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Submission to the Select Committee Queensland Parliamentary Inquiry into Coal Workers' Pneumoconiosis (CWP)

[This submission refers specifically to the terms of reference items b), c), e) and f)]

Preliminary reports indicate the re-emergence of CWP is a result of systemic failures at every level within the Queensland resources sector. However, I believe there is an undue focus on the failure of downstream reactive health surveillance protocols, which diverts attention from prevention and reliability using technological controls for dust suppression and mitigation.

During the resources boom there was an inordinate spotlight on production, which included expansion into development areas. Cutting faster produced excessive dust and encroachment into development areas with inadequate ventilation exacerbated the problem.

Excessive dust levels would surely have been reported by many mining employees, safety advisors and hygienists to site senior executives (SSEs) and the inquiry must address the following:

- Were there any records in mine log books covering dust complaints?
- What action did SSEs take when complaints were received?
- What records are available covering regulatory authority inspections?

Performance bonuses for SSEs were linked to production targets and any complaints raised by subordinates, safety advisors and hygienists regarding excessive dust levels could be summarily dismissed or ignored. This would result in intimidation and generate fear and the production versus protection dichotomy is detailed by Professor James Reason in his publication entitled *Managing the risks of organizational accidents.*

During the inquiry, interviews with employees, safety advisors and hygienists from the respective sites would establish the prevailing culture that existed if or when complaints about excessive dust were raised.

The recent resources boom in Australia saw a commensurate focus on occupational health and safety management. It also created a perfect opportunity to generate transformational change via a process and evidence based approach, underpinned by risk and energy damage theory.

Alas, direct observation of activities on various projects, indicates there has been a significant resurgence of accident theory. This has been supplemented with the nebulous concepts of behavioural based safety, safety culture and zero harm and progress has stagnated.

Corporate safety strategies and policies often embrace risk theory but it is a patina of good governance and corporate social responsibility and at operational and tactical levels there is invariably a misalignment of strategy and traditional accident theory prevails.

Furthermore, anecdotal evidence from colleagues over the past three years indicates accident theory is flourishing and embraced by many project safety managers and advisors. It is underpinned by inappropriate bureaucratic risk assessment techniques and linear cause-effect incident investigation tools.

This is complemented by an inordinate focus on reactive performance indicators, especially total recordable injury frequency rates.

Meanwhile, an ever-increasing array of displacement activities have been implemented including behavioural safety programs, safety incentive schemes and fuzzy soft systems change management processes, which are supported by a precarious over reliance on lower order administrative control measures and a relentless stream of corporate bilge masquerading as leadership.

This has diverted attention from operational risk to general safety risks and there is a predominant focus on system noise not signal. Moreover, transformational change and improved safety performance will not occur by window dressing.

I have attached a more comprehensive paper, which details the limitations of current approaches and offers a suitable risk management and process and evidence based alternative.

Yours faithfully,

Bernard Corden

Attachment 1 Zero to HRO (High Reliability Organisation) – Abandoning antediluvian accident theory

Zero to HRO (High Reliability Organisation)

Abandoning antediluvian accident theory

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The author of this paper declares no conflict of interest

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Zero to HRO (High Reliability Organisation)

Abandoning antediluvian accident theory

Abstract

The recent resources boom in Australia saw a commensurate focus on occupational health and safety management. It also presented a unique opportunity to generate transformational change using a process and evidence based approach.

However, direct observation of activities and anecdotal evidence from colleagues on various projects, indicates there has been a significant resurgence of traditional accident theory. This has been supplemented with an array of nebulous soft systems change management processes, which includes the ubiquitous concept of zero harm.

This paper evaluates the attributes of risk and energy damage theory and accident theory and compares them with the contemporary Shingo model of operational excellence and features of high reliability organisations.

It recommends abandoning conventional accident theory and adopting risk and energy damage theory, which offers a process and evidence based approach to align with the guiding principles of operational excellence and the unique attributes of high reliability organisations.

Keywords

Accident theory, risk theory, operational excellence, high reliability organisations

Conflict of interest

The author of this paper declares no conflict of interest

Table of Contents

Introduction

The recent resources boom in Australia saw a commensurate focus on occupational health and safety management. It also created a perfect opportunity to generate transformational change via a process and evidence based approach, [1] underpinned by risk and energy damage theory.

Alas, direct observation of activities on various projects, indicates there has been a significant resurgence of accident theory. This has been supplemented with the nebulous concepts of behavioural based safety, safety culture and zero harm and progress has stagnated.

Corporate safety strategies and policies often embrace risk theory but it is a patina of good governance [2] and corporate social responsibility [3] and at operational and tactical levels there is invariably a misalignment of strategy and traditional accident theory prevails.

Moreover, anecdotal evidence from colleagues over the past three years indicates accident theory is flourishing and embraced by many project safety managers and advisors. It is underpinned by inappropriate bureaucratic risk assessment techniques and linear cause-effect incident investigation tools. [4]

This is complemented by an inordinate focus on reactive performance indicators, especially total recordable injury frequency rates.

Meanwhile, an ever-increasing array of displacement activities have been implemented which include behavioural safety programs, safety incentive schemes and fuzzy soft systems change management processes. [5] Furthermore, these are supported by a relentless stream of corporate bilge masquerading as leadership and a precarious over reliance on lower order administrative control measures.

Accident theory

Accident theory emerged in the 1930s and was immortalised by the work of H. W. Heinrich [6] and remains conventional with many organisations and safety evangelists. However, closer scrutiny indicates it lacks logical analysis and scientific rigour and is littered with pejorative terminology. [7]

It is reactive and focuses downstream using a mechanistic, reductionist and linear cause-effect approach. This relies heavily on the benefit and bias of hindsight, [8] [9] which can create a robust cognitive illusion with a pernicious influence on decision makers. [10]

A fundamental weakness of accident theory is its reliance on the judgemental term unsafe, which is so easy to establish following an event but surprisingly difficult to determine beforehand. [11] Its emphasis on unsafe acts diverts attention from operational risk to general safety risks. This places an unwarranted focus on system noise, which can lead to ignoring signal [12] and may result in catastrophic consequences. [13]

Its cause-effect ideology generates dispositional and situational attribution error and a quest for blame ensues, [14] [15] which creates fear. The next casualty is truth, which may compromise the subsequent investigation process. [16]

Many global US organisations with adversarial and militaristic structures display symptoms of entrenched Taylorism. This depicts employees as extensions of machines and alienates them from their work. [17] Accident theory and its symptoms thrive in such environments, with an inherent focus on unsafe acts, cause-effect ideology, blame and changing behaviour.

In adversarial structures, line managers or supervisors become unfamiliar with processes such as safety and frequently resort to managing the structure. [18] In sporting vernacular, they prefer to play the man and not the ball and Kaizen [19] principles, which reinforce that systems and processes influence performance, are often disregarded or neglected.

Safety advisors or evangelists

The appointment of safety advisors during the resources boom in Australia was quite frantic and recruitment and selection processes require significant improvement. [20]

Many advisors were appointed holding a Certificate IV in Occupational Health and Safety [21] and accreditation was easily obtained through registered training organisations.

This qualification provides generalist safety advisors with an overview of the legislative framework. [22] [23] and traditional accident theory. Unfortunately, it does not address contemporary key concepts, theories or business processes [24] [25] sufficiently and inexperienced advisors can soon become lost if they're not bossed.

The recent Safety Institute of Australia certification scheme for accreditation of safety professionals has honourable intentions. However, it contains adversarial elements, especially in the verification process. [26] This can intimidate inexperienced safety advisors, stifle creativity and inhibit progress and the scheme requires further systemic thought.

Toolbox talks and prestart meetings at various sites often resembled quasi-religious tribal rituals, with project safety managers and safety evangelists proselytising and beseeching employees to behave safely.

The terms faith and hope belong in intelligent design and may occasionally appear in fuzzy soft systems change management processes. However, they have no place in risk and energy damage theory and do not belong in any safety management strategy. [27]

This was compounded by safety evangelists patrolling sites like fervent overpaid swimming pool attendants armed with digital cameras, electronic hazard identification sheets and behavioural safety checklists to target unsafe acts and conditions. It merely generated a Gotcha culture underpinned by cognitive dissonance [28] and a somewhat predictable bureaucratic email war ensued.

Many of these administrative tools, especially behavioural safety checklists, use pejorative descriptors such as line of fire, eyes on path and eyes on task. [29]

If you ask vague questions you will receive vague answers and measuring individual performance using qualitative and irrational indicators will merely generate specious outcomes. [30]

It is debatable whether such tactics are appropriate for managing general safety risks but applying similar methodology to operational risks [31] can lead to and has resulted in catastrophic consequences. [32]

More appropriate terms for the discipline using such approaches would be safety damagement or Facebook safety and ultimately, it generates disdain.

Bureaucratic and qualitative risk management processes

There are statutory requirements covering risk management in the Queensland Work Health and Safety Regulation 2011 [33] and safe work method statements are mandatory for high risk construction work. [34]

On several projects, direct observation of activities confirm safe work method statements are frequently supplemented by additional risk assessment processes, which include a job safety analysis, task hazard analysis, take five process and standard operating procedures.

Nominated high risk activities also require a permit to work and the entire administrative process degenerates into gridlock, creates frustration and a bureaucratic culture prevails. [35]

Safe work method statements, [36] risk assessments and supplementary standard operating procedures are often overly complex and written to protect the writer. [37]

The documents are invariably produced using a word processor and its many decorative functions and describe only a limited resemblance to what is actually occurring at the tactical level. However, significant variances between the actual activity and the documented process are often evident. [38] [39] Mallen and Collins [40] refer to this as the process perception paradox and rather alarmingly, it can create a form over substance culture.

Risk evaluation is determined using the commonly accepted two dimensional consequence and probability matrix and contrary to popular belief, it is only a qualitative tool, which uses numbers as labels. It is a particularly blunt instrument, which can be manipulated to suit hidden agendas and it has many limitations. [41]

There has been significant discussion amongst safety professionals covering legislative requirements for risk assessments and their usefulness is critically reviewed by Viner. [42]

An over-egged safe work method statement or job safety analysis, which has been electronically manicured using a word processor, won't extinguish a fire.

Lower order control measures

Most safety advisors are fully conversant with the hierarchy of controls [43] but a review of investigation reports and action registers at project sites often indicates the Pareto principle applies. [44]

On one project an independent safety consultant reviewed investigation reports, which confirmed approximately 80% of corrective actions involved implementation of lower order administrative controls or use of personal protective equipment. [45] [46]

The Queensland Work Health and Safety Act 2011 [47] prescribes requirements covering reporting of notifiable incidents, which are normally followed by an exhaustive cause-effect investigation process.

However, discussions with colleagues and participation during investigations confirm paradoxical lower order administrative controls are often implemented. These include disciplinary action, additional training, warning signs and a revision of safe work method statements or standard operating procedures. [48] [49]

This generates distrust and renders documentation even more complex and enhances bureaucracy. [50]

Lower order controls focus on changing the person and it is much more effective to change the situation. [51]

At several projects one frequently encounters a plethora of warning signs, many of which fail to comply with *AS 1319 Safety signs for the occupational environment*. [52] They are often superfluous, ambiguous and temporarily affixed to equipment with adhesive tape.

These have included laminated signs on lockable engine cowls for elevating work platforms stating *Danger – Moving parts*.

Project offices, especially crib rooms, are decorated with unnecessary warnings, *Danger - Door opens inwards s*igns are displayed on access doors or *Danger – Hot water* tags are affixed above cistern dispenser taps. [53]

On one project the corrective action for light vehicles interacting with powered mobile plant on access roads involved a verification of competency process for light vehicle drivers. It was completed by an accredited trainer from a registered training organisation and every driver was assessed as competent.

This diverted attention from using higher order controls, such as segregation of powered mobile plant and light vehicles [54] [55] and the process was yet another displacement activity.

