by Empirisys supported by AKT Productions
- Process Safety Leadership failures at Piper Alpha ‘brought to life’ through theatre
- Leadership, culture and behaviour
- The role of leaders in organisational factor drift to failure



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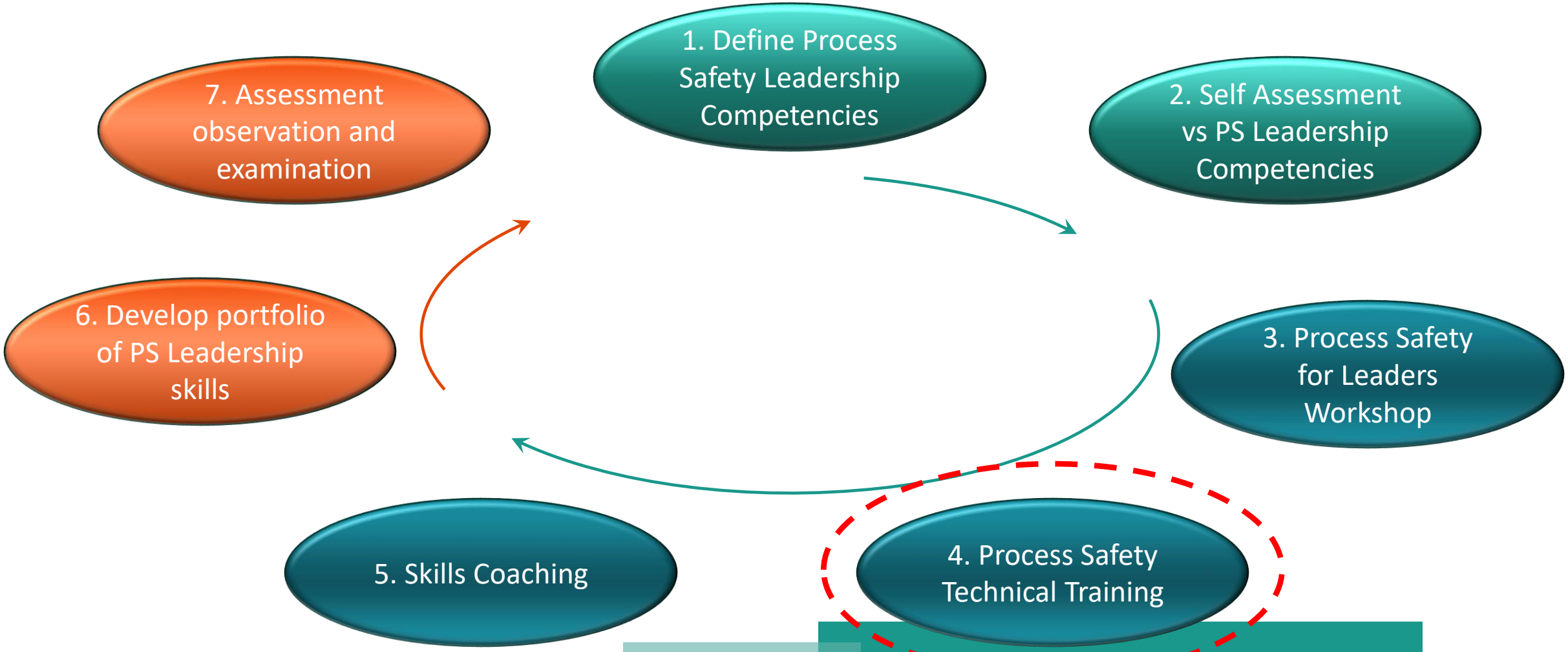
Process Safety for Leaders

