Accident Investigation and Safety Culture Event Report

The 'Accident Investigation and Safety Culture' webinar was held online on the 27th April 2022 by the Safety Culture Working Group. The event opened with Mike Parsons welcoming delegates and gratefully thanking our speakers. Michael Wright, Chair of the Safety Culture Working Group, reports on proceedings.

The event had several themes, including:

- Does learning from accidents support the improvement of safety performance?
- How can you encourage learning from incidents and accidents?

These themes were set in the context of "Safety II" that addresses criticisms of what is characterised as "Safety I" including that:

"… seeing deficiencies in hindsight does nothing to explain the generation or persistence of those deficiencies. " [1]

"I would be delighted if Root Cause Analysis would disappear, but I am not very optimistic. The simplicity of the method and the thinking behind it is too attractive to be overcome by sound arguments against its practical value."

Erik Hollnagel, Safety Management Trend Report 2017.

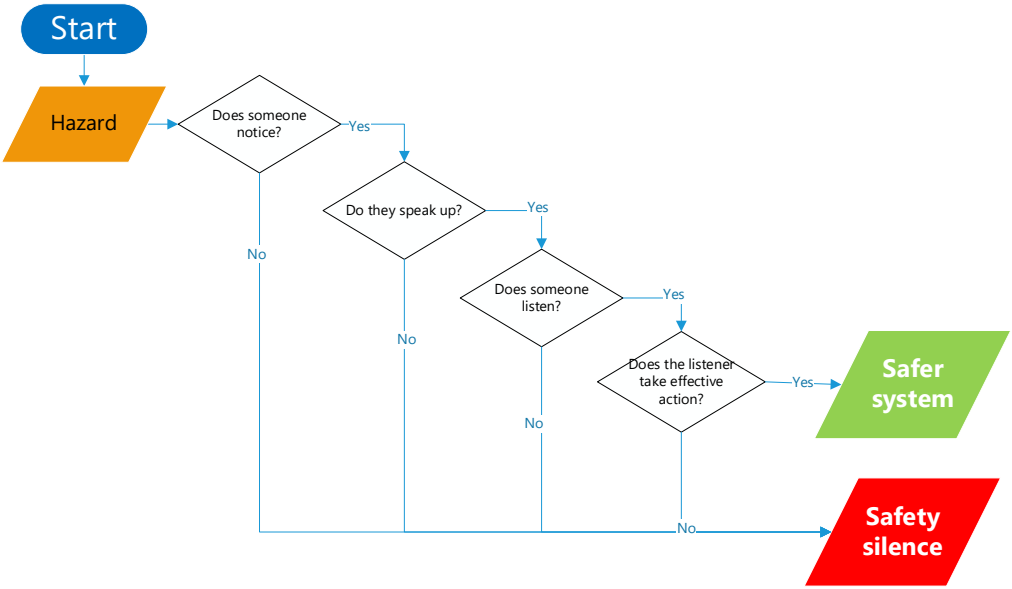
Overcoming a culture of safety silence to prevent accidents

Catherine Baker, Director of the Confidential Incident Reporting and Analysis Service (CIRAS) kicked off with an excellent talk on why people can remain silent about safety concerns and how this may be overcome, especially through confidential reporting. Catherine commenced with a musical reference to Simon and Garfunkel's "The Sound of Silence", particularly the lines:

- People talking without speaking
- People hearing without listening
- And no one dared
- Disturb the sound of silence
- Silence like a cancer grows
- Hear my words that I might teach you

A very engaging reference and poignant link to her talk.

Catherine went on to cite some incidents where someone knew that something could happen, including visible erosion that led to a train derailment, a ship taking a turn too fast and a worker habitually breaching safety rules. In all cases there was "endemic silence". This was built upon by a film of a worksite at which a person fell from scaffold, where 66 people either fail to notice or mention the visible unsafe conditions. Catherine presented an anatomy of silence, shown below. In this model, if someone notices and speaks up, this helps recognise and act on unsafe conditions. Clearly if someone fails to speak up, an unsafe condition may persist. Catherine drew out many factors that can contribute to silence, such as fear of adverse reactions, large power-distance relationships, and a sense of individual vulnerability.



