University of Bristol

Safety Systems Research Centre

Managing the Organisational and Cultural Precursors to Major Events - Recognising and Addressing Complexity

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Events in Different Industries

- There have been many organisational accidents and near-misses across industries such as petrochemical, nuclear, transport, major civil engineering projects, etc;
- Some have been during ‘normal’ operation, some during outages and some during one-off projects;
- Looking at these collectively/holistically allows us to identify event precursors. There are strong similarities between them and clear patterns of failure emerge;
- We will summarise some key findings and then discuss techniques that are being developed to address them more effectively;
- Events studied include the following:

EVENTS STUDIED

- Port of Ramsgate walkway collapse (UK, September 1994);
- Heathrow Express NATM tunnel collapse (UK, October 1994);
- Esso Longford gas plant explosion (Australia, September 1998);
- Tokai-mura JCO criticality accident (Japan, September 1999);
- Hatfield railway accident (UK, October 2000);
- Davis-Besse nuclear reactor incident (USA, February 2002);
- Columbia Shuttle disaster (USA, February 2003);
- Paks Nuclear Plant fuel cleaning accident (Hungary, April 2003);
- BP Texas City refinery accident (USA, March 2005);
- THORP Sellafield reprocessing incident (UK, April 2005).
- Buncefield Explosion (UK, December 2005)
- Nimrod Aircraft Crash (Afghanistan, September 2006)

IDENTIFIED KEY ISSUES

1. Leadership issues;
2. Operational attitudes and behaviours;
3. Business environment;
4. Competence;
5. Risk assessment and management;
6. Organisational Learning;
7. Oversight and scrutiny; and
8. Communication.

Examples will now be given of ‘Findings’ in two areas

ORGANISATIONAL LEARNING (I)

Most events can be avoided if learning opportunities are acted upon – but failures to learn are recurrent.

- Reporting and follow-up systems were deficient (staff pressures, blame culture etc);
- Failures to investigate previous events (precursors) and/ or to address real root causes;
- Learning from previous events (internal or external) had been ‘lost’ (corporate memory) or ineffectively communicated and followed up

ORGANISATIONAL LEARNING (II)

- The workforce were not aware of the potential impact of poor practices/failed equipment etc;
- A ‘narrow’ view taken of learning opportunities (too easily dismissed as ‘not relevant to us’);
- Involvement in learning and improvement through team- and self- reviews was not encouraged (peer review);
- In many cases, organisational barriers (silos) inhibited mutual learning.

How can we best structure and use this knowledge to support

Sustainable Safety Cultures?

What Can We Do With These 'Common' Findings?

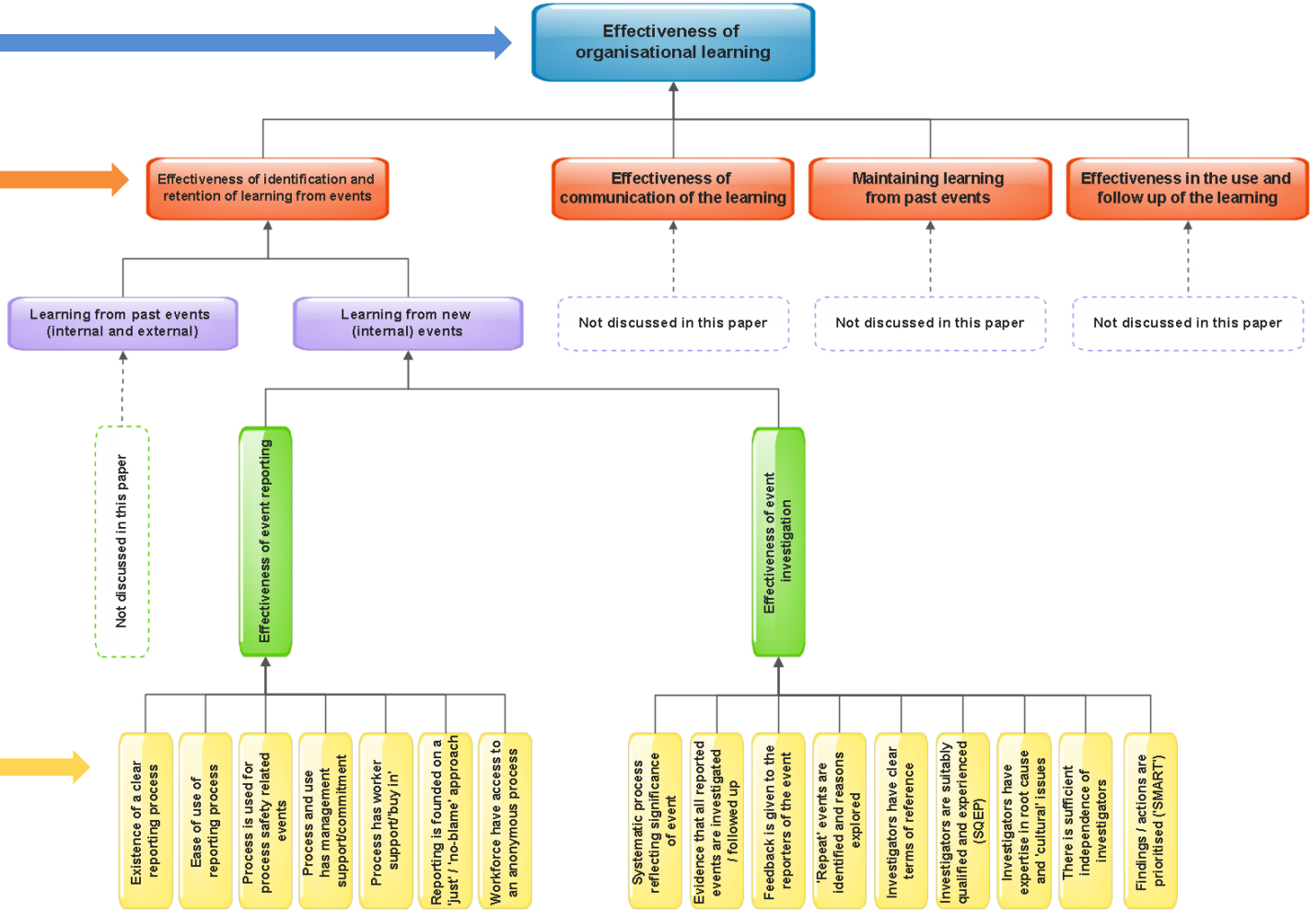
- **Raise awareness** of these often common repetitive precursors;
- Equip/encourage new **event investigations to go deeper** than some do currently;
- **Review** Corporate or Regulatory 'Requirements/Objectives';
- Use them to probe deeper into the way the organisation actually performs and responds to 'Objectives' (**condition monitoring**);
- Develop a **systematic approach** (akin to use of PRA for engineering and HF factors) – **Hierarchical Process Modelling**, and
- Provide new techniques to take a **systems view** of performance and the impacts of potential changes (**flight simulation**) – **System Dynamics**.

