Lloyd's Register Foundation

The University of Manchester

Thomas Ashton Institute

HSE

Avoiding Engineering Catastrophe: New Insights from Data

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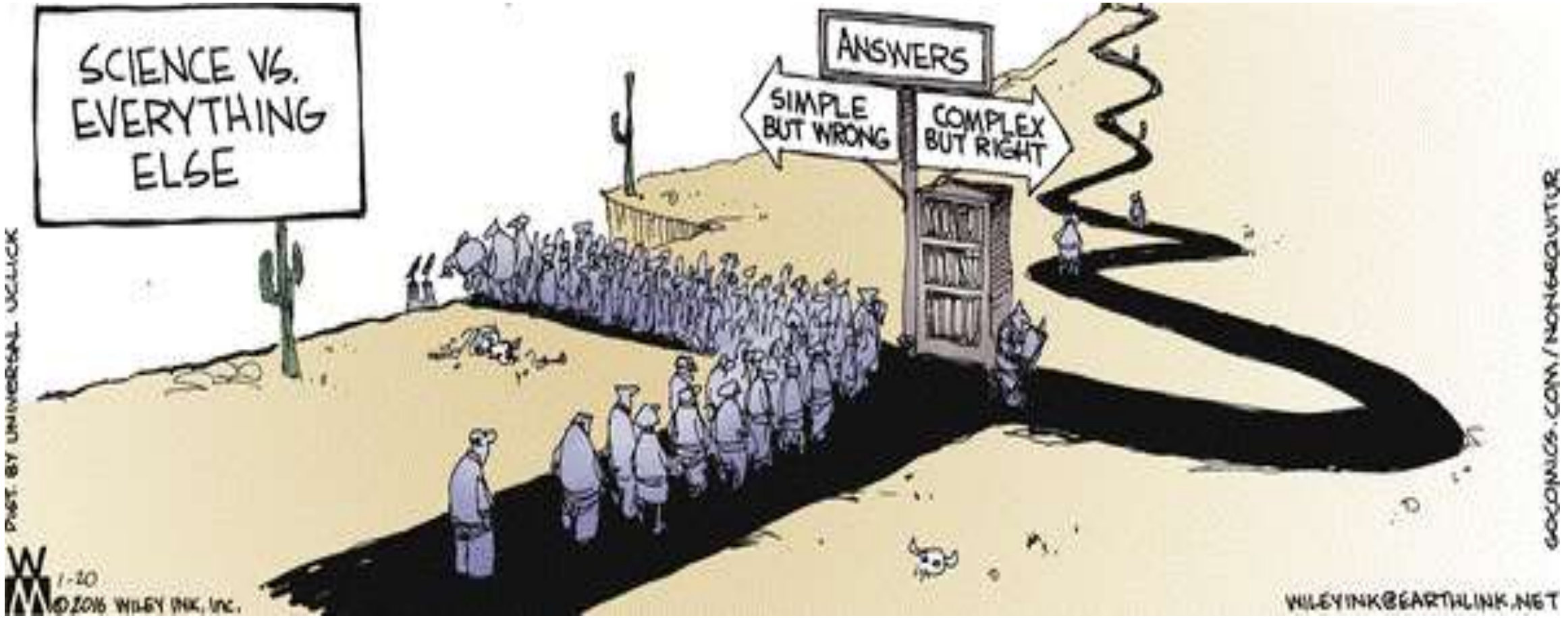


Content

- Overview of Discovering Safety Programme
- Loss of Containment Insights Project
- Data sources & new approaches
- Can occupational safety datasets provide process safety intelligence?
- Limitations of existing data
- Proposals for moving forward
- Feedback & engagement

Discovering Safety Programme

Loss of Containment Insights Project

TOXIC RELEASE
Bhopal, India 1984
~3928 official deaths
16,000+ ?

FIRE & EXPLOSION
Buncefield, UK 2005
No deaths
~£1 Bn economic damage

FIRE & EXPLOSION
FPSO Cidade de São Mateus, Brazil
2015
9 deaths
~£200M Repair Claim

Video

Focus

- High-consequence, low-frequency events
- Onshore process industy (to begin with)
- Assisting technical risk assessment but wider (e.g. insurance industry)
- Lessons from wider data initiatives – e.g. RAMS (Reliability, Availability, Maintainability and Safety) databases.