Site inductions have become an exercise in death by PowerPoint and merely prove that the presenter has a pulse and participants can scrawl their name on the attendance register.

Many project sites also display and enforce golden or life-saving rules, which are regularly reiterated during inductions, prestart meetings and toolbox talks. Breaches can often result in dismissal and rather predictably, it generates blame and fear, which conflicts with Deming's principles for transformation of western management. [56]

It was the great dissenting philosopher, William Hazlitt, who commented that…….*rules and models destroy art and genius* [57] and Marcus Tullius Cicero also remarked…….*more law, less justice.* [58]

Laws of fear and alternative approaches for achieving compliance using nudge theory, which promotes a libertarian paternalism and choice architecture philosophy, are discussed by Sunstein and Thaler. [59] [60]

The dominance of lower order controls is redolent of accident theory and aims to create a safer person, which conflicts with statutory obligations. [61]

Risk and energy damage theory promotes reliability using technological controls. This minimises or reduces reliance on human behaviour. It targets the source and creates a safe place, which aligns with common law duty of care requirements. [62]

Cause-effect analysis and human error

Cause-effect ideology is a fundamental tenet of accident theory and has been subject to extensive critical analysis over many years [63] and affords a simplistic and mechanistic notion. It advocates that unsafe acts or human error lead to injury or damage. This has received widespread acceptance amongst the general public and many safety advisors and remains entrenched in the resources sector.

Modern variations covering incident aetiology have since been adopted [64] and contemporary investigation tools include the proprietary Incident Cause Analysis Method (ICAM) [65] and TapRoot Root Cause Analysis System. [66] These are essentially linear and suit tractable processes but are considered inappropriate for socio-technological systems. [67]

Another significant limitation with cause-effect thinking is that it nurtures a primitive and overwhelming desire to apportion blame and seek retribution. [68] [69]

Many of these symptoms were evident following the Hillsborough stadium disaster in April 1989 and are discussed extensively by Scraton. [70]

Following disasters, especially involving aircraft and trains, human error is the most established cause ascribed by the media and investigators. However, it is often a consequence which is influenced and provoked by other factors. [71]

The term cause should be used sparingly during investigation processes. Nonetheless, it features prominently within the title of two commonly used proprietary tools. It often implies blame and human error, which is misleading and pejorative. This diverts attention from engineering controls, which focus on changing the situation and addressing the problem at the source. [72]

It is a complex and difficult task changing the human condition but the conditions in which people work can often be changed much more easily. [73]

Reactive performance indicators

Injury frequency rates are commonly used for monitoring safety performance in the resources sector and include the total recordable injury frequency rate (TRIFR), which is a reactive indicator and does not provide a valid or reliable measure of performance. [74]

Lag indicators such as TRIFR are an ex post facto mechanism that use a system failure to measure success. It is statistically unreliable as an indicator for potential disasters and is exclusively influenced by relatively insignificant cases. [75]

The definition of a recordable injury varies between international jurisdictions and is subject to interpretation. [76] [77]

Furthermore, discussions with colleagues indicate injury frequency rates can be manipulated to meet prescribed project performance targets, which are often linked to incentive schemes and bonus payments.

This can easily be accomplished using accumulated project hours from tenuous sources such as indirect employees in corporate offices, catering and accommodation contractors and logistics providers.

However, if these indirect employees sustain a recordable injury, it can be conveniently categorised as unrelated to the project and excluded from statistics. The frequency rate soon tumbles, targets are achieved and project bonuses are preserved accordingly.

Modified injury frequency rates can then be presented to corporate executive leadership team members, who are appeased and the illusion, that worthless statistics are better than no data at all, is complete and the measure gets managed not performance. [78]

Statistics such as total recordable injury frequency rates often conceal more than they reveal and must always be viewed with caution because correlation is only a measure of association between two variables and does not imply causation. [79]

Safety slogans and incentive schemes

At many project sites one often encounters an assortment of Orwellian safety slogans and posters. They are merely another displacement activity and can indicate accident theory is thriving [80] and supported by an adversarial regime.

Crib room walls and toilet doors are festooned with a beguiling array of posters beseeching employees to be safe and supplementary slogans are displayed at security entrance gates and embroidered into company clothing.

On one major coal seam gas project a safety theme was promoted each month and advisors would affix posters to the rear of toilet doors across the site. Many posters were ripped down or defaced with derogatory comments and a confrontational environment underpinned with distrust and loathing was evident.

Slogans and posters are supplemented with incentive schemes, [81] where individuals or work groups receive awards or trinkets such as binoculars, polo shirts (with embroidered slogans), Akubra hats and even steak knives for safety performance. However, these schemes are condescending and may inhibit reporting and can become counterproductive. [82]

This process aims at changing attitudes and is actually incongruous with behavioural safety theory because according to psychologists, attitude does not necessarily correlate with behaviour. [83]

Further interesting observations and extensive comments on the vast and mysterious field of psychology, which includes psychoanalysis, behaviourism, cybernetics, socio-biology, evolutionary psychology and neuroscientific imaging are provided by Dalrymple, who critically evaluates how psychology undermines morality. [84]

Zero harm and safety culture

In recent years the ubiquitous concept of zero harm has been introduced into corporate safety strategies and is merely a soft systems change management process and an extension of accident theory. [85]

It is a symbolic gesture, which focuses on meaning and culture in organisations. This enables leaders and managers to shape values and beliefs and build spirit through ritual and ceremony [86] and is often supplemented with other organisational development techniques. These include role negotiation, inter-group confrontation, organisational mirroring, fish-bowling, team building exercises and cultural surveys. [87]

Like many soft systems change management elements, the term zero harm is somewhat vague and subject to definitional dilemma. It is a safety slogan, [88] which is often perceived as a numerical target and aligns with the attributes of accident theory.

The zero harm concept is incompatible with the principles of quality management and several of the fourteen points for transformation described by W. Edwards Deming. These include avoid using numerical targets and quotas and remove slogans imploring employees to achieve unrealistic goals. [89]

Safety culture is subject to extensive debate amongst academics and most safety professionals are conversant with the Hudson pathological to generative cultural maturity model [90] or the Dupont Bradley curve, [91] which is critically reviewed by Long.

It remains a confusing and ambiguous concept without any empirical evidence covering its relationship to safety performance and it has been scathingly rebuked as ontological alchemy. [92]

Behavioural safety

Most organisations embracing accident theory are acolytes of behavioural safety programs, which predictably target unsafe acts at the human machine interface.

Its assessment tools focus predominantly on compliance with lower order controls and are littered with an argot of pejorative terminology. This includes vague descriptors such as line of fire, eyes on path and eyes on task.

Behavioural safety is not measuring performance, it is counting and generates descriptive, qualitative and categorical data, which is of limited use or value [93] and statisticians often reiterate that correlation does not necessarily imply causation.

Behavioural safety is an administrative control and extremely popular in US companies or organisations with adversarial structures. Albeit much less scientific, it is analogous with Taylorism time-motion studies, which alienate employees from their work [94] and can create a dystopian environment. [95] Despite statutory requirements, many behavioural safety advocates disregard the hierarchy of controls and focus on changing the person.

This is accomplished by monitoring and correcting behaviour at a tactical level using the occupational psychology techniques of positive and negative reinforcement for controlling the associated risks. [96]

Fleming and Lardner [97] recommend caution with behaviour based safety approaches and reinforce how it can divert attention to address symptoms and disregard the cause.

This focus on the receiver and changing individual behaviour is incompatible with common law duty of care requirements. [98]

Risk and energy damage theory – A process based approach

Despite its conventional recognition by many organisations and safety evangelists, when subjected to critical evaluation accident theory is lacking in logical analysis and scientific rigour. [99]

Haddon et al [100] reinforced that science needs to be based on an understanding of the fundamental processes involved rather than using descriptors.

Accident theory has been reviewed previously by road safety researchers in the United States. It was discarded and the field of industrial safety was dismissed as being in a state of conceptual rigor mortis. [101]

More recent developments have seen the process of risk estimation by Rowe [102] and energy damage concepts of Haddon [103] consolidated by Viner. [104] This provides the field of industrial safety with a uniform process based theory, which adopts an objective and scientific evidence based approach. It consists of three principal features:

1) Events resulting in injury or damage involve energy
2) The process occurs sequentially
3) There is a degree of uncertainty or risk

A fundamental tenet of risk theory is that if something is possible it is only a matter of time before it happens and risk is defined as the effect of uncertainty on objectives, which also encompasses speculative risk. [105]

A suitable definition of pure risk, which is more applicable to industrial safety, is the uncertainty that an adverse consequence of a given size will occur. [106]

Furthermore, the interrelationship between the components of risk and the inverse relationship between frequency and consequence value, enables us to measure risk quantitatively and fiscally using real numbers. [107]

Operational excellence and high reliability organisations (HROs)

Despite its enduring popularity, accident theory sits incongruously with total quality management principles [108] and the Shingo model of operational excellence. [109]

Operational excellence guiding principles embrace process based scientific and systemic thinking and focus on addressing problems at the source and adding value.

The attributes of risk and energy damage theory are summarised in Table 1 below and it is evident they align with and reflect the guiding principles of the Shingo model of operational excellence.

High reliability organisations display unique characteristics for managing unexpected threats or uncertainty. These include a preoccupation with failure, reluctance to simplify, sensitivity to operations, resilience and a deference to expertise. [110]

These five fundamental processes are tenets for improvement in quality, reliability and productivity and align with risk and energy damage theory. However, traditional accident theory is incompatible with these principles:

Preoccupation with failure

Risk and energy damage theory is underpinned by the concept of uncertainty and if something is possible it is only a matter of time before it happens. This aphorism, which is colloquially referred to as Murphy's Law [111] reflects and aligns with the attribute of preoccupation with failure. This focuses on exemplary performance in complex environments and managing the unexpected or uncertainty and if eternal vigilance is the price of liberty, chronic unease is the price of safety. [112]

Reluctance to simplify

Risk and energy damage theory adopts a systemic approach and embraces practical systems thinking. [113] [114] It employs scientific logic and measures risk quantitatively using real numbers via its inverse relationship between frequency and consequence value. Its organic configuration and collaborative process encourages diverse and challenging opinions with a reluctance to simplify or disguise complexity. [115]

Sensitivity to operations

Risk and energy damage theory is suitable for managing operational risk and general safety risks. It provides a systemic process based approach, which is suitable for addressing latent conditions and active failures [116] via objective evaluation. It employs quantitative risk analysis and estimation techniques, which synchronize with process safety architecture and tools [117] and affords a sensitivity to operations accordingly.

Resilience

Key attributes of risk and energy damage theory are its upstream focus and predictive and preventive foresight. This provides for attention to design and use of technological controls in response to functional failures, which ensures processes default into safe mode or soft landing when failures occur. This is referred to as resilience engineering. [118]

Deference to expertise

Additional key attributes of risk and energy damage theory are its technological focus, organic architecture and collaborative processes, which loosen hierarchical constraints. This encourages and enhances fluid decision making with a deference to expertise at operational or tactical levels. [119]

Conclusion

The 21st October 2016 marks 50 years since the Aberfan disaster in South Wales, United Kingdom [120] which resulted in the deaths of 116 school children and 28 adults and wiped out a generation.

Over the past 50 years, legislation has been implemented and supplemented by the introduction of many fashionable psychological approaches, which have been offered as silver bullets. [121]

However, traditional accident theory and its many accoutrements remain enduringly popular despite their ostentatiously unscientific principles and social encumbrances. [122]

Meanwhile, the carnage continues unabated and our performance can only be described as mediocre, at best. In Australia, the annual direct costs amount to approximately $80 billion or almost 8% of our gross domestic product. [123]

Moreover, the comments from Haddon et al [124] and Waller and Klein, [125] remain as pertinent today and still resonate with most academics and safety professionals.

Reactive accident theory does not manage risk or measure performance, we are merely counting with our fingers and toes crossed until……..