Catherine highlighted several methods for overcoming a culture of silence, including:

1. Overcoming fear of:

- Reprisals
- Peer reaction
- Being incorrect
- Not being listened to
- Damaging relationships

2. Closed loop guarantees:

- I get to see what action is taken
- I can challenge back if the action has missed the mark

CIRAS provides one means by which these fears can be overcome. It provides a confidential reporting process. Catherine was also confidently able to cite many examples where CIRAS had linked reports back to the responsible organisations, leading to safety improvements. This recognises the importance of people being able to see that action is taken in response to their concerns.

Discussion explored several points, including why organisational cultures may create endemic silence and why there is a need for confidentiality. It was also discussed whether CIRAS is a reactive approach to safety improvement – the answer being that by reporting concerns early on, this prompts improvements that prevent the accident from occurring.

Nuclear Safety Culture: From the biggest accident that never was (Davis-Besse) to the realities of building the first new nuclear plant in a generation

Tom Hughes (Nuclear Safety Culture Lead at Hinkley Point C) talked us through the 'biggest accident that never was' – at a plant called Davis-Besse (shown on the right here) in the USA in 2002. Severe corrosion was discovered on the reactor pressure vessel that put the plant in grave danger. Minor leakage of coolant corroded the carbon steel head. Over time, a cavity formed around the control rod. The cavity was discovered when someone touched the rod and it leaned over. This condition had been developing over years and the warning signs were there. The first warning of potential corrosion was issued in 1988, a leak was spotted in 1991, with further leaks in 1992-96, none of which were adequately investigated. Concerns were raised about inadequate cleaning in 2000.

Reflecting on the lessons learned from this near-miss, the talk considered the challenges surrounding developing and embedding a robust safety culture on the largest construction site in Europe, Hinkley Point C. The challenges include:

- Construction mindset
- Complex contracting model
- Enabling senior leadership engagement
- Large number and high "churn" in staff

A successful response to these challenges entailed a multi-faceted strategy illustrated in the figure below. Key aspects include: encouraging learning about nuclear safety, influencing the supply chain, improving awareness of the link between safety and quality and pushing the importance of safety from the top down.

The strategy includes clear elements of reporting and sharing learning. Again, this highlights the importance of facilitating an open and learning culture.

Discussion highlighted how EDF has engaged the supply chain, many of whom had no nuclear safety experience, in the principles of nuclear safety.

Organisational influences on safety: RFA Argus – Wildcat Case Study

Cdr Steve Gamble provided a gripping summary of a series of aviation accidents. By using a case study from a Wildcat helicopter incident in 2017, he used this 'near-miss' to provoke debate and highlight some of the long term organisational and human behaviours which may adversely influence safe operations.

The helicopter attempted to take off while only one of two sets of engines were engaged. The crew recognised the problem and landed back on the edge of the deck.

This occurred during an extended 14-day training period, where multiple crews performed flights under supervision of instructors, including night flights.

The investigation determined that there was a higher than standard ratio of students to instructors, and use of less experienced crew than the norm. At the time of the incident it was thought that crew were fatigued, and distracted by events such as a delayed launch. There were five missed opportunities during take-off where the error could have been spotted by the crew. The design of the rotor controls did not meet good human factors, with the potential to overlook that the rotor engine settings were not both at the same position.

Concerns had been raised about the ratio of instructors to students in previous incidents. It was thought that the high ratio of students to instructors had become normalised. The discussion explored why lessons from previous incidents had not been carried forward, and why known shortcomings in training arrangements were tolerated. It was speculated that lessons learned had not been carried forward, possibly due to churn in personnel and the passage of time.