Stakeholder views

- Supportive of the need for more intelligence to assist with preventing LoC events
- Process industry is diverse with different hazard/risk profile and different needs (e.g. tank farm v pharma manufacture)
- Ongoing challenges as time progresses (e.g. Ageing/Life Extension, new technologies, new fuels, new processes)
- People are ‘time poor’ so additional new data collection burdens a non-starter.
- “We are proud to have the opportunity of being part of Discovering Safety…we will be willing to support any request that moves forward…and bring along safer operations in our region” Council for Process Safety in Latin America (CSP-LA)

Data

- Initial ‘proof of concept’ based on HSE’s GB data – to be expanded later
- HSE’s Corporate Operational Intelligence System (COIN)
- Holds records for regulatory interventions – more records for ‘occupational safety’
- Intended primarily for keeping a site history to inform interventions – very limited analysis/reporting tools in the database
- Loss of Containment data coding improved following Buncefield recommendations.
- Coded and narrative data held.

COIN size

- Company Records – 2855
- Sites – 10551
- Cases – 282846
- Service Orders – 65093
- Database Size (Data only) = 432GB
- Document Attachments Size = 1350 GB (1.35TB)
- Data is held for 7 years from the last activity on a case – this is a challenge for us
- The above is the total database size – LoC relevant entries will be a subset of this – single figure percent if that

LoC case header

LoC Coded Fields

Case	Customer	Contact	Status	Summary	Site
4	N	N	Closed - Inv...	N DO - 18/05/2016 - Escape of flamma...	HC

Underlying Causes — View All | First 1 of 1 Last

Underlying Causes
Maintenance Procedures

Safety Management System Failing — View All | First 1 of 1 Last

Safety Mgt Systems Failing
Organising - Communication

Nature of Substance — View All | First 1 of 1 Last

Substance	Area Affected(Extent/Severity)
Flammable	Potent serious damage to prop

Activity at Time of Release — View All | First 1 of 1 Last

Activity
Maintenance Planned

Site of Release — View All | First 1 of 1 Last

Site
Valve open end

Direct Cause of Incident — View All | First 1 of 1 Last

Cause of Incident
Human Error: Violations

Mitigating Defence Against Escalation — View All | First 1 of 1 Last

Defence
Contained within second cont

Secondary and/or tertiary containment failure causes — View All | First 1 of 1 Last