Westgate Bridge (1970), Ibrox Park (1971), Summerland (1973), Flixborough (1974), Granville (1977), Seveso (1976), Three Mile Island (1979), Bhopal (1984), Bradford (1985), Chernobyl (1986), Zeebrugge (1987), Kings Cross Station (1987), Piper Alpha (1988), Hillsborough (1989), Thredbo' (1997), Esso Longford (1998), Texas City Refinery (2005), Qinghe Steel China (2007), Deepwater Horizon (2010), Fukushima (2011), Lac Megantic (2013), Samarco (2015),…….??????

The re-emergence of coal workers' pneumoconiosis in the Queensland coal mining industry has also caught many asleep at the wheel. [126] [127]

It was the murderous tyrant, Joseph Stalin, (he was pretty conversant with totalitarian regimes and dystopian environments), who coined the phrase…..*one death is a tragedy and a thousand deaths is a statistic*.

On a much less sombre note, W. Edwards Deming, at a 1982 seminar in the United States, commented……*there are two ways to improve figures; cheat or lie and just change the numbers and don't count injuries or defective parts or improve the process.* [128]

Transformational change will only occur when antediluvian accident theory is abandoned in favour of a process and evidence based approach and incidentally, this transition does not require tearing the entire house down.

Risk and energy damage theory fulfils this requirement and it reflects and aligns with the contemporary guiding principles of operational excellence and unique characteristics of high reliability organisations. It has many advantages over accident theory and its attributes are compared and summarised in Table 1 below:

Table 1: Accident theory v risk and energy damage theory attributes

Accident theory	Risk and energy damage theory
Subjective speculation	Objective evaluation
Hierarchical	Organic
Adversarial	Collaborative
Downstream human focus	Upstream technological focus
General risk	General & operational risk
Descriptive	Process and evidence based
Linear and mechanistic cause-effect	Systemic
Intuitive	Scientific
Counting	Measuring
Pejorative	Constructive
Reactive hindsight	Predictive and preventive foresight
Blameworthy	Virtuous
Qualitative	Quantitative
Change the person	Change the situation
Receiver focus	Source focus

The author of this paper declares no conflict of interest.

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1st December 2016

Submission to the Select Committee Queensland Parliamentary Inquiry into Coal Workers' Pneumoconiosis (CWP)

[This submission aligns with the terms of reference]

Quis custodiet ipsos custodes? – Juvenal

Further to my attendance at the Brisbane public hearing on Friday, 11th November 2016, I confirm the recurrence of CWP has serious legal, moral and financial implications. However, the problem is not insurmountable and a reasonably practicable and simple solution exists.

This involves installation of intrinsically safe continuous dust monitoring equipment and linking its output to a variable speed drive and the ventilation system. It should provide sufficient extraction ventilation to prevent dust entering an individual's breathing zone. If dust levels rise above prescribed limits during cutting, drilling and other dust producing activities, equipment will automatically shut down.

The following issues also require further investigation:

- How many dust complaints were documented in mine log books?
- What constructive action did SSEs take when complaints were received?
- What records are available covering frequency of DNRM inspections?
- How many times was excessive dust identified during DNRM audits?
- What is the age and condition of drilling, cutting and ventilation equipment?
- How many DNRM inspectors are former SSEs?
- Is there any correlation between union/non-union sites and recurrence of CWP?
- What performance bonuses do SSEs and other senior employees receive in addition to their annual salary to meet production targets?
- Why cannot continuous dust monitoring be installed and linked to ventilation?
- Why cannot automatic shutdown systems activate when dust levels are exceeded?

I have attached a recent paper, which highlights the limitations of our current reactive accident theory approach. It provides a suitable alternative via a scientific, process and evidence based method for managing occupational health and safety risk.

Yours faithfully,

Bernard Corden

Attachment 1: Zero to HRO (High Reliability Organising) – Abandoning antediluvian accident theory

Zero to HRO
November 2016.doc

Zero to HRO (High Reliability Organising)

Abandoning antediluvian accident theory

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Zero to HRO (High Reliability Organising)

Abandoning antediluvian accident theory

Abstract

The recent resources boom in Australia saw a commensurate focus on occupational health and safety management. It also presented a unique opportunity to generate transformational change using a process and evidence based approach.

However, direct observation of activities and anecdotal evidence from colleagues on various projects, indicates there has been a significant resurgence of traditional accident theory. This has been supplemented with an array of nebulous soft systems change management processes, which includes the ubiquitous concept of zero harm.

This paper evaluates the attributes of risk and energy damage theory and accident theory and compares them with the contemporary Shingo model of operational excellence and features of high reliability organisations.

It recommends abandoning conventional accident theory and adopting risk and energy damage theory, which offers a process and evidence based approach to align with the guiding principles of operational excellence and the unique attributes of high reliability organisations.

Keywords

Accident theory, risk theory, operational excellence, high reliability organisations

Conflict of interest

The author of this paper declares no conflict of interest

Table of Contents

Introduction

A reasonable estimate of economic organization must allow for the fact that, unless industry is to be paralyzed by recurrent revolts on the part of outraged human nature, it must satisfy criteria, which are not purely economic.

R H Tawney – *Religion and the Rise of Capitalism* (1926) [1]

The recent resources boom in Australia saw a commensurate focus on occupational health and safety management. It also created a perfect opportunity to generate transformational change via a process and evidence based approach, [2] underpinned by risk and energy damage theory. Alas, direct observation of activities on various projects, indicates there has been a significant resurgence of accident theory. This has been supplemented with the nebulous concepts of behavioural based safety, safety culture and zero harm and progress has stalled.

Corporate safety strategies and policies often embrace risk theory but it is a patina of good governance [3] and corporate social responsibility. [4] Further investigation at operational and tactical levels often indicates there is a misalignment of strategy and traditional accident theory prevails. Moreover, anecdotal evidence from colleagues over the past three years indicates accident theory is flourishing and embraced by many project managers and obsequious safety evangelists. It is underpinned by inappropriate bureaucratic risk assessment techniques and linear cause-effect incident investigation tools. [5] This is complemented by an inordinate focus on reactive performance indicators, especially total recordable injury frequency rates.

Meanwhile, an ever-increasing array of nostrums and displacement activities have been implemented, which include behavioural safety programs, safety incentive schemes and fuzzy soft systems change management processes. [6] These are supported by a relentless stream of corporate bilge masquerading as leadership, intimidation and a precarious over reliance on lower order administrative controls and use of personal protective equipment.

Accident theory

If you think safety is expensive, try an accident - Trevor Kletz [7]

Accident theory emerged in the 1930s and was immortalised by the work of H. W. Heinrich [8] and remains conventional with many organisations and safety evangelists. However, closer scrutiny indicates it lacks logical analysis and scientific rigour and is littered with pejorative terminology. [9] It is reactive and targets downstream using a mechanistic, reductionist and linear cause-effect approach. This relies heavily on the benefit and bias of hindsight, [10] [11] which creates a robust cognitive illusion with a pernicious influence on decision makers. [12]

A fundamental weakness of accident theory is its reliance on the judgemental term unsafe, which is so easy to establish following an event but surprisingly difficult to determine beforehand. [13] Its emphasis on unsafe acts diverts attention from operational or material risk to general safety risks. This places an unwarranted focus on system noise, which can lead to ignoring signal [14] and may result in catastrophic consequences. [15]

Its cause-effect ideology generates dispositional and situational attribution error and a quest for blame ensues, [16] [17] which creates fear. The next casualty is truth, which may compromise the subsequent investigation process. [18] Many global US organisations with adversarial and militaristic structures display symptoms of entrenched Taylorism. This depicts employees as extensions of machines and alienates them from their work. [19]

Accident theory and its symptoms thrive in such environments, with an inherent focus on unsafe acts, cause-effect ideology, blame and changing behaviour. In adversarial structures, line managers or supervisors become unfamiliar with processes such as safety and frequently resort to managing the structure. [20] In sporting vernacular, they prefer to play the man and not the ball and Kaizen [21] principles, which reinforce that systems and processes influence performance, are often disregarded or neglected.

Safety advisors or evangelists

Reason before passion - Pierre Elliott Trudeau [22]

Hiring of safety managers and advisors during the resources boom was quite frantic and many were appointed holding a Certificate IV in Occupational Health and Safety. [23] Accreditation was easily and quickly obtained through registered training organisations [24] [25] and raw and unctuous evangelists were let loose across projects with the law of the instrument, Maslow's hammer. [26] It was soon evident that many were unable to articulate the fundamental test for a hazard [27] or differentiate between qualitative and quantitative data. [28] They were lost if not bossed and it was quite clear that recruitment processes required significant attention and vast improvement. [29]

The Certificate IV in Occupational Health and Safety provides an overview of the legislative framework [30] [31] and traditional accident theory. However, it does not fulfil Australian OHS Education Accreditation Board criteria as a professional education program. [32] Its coverage of contemporary key concepts, theories or business processes [33] [34] is limited and its kudos amongst safety professionals is somewhat dubious. [35]

The recent Safety Institute of Australia certification scheme for accreditation of safety professionals has honourable intentions. Nonetheless, it contains adversarial elements, especially in the verification process. [36] This can intimidate inexperienced safety advisors, stifle creativity and inhibit progress and the scheme requires further systemic thought.

Toolbox talks and prestart meetings at various sites often resembled quasi-religious tribal rituals, with project safety managers and safety evangelists proselytising and beseeching employees to behave safely. The terms faith and hope are more applicable to intelligent design and may occasionally appear in fuzzy soft systems change management processes. However, they have no place in risk and energy damage theory and certainly do not belong in any safety strategy. [37]

This was compounded by safety evangelists patrolling sites like fervent overpaid swimming pool attendants armed with digital cameras, electronic hazard identification sheets and behavioural safety checklists to target unsafe acts and conditions. It has created a Gotcha culture [38] underpinned by cognitive dissonance [39] with the emergence of an unnecessary and somewhat predictable bureaucratic email war.

Many of these administrative tools, especially behavioural safety checklists, use pejorative descriptors such as line of fire, eyes on path and eyes on task. [40] If you ask vague questions you will receive vague answers and measuring individual performance using qualitative and irrational indicators generates specious outcomes. [41] This has cultivated widespread disdain as not all unsafe acts are negligent and a careful appreciation of what constitutes negligence is required. It is a legal construct and must be based on an understanding of the application of law in the relevant jurisdiction. [42]

It is debatable whether such tactics are appropriate for managing general safety risks but applying similar methodology to operational risks [43] can lead to and has resulted in catastrophic consequences. [44] More appropriate terms for the discipline using such approaches would be safety damagement or Facebook safety.

Bureaucratic and qualitative risk management processes

The only thing that saves us from the bureaucracy is its inefficiency

Eugene McCarthy [45]

There are statutory requirements covering risk management in the Queensland Work Health and Safety Regulation 2011 [46] and safe work method statements are mandatory for high risk construction work. [47] On several projects, direct observation of activities confirm safe work method statements are frequently supplemented by additional risk assessment processes, which include a job safety analysis, task hazard analysis, take five process and standard operating procedures. Nominated high risk activities also require a permit to work and the entire administrative process degenerates into gridlock, creates frustration and a bureaucratic culture prevails. [48] Safe work method statements, [49] risk assessments and supplementary standard operating procedures are often overly complex and written to protect the writer. [50] The documents are invariably produced using a word processor and its many decorative functions and describe only a limited resemblance to what is occurring at the tactical level. However, significant variances between the activity and the documented process are often evident. [51] [52] Mallen and Collins [53] refer to this as the process perception paradox and rather alarmingly, it can create a form over substance culture.