HIERARCHICAL PROCESS MODELLING (I)

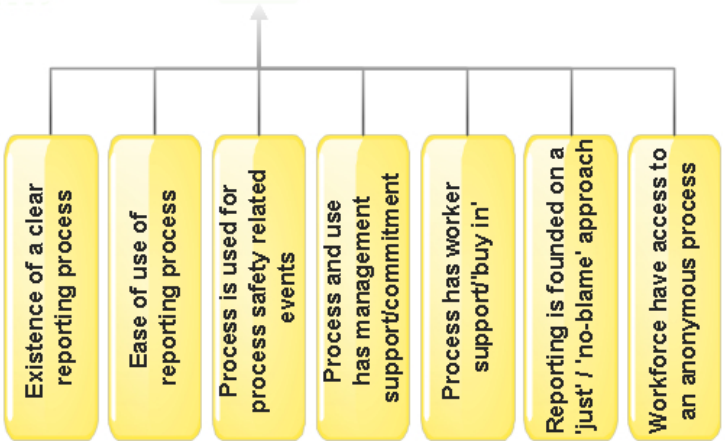
Key Issues

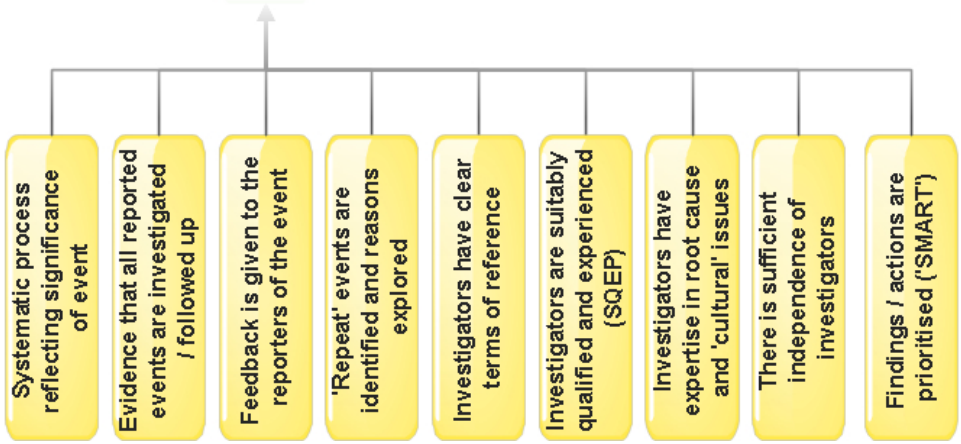
Necessary Processes

Probing Questions



HIERARCHICAL PROCESS MODELLING (II)