Competency Assessment Life Cycle

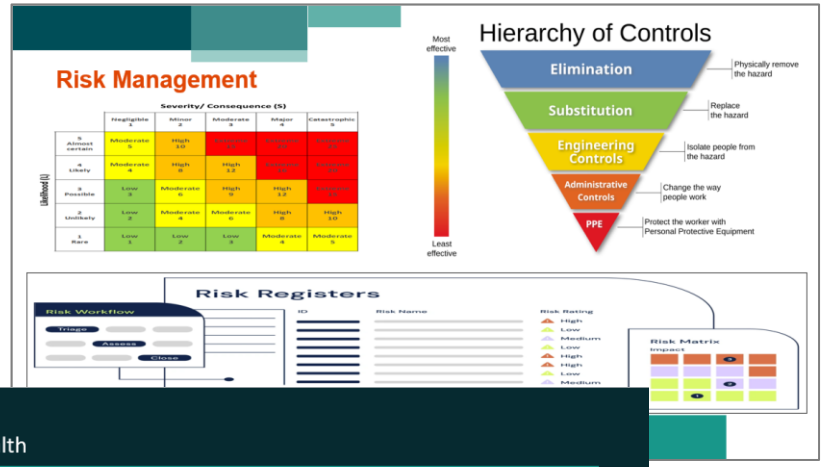


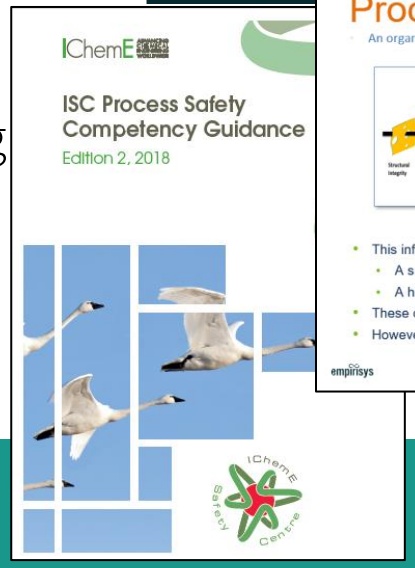
Process Safety – Technical Competencies

- Delivery of Process Safety Technical Competencies
- Risk Management
- Asset Integrity
- Performance & Assurance

- Workshop Vs Computer Based Training

- Technical competency element training can be tailored to deliver either a 'proficient' or 'aware' level of understanding dependent on the Safety Critical Leadership roles





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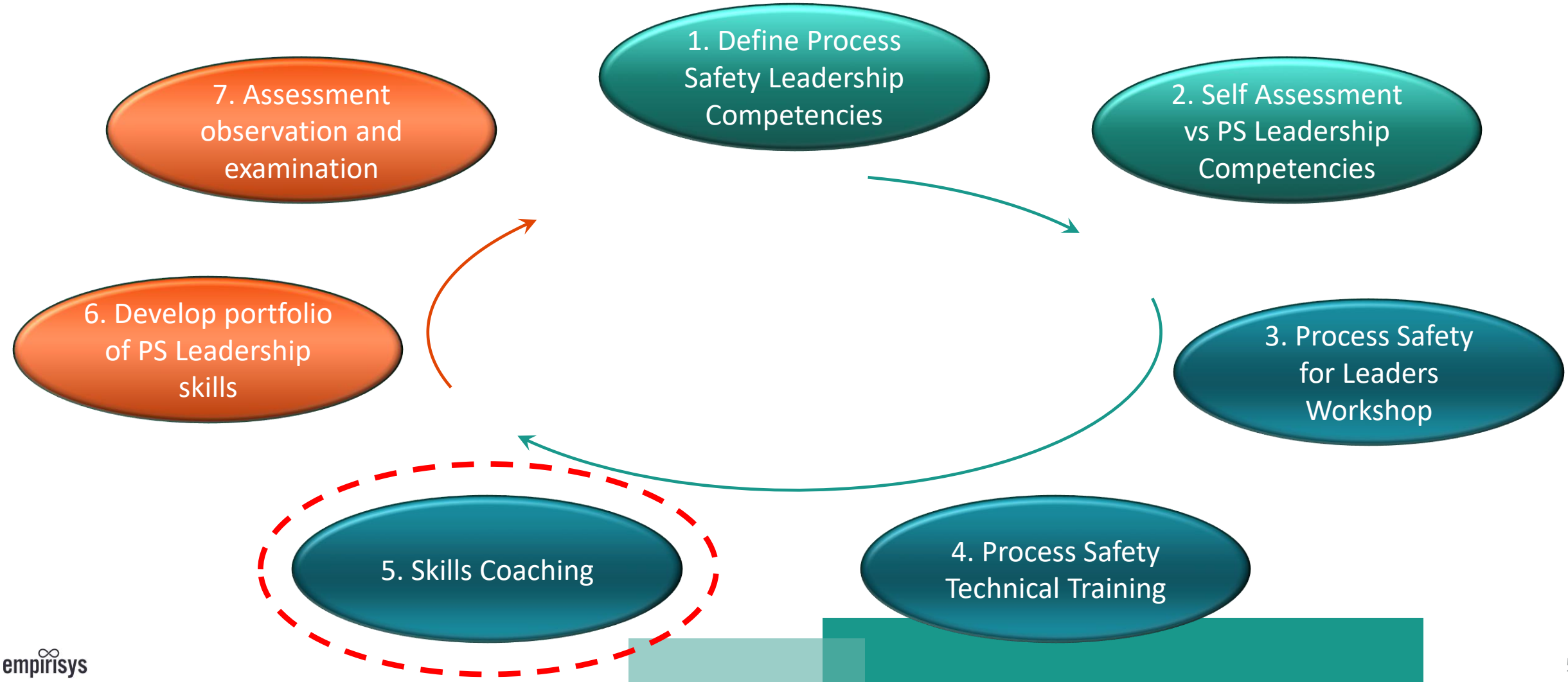