Just culture, psychological safety & facilitating learning from error

Michael Wright presented the findings from a review of research completed for the Energy Institute [2] into Just Culture and the concept of psychological safety. In contrast to Catherine Baker's talk, this one explored how to encourage openness within an organisation and overcome barriers to speaking up. The importance of an open culture was highlighted by the conclusions of the inquiry into the 2005 Texas City refinery explosion that said:

> *"BP should involve the relevant stakeholders to develop a positive, trusting, and open process safety culture within each U.S. refinery … establish a climate in which: workers are encouraged to ask challenging questions without fear of reprisal…"*

On a more positive note, a report from RSSB (2018) was quoted that said that over the last 15 years, a 90% reduction in SPADs (Signals Passed at Danger) has been seen in the rail industry and they attribute it, in part, to an "open and mature safety culture".

The presentation went on to first define Just Culture as *"An atmosphere of trust in which people are encouraged (even rewarded) for providing essential safety-related information, but in which they are also clear about where the line must be drawn between acceptable and unacceptable behaviour."* [3] It went on to cite research that reported a mixed impact of implementing Just Culture. While some studies cite increases in reporting of errors and near misses and decreases in the number of respondents who reported feeling fearful of reporting, others reported little evidence of an upward trend in non-punitive responses to error and little evidence of improvement in safety performance. This was thought to be related to a fear of adverse consequences, especially for 'blame worthy' vs 'blameless' acts.

It was noted that some businesses had reformulated the 1997 version of the Just Culture culpability decision flow chart, to focus on the role of organisational culture in violations and the individual's intent. In practice, most violations are prompted by an "organisational optimisation" motive and action should focus on the organisation rather than blaming the individual.

The talk went on to define psychological safety as "A shared belief held by members of a team that the team is safe for interpersonal risk taking" [4] and contrasted it with Just Culture. It drew out some parallels, such as both aiming to learn from error. Psychological safety was said to focus more so on individual and team factors that may inhibit people, such as being a new employee, and how psychological safety may be facilitated by actions such as:

- Team building (developing trusting interpersonal relationships)
- Having (inclusive) leaders and role models facilitating learning through adoption of a set of supportive behaviours, accessibility, neutral language and positive reinforcement
- Providing assurance of no adverse personal consequences from reporting error
- Demonstrating the value of speaking up by acting effectively on feedback and reporting actions back to people

Error needs to be seen by the team and the organisation as a learning opportunity; and a shared experience about what works and what does not work. Learning from error is a collective responsibility aimed at performance improvement.

The concept of an error management culture was cited, quoting Guchait et al. (2014) [5]. Error management culture *"involves organizational practices related to communicating about errors, sharing error knowledge, quickly detecting and handling errors, and helping in error situations."*

The discussion explored the importance of an open culture in recognising and acting on safety concerns but also in helping to solicit new ideas to improve safety performance, especially in hierarchical organisations with high power distance relationships.

Learning from recent major accidents

There was a robust discussion about the Boeing 737 MAX and VSS Enterprise crashes facilitated by Michael Wright and Mike Parsons, focusing on the role of safety culture in these incidents and the value of learning from events. In both cases, single point failures with potential catastrophic consequences were tolerated within the design.


In-Flight Breakup During Test Flight
Scaled Composites SpaceShipTwo, N339SS
Near Koehn Dry Lake, California
October 31, 2014

aviation

Aerospace Accident Report

NTSB/AAR-15/02
PB2015-105454

National Transportation Safety Board

VSS Enterprise was the first SpaceShipTwo (SS2) spaceplane built for Virgin Galactic; it had a Feather flap assembly with twin tailbooms positioned upwards to stabilise attitude and increase drag on re-entry. These needed to be deployed (during ascent) by the time Mach 1.4 speed was achieved, so that the crew could abort before reaching Mach 1.8, thereby avoiding excessive speed on re-entry in the event that the feather mechanism did not deploy. This would give the crew a few seconds to be sure they could go supersonic.

The feather mechanism was deployed too early while still under rocket propulsion at Mach 0.8. The feathering mechanism then began moving due to aerodynamic forces on the tail and inertial loads, and the craft disintegrated. It was noted that the pilot had about 30 seconds to do three tasks from memory, while experiencing high acceleration and vibration which had not been replicated in simulator runs and of which they had no recent experience. There was no call and response system between the two pilots.

