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THE SAFETY PROBLEM - Do We Have a Solution?

PART 2 OF 3

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THE SAFETY PROBLEM: Do We Have a Solution?

by ARTHUR R. COLWELL   PART 2 OF 3 - JAN 2023

PART 2: New Perspectives and Critical Factors

Part One in this series focused on the problem of today's approach to safety management and included a review of relevant results and insights from recent research into human behavior and neuroscience. To review Part 1, [click here](#).

In **Part 2**, we begin looking at the changing perspectives now emerging from these findings and the critical factors these new perspectives have identified for successful safety management.

New Perspectives

Safety

One of the fundamental issues to be addressed in any safety management system is, "*What precisely do we mean by the word safety?*" We should not assume a common understanding of this term. This question is important because how we view and define safety is a major determinate of how we manage it.

Traditionally, safety is defined as "freedom from harm or danger." But this definition "feels" inadequate. Harm and danger are clearly unsafe situations that reduce the definition to "Safety is freedom from *unsafe* situations," essentially defining safety by its opposite (i.e., by the lack of safety and by what happens when it is not present).

Perhaps a better approach is offered from resilience engineering and Dr. Erik Hollnagel:

"Safety is a condition where as much as possible goes well. It is the ability (or capacity) to perform as required under varying conditions."[8]

Safety, based on this definition, is something that is possessed (i.e., capacity) – it is not the absence of something (e.g., accidents). It may be turned up or down as desired. In other words, it is the ability of an organization to r*espond to change on a continuous basis*.[1]

Notice that this definition does *not* say that safety is where as little as possible goes wrong. According to Dr. Hollnagel, this distinction is important– they are not synonymous.

Things go right because we make them go right through our understanding of how they work, and the conditions required to insure continuous right outcomes.

When things do not go wrong, the reason is that we prevent them from going wrong by focusing on known common causes. The processes are completely different. Making sure as much as possible goes right focuses on *successes*, whereas making as little as possible go wrong focuses on *failures*.[8]

When things do not go wrong, we have a safe situation – it is a non-event. Non-events occur because we are able to keep things momentarily under control.

These non-events are also dynamic – to maintain control we must continually perform them. Thus, safety can be described as a *dynamic non-event*:

"A Dynamic Non-Event is an on-going condition in which problems are momentarily under control due to compensating changes."[8]

In other words, people are working very hard to ensure that nothing bad happens.

Non-events happen all the time – safe outcomes are constant; we get use to them and stop paying attention to them.

In essence they become invisible. We notice them only when they are no longer there (e.g., an accident). Safety can therefore be characterized as an *Invisible Dynamic Non-Event.*

Accidents

Changing our perspective on safety rationally leads to an alternate perception of accidents. In our traditional approach to safety management, accidents are described as an "unplanned event with a realistic potential for causing harm, whether harm occurred or not".

Clearly, no one plans for an accident; but this definition of safety implies that if we had just made a better plan, one which considers all unseen and unknown circumstances and conditions, the accident could have been prevented.

Is this view realistic in today's world of multiple complex systems and environments?

As an alternative, Dr. Hollnagel, building on his definition and description of safety, developed the following definition of an accident:

> ***"An accident is the unexpected combination of normal performance variability."***[8]

This definition leads to some very interesting observations. Accidents don't simply happen because workers gamble and lose; accidents are the result of an unexpected combination of *normal experiences!*[15]

Accidents result when resources lack the ability to deal with demand (i.e., a lack of sufficient capacity). The implication is that the things that cause accidents are also the things that cause successes (i.e., things go right, and things go wrong in basically the same way).[15,16]

Success, therefore, is the result of an unexpected combination of normal experience.

> ***Success is not the absence of accidents – it is the presence of capacity.***

The message here is that management should focus more on what happens regularly (i.e., successes) rather than what happens rarely or not at all (i.e., accidents) - ***know what happens when "nothing" happens***.[15]

Seeing accidents and successes in this way allows us to better understand the three distinct components of an accident:[15,16]

- **Context** – everything that precedes the consequence of the accident
- **Consequence** – the bad event or circumstance that has happened
- **Retrospect** – how the organization sees the event after it has occurred

Safety management has traditionally focused on the consequence part of an accident and its prevention. But as Dr. Hollnagel's definition of an accident implies, the *context* of an accident is of most interest for it is here that the accident is *happening*; in the consequence, it has *already happened*.