Process Safety – Leaders Toolkit

- Delivery of Process Safety Behavioural Competencies
- Storytelling
- Active listening
- Giving & receiving feedback
- Relationship between values, behaviour, culture & rules
- Visible Felt Leadership (role modelling)
- Process Safety Leadership as a Manager, Coach, Leader
  [How, When, Where, Who, How, Why]

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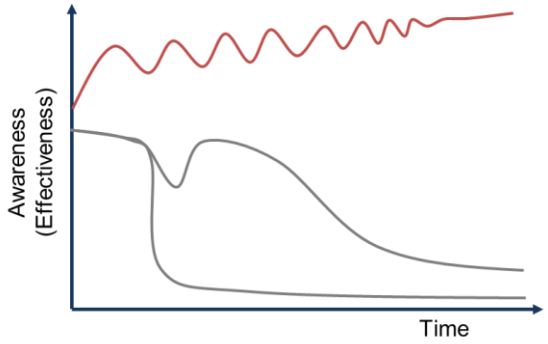
How Impactful is Your Training? Considerations-



Do Leaders & Managers:

- Understand why Major Accidents happen and the fundamentals of process safety management?
- Understand process safety with respect to their responsibilities, relevant legislation, facility hazards?
- Own and question process safety performance?
- Have the required technical competencies for process safety?
- Have the behavioural competencies to lead process safety?

- Has the organization implemented a competency assessment lifecycle to maintain awareness over time?

Thank you

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Poll Question

How effective is your organisations process safety leadership training programme?

a) We don't have one as its not relevant to our organisation

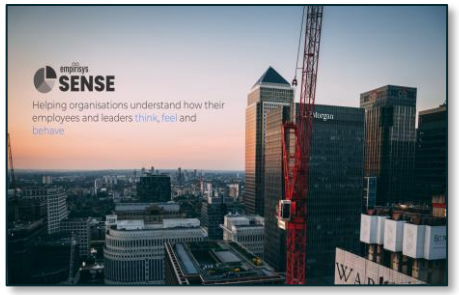
b) We've run an awareness campaign for process safety and major accident avoidance but nothing else recently

c) We've sent some of our leaders on a training course but there's been no follow on activity

d) We train and assess our internal teams regularly on effective process safety leadership

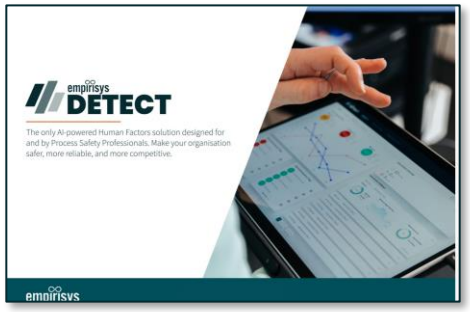
e) We have a process safety leadership competency programme which includes role based training, assessment and coaching for the technical & behavioural competencies we require

Our Products



SENSE

AI-enabled survey tool to create deep insight from structured & unstructured data using AI techniques (NLP/ LLM).