Risk evaluation is determined using the commonly accepted two dimensional consequence and probability matrix. Contrary to popular belief, this is only a qualitative tool which uses numbers as labels. Its categories precede the data [54] with a profound impact on decision making. [55] It is a particularly blunt instrument, which is easily manipulated to suit hidden agendas and it has many limitations. [56] There has been significant discussion amongst safety professionals covering legislative requirements for risk assessments and their usefulness is critically reviewed by Viner. [57] An over-egged safe work method statement or job safety analysis, which has been electronically manicured using a word processor, won't extinguish a fire. [58]

Lower order control measures

He blew his mind out in a car, he didn't notice that the lights had changed

Lennon & McCartney [59]

Most safety advisors are fully conversant with the hierarchy of controls [60] but a review of investigation reports and action registers at project sites often indicates the Pareto principle applies. [61] On one project an independent safety consultant reviewed investigation reports and confirmed almost 80% of corrective actions involved implementation of lower order administrative controls or use of personal protective equipment. [62] [63] The Queensland Work Health and Safety Act 2011 [64] prescribes requirements for reporting notifiable incidents, which are normally followed by an exhaustive cause-effect investigation process. However, discussions with colleagues and participation during investigations confirm paradoxical lower order administrative controls are often implemented. These include disciplinary action, additional training, warning signs and a revision of safe work method statements or standard operating procedures. [65] [66] This generates distrust and renders documentation even more complex and enhances bureaucracy. [67] Lower order controls focus on changing people and it is much more effective to change the situation. [68]

At various projects one frequently encounters a plethora of warning signs, many of which fail to comply with *AS 1319 Safety signs for the occupational environment*. [69] They are often superfluous, ambiguous and temporarily affixed to equipment with adhesive tape. These have included laminated signs on lockable engine cowls for elevating work platforms stating *Danger – Moving parts*. Project offices, especially crib rooms, are decorated with unnecessary warnings, *Danger - Door opens inwards s*igns are displayed on access doors or *Danger – Hot water* tags are affixed above cistern dispenser taps. [70]

Laminated warning signs may assist paramedics find an injured person on a large construction site but they are more often heard, fluttering in the breeze, like plastic windmills on a suburban cemetery grave.

On one project the corrective action for light vehicles interacting with powered mobile plant on access roads involved a verification of competency process for light vehicle drivers. It was completed by an accredited trainer from a registered training organisation and every driver was assessed as competent. This diverted attention from using higher order controls, such as segregation of powered mobile plant and light vehicles [71] [72] and the process was yet another displacement activity.

The Queensland Work Health and Safety Regulation 2011 prescribes requirements covering general construction induction training. [73] This is supplemented by site specific inductions, which can provide organisations with a perfect opportunity to improve recruitment processes and demonstrate leadership. [74] However, participant feedback confirms site inductions have degenerated into a death by PowerPoint exercise. Every attendee passes with flying colours and the process merely verifies the presenter has a pulse and inductees can scrawl their name on the attendance register.

Many project sites also display and enforce golden or life-saving rules, which are regularly reiterated during inductions, prestart meetings and toolbox talks. Breaches often result in dismissal and rather predictably, it generates blame and fear, which conflicts with Deming's principles for transformation of western management. [75] It was the great dissenting philosopher, William Hazlitt, who commented that…….*rules and models destroy genius and art* [76] and the renowned Roman philosopher, Marcus Tullius Cicero, also remarked……. *the more laws, the less justice.* [77] Laws of fear and alternative approaches for achieving compliance using nudge theory, which promotes libertarian paternalism and offers a choice architecture philosophy, are discussed by Sunstein and Thaler. [78] [79]

The dominance of lower order controls is redolent of accident theory and aims to create a safer person, which conflicts with statutory obligations. [80] Risk and energy damage theory promotes reliability using technological controls. This minimises or reduces reliance on human behaviour. It targets the source and creates a safe place, which aligns with common law duty of care requirements. [81]

Cause-effect analysis and human error

Do not choose a coward's explanation that hides behind the cause and the effect

Leonard Cohen [82]

Cause-effect ideology is a fundamental tenet of accident theory and has been subject to extensive critical analysis over many years [83] and affords a simplistic and mechanistic notion. It advocates that unsafe acts or human error lead to injury or damage. This has received widespread acceptance amongst the public and safety advisors and remains entrenched in the resources sector. Modern variations covering incident aetiology have since been adopted [84] and contemporary investigation tools include the proprietary Incident Cause Analysis Method (ICAM) [85] and TapRoot Root Cause Analysis System. [86] These are essentially linear and suit tractable processes but are considered inappropriate for socio-technological systems. [87]

Another significant limitation with cause-effect thinking is that it nurtures a primitive and overwhelming desire to apportion blame and seek retribution. [88] [89] Many of these symptoms were evident following the Hillsborough stadium disaster in April 1989 and are discussed extensively by Scraton. [90] Following disasters, especially involving aircraft and trains, human error is the most established cause ascribed by the media and investigators. However, it is often a consequence which is influenced and provoked by other factors [91] and the term cause should be used sparingly during investigation processes. Nonetheless, it features prominently within the title of two commonly used proprietary tools. It often implies blame and human error, which is misleading and pejorative. This diverts attention from engineering controls, which focus on changing the situation and addressing the problem at the source. [92] It is a complex and difficult task changing the human condition but the conditions in which people work can often be changed much more easily. [93]

Reactive performance indicators

Rational behaviour requires theory. Reactive behaviour requires only reflex action

W Edwards Deming [94]

Injury frequency rates are commonly used for monitoring safety performance in the resources sector and include the total recordable injury frequency rate (TRIFR), which is a reactive indicator and does not provide a valid or reliable measure of performance. [95] Lag indicators such as TRIFR are an ex post facto mechanism that use a system failure to measure success. [96] It is statistically unreliable as an indicator for potential disasters and is exclusively influenced by relatively insignificant cases. [97] The definition of a recordable injury varies between international jurisdictions and is subject to interpretation. [98] [99]

Furthermore, discussions with colleagues indicate injury frequency rates can be manipulated to meet prescribed project performance targets, which are often linked to incentive schemes and bonus payments. This can be easily accomplished using accumulated project hours from tenuous sources such as indirect employees in corporate offices, catering and accommodation contractors and logistics providers. However, if these indirect employees sustain a recordable injury, it can be conveniently categorised as unrelated to the project and excluded from statistics. The frequency rate soon tumbles, targets are achieved and project bonuses are preserved accordingly. Modified injury frequency rates can then be presented to corporate executive leadership team members, who are appeased and the illusion, that worthless statistics are better than no data at all, is complete and the measure gets managed not performance. [100] Statistics such as total recordable injury frequency rates often conceal more than they reveal and must always be viewed with caution because correlation is only a measure of association between two variables and does not imply causation. [101]

Safety slogans and incentive schemes

Our major obligation is not to mistake slogans for solutions

Edward Murrow [102]

At many project sites one often encounters an assortment of Orwellian safety slogans and posters. They are merely another displacement activity and can indicate accident theory is thriving [103] and supported by an adversarial regime. Crib room walls and toilet doors are festooned with a beguiling array of posters beseeching employees to be safe and supplementary slogans are displayed at security entrance gates and embroidered into company clothing. On one major coal seam gas project a safety theme was promoted each month and advisors would affix posters to the rear of toilet doors across the site. Many posters were ripped down or defaced with derogatory comments and a confrontational environment underpinned with distrust and loathing was evident.

Slogans and posters are supplemented with safety performance incentive schemes, [104] where individuals or work groups receive awards or trinkets such as binoculars (for covert surveillance of unsafe acts), polo shirts (with embroidered safety slogans), Akubra hats and even steak knives. However, these schemes are condescending and may inhibit reporting and can become counterproductive. [105] This process aims at changing attitudes and is incongruous with behavioural safety theory because according to psychologists, attitude does not necessarily correlate with behaviour. [106] Further interesting observations and extensive comments on the vast and mysterious field of psychology, which includes psychoanalysis, behaviourism, cybernetics, socio-biology, evolutionary psychology and neuroscientific imaging are provided by Dalrymple, who critically evaluates how psychology undermines morality. [107]

Zero harm and safety culture

Everything is arranged so that it be this way, this is what is called culture

Jacques Derrida [108]

In recent years, the ubiquitous concept of zero harm has been introduced into corporate safety strategies and is merely a soft systems change management process and an extension of accident theory. [109] It is a symbolic gesture, which focuses on meaning and culture in organisations and enables leaders and managers to shape values and beliefs and build spirit through ritual and ceremony. [110] This is often supplemented with other organisational development techniques, which include role negotiation, inter-group confrontation, organisational mirroring, fish-bowling, team building exercises and cultural surveys. [111]

Like many soft systems change management elements, the term zero harm is somewhat vague and subject to definitional dilemma. It is a safety slogan, [112] which is often perceived as a numerical target and aligns with the attributes of accident theory. The zero harm concept is incompatible with the principles of quality management and several of the fourteen points for transformation described by W. Edwards Deming. These include avoid using numerical targets and quotas and remove slogans imploring employees to achieve unrealistic goals. [113] This pursuit of excellence can generate maladaptive anxiety, which cultivates avoidance and under reporting. It also amplifies trivial issues and exaggerates criticism. [114]

Safety culture is subject to extensive debate amongst academics and most safety professionals are conversant with the Hudson pathological to generative cultural maturity model [115] or the Dupont Bradley curve, [116] which is critically reviewed by Long. It remains a confusing and ambiguous concept without any empirical evidence covering its relationship to safety performance and it has been scathingly rebuked by as ontological alchemy. [117]

Behavioural safety

Behaviour arises from the level of one's consciousness

Maharishi Mahesh Yogi [118]

Most organisations embracing accident theory are acolytes of behavioural safety programs, which predictably target unsafe acts at the human machine interface. Its assessment tools focus predominantly on compliance with lower order controls and are littered with an argot of pejorative terminology. This includes vague descriptors such as line of fire, eyes on path and eyes on task. Behavioural safety is not measuring performance, it is counting and generates descriptive, qualitative and categorical data, which is of limited use or value [119] and statisticians always reiterate that correlation does not necessarily imply causation.

Behavioural safety is an administrative control and extremely popular in US companies or organisations with adversarial structures. Albeit much less scientific, it is analogous with Taylorism time-motion studies, which alienate employees from their work [120] and can create a dystopian environment. [121]

Despite statutory requirements, many behavioural safety advocates disregard the hierarchy of controls and focus on changing the person. This is accomplished by monitoring and correcting behaviour at a tactical level using the occupational psychology techniques of positive and negative reinforcement for controlling the associated risks. [122] Fleming and Lardner [123] recommend caution with behaviour based safety approaches and reinforce how it can divert attention to address symptoms and disregard the cause. This focus on the receiver and changing individual behaviour is inconsistent with common law duty of care requirements. [124]

Risk and energy damage theory – A process based approach

Risk comes from not knowing what you are doing

Warren Buffet [125]

Despite its conventional recognition by many organisations and safety evangelists, when subjected to critical evaluation accident theory is lacking in logical analysis and scientific rigour. [126] Haddon et al [127] reinforced that science needs to be based on an understanding of the fundamental processes involved rather than using descriptors. Accident theory has been reviewed previously by road safety researchers in the United States. It was discarded and the field of industrial safety was dismissed as being in a state of conceptual rigor mortis. [128]

More recent developments have seen the process of risk estimation by Rowe [129] and energy damage concepts of Haddon [130] consolidated by Viner. [131] This provides the field of industrial safety with a uniform process based theory, which adopts an objective and scientific evidence based approach. It consists of three principal features:

1) Events resulting in injury or damage involve energy
2) The process occurs sequentially
3) There is a degree of uncertainty or risk

A fundamental tenet of risk theory is that if something is possible it is only a matter of time before it happens and risk is defined as the effect of uncertainty on objectives, which also encompasses speculative risk. [132] A suitable definition of pure risk, which is much more applicable to industrial safety, is the uncertainty that an adverse consequence of a given size will occur. [133] Furthermore, the interrelationship between the components of risk and the inverse relationship between frequency and consequence value, enables us to measure risk quantitatively and fiscally using real numbers. [134]

Operational excellence and high reliability organisations (HROs)

Next to excellence is the appreciation of it

William Makepeace Thackeray [135]

Despite its enduring popularity, accident theory sits incongruously with total quality management principles [136] and the Shingo model of operational excellence. [137] The guiding principles of operational excellence embrace process based scientific and systemic thinking and focus on addressing problems at the source and adding value. The attributes of risk and energy damage theory are summarised in Table 1 below and it is evident they align with and reflect the Shingo model of operational excellence guiding principles.

