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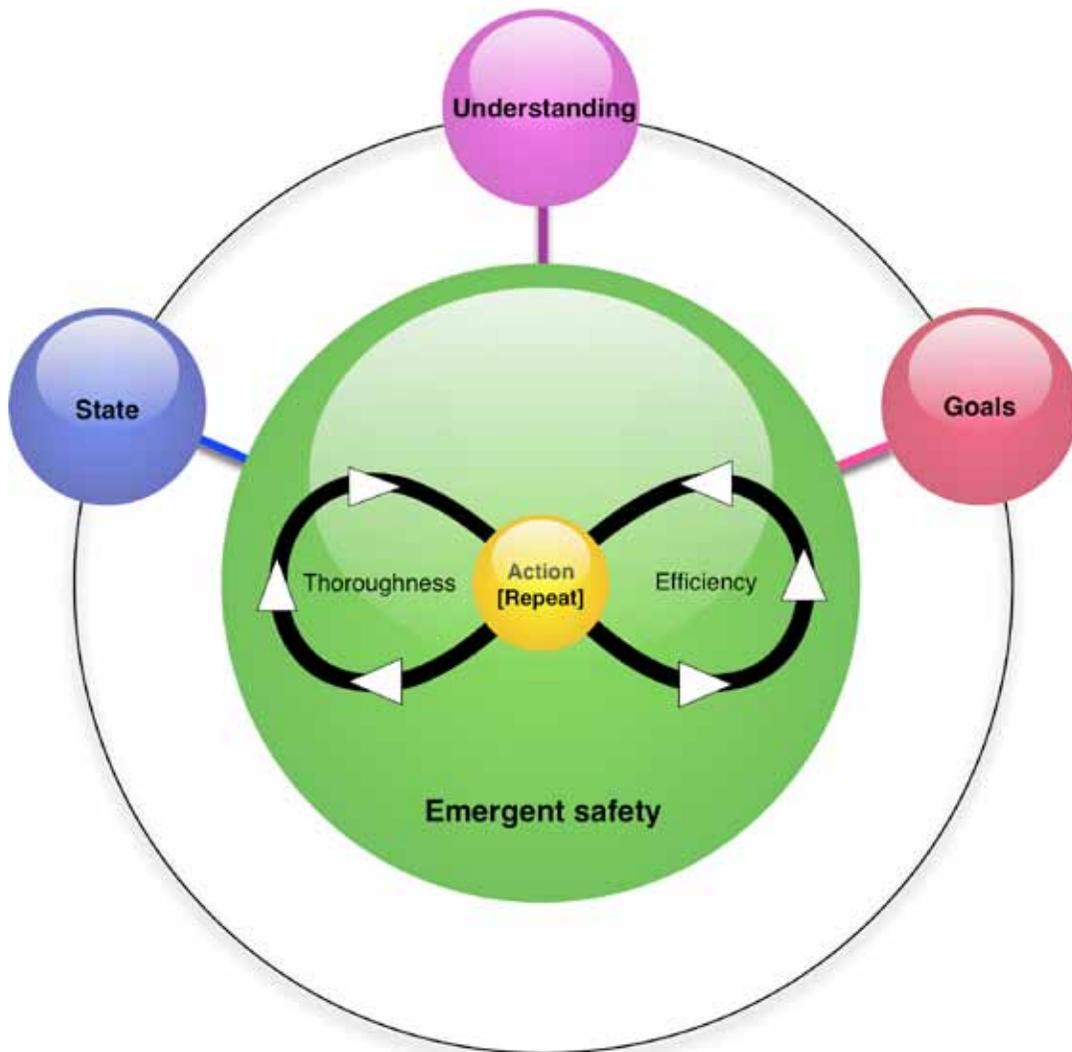
# Utilising mindset

How to learn from what happened

Dik Gregory and Paul Shanahan

gs partnership ltd

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**SUGAR** *A model of purposeful human action in complex, adaptive systems*

In this position paper, we show how the powerful, but illusory nature of hindsight must be enhanced with mindset analysis if organisations are to draw meaningful lessons from their investigations of things that go wrong.

*Mindset analysis is based on a model of purposeful human action in complex, adaptive systems, in which a cluster of ever-changing influences on human behaviour constantly impact upon our trade-off decisions.*

The result of using mindset analysis is that different kinds of lessons can be learned. Instead of shaping people's behaviour to avoid future blame, attention is focused on how to increase future organisational resilience.