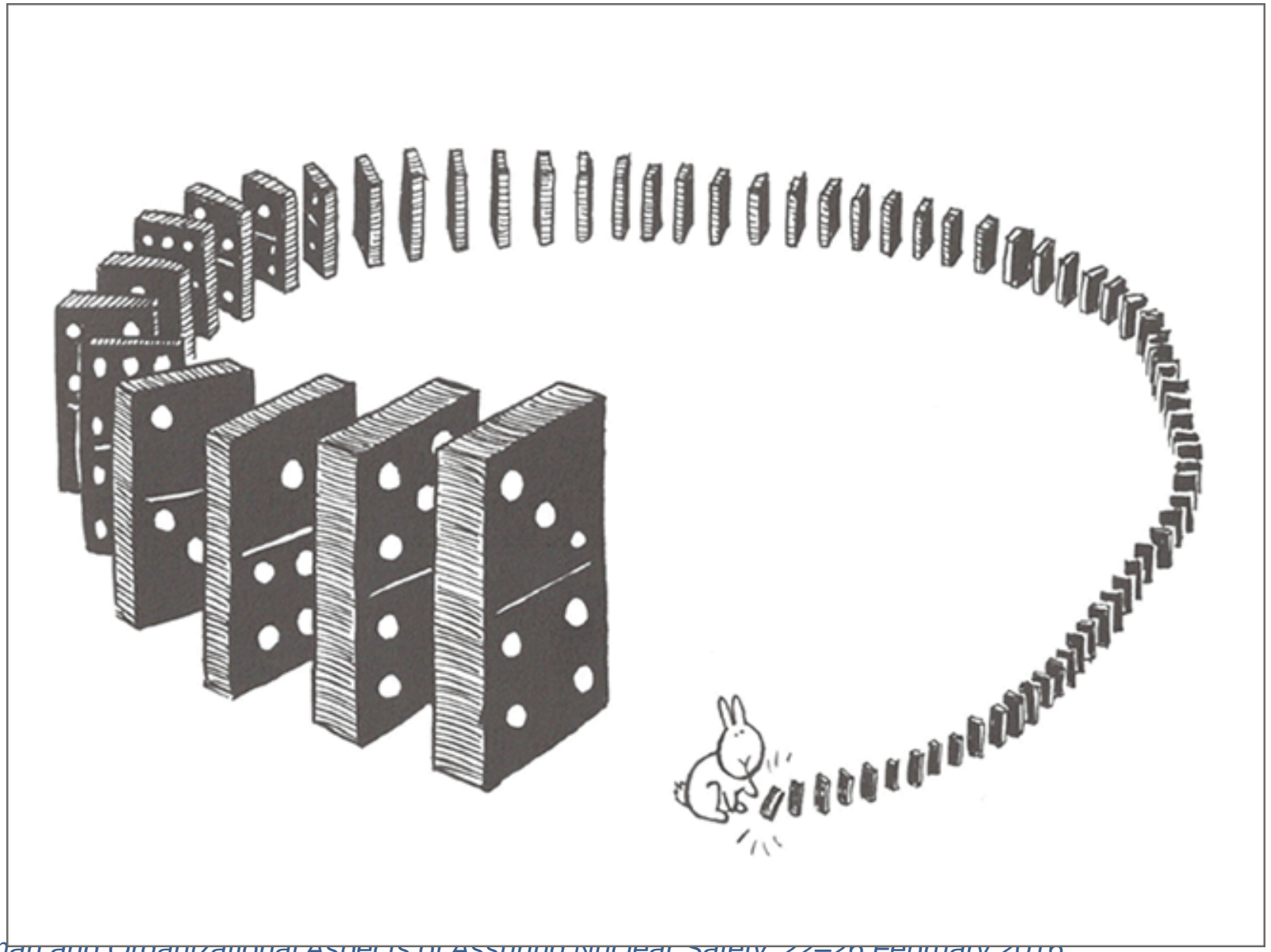
These issues do not exist in isolation from one another – although HPM is a valuable approach, patterns of failure and unintended consequences mean that a systems approach needs to be taken.

*"A **system** is a set of parts which, when combined, have qualities that are not present in any of the parts themselves. Those qualities are the **emergent** properties of the system."*

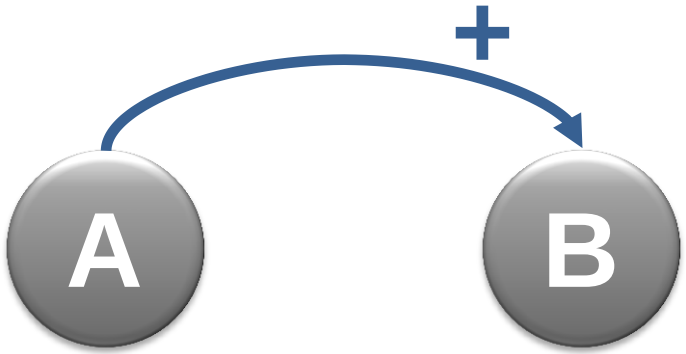
Royal Academy of Engineering (2007)

Creating systems that work: Principles of engineering systems for the 21st century

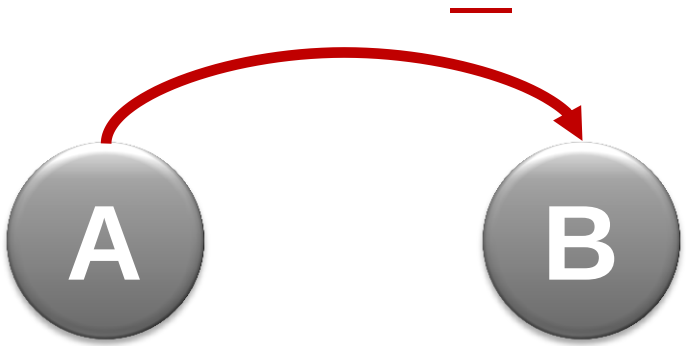
DOMINO EFFECT - UNINTENDED CONSEQUENCES!



CAUSAL LOOP DIAGRAMS (I)



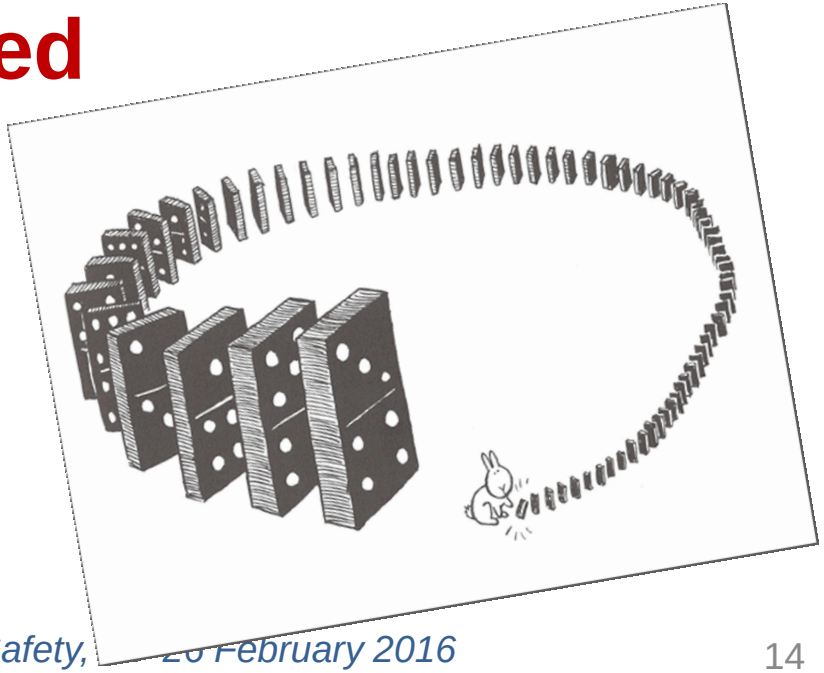
- If A increases, B increases
- If A decreases, B decreases