Secondary Containment Failure
Not Applicable

Attachments

Summary of Notes

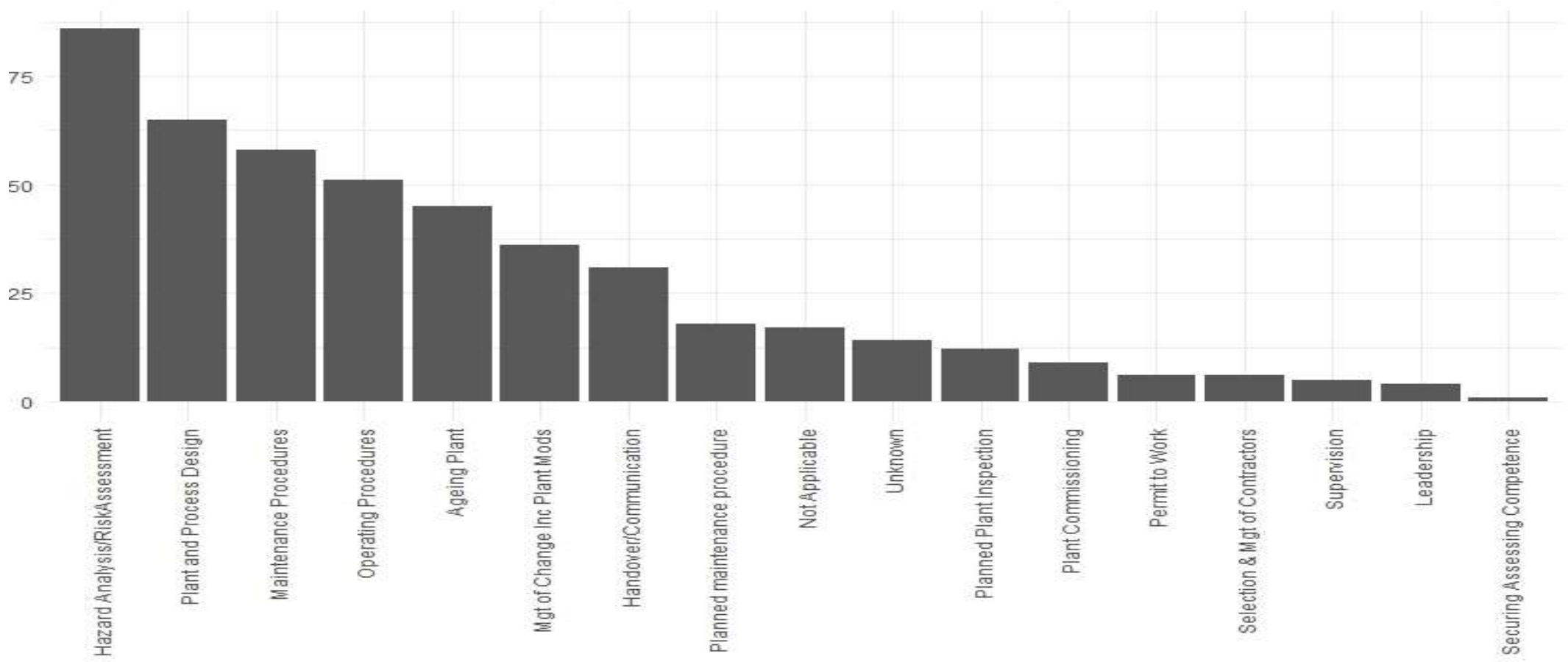
Attachments Summary Customize | Find | First 1-15 of 15 Last

File Name	Description	Added By	Date Added	Associated Note
EMM [redacted] DO 31-5-13.doc	emm1 for [redacted] DO case 4324335	[redacted]	10/05/2013 11:14 BST	
[redacted] Dangerous Occurrence case 4324335 inv report.DOC	[redacted] DO case 432335 inv report	[redacted]	10/05/2013 11:14 BST	
[redacted] Dangerous Occurrence.pdf	[redacted] Dangerous Occurrence.pdf	[redacted]	10/05/2013 11:14 BST	
Interim L to [redacted] re DO 4324335.pdf	Interim L to [redacted] re DO 4324335	[redacted]	10/05/2013 11:14 BST	
L to [redacted] contractors [redacted] DO 4324335 - 9 May 2013.pdf	L to [redacted] contractors [redacted] DO	[redacted]	10/05/2013 11:14 BST	
ESA-FSA-Guidelines-Flange-Gaskets-009_98_ENG.pdf	ESA-FSA-Guidelines-Flange-Gaskets	[redacted]	10/05/2013 11:14 BST	
EI 720 Management of the Integrity of Bolted Joints.pdf	EI Guidelines	[redacted]	10/05/2013 11:14 BST	
L to [redacted] re DO 4324335 15 July 2013.pdf	L to [redacted] e DO 4324335 15 July 20	[redacted]	16/07/2013 11:03 BST	Visit report(s)
[redacted] Inv Report - [redacted] final .pdf	[redacted] ME Inv Report [redacted] final	[redacted]	16/07/2013 11:03 BST	Visit report(s)
[redacted] reponse email plus 29-8-13.doc	Email and attachments 29-8-13.do	[redacted]	17/09/2013 14:48 BST	Visit report(s)