While our knowledge of safety is an important input to our behaviour, safety itself is better construed as an organic output from our behaviour, that emerges from informed trade-offs in time-constrained operational settings.

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## GETTING STRONG FROM THINGS THAT GO WRONG

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### What is mindset analysis?

Mindset refers to a person's predominant set of attitudes, beliefs and expectations, all wrapped up in their theory about the way the world works. It is mindset that helps people expect particular events, direct their attention to what seems to be important, and make sense of what their senses tell them.

Mindset analysis is the name we have given to a four-step process (explained later) designed to establish the influences on people at the time they take a decision that, with hindsight, is deemed to be significant. We propose mindset analysis as an important enhancement to incident investigation.

At the point of a decision, hindsight is (by definition) never available to the decision maker who is immersed in the flow of operational activity. What is available is the decision maker's ongoing sense of the 'story' they have created to provide meaning to the events around them and the role they are carrying out. Mindset analysis is a systematic process for eliciting and understanding the decision maker's 'story', how that story came about, what the alternatives were at the time (if any) to the decision taken, and what the learning implications are for the organisation.

*"A root cause is the contributing factor that you are working on when the money or the time runs out"*  
Jim Reason

### Why do we need it?

The standard approach to incident investigation involves establishing a clear timeline of the key moments, actions and decisions in order to determine the contributing factors and root causes that led to the observed outcome. All of this is

established very usefully with hindsight. Unfortunately, and by definition, hindsight is always unavailable to the participants at the time of an incident. In fact hindsight is an illusion arising from a deterministic view that the world works by linear casual connection. You can find out more about hindsight and complexity in the panel at the end of this paper, *What is complexity and why can't hindsight cope?*

Mindset analysis has two important benefits.

**First**, it allows a safety-critical organisation to deal properly with the fact that is a complex, adaptive system where incidents are usually non-linear rather than causal, and safety is created by people's behaviour rather than by management demands.

**Second**, it helps the organisation to win the hearts and minds necessary to establish honest and open reporting. Open reporting is a known pre-requisite for making progress towards an effective safety culture that is based on responsibility and 'justness', rather than being seduced by blame and its avoidance.

### How can we do mindset analysis?

#### *People trade-off efficiency with thoroughness*

First a bit of essential background. The diagram on the cover of this paper depicts human action as a trade-off between efficiency and thoroughness<sup>1</sup>. It captures the idea that at each moment, busy people engaged in purposeful work try to act as efficiently as possible, but with sufficient thoroughness to ensure that they achieve their objectives without wasted effort.

It is not possible to maximise efficiency and thoroughness at the same time since increasing efficiency (ie saving time, energy, materials or money) will always take time or attention away from the checking and auditing required to guarantee effectiveness and/or safety.

Given that people need to make constant trade-offs between efficiency and thoroughness, the question arises as to what factors influence their trade-off decisions, moment by moment.

#### *What influences our trade-offs?*

Our diagram shows three key sources of influence for trade-off decisions. It is these three sets of influences that help generate the name of the model – SUGAR – as follows.

- o **State** – refers to the sum total of our current temporary state (levels of fatigue, stress, health, emotions, level of interest etc) together with our more permanent state (our personality, and long-standing cultural and ethnic backgrounds etc).
- o **Understanding** – includes the technical, social and cultural knowledge that allows us to carry out our tasks – often as team members – within the prevailing rules, regulations, procedures and social norms of our operational settings. Crucially, our knowledge and interpretation in these areas is governed by a large range of perceptual and cognitive biases that exert huge influence on our ability to make sense of things and to decide what is relevant (see panel, *Bias? What bias?*).

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<sup>1</sup> Introduced by Erik Hollnagel in *The ETTO Principle: Efficiency-Thoroughness Trade-offs - Why Things That Go Right Sometimes Go Wrong*, Ashgate, 2009.

### Bias? What bias?

Type "list of cognitive biases" into Wikipedia and you get over 100 sources of bias that research has shown influence the way we think and perceive.