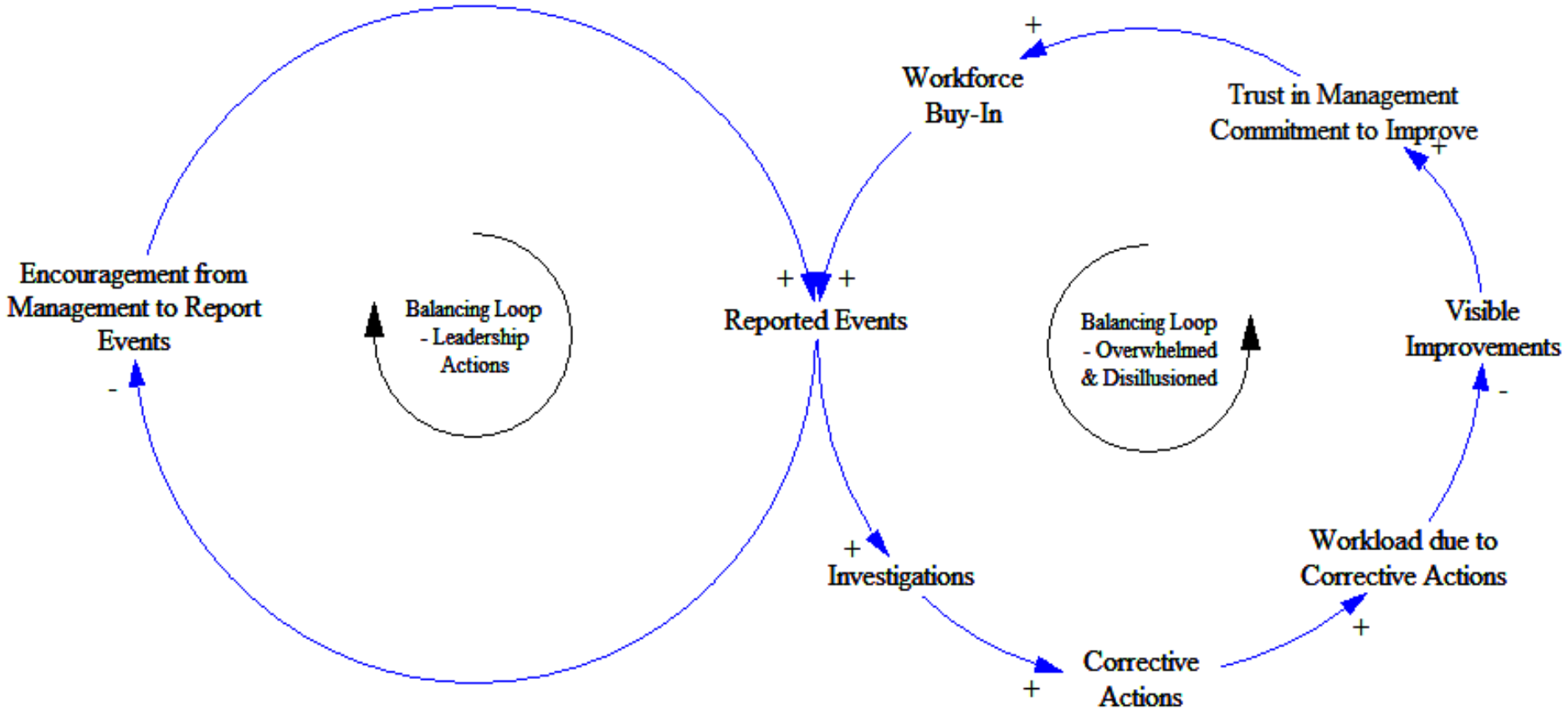
- If A increases, B decreases
- If A decreases, B increases

CAUSAL LOOP DIAGRAMS (II)

This allows for feedback to be taken into account and enables complexity and dynamic factors to be addressed. Unintended consequences of actions and better performance indicators can be identified