High reliability organisations display unique characteristics for managing unexpected threats or uncertainty. These include a preoccupation with failure, reluctance to simplify, sensitivity to operations, resilience and a deference to expertise. [138] These five fundamental processes are tenets for improvement in quality, reliability and productivity and align with risk and energy damage theory. However, traditional accident theory is incompatible with these principles:

Preoccupation with failure

Risk and energy damage theory is underpinned by the concept of uncertainty and if something is possible it is only a matter of time before it happens. This aphorism, which is colloquially referred to as Murphy's Law [139] reflects and aligns with the attribute of preoccupation with failure. This focuses on exemplary performance in complex environments and managing the unexpected or uncertainty and if eternal vigilance is the price of liberty, chronic unease is the price of safety. [140]

Reluctance to simplify

Risk and energy damage theory adopts a systemic approach and embraces practical systems thinking. [141] [142] It employs scientific logic and measures risk quantitatively using real numbers via its inverse relationship between frequency and consequence value. Its organic configuration and collaborative process encourages diverse and challenging opinions with a reluctance to simplify or disguise complexity. [143]

Sensitivity to operations

Risk and energy damage theory is suitable for managing operational risk and general safety risks. It provides a systemic process based approach, which is suitable for addressing latent conditions and active failures [144] via objective evaluation. It employs quantitative risk analysis and estimation techniques, which synchronize with process safety architecture and tools [145] and affords a sensitivity to operations accordingly.

Resilience

Key attributes of risk and energy damage theory are its upstream focus and predictive and preventive foresight. This provides for attention to design and use of technological controls in response to functional failures, which ensures processes default into safe mode or soft landing when failures occur. This is referred to as resilience engineering. [146]

Deference to expertise

Additional key attributes of risk and energy damage theory are its technological focus, organic architecture and collaborative processes, which loosen hierarchical constraints. This encourages and enhances fluid decision making with a deference to expertise at operational or tactical levels. [147]

Conclusion

Progress is impossible without change and those who cannot change their minds cannot change anything

George Bernard Shaw [148]

The 21st October 2016 marks 50 years since the Aberfan disaster in South Wales, United Kingdom [149] which resulted in the deaths of 116 school children and 28 adults and wiped out a generation. Over the past 50 years, legislation has been implemented and supplemented by the introduction of many fashionable psychological approaches, which have been offered as silver bullets. [150] However, traditional accident theory and its many accoutrements remain enduringly popular despite their ostentatiously unscientific principles and social encumbrances. [151] Meanwhile, the carnage continues unabated and our performance at best, can only be described as mediocre.

In Australia, the annual direct costs amount to approximately $80 billion or almost 8% of our gross domestic product. [152] Moreover, the comments from Haddon et al [153] and Waller and Klein, [154] remain as pertinent today and still resonate with most academics and safety professionals. Reactive accident theory does not manage risk or measure performance, we are merely counting how many sheep we have left and keeping our fingers and toes crossed until……..

Westgate Bridge (1970), Ibrox Park (1971), Summerland (1973), Flixborough (1974), Seveso (1976), Granville (1977), Three Mile Island (1979), Bhopal (1984), Bradford (1985), Chernobyl (1986), Zeebrugge (1987), Kings Cross Station (1987), Piper Alpha (1988), Hillsborough (1989), Thredbo' (1997), Esso Longford (1998), Texas City Refinery (2005), Qinghe Steel (2007), Deepwater Horizon (2010), Fukushima (2011), Lac Megantic (2013), Samarco (2015), Dreamworld (2016), Fengcheng (2016)…….??????

It was the murderous tyrant, Joseph Stalin, (he was pretty conversant with totalitarian regimes and dystopian environments), who allegedly coined the phrase…..*one death is a tragedy and a million deaths is a statistic*. [155]

On a much less sombre note, W. Edwards Deming, at a 1982 seminar in the United States, commented……*there are two ways to improve figures; cheat or lie and just change the numbers and don't count injuries or defective parts or improve the process.* [156]

Meanwhile, during all the window dressing, we have witnessed the recurrence of coal workers' pneumoconiosis, in the Queensland mining industry and an operational or material risk has caught many asleep at the wheel. [157] [158] Transformational change will only occur when antediluvian accident theory is abandoned in favour of a process and evidence based approach.

Risk and energy damage theory fulfils this requirement and it reflects and aligns with the contemporary guiding principles of operational excellence and unique characteristics of high reliability organisations. It has many advantages over accident theory and its attributes are compared and summarised in Table 1 below.

Incidentally, this transition does not require tearing down the entire house and to reiterate the loose legal philosophy of the late Justice Thurgood Marshall [159] ……. *you do what you think is right and let the law catch up.*

Table 1: Accident theory v risk and energy damage theory attributes

Accident theory	Risk and energy damage theory
Subjective speculation	Objective evaluation
Hierarchical	Organic
Adversarial	Collaborative
Downstream human focus	Upstream technological focus
General risk	General & operational risk
Descriptive	Process and evidence based
Linear and mechanistic cause-effect	Systemic
Intuitive	Scientific
Counting	Measuring
Pejorative	Constructive
Reactive hindsight	Predictive and preventive foresight
Blameworthy	Virtuous
Qualitative	Quantitative
Change the person	Change the situation
Receiver focus	Source focus

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16th March 2017

Submission to the Select Committee Queensland Parliamentary Inquiry into Coal Workers' Pneumoconiosis (CWP)
[This submission aligns with the terms of reference]

A healthy loyalty is not passive and complacent but active and critical – Harold Laski

After approximately 30 public hearings and almost 40 submissions, the Queensland parliamentary inquiry into coal worker's pneumoconiosis is drawing to a close and evidence from the United States indicates it is a significant public and occupational health issue. Since 1975 the US Department of Labour has paid out almost $US 45 billion in CWP related compensation payments, which is a lot of hospitals and other infrastructure.

I have provided two previous submissions, reviewed transcripts and many related publications and attended several public hearings in Brisbane and the following significant contributory factors must be addressed:

- Regulatory capture
- Contingent and precarious employment arrangements via labour hiring agencies
- Linking of substantial performance bonuses to extreme production targets
- Intimidation

Exposure to excessive concentrations of respirable coal dust and silica must target the source. The controls must be proportional to the likely worst consequence and include:

- Increased automation to eliminate or reduce operator exposure
- Fixed intrinsically safe dust monitoring equipment
- Linking of monitoring equipment to extraction ventilation via a variable speed drive
- Installation of warning alarms and automatic shutdown devices
- Suitable dust suppression techniques including well maintained water sprays

These controls can be supplemented by:

- Intrinsically safe personal dust monitors to record individual exposure
- Personal protective equipment
- Reliable health surveillance
- Humane rehabilitation protocols

I have since reviewed an amended my attached supplementary paper, which includes references to CWP and further related information and guidance material.

Yours faithfully,

Bernard Corden
[redacted]

Zero to HRO 15
March 2017 Version

Zero to HRO (High Reliability Organising)

Abandoning antediluvian accident theory

Contributing author

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GDipOHM

Er cof am blant y ysgol 116 a 28 o oedolion a fu farw yn Aberfan 21ain Hydref 1966

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Zero to HRO (High Reliability Organising)

Abandoning antediluvian accident theory

Abstract

The recent resources boom in Australia saw a commensurate focus on occupational health and safety management. It also presented a unique opportunity to generate transformational change using a process and evidence based approach.

However, direct observation of activities and anecdotal evidence from colleagues on various projects, indicates there has been a significant resurgence in traditional accident theory. This has been supplemented with an array of nebulous soft systems change management processes, which includes the ubiquitous and pestilent concept of zero harm.

This paper evaluates the attributes of risk and energy damage theory and accident theory and compares them with the contemporary Shingo model of operational excellence and features of high reliability organisations.

It recommends abandoning atavistic accident theory and adopting risk and energy damage theory, which offers a process and evidence based approach to align with the guiding principles of operational excellence and the unique attributes of high reliability organisations.

Keywords

Accident theory, risk theory, operational excellence, high reliability organisations

Conflict of interest

The author of this paper declares no conflict of interest

Table of Contents

Introduction

A reasonable estimate of economic organization must allow for the fact that, unless industry is to be paralyzed by recurrent revolts on the part of outraged human nature, it must satisfy criteria, which are not purely economic

R H Tawney – *Religion and the Rise of Capitalism* (1926) [1]

The recent resources boom in Australia saw a commensurate focus on occupational health and safety management. It also created a perfect opportunity to generate transformational change via a process and evidence based scientific approach, [2] [3] underpinned by risk and energy damage theory. [4] [5] Alas, observation of activities at various projects, indicates a significant resurgence in traditional egocentric accident theory, [6] which has been supplemented by a plague of complex and nebulous psychology based nostrums. This has generated a concomitant increase in obscurantism [7] and agnotology [8] [9] and progress has stalled accordingly.

Corporate safety strategies and policies often embrace risk theory but it is a patina of good governance, [10] and corporate social responsibility. [11] [12] Further investigation at operational and tactical levels indicates there is often a misalignment of strategy and traditional accident theory prevails. Anecdotal evidence from colleagues confirms accident theory is flourishing and subliminally embraced by many project managers and safety evangelists. It is complicated by contingent precarious casual labour hire arrangements, [13] [14] inappropriate bureaucratic risk assessment techniques and linear cause-effect investigation tools. [15] This is exacerbated by an inordinate focus on reactive performance indicators, especially total recordable injury frequency rates. [16] Meanwhile, an ever increasing array of displacement activities [17] have been implemented, which include behavioural safety programs, incentive schemes, cultural surveys and fuzzy soft systems change management processes. [18] [19] It is compounded by a relentless stream of corporate bilge masquerading as leadership, with a precarious over reliance on bureaucratic lower order administrative controls and the use of personal protective equipment. [20] This is fortified by intimidation [21] [22] [23] and regulatory capture, [24] which begs the question…….*Quis custodiet ipsos custodes*?