> ***The focus of safety management is transforming from consequence management to context management.***[15]

Procedures

Our current approach to safety management places great emphasis on the importance of following procedures. We assume that our success (i.e., "nothing" happens) is the result of performing the work (Work-As-Done) in accordance with the written procedures (Work-As-Imagined).

But are we realistic to expect Work-As-Done and Work-As-Imagined to always be identical?

Consider the following questions carefully:

- Are written procedures in accordance with learnings from human factor studies?
- Are the authors of the procedures trained in human factors, procedure writing, and the work itself?
- Do the written procedures anticipate all of the possible variable conditions that may exist now and in the future?
- What *exactly* does it mean to "follow procedures"? How would someone know if he/she, indeed, had followed procedures?
- What knowledge level on the part of workers do the procedures assume? Does the same knowledge level exist for all procedures?
- Are the answers to the above questions known by all who use or are impacted by the procedures?

Influenced by changing conditions, workers will invariably stray from habitual behaviors and/or procedures in an effort to realize success.[15]

This variability is what workers manage every day. They must *adapt* to the changing circumstances. Unfortunately, this adaptation is also how failure is created – we must insure they do not "drift into failure" (i.e., a long, steady decline into greater risk).

In achieving this objective, should the focus shift from modifying employee behaviors to improving employee adaptability?

Let's be clear, work procedures matter, but they are not real. They represent the *ideal* state for the manner in which work is to be carried out.

It is not the procedures that we have to manage every day – it's the *variability around the procedures*.[15] Never assume Work-As-Imagined and Work-As-Done are the same (**Figure 3**).

Resilience

Resilience engineering has expanded the scope of safety management –not only to prevent accidents but also to insure *resilience*:[14, 17]

"Resilience is the ability of an organization to function as required under expected and unexpected conditions alike."

The resilience of an organization is an expression of its ability to sustain its own existence (i.e., to survive and thrive) – how it performs, how it is able to cope with unexpected situations (both threats and opportunities). It is also an expression of how people cope with everyday situations by adjusting their performance to the conditions.[14]

Resilience engineering is redefining the meaning of safety management.

A Summation

The new perspectives presented above can be summarized as follows:

- Safety is a condition where as much as possible goes well – it is the presence of capacity.
- Safety can be characterized as an invisible dynamic non-event.
- An accident is the unexpected combination of normal experiences.
- Things that go right (successes) and things that go wrong (failures) happen in basically the same way.
- It is the context of an accident (NOT its consequence) that is of most interest to Safety Management.
- Procedures are the ideal state for how work happens – everyday, people manage the variability around the procedure.

- The aim of safety management is not just the elimination of hazards and the prevention of failures and malfunctions but also how best to develop an organization's resilience.

Critical Factors for Managing Safety[17,18]

Signals

Effectively managing safety requires us to look for signals from our system that inform us about its performance. We must understand these signals and what they are telling us.

Strong signals are typically distinctive and disruptive events such as accidents. Well defined, they are difficult to miss. We recognize that we must pay attention to them.

So, no matter how rare they may be, they get noticed. Investigations of these events are certainly necessary but *not* sufficient.

Such investigations yield only a "snapshot" of the system – and only after it has failed (i.e., when safety was lacking).[17]

Accidents are, therefore, not representative of how an organization performs and can offer us no insights into how the system functions normally. Experience teaches us that safety management cannot rely exclusively on strong signals such as accidents.

Weak signals, on the other hand, are seemingly random, disconnected pieces of information that don't attract attention due to their low visibility and therefore typically go unnoticed. Nevertheless, they are extremely important.

These signals can be weak for two reasons:

- They are weak in energy and so are undetectable by our sensors or measurements.
- They are stretched over time – happen so slowly that we don't notice them.

Weak signals are characteristic of dynamic non-events such as safety.[17] Much of what we talk about in organizations such as safety, soft risks (e.g., leadership, experience, etc.), quality, culture, and others develop so slowly that we don't notice a change in them – they are weak signals.[17,18]

To see them we have to take measurements over time similar to slow motion photography (experienced operators have learned to notice weak signals – a key reason in understanding what actually happens when things go well[18]).

Learning to monitor and track the appropriate weak signals over time can help prevent a "Drift into Failure" (**Figure 4**)[15].

Drift into failure is about slow, incremental movement of systems operations toward the edge of their safety envelope,5 i.e., the gradual normalization of deviation.