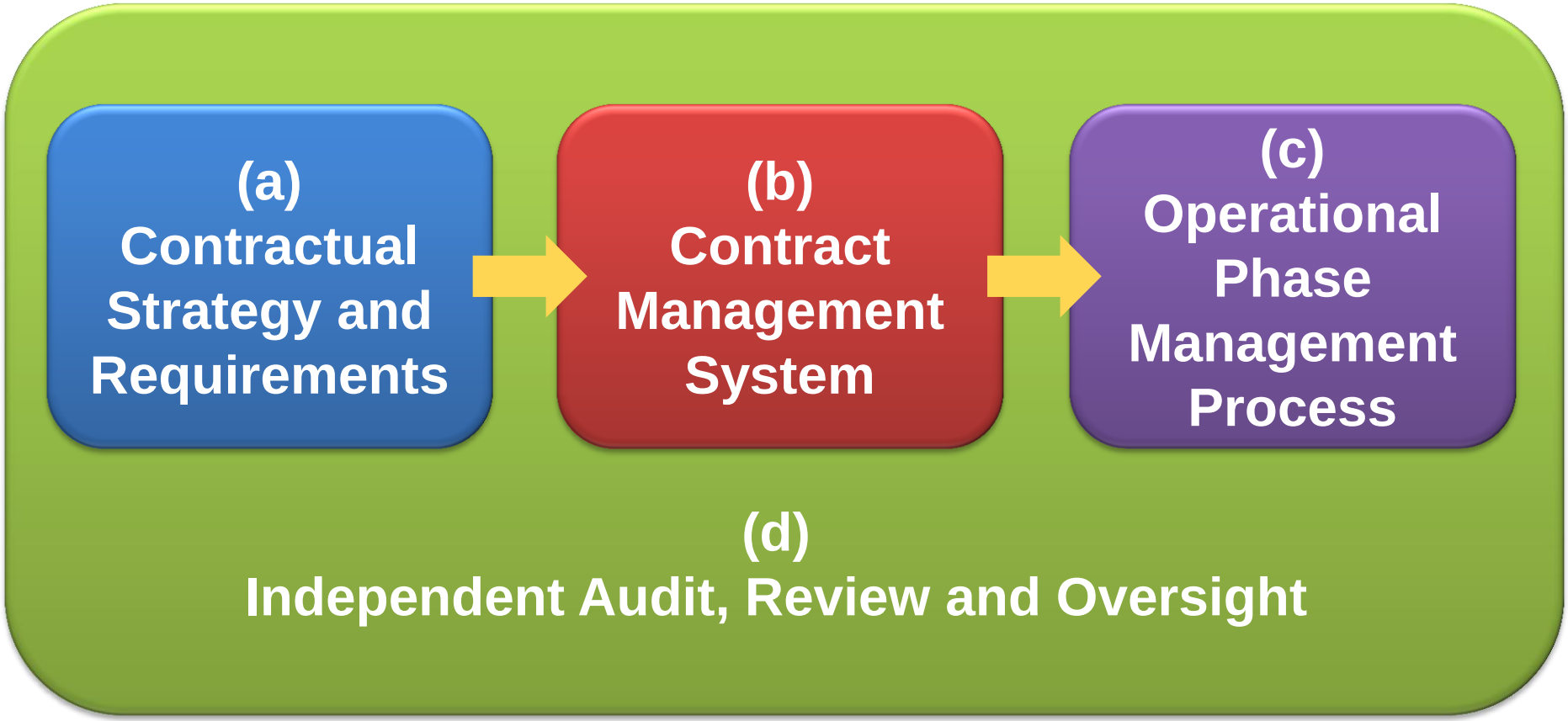


A simple example relating to 'event' reporting



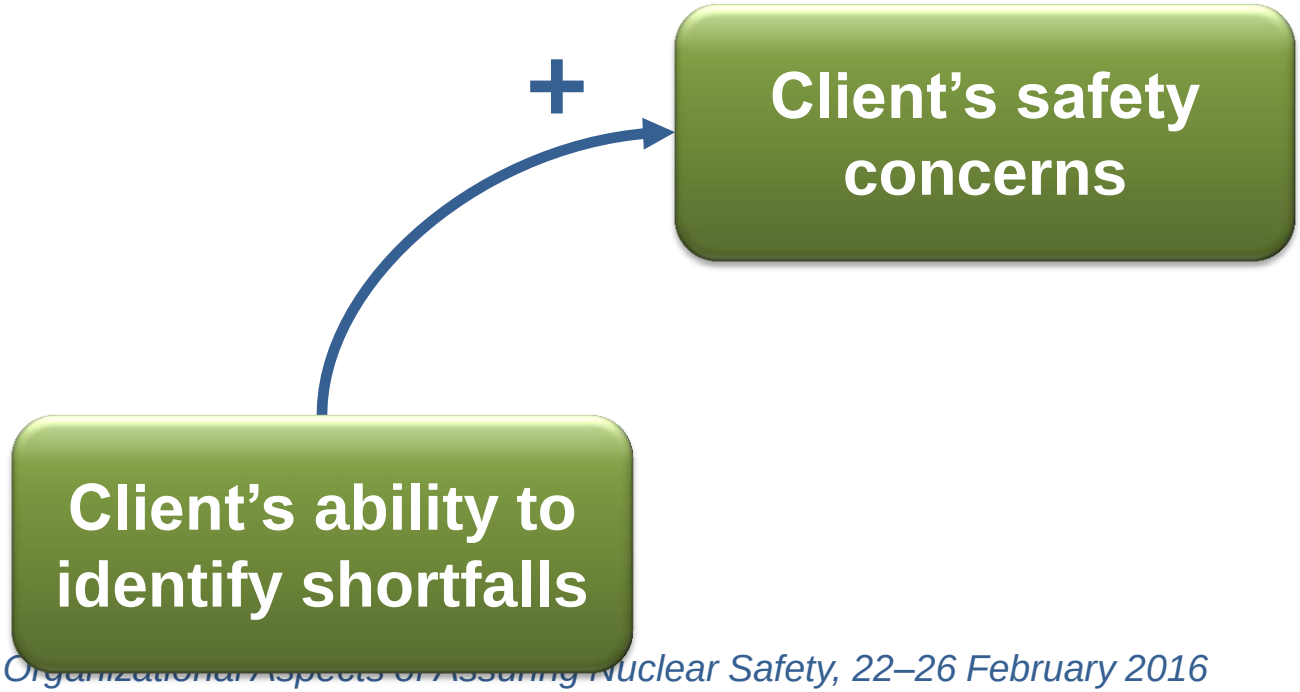
EVENTS INVOLVING CONTRACTORS (SUPPLY CHAIN)