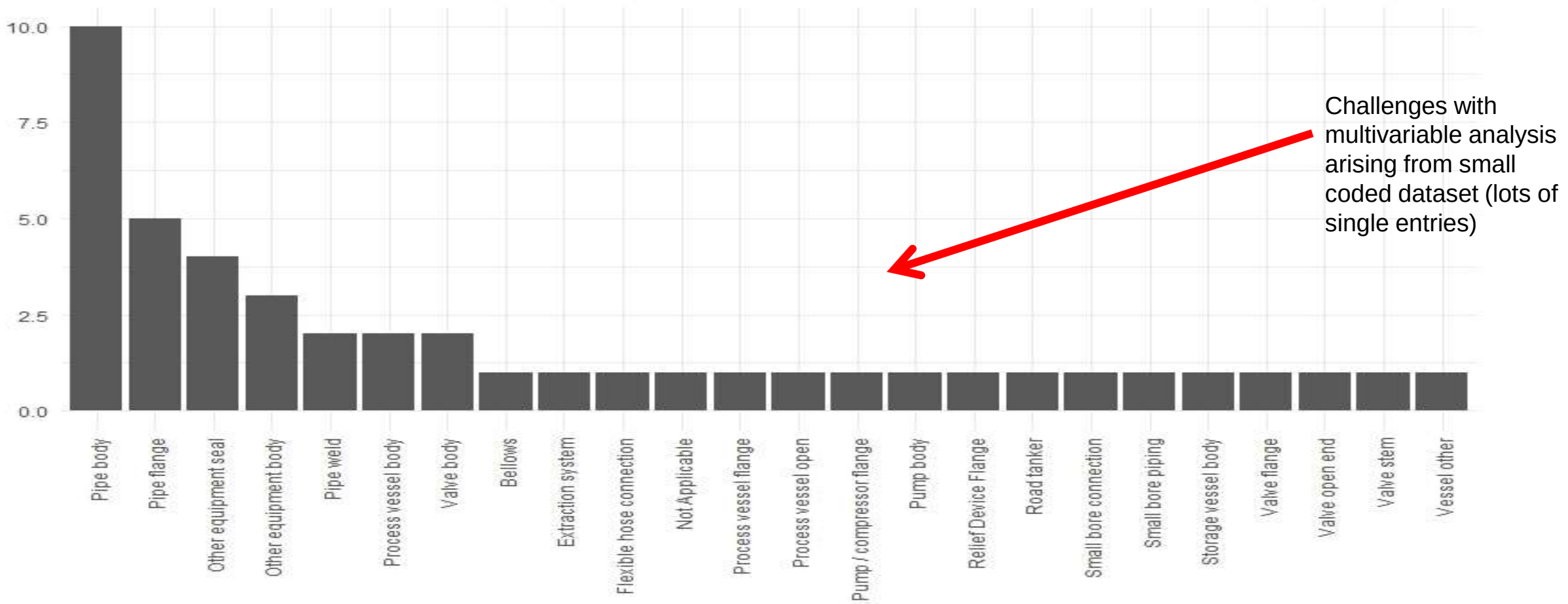
Emerging findings

- Some good data in the coded fields – useful findings for industry in terms of taxonomy
- Small data size (N=~670) due to
  - Short data retention policy (~7 years)
  - Coded data only collected from RIDDOR Dangerous Occurences not other data (e.g. LoC events causing injury)
- Much more value in the unstructured data – text mining required.
- Huge value in the associated attachments – but significant challenges around lack of consistent structure and depth
- Some attachments are ‘flattened’ PDF with no OCR text associated (e.g. scanned investigation reports) etc.

Underlying causes



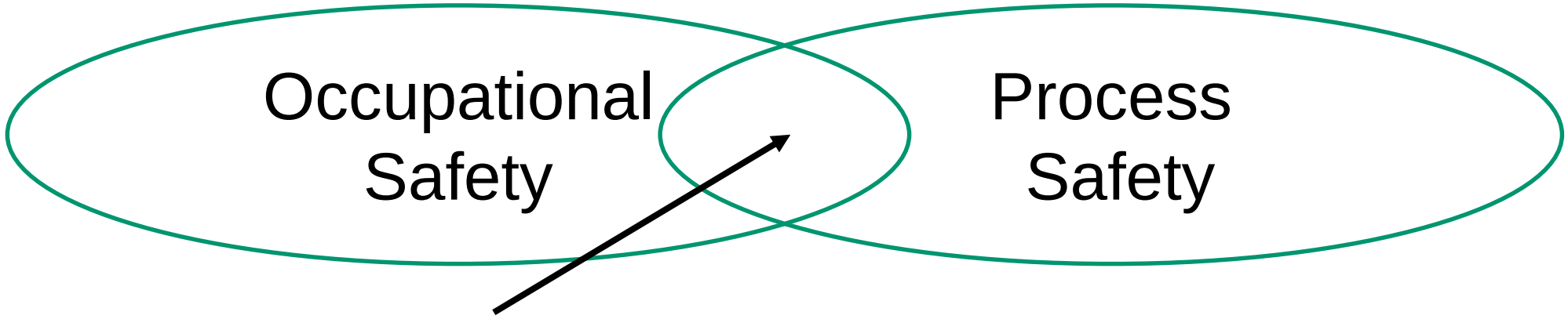
Plant item (ageing plant cases)