For example, we are prone to see what we expect to see and fail to pay any conscious attention to most information that is available. We are happy to jump to conclusions with scant evidence. We routinely base judgments on irrelevant information. Having arrived at a decision, we are very reluctant to change our minds and maybe lose face. We assume others around us know what they are doing and tend to go along with them. We easily convince ourselves that past events were predictable in principle. And we tend to seek information to confirm we are right – which is usually a lot easier than testing why we might be wrong.

The list of ways in which our perception and thinking can be apparently hi-jacked is long. They are always there though, and always in operation. Research has also shown that they are much easier to spot in others than in yourself.

- o **Goals** – the aims we have, including our personal goals, our operational targets, and our organisational objectives. What these are, how clear we are about them, how conflicting they are and how we balance them will also affect our judgments of what is most important or most relevant at any particular moment.
- o **Action** - the action or decision that flows consciously or unconsciously from the juxtaposition of state, understanding and goals at each moment. Each such action constitutes the trade-off that makes most sense to the decisionmaker "all things considered".
- o **Repeat** - an acknowledgement that, having completed, the cycle begins again, seamlessly connecting our actions and decisions moment by moment. More accurately, what happens is a Recursion rather than a Repetition. Recursion is more appropriate since it allows for the fact that the world is forever changed by the influence of each successive action.

### General method

Mindset analysis involves using the three sources of influence (S,U,G) above to generate questions designed to tease out the context of the decision maker at the moment a key decision or action was taken.

Key decisions can usefully be established by a hindsight-based narrative analysis. This kind of analysis is what happens anyway in a typical accident investigation.

Ideally, the target for the questions should be the person who made the decision or action. Tragically, this will not always be the possible and in these circumstances, mindset questions should be discussed with other key witnesses and/or experts who are able to immerse themselves into the scenario.

Scenario immersion requires personnel who not only have a similar level of technical expertise as the original decision maker, but who are also (able to become) familiar with company practices and culture, and are able to use the mindset questions to gain an insight into the dynamics of the situation faced by the original decision maker.

### Four key steps for Mindset Analysis

The general procedure for mindset analysis as part of an incident investigation involves four analytic steps:

- 1 **Narrative analysis** – to establish the facts and chronology of the incident with the benefit of hindsight
- 2 **SUGAR analysis** – to establish witness mindsets at key moments of the incident
- 3 **Resilience analysis** – to establish the degree of organisational brittleness associated with the witness mindsets described, and to identify opportunities for improving organisational resilience
- 4 **Accountability analysis** – to establish a fair-minded share and spread of accountability for witness mindsets in the context of the organisational brittleness established in the previous step.

The output of mindset analysis is a rich picture of the reasons and purposes for each significant decision or action. The picture is rich because there may be several reasons and purposes for each decision. But it is even richer than this, because mindset analysis captures the reasons for the reasons and the purposes of the purposes and so on. In this way, the rationale for each decision is captured in terms of the decision maker's basic assumptions, resources, beliefs and values at the time.

Examining these assumptions for their organisational implications produces opportunities to go beyond the traditional recommendations of incident investigations. Instead of new rules, procedures, training and information campaigns, opportunities are revealed to address areas of *organisational brittleness*, where margins of manoeuvre have been eroded and the system is operating with insufficient degrees of freedom.

Such areas generally require interventions aimed at increasing resource or reducing demands somewhere in the system – but not necessarily at that point in the system occupied by the decision maker at the centre of the incident.

The four steps are summarised in the panel above and spelt out in a bit more detail below.

### Step 1 Narrative analysis

The first step is to create a narrative – the story – of the incident. This step is already a normal part of current incident investigation and involves interviews with as many witnesses as necessary, together with other investigations (eg of equipment, environmental conditions etc), in order to develop a comprehensive and factual account of the incident's timeline. The output from narrative analysis is the set of decisions or actions that, with hindsight, appear to be significant to the development of the incident.

### Step 2 SUGAR analysis

Each of the significant decisions identified in the Narrative analysis can now be subjected to a SUGAR analysis. With the focus on each of these decisions in turn, the relevant witness (or their stand-in) should be asked questions designed to establish the context and rationality<sup>2</sup> of their thinking at the time.

<sup>2</sup> The actions and decisions of people engaged in work may not seem rational in an absolute sense to an outsider who uses hindsight. How-

Examples of such questions are:

- o How far did you believe you had the knowledge & skills to solve the problem at the time – and why?
- o What were your goals at the time, how clear-cut were your priorities – and why?
- o How safe did you feel at the time – and why?
- o What sense of obligation did you feel at the time – to whom, and why?
- o How pressing did the problem seem at that time – and why?