THE CLIENT-CONTRACTOR INTERFACE (I)



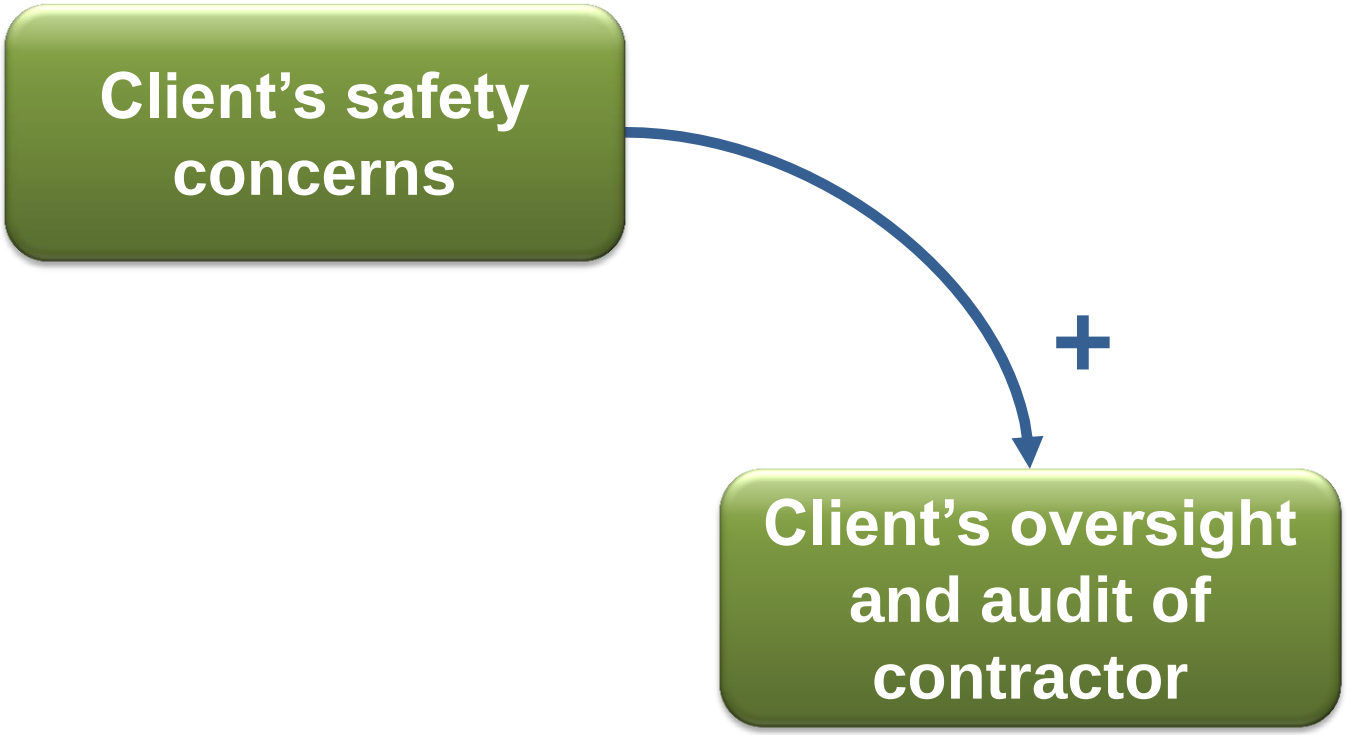
For example:

"The clients ability to identify shortfalls in the contractors work will affect their level of concern"