DETECT

bp

HSE Health & Safety Executive

Create early warning indicators into performance influencing factors from organisational data

BOOST

STEP CHANGE IN SAFETY

Create systemic insight into challenges to hardware and human barriers from HSE observations

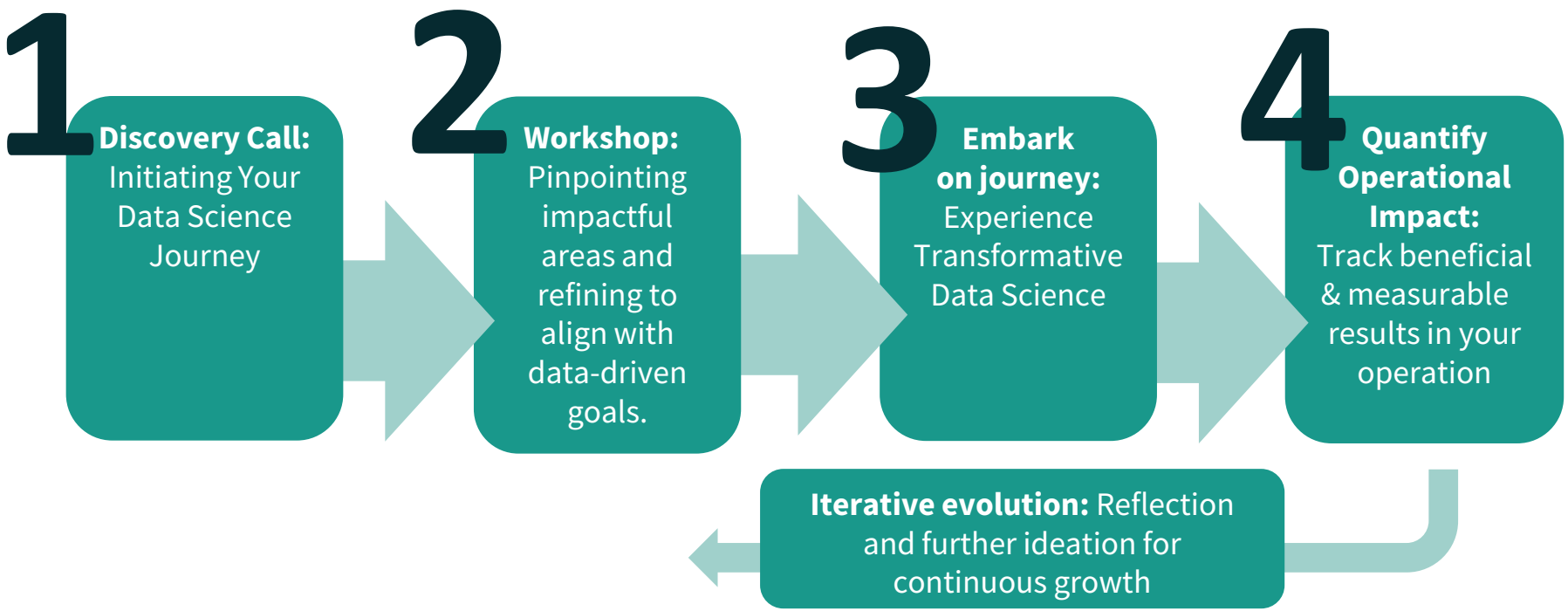
Our Services

Consulting

- Bespoke data analytics for improving process safety
- AI solutions for automating processes
- Data insight from large industry datasets

PS Leadership

- Board and SLT
- Technical & other leaders across asset lifecycle
- Front line workforce



Harness Your Data: Stay Safe, Profitable, and Ahead of Competition

Take the Next Step!

info@empirisys.io

www.empirisys.io

Nyala Noe: nyala@empirisys.io
Gwilym Rees: gwilym@empirisys.io
Roger Berriman: roger.berriman@empirisys.io

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