#### Two kinds of why?

It is important to distinguish between two kinds of why? question.

One kind is concerned with reason in the sense of 'because': for example "I carried out a safety equipment audit because the daily orders said so".

The other is concerned with purpose in the sense of 'in order to': for example, "I checked the PTE in order to ensure it would protect me in the enclosed space I was about to enter."

SUGAR analysis is interested in capturing both. Reason-type answers indicate witness pre-occupations with, and responses to, pre-existing cues, conditions, and circumstances, while purpose-type answers point to witness considerations of future plans, ideas and expectations.

Whenever the witness can answer a why? question (of either type), they should be asked why? again until further answers are unforthcoming. Pursuing purposes reveals more and more about witness future expectations and planning, while pursuing reasons reveals more and more about witness assumptions and context.

For each response to a question (or a supporting probe), the witness should be asked why s/he has answered in that way (so as to provide rationale or evidence for their stated answer). See the panel, *Two kinds of why?* for further information.

The output of SUGAR analysis is a set of answers to the why? questions – the trail of reasons and purposes – for each significant decision or action explored. A good way of capturing this information is in the form of a mindset picture, such as an influence diagram or a mindmap.

#### Step 3 Resilience analysis

Studies of adverse incidents arising in complex, adaptive systems (see Panel, *What is complexity and why can't hindsight cope?*) show that they occur due to increasing brittleness – in which the organisation loses its ability to flex, or fails to retain sufficient degrees of freedom to deal with normal variations of performance between its interacting parts.

Such brittleness tends to arise for one of three main reasons:

- o *Loss of coordination* – in which different parts of the organisation pursue different goals, but there is insufficient

ever, it is always rational to people at the time with respect to what they know, think they know, and are trying to achieve. The goal of mindset analysis is to determine local rationality relative to their assumptions, and thereby, the reasons for those assumptions.

coordination between them – resulting in different parts of the organisation working at cross-purposes.

- o *Loss of margin* – in which a part of the organisation runs too short of essential resource to meet the expectations of its other parts – resulting in overwhelming pressure and burn-out.
- o *Loss of adaptability* – in which part (or all) of the organisation finds itself operating according to assumptions, rules and practices that were once pertinent, but from which the world has moved on – resulting in anachronistic (and often considerable) activity of dubious relevance.

The output of the previous Step 2 (SUGAR analysis) is a picture of witness mindsets expressed in terms of purposes and reasons, which show how these mindsets are connected to the organisational contexts that helped produce them.

Now, in Step 3, these mindsets must be reviewed in terms of the three sources of brittleness just outlined. Understanding the brittleness of the organisational contexts that produced the witness mindsets produced in Step 2 (SUGAR analysis) allows the organisation to focus on how resilience in these areas can be restored or increased. (See gsp position paper on *Developing resilience: what companies really need to measure*).

#### How can your organisation increase its resilience?

By addressing the following 12 questions for the three sources of organisational brittleness:

##### Loss of coordination

- 1 To what extent was this incident due to the failure of different parties to understand each other's objectives?
- 2 What were the coordination and communication failures that led to this incident? Where, when and why did these arise?
- 3 In what ways could the organisation change to eliminate the kind of coordination and communication problems that occurred in this incident?

##### Loss of margin

- 4 To what extent was this incident due to one or more parties operating at the edge of their ability?
- 5 How routine is it for these parties to operate in this way?
- 6 What are the sources of this pressure, how did they develop and over what period of time?
- 7 What action would senior management have taken about this loss of margin had it been pointed out before the incident occurred?
- 8 What is a safe and acceptable level of margin for these parties, and in what ways could the organisation change to create or restore it – without reducing the margin of manoeuvre for other parties in the system?

##### Loss of adaptability

- 9 To what extent was this incident due to the violation of everyday assumptions or common expectations?
- 10 How much of a surprise was the incident – who to, and why?
- 11 How well established are these assumptions and expectations – and how have they become so?
- 12 In what ways could the organisation change to both stimulate and listen to challenges about commonly-held assumptions and beliefs?