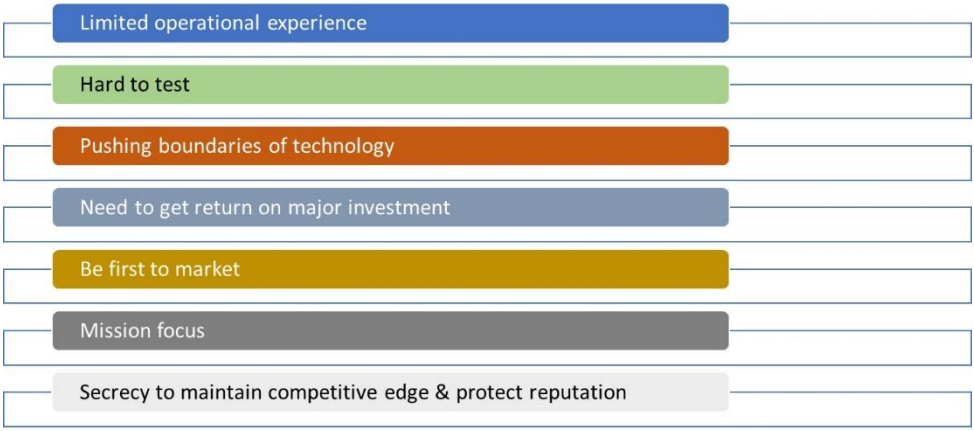
The Hazard analysis had not considered the possibility of error of premature unlocking of the feather mechanism, and it had been assumed that the pilots would always operate correctly due to their training and simulation runs. Despite failing to meet hazard analysis requirements, the Federal Aviation Administration waived the hazard analysis. The SS2 preapplication process began about 2 years before the developer submitted its initial application but after the vehicle had been designed and manufactured. The NTSB concluded that *"there was 'a lot of pressure, political pressure' to issue experimental permits, even when FAA/AST evaluators were uncomfortable with an application, which diminished AST's safety culture."*

The well-known Boeing 737 MAX accidents involved the automatic nose-down trim commanded by the Maneuvering Characteristics Augmentation System (MCAS) forcing two planes into dives. The accident investigation reported that:

- The FAA were largely unaware of an automated flight-control system that played a role in the crashes
- The FAA management overruled the determination of the FAA's own technical experts at the behest of Boeing
- Boeing employees cavalierly dismissed the FAA
- Boeing concealed crucial information from the FAA and pilots
- There was knowing reliance on a single sensor and automated activation despite reported concerns

It was also reported that Boeing had a business objective for the 737 MAX to not require any simulator training for pilots who were already flying the 737 NG.

It was suggested that in both cases, the development and regulation was impacted by a range of factors as shown in the figure below.



The discussion explored three questions:

1. What are the pressures on safety climate from developing new (expensive) technology?
2. How do you create an organisational climate that assures safety and adherence to recognised standards in the context of experimental and new technology?
3. Is there value in learning from accidents?

Delegates stated that it was clearly essential to learn from accidents. Indeed, it was noted that a different response to the first Boeing 737 MAX accident may have helped to prevent the second crash.

The discussion also explored how good safety culture can be eroded, with the suggestion that safety culture is fragile and may be adversely impacted by influences such as production and competitive demands.

As regards maintaining a safety culture during the development process, the role of a truly independent and effective regulator was highlighted. As stated by the NTSB chairman Christopher Hart in relation to the Virgin SS2 crash: *"Many of the safety issues that we will hear about today arose not from the novelty of a space launch test flight, but from human factors that were already known elsewhere in transportation".* This also highlighted the value of sharing good practice and lessons learned between sectors.

The discussion concluded that it is unclear how a business may mitigate pressures on its culture and avoid erosion of a good safety culture. This was thought to be a good topic for a future event!

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