Challenges with multivariable analysis arising from small coded dataset (lots of single entries)

Occupational & Process Safety

"…the presence of an effective personal safety management system does not ensure the presence of an effective process safety management system." [Baker Panel, 2007]



Does this area exist? How big is it? What are the limitations of the overlap?

Gold in them hills?

Example 1

One employee sustained burns to their ankles when a high temperature and caustic liquid mixture flowed over their chemical resistant shoes and came into contact with their ankles. This resulted in several weeks off work, but the individual is expected to make a full recovery. The incident was reported to HSE as a RIDDOR over seven-day injury accident.

The incident occurred during a post-reaction cleaning operation on a chemical reactor when the vessel was being filled with a caustic cleaning solution whilst agitation and heating were applied. The intention was to heat the solution to approximately 65°C and to fill the vessel to 90% capacity. Level control was due to be achieved by manual dipping. Temperature control was also monitored manually, as the vessel had no instrumentation and no high-level alarms fitted. There was some confusion as to whether the vessel needed to be filled to 100% capacity to clean the upper levels of the vessel and fittings.

The incident occurred when either level control was lost and the vessel was overfilled onto the upper reactor floor, or when temperature control was lost and boiling occurred. In addition to the lack of instrumentation, there was also no written operating procedure for reactor cleaning operations at the time of the incident.

This injury accident, whilst only briefly outlined here, clearly provides process safety insight in respect of process plant design as well as operational procedures. Failure to achieve level and temperature control in the process industry has been associated with many major accidents causing on and off-site implications.

Gold in them hills?

Example 2

One employee sustained superficial burns to their face following a short duration flash fire resulting in approximately two weeks off work on medical advice. This was reported to HSE as a RIDDOR over seven-day injury. Had no injury occurred this incident would not have needed to be reported as a DO since it would not meet the criteria for a process fire as it did not result in 24-hour plant stoppage.

The incident occurred when the employee was adding a powder to a reactor which already contained significant quantities of the solvent Methyl Ethyl Ketone (MEK) which had recently been 'splash filled' into the reactor contrary to company recognised good practice. The powder was dispensed directly from the polymer bag it was supplied in and it is believed this may have created a static spark which ignited the solvent vapours present in the reactor following the splash loading of solvent. The area around the reactor port was designated an explosive atmospheres (ATEX) zone 1 area and there is no evidence of any unsuitable equipment having been brought into this zoned area prior to the ignition. The process operator filling the vessel was wearing anti-static footwear. Once ignition occurred, a flash fire resulted at the reactor port causing superficial burns to the operator who was standing upright decanting the powder. The fire was rapidly and completely extinguished by a second process operator closing the reactor lid shut.

Clearly this is another injury accident with the potential to have escalated into a large-scale process safety event given the large amount of solvent present in the reactor and the presence of other adjacent processes and employees.

Summary & next steps

- LoC events continue to be a problem around the world
- There is a demonstrable need to improve intelligence available to prevent LoC events
- We have credible data available now
- Any successful initiative must not impose new data collection burdens on field based personnel
- This means that the analysis of unstructured data, including data not deliberately created for process safety reasons is important.
- We are now in a position to commence analysis techniques based on HSE's data, present to stakeholders and expand/iterate.

Engagement / questions

- Register for updates on the project/programme at discoveringsafety@hse.gov.uk
- General feedback and suggestions welcomed
- Signposts to global sources of process safety intelligence even if badly structured/exploited – particularly onshore data and data within emerging economies
- Sharing your experiences of the challenges experienced in-company or across-sector which have arisen in respect of data collection, analysis and sharing of process safety learning.
- Types of insights which would be most valuable to emerge from the work – for example what process safety questions would users most want answered from robust analysis?
- What type of sustainable model would enable the sharing of intelligence on a sustainable and user-friendly basis?