To do so, the mindset picture produced from the witness interview data should be considered in terms of the questions in the panel, *How can your organisation increase its resilience?*

#### **Step 4 Accountability analysis**

The result of Step 3 (Resilience analysis) should be a clear view of the degree of brittleness associated with the witness mindsets produced by Step 2 (SUGAR analysis), together with the identification of strategies for improving organisational resilience.

The purpose of Step 4 is to use the insights revealed by the preceding analyses to help consider how to apportion accountability for the incident. Apportioning accountability fairly is both a key purpose and a critical output of mindset analysis. If this is done unfairly, it is entirely counter-productive to the development of an effective reporting culture that learns to adapt towards optimal levels of safe behaviour. Instead, people simply learn how to protect themselves from blame and unjust punishment by developing defensive behaviour that masks the complex dynamics that are really responsible.

Unfair accountability happens when someone has responsibility, but insufficient authority to control the outcomes for which they will nevertheless be sanctioned. A common example is when following all the rules and procedures imposed by senior management will not get the job done and then being sanctioned for not following the rules in the event of an incident or failed safety inspection.

If people are made unfairly accountable, they will often respond in one of two ways. Either they try to transfer the responsibility to others eg by working strictly to rule even when it's clearly inappropriate or unhelpful (thereby transferring the responsibility to the rule-makers); or else (and more commonly), they operate two different work systems. Here, they may appear to be working according to laid down procedures eg by completing all the right paperwork (working hours logs, checklists etc), but actually carry out the work in a different, unauthorised way. If sanction threatens, they will seek refuge in the documentary evidence that they have created to mask their actual activities, and the organisation is blocked from real learning.

Fair accountability needs to take into account all those reasonings – and how they came about as exposed by SUGAR analysis – that created the prevailing mindsets significant to the incident. This is achieved by considering the degree of responsibility exercised by the witness in making the assumptions they did. Some of these assumptions will relate to witness trust in technology, or trust that their colleagues, managers and directors would carry out (or had carried out) their own responsibilities to the witness.

Judgment about witness responsibility comes down to these three considerations:

- o How consistent were all the witness assumptions with each other?
- o Was it reasonable for the witness to fail to challenge or repair assumptions that were knowably inconsistent at the time?
- o What did the witness actually elect to do, given the inconsistencies known at the time?

Judged this way, the action or inaction of all those witnesses implicated in the incident is held accountable by reference only to what it was they were reasonably responsible for, given their mindset at the time.

When accountability has been fairly made, any sanctions that follow will be seen by everyone in the organisation to be fair and justified. It will frequently be the case, however, that much responsibility for the incident cannot be laid at the door of specific agents and witnesses. This is because it is in the nature of complex, adaptive systems that adverse events arise due to unintended and unwanted consequences of unforeseen combinations of normal variations in performance, rather than causal chains involving failed components (see panel, *What is complexity and why can't hindsight cope?*).

It follows that much accountability for an incident rests in the organisation's failure to notice increasing brittleness and its resulting drift towards danger. For a discussion of what organisations can do about this, see gsp position paper on ***Developing resilience: what companies really need to measure.***

As a key enhancement to incident investigation, mindset analysis is not only aimed at bringing about a regime of fairer accountability, more open reporting, better organisational learning and increased safety. By focusing attention on areas of brittleness that are produced by variations of normal performance, the introduction of mindset analysis will also contribute to more fitting systems of governance that support the establishment of an intrinsically safer culture.

#### **What happens next?**

This paper presents the rationale and protocol for mindset analysis. Its further development will benefit from application to safety-critical incidents within organisations that wish to maximise their operational resilience.

We welcome opportunities to do this in order to refine and polish the technique.

With practical experience, we foresee opportunities to develop tools for supporting each of the four steps of the process, resulting in a significantly enhanced ability for organisations to learn and prosper from the things that go wrong.

Mindset analysis has been presented here as an enhancement to existing incident investigation processes. However, we also believe that the thinking behind the technique can be applied

to the development of a proactive tool designed to detect the signs of increasing brittleness, based on a new kind of leading safety indicator, before an incident occurs.

Consistent with our approach to resilience engineering set out elsewhere<sup>3</sup>, we foresee that such a tool would help maintain appropriate levels of organisational resilience in, and inform governance of, the complex, adaptive systems in which we live.



Dik Gregory



Paul Shanahan

### **Dik Gregory & Paul Shanahan**

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<sup>3</sup> See gsp position paper on *Developing resilience: what companies really need to measure*).