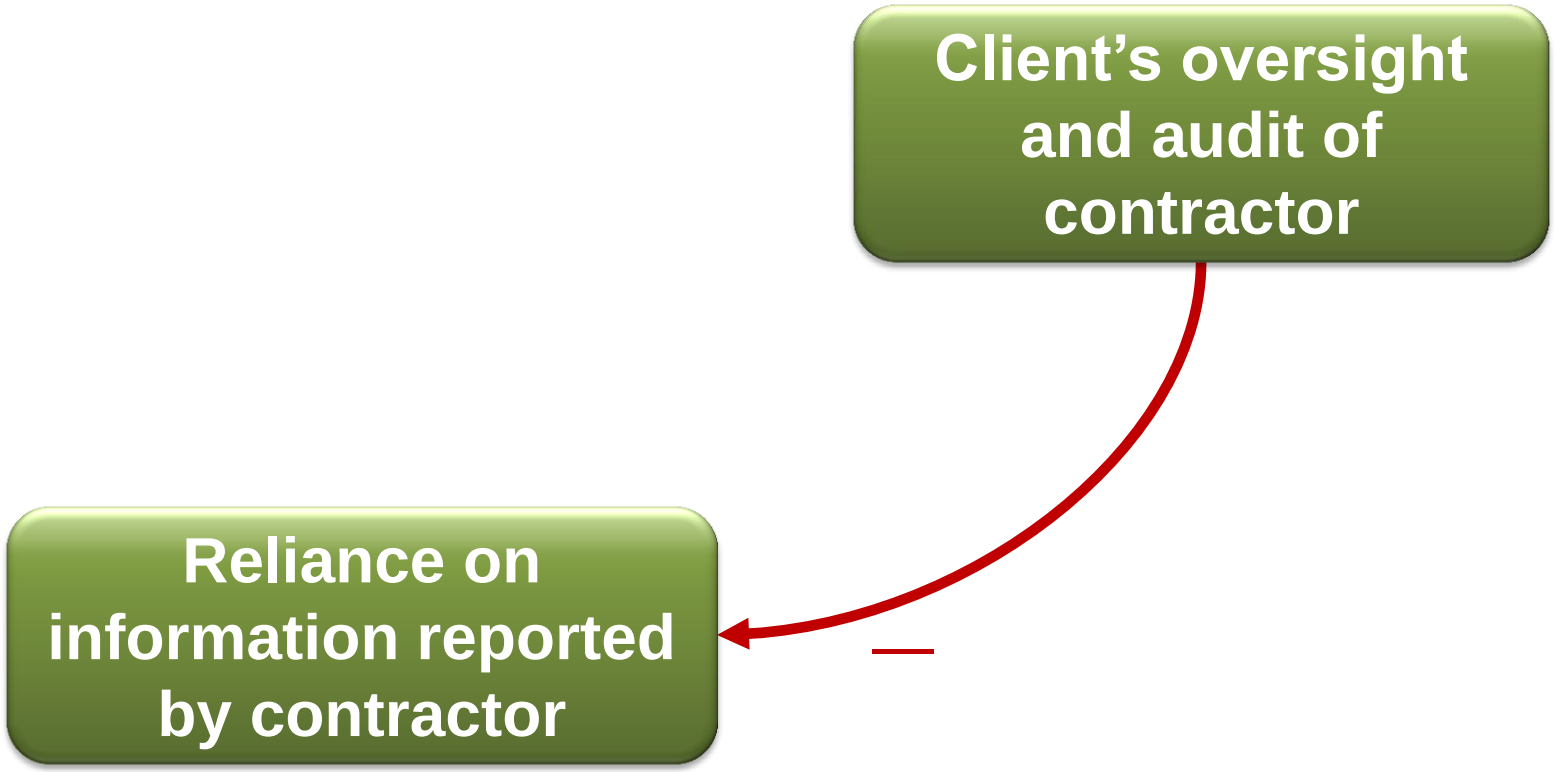
THE CLIENT-CONTRACTOR INTERFACE (III)

"*The amount of active oversight of the contractor may depend on how concerned the client is with the safety of the operation*"



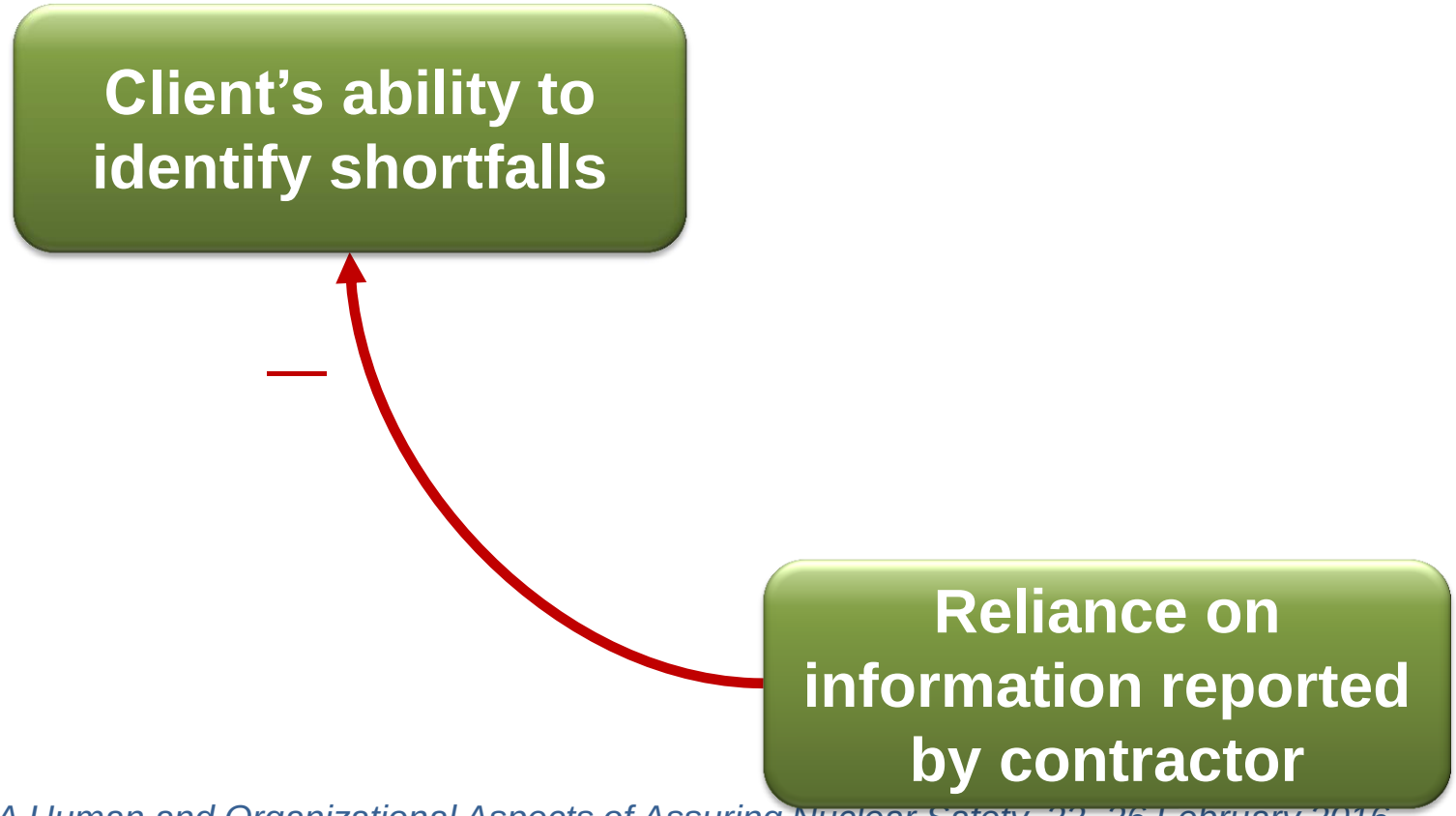
THE CLIENT-CONTRACTOR INTERFACE (IV)