The potential for an accident, therefore, accumulates over time and typically goes unrecognized due to its slow development.

Tracking the appropriate weak signals is critical to knowing when a system is drifting. The trick is to understand what constitutes a meaningful signal.

Potentials

Advances in resilience engineering suggest that dynamic non-events such as safety occur because the system has the "Potential" to:[14,17,18]

- ***Respond*** in a flexible way - Without a flexible response, threats and opportunities will go unanswered.
- ***Monitor*** what goes on - Without monitoring, everything that happens will be a surprise.
- ***Learn*** what works and what doesn't work - Without learning, the system will always respond in the same way and rely on the same indicators.

- ***Anticipate*** and look ahead - Without anticipation, the future is assumed to be a repetition of the past.

It's important to emphasize that resilience is associated with an organization's performance – what it does and how it does it.

In order to perform as required under expected and unexpected conditions alike, these four potentials are critical. They *create* the resilience that allows the organization to "cope" with the variable conditions it faces on a continuous basis.

The actual "coping" performance an organization exhibits in any given situation or condition will always be some function of its maximum capability. This capability is not the result of a single, isolated factor, but rather a synthesis of several factors or potentials.

Each potential can be seen as comprising a number of more specific factors that are common to many types of activity. Instead of assessing each potential as a self-contained element, the potential can be characterized in terms of the several factors that a potential represents.[18]

In the energy and chemical industries these potentials and their component factors are typically classified as *soft risks*.[19] The key question, of course, is how to best manage them.

Resilient performance cannot be directly managed any more than safety culture can be directly controlled; however, it can be indirectly managed through these potentials.

The strength or weakness of the potentials and their component factors (e.g., soft risks) develops slowly over time. Diagnostic questions can be utilized to assess each individual potential to determine the organization's overall resilient performance – a weak signal.

Repeated assessments allow the organization to track its progress over time (the Pilko 8ight Drivers® tool has been designed to accomplish this measurement).

Organizations must realize that managing these resilient potentials in this manner does not mean that an organization will always perform in a resilient manner – *but an organization that lacks these potentials will be incapable of resilient performance.*[14]

A prediction from Dr. Sydney Dekker:[5]

"Safety will philosophically change from an outcome to be measured to a capacity to be maintained..."

In **PART 3**, we will discuss the "New View" emerging from the new perspectives and critical factors discussed above – a view that proposes to change the focus of our current safety management systems.

Part 3 will also provide a guideline for how to begin transitioning to this "New View".

ABOUT THE AUTHOR:

Art Colwell has spent over 30 years in the chemical industry. At Pilko & Associates, he has been able to leverage that experience to help companies improve overall EHS performance. Working directly with senior corporate executives, Art has advised and provided guidance on EHS risk assessment, risk mitigation and governance.

Prior to his retirement in 2010, Art was responsible for BASF's largest North American manufacturing facility located in Freeport, Texas. In this role, Art oversaw the daily operation of 24 plants that manufacture 23 different products, including acrylic acid used in textiles, adhesives, and plastics; superabsorbent polymers used in baby diapers; caprolactam used in nylons and solvents; and intermediate chemicals like oxo alcohols (N-Butanol, Iso-Butanol, 2-Ethylhexanol) used to produce polyesters, surface coatings and plasticizers. During Art's tenure, the Freeport site was recognized by the Texas Chemical Council with its two highest honors – the Best in Texas Safety Award (4 of the last 6 years) and the Sustained Excellence in Caring for Texas Award (last 4 years).

Art also served as Chairman for BASF's North American Manufacturing Community (2005-2008). In this role Art was responsible for the development and implementation of operational excellence programs across all North American manufacturing facilities.

An active supporter of the industry, Art served on the Board of Directors for the Texas Chemical Council for 9 years. He held a variety of offices, culminating in his selection as TCC Chairman for 2009 – 2010.

Prior to his role as Freeport Site Manager, Art served as Operations Director for Caprolactam, Cyclohexanone, and Hydroxylamine Production (BASF's Freeport, Texas site), Ethylene Oxide Production (BASF's Geismar, Louisiana site), and Pharmaceutical Production (as Director of Operations for BASF's Knoll Pharmaceuticals in the United Kingdom).

A native of Huntsville, Alabama, Art Colwell earned both a bachelor's degree and a Master of Science degree in Chemistry from the University of Alabama in Huntsville.

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