## What is complexity and why can't hindsight cope?

Human organisations are complex, adaptive systems. There are fundamental differences between simple systems, complicated systems, and complex systems. Whether it is a simple circuit or a modern automobile, simple and complicated systems share many of the same characteristics. They have both been designed, and are understandable in terms of their component parts. They exhibit linear behaviour which can be conveniently expressed in terms of causal sequences of activity. They have a finite number of states. The mean time between failures (MTBF) of components can be calculated, and the conditions of their use can be completely specified. The result is predictable performance, reliable preventive maintenance schedules, causal diagnostics, and straightforward management.

By contrast, complex systems - such as a network of road users - are populated by potentially many adaptive agents (ie people) each with many different aims and agendas and degrees of freedom. Behaviour tends to be self-organising as the agents in the system pursue their different goals via under-specified, unscripted interactions with each other. Behaviour is non-linear and small events can quickly radiate through the system to produce huge impact through circular feed forward (reinforcing) and feedback (correcting) loops (eg the stop-go wave effect on motorways as miles of traffic builds up behind a single driver who briefly touched the brakes).

The successes and failures of a complex system cannot be predicted from the behaviour of its parts. Instead they emerge from the normal variability of performance that comes from the requirement for each agent to constantly sense and adjust their individual activity in order to maintain local coordination. And as these interactions and coordinations take place over time, solving local problems, and in turn opening up new possibilities and creating new demands, so the behaviour of the system adapts both locally and globally. Organisations can start, unknowingly, to drift towards danger. They may start to take more time than before to resist or recover from the pressures exerted upon and within them. The regulatory frameworks of rules and procedures with which they began life may become increasingly overlooked, imperiling the safety of the organisation; or the same frameworks may become archaic prisons, threatening the organisation's economic survival in a world to which it has adaptively adjusted. Quite often, organisations don't know how resilient they are, or how brittle they have become: see gsp position paper on **Developing resilience: what companies really need to measure**, for more on the detection of organisational brittleness before catastrophe occurs.

Unlike simple and complicated systems, failures in complex systems are not primarily due to component failure (including human error), but rather to the unintended and unwanted consequences of unforeseen combinations of normal variations in performance. These same variations produce acceptable performance on most occasions and are also responsible for unintended but highly desirable consequences at other times when organisations exceed themselves. As Sidney Dekker has observed, in complex systems "no part of the system needs to be broken for the system to break".

When hindsight-based methods (like root cause analysis) are used to investigate a complex system failure, the illusion is easily created that the incident unfolded as a linear, causal chain – an inevitable result of a series of errors made by the agents located on the critical path to disaster. A variation on this illusion is to speak of 'layers of organisational defence' failing, the resulting 'holes lining up to allow the accident through' as if it were on some sort of trajectory. This correctly shifts attention to include not just the people at the sharp end (ie the operators), but also to decision makers at the blunt end (ie the policy makers, finance directors, and equipment designers). However, it fails to remove the beguiling assumption of linearity.

At each moment in a complex, adaptive system agents at all levels choose the most effective and rational actions within a multi-dimensional trade-off space. Assumptions of linearity do not describe this space very well – in fact most of the richness of the space is ignored by such assumptions. The rationality employed within the space is always bounded. That is to say, it is always relative with respect to what agents know at the time, their purposes, the risks they perceive, the demands exerted upon them and the responsibilities they happen to feel.

Decision makers 'in the moment' are neither omniscient, nor omnipotent as hindsight suggests they could or should be. In fact hindsight itself is blind to the (often) vast amount of noise and other signals that were competing for attention, the perceived circumstances and the sense being made by the decision makers involved at the time they took their decision or action. With hindsight, everything is crystal clear: it's obvious what should (not) have happened. Such obviousness is rarely present 'in the moment'.

Hindsight analysis provides the means to determine the decision or actions that proved to be significant once an incident has occurred. The purpose of mindset analysis is to reveal the bounds of rationality for those decisions or actions at the time they were made. In so doing, mindset analysis seeks to respect the true nature of a human decision maker in the moment of a significant interaction within a complex, adaptive system: not as a link on a causal chain to a bad outcome, but as an agent trying to solve the problems that seemed to matter to them at the time, within an uncertain world of constraints and possibilities that was unique to them.