"*The less active oversight there is, the more the client has to rely on what the contractor is reporting to them.*"

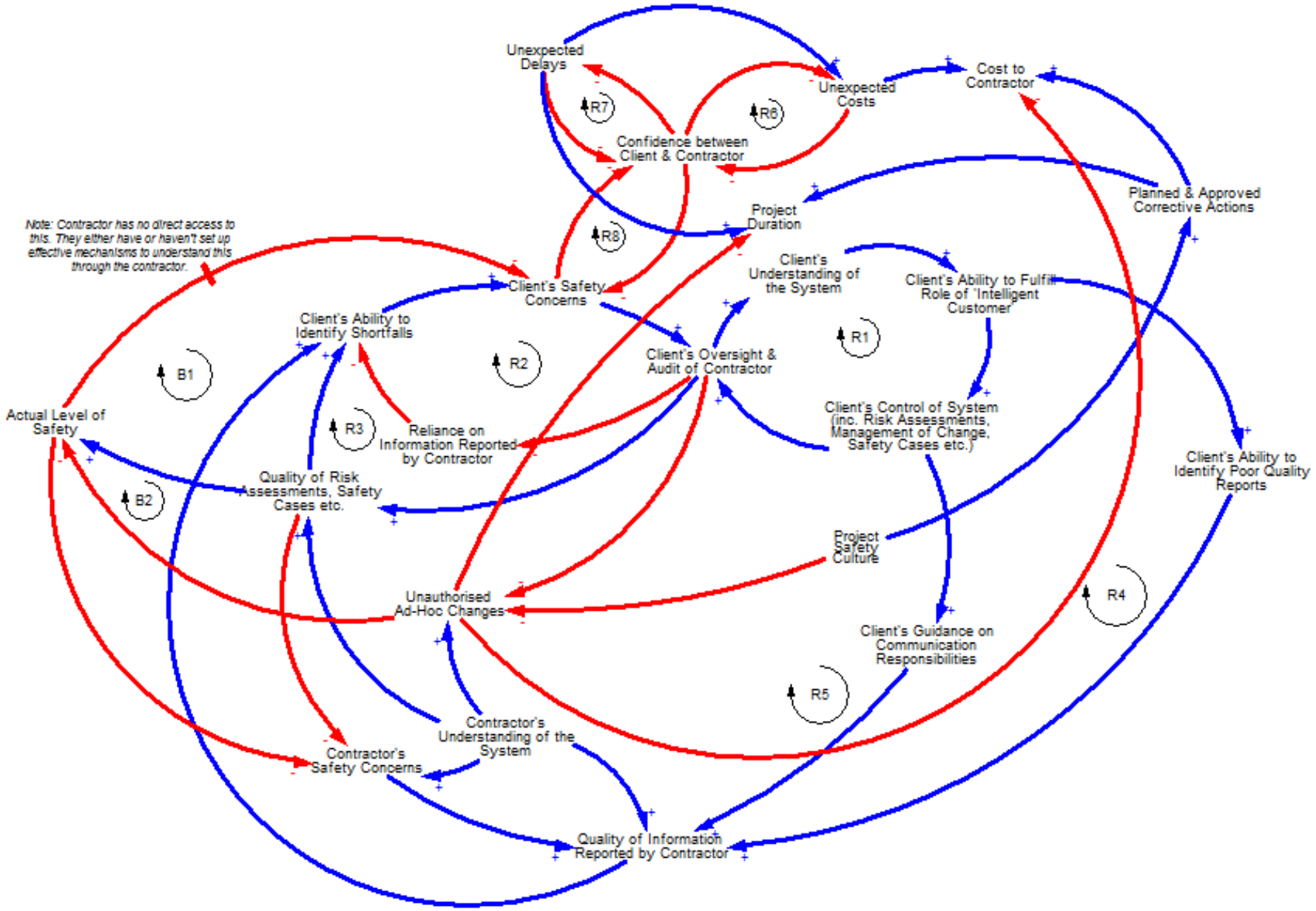


THE CLIENT-CONTRACTOR INTERFACE (V)

"*Relying only on reported information could result in an incomplete view of the system*"



THE CLIENT-CONTRACTOR INTERFACE (VI)



CONCLUSIONS

- The study of 12 major events across several technologies shows that there are many common organisational and cultural precursors. These have been categorised under eight ‘generic areas’
- Many of the findings ‘align’ with our identified safety culture improvement requirements, demonstrating again how these are vital components of minimising major events. Our study aims to raise leadership awareness.
- We are developing techniques (working with industry) to take a more systematic approach to using the findings (‘condition monitoring’ and ‘flight simulation’).
- Systems Theory provides ways in which we can understand the underlying complex networks which influence behaviour.
- Working with several industries (including nuclear), further research is planned – including examining common ‘patterns’ of failure such as the supply chain example given here. This should enable the often complex impacts of improvement actions to be assessed and allow better planning processes and performance indicators to be developed.

Thank you

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For more details on the event analysis see:

http://goo.gl/**EG5xKP**

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