Accident theory

A healthy loyalty is not passive and complacent but active and critical - Harold Laski [25]

Accident theory [26] emerged in the 1930s. It was immortalised by the work of Heinrich [27] and despite its reactive and foreboding nomenclature, [28] [29] it remains conventional with many organisations and safety evangelists. [30] Closer scrutiny confirms it lacks logical analysis and scientific rigour [31] and is littered with pejorative terminology. [32] [33] It targets downstream using reductionist, mechanistic and linear cause-effect methodology. This relies heavily on the benefit and bias of hindsight, [34] [35] which creates a robust cognitive illusion with a pernicious influence on decision makers. [36] A fundamental weakness of accident theory is its reliance on the judgemental term unsafe, which is so easy to establish following an event but surprisingly difficult to determine beforehand. [37] Its emphasis on unsafe acts diverts attention from operational or material risk to general safety risks. [38] This places an unwarranted focus on system noise, which leads to ignoring signal [39] and can result in catastrophic consequences. [40] Its cause-effect ideology generates dispositional and situational attribution error and a quest for blame ensues, [41] [42] which creates fear. [43] The next casualty is truth, which compromises the subsequent investigation. [44]

Many global corporate behemoths with authoritarian or militaristic structures display symptoms of entrenched Taylorism. [45] This depicts employees as extensions of machines and alienates them from their work. [46] Accident theory and its attributes thrive under such conditions, with an inherent focus on unsafe acts, cause-effect ideology, blame and changing behaviour. [47] The introduction of new technology and casual labour hire arrangements often generates insecurity and atavism [48] and employees frequently resort to managing the structure, [49] especially in adversarial environments. In sporting vernacular, they play the man not the ball and Kaizen principles, which emphasise that systems influence performance, are neglected or discarded. [50] The impact of technology and its transformation of organisational structures is reviewed extensively by Drucker. [51]

Casual labour hire arrangements

Work keeps away those three great evils: boredom, vice and poverty - Voltaire [52]

Over the past few decades traditional employment relationships have changed considerably, with a dramatic increase in contingent or precarious arrangements, [53] using contract labour through hiring agencies. [54] This trend is noticeable across Australia and overseas, especially throughout the construction, resources and horticultural sectors and it shows no signs of abating. [55] Arrangements normally consist of a loose tripartite agreement between the host who provides the work, the labour hiring agency and the employee, who is effectively a ragged trousered philanthropist. [56] Responsibilities are often vague and there is confusion whether arrangements are a contract of service or a contract for service, [57] which generates legal [58] and organisational uncertainty. [59] Labour hire networks are quite intricate and the courts adopt a multi-factorial approach [60] to confirm precise contractual relationships, which evaluates the degree of control, level of integration and the totality of interdependence. [61]

Labour hiring agencies experience extreme difficulty in the supervision of its employees, especially across multiple sites, with host organisations more than willing to relay or transfer the associated risks. [62] It becomes increasingly complex to synchronise activities, coordinate decisions and manage risks. Agency employees are invariably unfamiliar with the host site and its workforce, which significantly increases occupational health and safety risks. [63] [64] Labour hire arrangements also compromise consultation mechanisms [65] through the deliberate or inadvertent exclusion of agency employees from the host organisation health and safety committee meetings. [66] [67] It is a fertile environment for reactive accident theory. Many of its symptoms, which include fear and blame, evolve and flourish accordingly. The legal and organisational complexities and uncertainties generated by labour hire arrangements are somewhat antagonistic and create negative behaviour patterns, which can result in increased injury rates, psychosocial risks and long term health problems. [68] This may be a significant contributory factor in the recent resurgence of coal workers' pneumoconiosis throughout Appalachia in the United States [69] and across Queensland in Australia. [70]

Regulatory capture

Quis custodiet ipsos custodes? - Juvenal [71]

Accident theory renaissance has coincided with an emergence of regulatory capture, [72] especially in Queensland. [73] This consists of financial and cognitive capture and occurs when statutory officials develop convivial relationships with the regulated industry. [74] A perception transpires whereby the regulated entity receives benefits or preferences at the expense of the regulatory authority or public interest and the liaison appears unethical. [75] This risk is significantly increased when statutory officials adopt conciliatory and cooperative approaches using persuasion and negotiation as opposed to adversarial and punitive enforcement. [76] A conflict of interest also arises if the inspectorate belongs to a government department which has principal responsibility for ensuring the productivity and economic success of the regulated industry. [77] [78] The provincial occupational health and safety regime in Alberta, Canada exhibits classic symptoms of regulatory capture. [79] Financial capture is accomplished via employer funding of regulatory activity, which provides preferential access to policy making. [80] Cognitive or cultural capture is achieved using propaganda [81] and the regulator and employers promulgate a narrative of culpability, promoting the careless worker myth. [82] Media safety campaigns target downstream with a focus on injury management and rehabilitation, [83] which often features grieving dependents. [84] This subliminally transfers duty of care onto the victim in an attempt to absolve employer negligence. [85] It has indirectly resurrected atavistic accident theory, promoted the concept of zero harm and created a sinister revival in behavioural safety programs. In Australia regulatory capture has been identified as a contributory factor in the resurgence of coal workers' pneumoconiosis. [86] [87]

The dilemma of responsive regulation [88] and whether to punish or reward is reviewed by Kolieb [89] and promotes compliance and aspirational approaches via a regulatory diamond model. More recent developments include the behavioural economics concept of nudge theory [90] but left unfettered this can easily degenerate into a laissez faire regime [91] [92] and subsequent deregulation. [93] [94] Further guidance on reducing regulatory capture risks is provided by the Australian National Audit Office. [95]

Safety advisors or evangelists

Reason before passion - Pierre Elliott Trudeau [96]

Hiring of safety managers and advisors during the resources boom was quite frantic. The minimum qualification required was a Certificate IV in Occupational Health and Safety [97] and accreditation was easily and quickly obtained, [98] through numerous registered training organisations. [99] [100] Projects were besieged by raw and unctuous safety evangelists wielding Maslow's hammer, the law of the instrument, [101] without any concept of business systems and processes or critical thinking. [102] [103] They were soon lost if not bossed and terms such as unsafe, hazard, mate and risk were often used indiscriminately and synonymously. Many advisors were unable to articulate the fundamental test for a hazard [104] [105] or distinguish between qualitative and quantitative data or descriptive and inferential statistics. [106] [107] This has emasculated, discredited and dumbed down [108] the safety profession and an extensive review of the curriculum [109] [110] and recruitment processes [111] is required. The Certificate IV qualification merely provides an overview of the legislative framework [112] [113] and traditional accident theory. It does not fulfil Australian OHS Education Accreditation Board criteria [114] as a professional education program and the coverage of key concepts, theories and business processes [115] [116] is limited. Its integrity. [117] [118] amongst many safety professionals is regarded with some cynicism. However, the Safety Institute of Australia professional certification scheme has honourable intentions. Nonetheless, it contains adversarial elements, especially in the verification process. [119] This can intimidate inexperienced safety advisors, stifle creativity and inhibit progress and the scheme requires further systemic thought.

Toolbox talks and prestart meetings at various projects often resembled quasi-religious tribal rituals, with project safety managers and safety evangelists proselytising, chanting and beseeching employees to behave safely. The terms faith and hope are more applicable to creationism, [120] scientology [121] or intelligent design [122] and may occasionally appear in fuzzy soft systems change management processes [123] or neurolinguistic programming. However, they have no place in risk and energy damage theory and certainly do not belong in any safety strategy. [124] [125]

This was exacerbated by functionally illiterate safety crusaders patrolling sites like neurotic Tonton Macoutes, [126] armed with digital cameras, electronic hazard identification sheets and behavioural safety checklists to target unsafe acts and conditions. It has created a Gotcha culture [127] underpinned by cognitive dissonance, [128] blame and fear, [129] with the emergence of an unnecessary and somewhat predictable bureaucratic email war. [130] Many of these administrative tools, especially behavioural safety checklists, use pejorative descriptors such as line of fire, eyes on path and eyes on task. [131] Qualitative irrational performance indicators generate misleading data [132] and if you ask vague questions, expect vague answers. It is opening a Pandora's Box [133] and cultivating widespread disdain. Unsafe acts and negligence are not synonymous, it is a legal concept and an industrial relations minefield. Moreover, it requires a careful understanding of jurisprudence [134] and a discreet appreciation of the fundamental tests, which are used to establish the tort of negligence. [135]

It is debatable whether such tactics are appropriate for managing general safety risks and the application of similar methods to operational risks [136] has resulted in catastrophic consequences. [137] More appropriate terms for the discipline using such approaches would be safety damagement or Facebook Safety™.

In 2010 an extensive review of health and safety legislation in the United Kingdom [138] triggered comments from David Cameron, who pledged to kill off the health and safety monster and claimed it was an albatross around the neck of British businesses. [139] He need never have bothered because much like Shelley's Victor Frankenstein, [140] it is imploding and self-destructing [141] and to reiterate the British philosopher and logician, Bertrand Russell…*all movements go too far*. [142]

Bureaucratic and qualitative risk management processes

The only thing that saves us from the bureaucracy is its inefficiency - Eugene McCarthy [143]

Queensland safety legislation [144] prescribes requirements covering risk management and safe work method statements are mandatory for high risk construction work. [145] On several projects, direct observation of activities confirm safe work method statements are frequently supplemented with additional risk assessment processes, which include a job safety analysis, task hazard analysis, take five process and standard operating procedures. Nominated high risk activities also require a permit to work [146] and the entire administrative process degenerates into gridlock, creates frustration and a bureaucratic culture prevails. [147] Safe work method statements, [148] risk assessments and supplementary standard operating procedures are often overly complex [149] and written to protect the writer. [150] Documentation is produced using word processing software with its many decorative functions and describes only a limited resemblance to what is occurring at the human machine interface. However, there are often significant variances between the activity and documented procedures [151] [152] and a process perception paradox [153] is evident, which somewhat alarmingly creates a form over substance culture. [154]

Risk estimation [155] is determined using the conventional consequence and probability two dimensional matrix. [156] Contrary to popular belief, this is only a qualitative tool which uses numbers as labels. Its categories precede the data, [157] with a profound impact on decision making. [158] It disguises the significant variable of exposure and does not reflect the typical inverse logarithmic relationship between frequency and consequence value. [159] The matrix is a particularly blunt instrument and is easily manipulated to suit hidden agendas and it has many other imperfections. [160] [161] Viner provides a critical review covering effectiveness of risk assessments [162] and additional limitations are discussed by Pickering and Cowley, [163] Hopkins [164] and Gadd et al. [165] An electronically manicured and over-egged safe work method statement or job safety analysis won't extinguish a fire [166] and indeed, much of the documentation observed across several projects merely represents a combustible hazard.

Lower order control measures

He blew his mind out in a car, he didn't notice that the lights had changed

Lennon & McCartney [167]

Most safety advisors are fully conversant with the hierarchy of controls [168] but a review of project risk registers and investigation reports often exposes the Pareto principle. [169] Almost 80% of corrective actions involve lower order administrative controls or use of personal protective equipment. [170] [171] Queensland legislation [172] prescribes requirements for reporting notifiable incidents, which are followed by a comprehensive investigation process. However, anecdotal evidence and participation during investigations, confirm paradoxical nostrums are often implemented. These include additional warning signs, disciplinary action, retraining, revision of safe work method statements or standard operating procedures and supplementary personal protective equipment. [173] [174] It is a decorous façade, which does not significantly reduce the associated risk. [175] Documentation becomes increasingly complex, which cultivates bureaucracy and eventually generates disdain and distrust. [176] Active lower order controls focus on changing people and it is much more effective to change the situation. [177]

A panoply of safety signs is commonplace on most projects and superfluous laminated warnings are often displayed haphazardly and mounted using string, cable ties or adhesive tape. Many are confusing, noncompliant with guidance standards and ineffective. [178] [179] Engine hoods on elevating work platforms display a betokening - *Danger Moving Parts*. Project offices, especially crib rooms, are bedecked with futile warnings. Doors are affixed with a presaging - *Danger Door Opens Inwards* and kitchen cisterns are supplemented with soothsaying labels - *Danger Hot Water*. [180] Departure lounge windows at a regional airport were decorated with a wonderful oxymoronic pièce de résistance - *No Smoking Prohibited*. At least it was spelt correctly or perhaps it was innovative choice architecture. [181] Laminated safety signs may assist paramedics find an injured person on a large construction site. However, they are more often heard, fluttering in the breeze, like plastic windmills on a suburban cemetery grave or makeshift roadside traffic accident memorial.

At one project, the corrective action for light vehicles interacting with powered mobile plant on access roads involved a verification of competency for light vehicle drivers. This was completed by an accredited trainer from a registered training organisation and every driver was assessed as competent. It was a classic displacement activity and diverted attention from using higher order controls, such as segregation of powered mobile plant and light vehicles. [182] [183] If the terms mate and buddy were excluded from two way radio chatter during traffic control, the silence would be deafening.

Queensland legislation prescribes requirements covering general construction induction training. [184] This is supplemented with site specific inductions, which can provide organisations with a perfect opportunity to improve recruitment processes and demonstrate leadership. [185] [186] However, participant feedback confirms site inductions have degenerated into a death by PowerPoint exercise. Every attendee passes with flying colours, which verifies the presenter has a pulse and inductees can scrawl their name on the attendance register. Many projects also display and enforce platinum, golden, cardinal or life-saving rules, [187] which are regularly reiterated during inductions, prestart meetings and toolbox talks. Breaches often result in dismissal and rather predictably, it generates blame and fear, which conflicts with Deming's principles for transformation of western management. [188] It was the great dissenting philosopher, William Hazlitt, who commented that…….*rules and models destroy genius and art* [189] and the renowned Roman philosopher, Marcus Tullius Cicero, remarked…….*the more laws, the less justice.* [190] Laws of fear and alternative approaches for achieving compliance using nudge theory, which promotes libertarian paternalism and offers a choice architecture philosophy, are discussed by Sunstein and Thaler. [191] [192]

The dominance of active lower order controls is redolent of accident theory and atavistic regimes and aims to create a safer person, which conflicts with statutory obligations. [193] Risk and energy damage theory promotes reliability using passive [194] technological controls. This minimises or reduces reliance on human behaviour. [195] It targets the source and creates a safe place, which aligns with common law duty of care requirements. [196]

Cause-effect analysis and human error

Do not choose a coward's explanation that hides behind the cause and the effect

Leonard Cohen [197]

Cause-effect ideology [198] [199] is a fundamental tenet of accident theory and has been subject to extensive critical analysis over many years. [200] [201] It is overly simplistic and mechanistic and advocates unsafe acts or human error lead to injury or damage. This has received widespread acceptance amongst safety advisors and is entrenched in the resources sector. Several variations have evolved, [202] [203] which are essentially linear and suit tractable processes [204] [205] and are fundamentally flawed. They are inappropriate for socio-technological systems and constrain investigations. [206] [207] Following several hours of painstaking and thoughtless deliberation over proximal, distal, contributory and necessary causes, [208] the outcome usually divulges a statement of the bleeding obvious. [209] This often discloses human error [210] and with the benefit and bias of hindsight, [211] [212] it allocates or redirects blame onto subordinates [213] [214] and the culpability cycle continues ad infinitum. [215]

Another significant limitation with cause-effect thinking is that it nurtures an atavistic and overwhelming desire to find scapegoats and seek closure or retribution. [216] [217] Many of these symptoms were evident following the Hillsborough stadium disaster in April 1989 and are discussed extensively by Scraton. [218] Following disasters, especially involving transport, [219] human error [220] is usually ascribed as the cause by investigators and the media. [221] It is often a consequence, which is influenced and provoked by other factors. [222] The term cause must be used sparingly during investigations, nonetheless it features prominently within the title of two conventional proprietary tools. Ascription of human error is unhelpful and akin to saying falls are due to gravity. [223] It often implies blame, which is misleading and pejorative and compromises investigations. [224] This diverts attention from engineering controls, [225] which focus on changing the situation and addressing the problem at the source. Changing the human condition is a complex and difficult task. However, modifying the working environment is often more effective and far less complicated. [226] [227]

Reactive performance indicators

Rational behaviour requires theory. Reactive behaviour requires only reflex action

W Edwards Deming [228]

Reactive injury frequency rates are commonly used for monitoring safety performance in the resources sector and include the total recordable injury frequency rate. [229] This is an unreliable ex post facto performance metric, [230] which uses a system failure to measure success. [231] It is exclusively influenced by relatively insignificant cases and is statistically deceptive as an indicator for potential disasters. [232]

The definition of a recordable injury varies between international jurisdictions and is subject to interpretation. [233] [234] Furthermore, discussions with safety professionals confirm injury frequency rates are regularly manipulated [235] to meet prescribed project performance targets, [236] which are linked to incentive schemes and bonus payments. [237] This is easily accomplished using accumulated project hours from tenuous sources. These include indirect employees in corporate offices, logistics providers and catering and accommodation contractors. If any indirect employees sustain a recordable injury, it is conveniently categorised as unrelated to the project, excluded from statistics and the frequency rate soon tumbles. [238] Massaged statistics are then presented to the executive leadership team, who are assuaged. Performance targets are achieved, project bonuses are preserved and the increasingly prevalent illusion, that worthless statistics are better than no data at all, is complete. [239] It is so much easier to fool people than to convince them that they have been fooled [240] and the measure gets managed not performance. [241] This reflects the comments of W. Edwards Deming……*people with targets and jobs dependent upon meeting them will probably meet the targets - even if they have to destroy the enterprise to do it*. [242] Statistics such as total recordable injury frequency rates often conceal more than they reveal [243] and must always be evaluated with extreme caution. Correlation is only a measure of association between two variables and does not imply causation. [244]

Safety slogans, posters and incentive schemes

Our major obligation is not to mistake slogans for solutions

Edward Murrow [245]

At many projects one often encounters an assortment of patronising and jingoistic Orwellian safety slogans and posters, which are like the rattling of a stick inside a swill bucket and similar to advertising or junk mail. [246] They do not save lives, [247] provide insignificant protection and offer no value. It is merely another displacement activity, which indicates accident theory is thriving [248] and supported by an adversarial regime. [249] Crib room walls and toilet doors are festooned with a beguiling array of posters beseeching employees to behave safely and supplementary slogans are displayed at security entrance gates and embroidered into company clothing. On one major coal seam gas project a monthly safety theme was promoted and advisors would affix posters to the rear of toilet doors across the site. Many were ripped down or defaced with derogatory comments and a confrontational environment underpinned with distrust and loathing was evident.

Slogans and posters are supplemented with safety incentive schemes, [250] [251] which inveigle employees and attempt to change attitudes. Nominated individuals or groups receive bonuses, recognition, awards or trinkets for exceptional safety performance. These include binoculars (for covert surveillance of unsafe acts), Akubra hats, polo shirts (with embroidered safety slogans), leather belts and even steak knives. This is inconsistent with behavioural safety theory because attitude does not necessarily correlate with behaviour. [252] [253] Incentive schemes are considered denigrating, counterproductive and can inhibit reporting. [254]

Production bonuses and incentive schemes were intensely debated at recent public hearings during the Queensland parliamentary inquiry into coal workers' pneumoconiosis. [255] They were also evaluated during the New South Wales Mine Safety Advisory Council Digging Deeper project. Its subsequent report recommended schemes be carefully reviewed to ensure rewards do not compromise safe working arrangements. [256]

Zero harm and safety culture

Wenn ich Kultur höre entsichere ich meine Browning

Hanns Johst [257]

In recent years, the ubiquitous and pestilent concept of zero harm [258] [259] has been introduced into corporate safety strategies and is merely a soft systems change management process and an extension of accident theory. [260] It is a symbolic gesture, which focuses on meaning and culture in organisations and enables leaders and managers to shape values and beliefs and build spirit through ritual and ceremony. [261] This is often supplemented with other organisational development techniques, which include role negotiation, inter-group confrontation, organisational mirroring, fish-bowling, team building exercises and cultural surveys. [262]

Like many soft systems change management features, [263] the term zero harm is somewhat vague and subject to definitional dilemma. It is a safety slogan, [264] which is often perceived as a numerical target and aligns with the attributes of accident theory. The zero harm concept is incompatible with quality management principles and several of the W. Edwards Deming fourteen points for transformation of management. These include avoid using numerical targets and quotas and remove slogans imploring employees to achieve unrealistic goals. [265] This pursuit of excellence can generate maladaptive anxiety and apophenia, [266] [267] which cultivates avoidance and under reporting. It also amplifies trivial issues and exaggerates criticism. [268]

Safety climate or culture [269] [270] is subject to extensive discussion amongst academics [271] [272] and most safety professionals are conversant with the Hudson pathological to generative cultural maturity model [273] or the Dupont Bradley curve. [274] The European Agency for Safety and Health at Work provides a review of key approaches and selected tools. [275] It remains a confusing and ambiguous concept without any empirical evidence covering its relationship to safety performance. It has been scathingly rebuked as ontological alchemy [276] and the debate rekindles Snow's controversial 1959 Rede lecture, [277] The Two Cultures. [278]

Behavioural safety

If your only tool is a hammer, every problem becomes a nail – Abraham Maslow [279]

Most organisations embracing accident theory are acolytes of behavioural safety [280] and predictably target unsafe acts at the human machine interface, [281] which cultivates blame [282] and impedes organisational development. [283] The focus is predominantly on the absence of safety [284] and compliance with lower order controls. Assessment tools are littered with an argot of pejorative terminology, [285] which include vague descriptors such as line of fire, eyes on path and eyes on task. This implies human error and is inconsistent with the philosophy of multifactorial causation [286] and can significantly increase psychosocial risk. [287]

Behavioural safety [288] [289] is only an administrative control and extremely popular in American companies or organisations with adversarial structures. [290] It does not measure safety performance and is merely counting, which generates descriptive, subjective, qualitative and categorical data. This is of limited use or value [291] and statisticians frequently reiterate that correlation does not necessarily imply causation. [292] Albeit much less scientific, it is analogous with Taylorism time and motion studies, [293] which alienate employees from their work [294] and creates a dystopian environment. [295]

Despite statutory requirements, many behavioural safety advocates disregard the hierarchy of controls and focus on changing the person. [296] This is accomplished by monitoring and correcting behaviour using operant conditioning [297] and techniques of positive and negative reinforcement for controlling the associated risks. [298] Fleming and Lardner [299] recommend caution with behaviour based safety approaches and reinforce how it can divert attention to address symptoms and disregard the cause. This focus on the receiver and changing individual behaviour is inconsistent with common law duty of care requirements. [300] Cohen and Nader provide further extensive discussions covering road safety, vehicle engineering design and the effectiveness and complexity of changing human behaviour. [301] [302]

Skinner, a pioneer of radical behaviourism, has been described as a man who conducted many experiments on rodents and pigeons and wrote most of his books about people. [303] Kohn claims operant conditioning has many misleading assumptions and limitations and its effectiveness is only ephemeral. It also generates intrinsically objectionable and persistent counterproductive consequences. [304]

Recent papers from prominent American behavioural safety consultants indicate there is a conceptual transition. Many of the claims and hyperbole extolling phenomenal accomplishments have been moderated and there is now some acceptance that most workplace injuries are not the sole consequence of unsafe acts. [305]

Nonetheless, there has been extraordinary growth in the study of human behaviour, which includes psychoanalysis [306] psychotherapy, [307] behaviourism, [308] cognitive behaviour therapy, [309] cybernetics, [310] [311] sociobiology, [312] evolutionary psychology, [313] neurolinguistic programming, [314] neuroscientific imaging [315] and neurochemistry. [316] [317] Dalrymple critically evaluates how psychology undermines morality and provides further interesting observations and extensive comments on this vast, arcane and dynamic discipline. [318] Notwithstanding these remarkable developments and despite the logorrhea, [319] it would be a bold person who claims that our self-understanding, with the forlorn hope of an existence free of inner and outer conflict, is now greater than that of Montaigne [320] or Shakespeare. [321] Human motives are rarely pure and never simple and we owe incomparably more to improved sewerage than to psychology. The human brain, for something supposedly so brilliant and evolutionary advanced, is a pretty messy, extremely fallible and complicated organ. [322] This supports the philosophy of the late and much lamented Trevor Kletz [323] ……..*try to change situations, not people*. It is much less complicated than teaching rodents or pigeons how to play table tennis and wallowing in scientology, [324] neurolinguistic programming or obscurantist psychobabble.

Risk and energy damage theory – A process based approach

Ask not what's inside your head but what your head's inside of - William M Mace [325]

Despite its conventional recognition by many organisations and safety evangelists, when subjected to critical evaluation, accident theory is lacking in logical analysis and scientific rigour. [326] Haddon et al [327] [328] reinforced that science must be based on an understanding of its fundamental processes rather than using descriptors. [329] [330] Accident theory was reviewed during road safety research in the United States [331] [332] and the discipline was described as being in a state of conceptual rigor mortis. [333] Since the 1950s, accident epidemiological research by Gordon [334] and Gibson's ecopsychology principles [335] [336] and affordance theory [337] [338] have converged with the pioneering energy damage concepts of Haddon. [339] [340] More recent developments include integration with Rowe's anatomy of risk, which has been consolidated and reified by Viner. [341] [342] This provides industrial safety with a uniform process based theory. It generates synergy and adopts an objective and scientific evidence based approach consisting of three principal features:

1) Events resulting in injury or damage involve energy
2) The process occurs sequentially
3) There is a degree of uncertainty or risk

A fundamental tenet of risk theory is that if something is possible it is only a matter of time before it happens. [343] Risk is defined as the effect of uncertainty on objectives, which encompasses speculative risk. [344] However, pure risk, which is more applicable to industrial safety, is the uncertainty that an adverse consequence of a given size will occur. [345] Frequency is a critical parameter in risk estimation and is a function of probability and exposure. It enhances perception of risk based on experience and displays an inverse logarithmic relationship with consequence value. This reifies risk and enables it to be measured objectively, quantitatively and fiscally using real numbers. It is a logical approach, which offers a rational and simple appreciation of the connection between risk and loss. [346] Tannert et al discuss the ethics of uncertainty and decision making extensively and introduce an interesting taxonomy, the igloo of ignorance. [347]

Operational excellence and high reliability organisations (HROs)

Next to excellence is the appreciation of it

William Makepeace Thackeray [348]

Despite its persistent popularity, accident theory sits incongruously with total quality management principles [349] and the Shingo model of operational excellence. [350] The guiding principles of operational excellence embrace process based scientific and systemic thinking and focus on addressing problems at the source and adding value. [351] The attributes of risk and energy damage theory are summarised in Figure 1 below and it is evident they align with and reflect the Shingo model of operational excellence guiding principles.

High reliability organisations [352] [353] display unique characteristics for managing unexpected threats or uncertainty. These include a preoccupation with failure, reluctance to simplify, sensitivity to operations, resilience and a deference to expertise. [354] These five fundamental processes are tenets for improvement in quality, reliability and productivity and align with risk and energy damage theory. However, traditional accident theory is incompatible with these principles:

Preoccupation with failure

Safety or reliability has been defined as a dynamic non-event, [355] which is consistent with risk and energy damage theory and the concept of uncertainty. If something is possible it is only a matter of time before it happens. This aphorism, colloquially ascribed to Murphy, [356] implies a preoccupation with failure. It involves managing the unexpected or uncertainty and ensuring exemplary performance in complex stochastic environments. If eternal vigilance is the price of liberty, chronic unease is the price of safety. [357]

Reluctance to simplify

Risk and energy damage theory adopts a systemic approach and embraces practical systems thinking. [358] [359] It employs scientific logic and measures risk quantitatively using real numbers via its inverse relationship between frequency and consequence value. Its organic configuration and collaborative process encourages diverse and challenging opinions with a reluctance to oversimplify [360] or disguise complexity. [361]

Sensitivity to operations

Risk and energy damage theory is suitable for managing operational risk and general safety risks. It provides a systemic process based approach, which is suitable for addressing latent conditions and active failures [362] via objective evaluation. It employs quantitative risk analysis and estimation techniques, [363] which synchronize with process safety architecture and tools and affords a sensitivity to operations accordingly. [364] [365]

Resilience

Key attributes of risk and energy damage theory are its upstream focus and predictive and preventive foresight. This provides for attention to design and use of technological controls in response to functional failures, which ensures processes default into safe mode or soft landing when failures occur. This is referred to as resilience engineering. [366]

Deference to expertise

Additional key attributes of risk and energy damage theory are its technological focus, organic architecture and collaborative processes, which loosen hierarchical constraints. This encourages and enhances fluid decision making with a deference to expertise at operational or tactical levels. [367] This also reflects and aligns with Drucker's concepts covering the impact of technology and transformation of organisations into information and knowledge based organic structures. [368]

Conclusion

Progress is impossible without change and those who cannot change their minds cannot change anything

George Bernard Shaw [369]

The 21st October 2016 commemorated half a century since the Aberfan disaster in South Wales, United Kingdom [370] which resulted in the deaths of 116 school children and 28 adults and wiped out a generation. Over the past 50 years, legislation has been implemented and supplemented by the introduction of many fashionable psychological approaches, which have been offered as silver bullets. [371] However, traditional egocentric accident theory and its many accoutrements remain enduringly popular despite their ostentatiously unscientific principles [372] and social encumbrances. [373] Meanwhile, the carnage continues unabated and our performance at best, can only be described as mediocre. [374] [375] In Australia, the annual direct costs amount to approximately $80 billion, which is almost 8% of our gross domestic product. [376] Moreover, comments from Haddon et al, [377] [378] Waller [379] [380] and Klein, [381] remain as pertinent today and still resonate with most academics and safety professionals. Reactive antediluvian accident theory does not manage risk or measure performance, we are merely keeping our fingers and toes crossed and counting how many sheep we have left until that black swan or wild card event: [382] [383] ……

Westgate Bridge (1970), [384] Ibrox Park (1971), [385] Summerland (1973), [386] Flixborough (1974), [387] Seveso (1976), [388] Granville (1977), [389] Three Mile Island (1979), [390] Bhopal (1984), [391] Bradford (1985), [392] Chernobyl (1986), [393] Zeebrugge (1987), [394] Kings Cross (1987), [395] Piper Alpha (1988), [396] Hillsborough (1989), [397] Grafton (1989), [398] [399] Kempsey (1989), [400] [401] Cowan (1990), [402] Thredbo' (1997), [403] Esso Longford (1998), [404] Mont Blanc Tunnel (1999), [405] Ladbroke Grove (1999), [406] [407] Glenbrook (1999), [408] Toulouse (2001), [409] Waterfall (2003), [410] BP Texas City (2005), [411] Qinghe Steel (2007), [412] BP Deepwater Horizon (2010), [413] Upper Big Branch (2010), [414] Fukushima (2011), [415] Rabaul Queen (2012), [416] Lac Megantic (2013), [417] Rana Plaza (2013), [418] Soma Eynez (2014), [419] Samarco (2015), [420] Dreamworld (2016), [421] Fengcheng (2016), [422] ……????

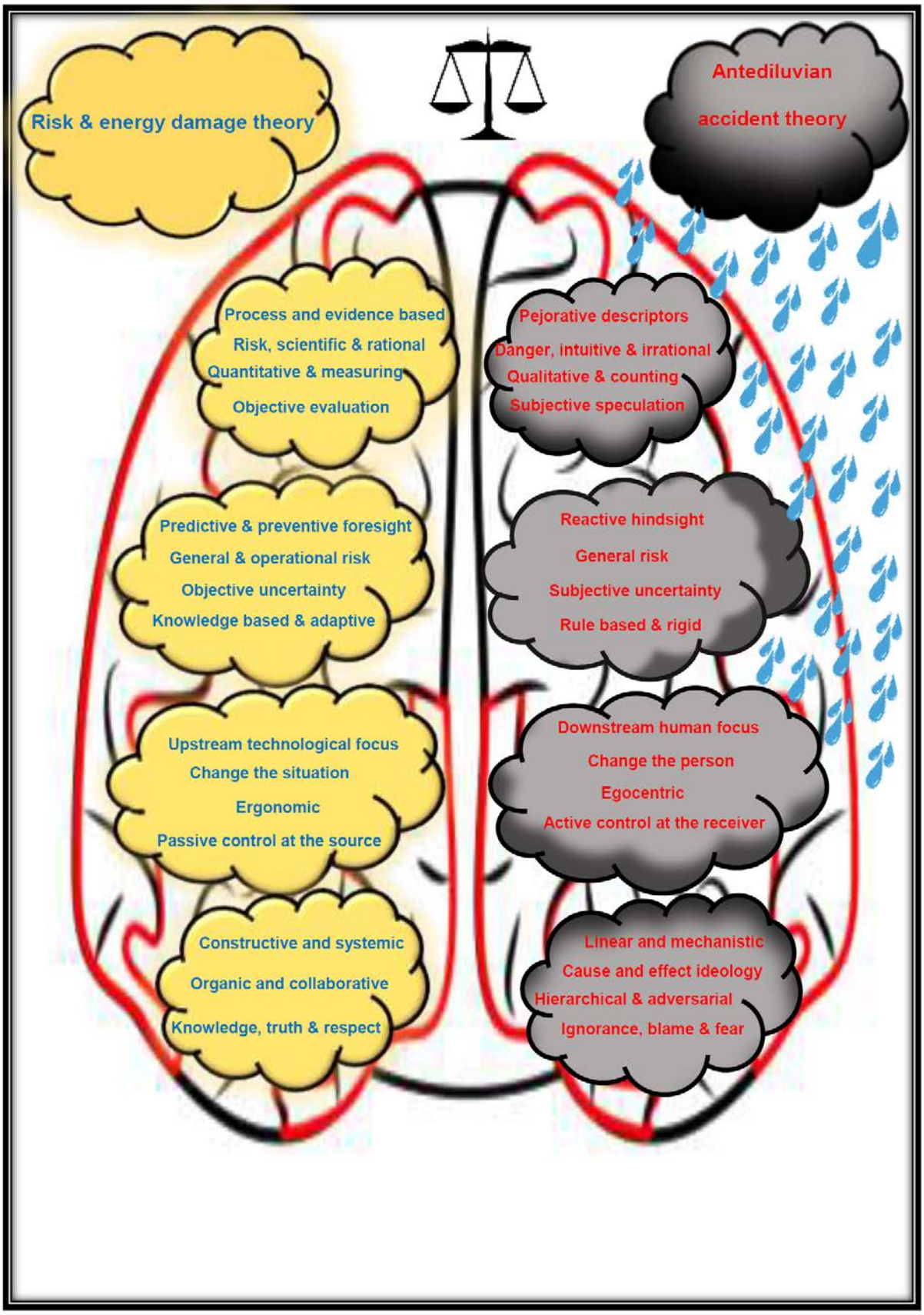
The region has also experienced its share of mining fatalities [423] and disasters, which include: Moura 4 (1986), [424] South Bulli (1991), [425] Porgera (1994), [426] Moura 2 (1994), [427] Gretley (1996), [428] Northparkes (1999) [429] and Pike River (2010). [430] [431]

In developing countries, especially China, statistics are even more appalling and many incidents remain undisclosed. [432] Interesting distinctive patterns have emerged from the study of disasters, which are discussed extensively by Quinlan. [433] [434] Meanwhile, notwithstanding the window dressing, we have witnessed a resurgence of coal workers' pneumoconiosis [435] [436] in the Queensland mining industry and an operational or material risk has found many asleep at the wheel. [437] [438] The standard of risk control must be proportional to the likely worst consequence [439] and a fragile production and protection dichotomy will obviously arise when mercenary rednecks receive substantial performance bonuses to achieve extreme production targets. [440] [441] It was the murderous tyrant, Joseph Stalin, (he was pretty conversant with totalitarian regimes and dystopian environments), who allegedly coined the phrase…*one death is a tragedy and a million deaths is a statistic*. [442] Corporations are an anthropomorphic fallacy, [443] they have no memory, [444] soul to save [445] or body to incarcerate. [446] On a much less sombre note, W. Edwards Deming, at a 1982 seminar commented….*there are two ways to improve figures; cheat or lie and just change the numbers and don't count injuries or defective parts or improve the process.* [447]

Transformational change will only occur when antediluvian accident theory is abandoned in favour of a process and evidence based scientific approach. Incidentally, this transition does not require tearing down the entire house and to reiterate the loose legal philosophy of the late Justice Thurgood Marshall…..*you do what you think is right and let the law catch up.* [448]

Risk and energy damage theory fulfils this requirement and it reflects and aligns with the contemporary guiding principles of operational excellence and unique characteristics of high reliability organisations. It has many advantages over reactive accident theory, which significantly impedes organisational development. Attributes and consequences are categorised, summarised and compared in Figure 1 below:

Figure 1: Attributes and consequences



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