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Dekker, Sidney W.A.; Tooma, Michael

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A capacity index to replace flawed incident-based metrics for worker safety

Sidney W.A. DEKKER* and Michael TOOMA**

Abstract. *The shortcomings of incident-based metrics for worker safety such as total recordable incident frequency rate (TRIFR) are well documented. In particular, a low TRIFR is no assurance against legal liability. There is considerable overlap between the literature on safety as the presence of capacities to make things go well, and jurisprudence in labour and workplace safety law on employer due diligence. In this article, the authors propose an index that merges the two, measuring the capacities to acquire and maintain safety knowledge, to understand the nature of operations, to resource for safety, to respond to risks, to demonstrate engagement and compliance, and for assurance.*

Keywords: *legal compliance, capacity index, TRIFR, occupational safety, safety management, occupational accident, occupational injury.*

1. Introduction: A “measure” that does not work

The use of incident-based metrics for worker safety is still widespread (see, for example, Collins 2013). Their prevalence is explained in part by a misunderstanding of the legal requirements placed on directors of corporate boards to exercise due diligence and ensure compliance with safety obligations. Some organizations use only a single metric, such as the total recordable incident frequency rate (TRIFR),¹ as a putative safety measure to monitor performance, assess trends and enable comparison with other organizations or industries. However, the presumed advantages of this single measure have been disproved or are easy to disprove. For example, comparison between industries or business

* Griffith University, Australia; Delft University, the Netherlands, email: s.dekker@griffith.edu.au (corresponding author). ** Clyde & Co., Australia, email: Michael.Tooma@clydeco.com.

¹ Calculated as the sum of recordable incidents (fatalities, lost time injuries, restricted work cases and medical treatment cases) per million hours worked.

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units is impossible because the measure relates to shifts, not to people or jobs, because it is a rate (meaning it requires a denominator, which is a malleable choice), and because the definition of “injury” is both variable and gameable. There is little consistency in practice as supervisors – often in coordination with health and safety professionals – make their own calls on whether to record a worker’s injury or not.

Deriving trends or changes from the TRIFR is meaningless because of its considerable lack of statistical power. Injury numbers relative to hours worked (in an injury *rate* or any other rate) being as low as they are, it is easy to show that the requirements of statistical significance are never met. In other words, claims by managers or boards that they have recorded a significant reduction in their injury rate, or a significant difference between the unit’s injury rate and the injury rate elsewhere, actually have no statistical basis. In addition, because of the TRIFR’s low statistical power, statistical variations in injury rates from year to year or between companies or business areas are completely random and cannot be provably related to a manager’s or board’s actions or inactions under their due diligence responsibilities (Muller 2018).

Due diligence is concerned not only with receiving information about incidents, hazards and risks but, importantly, with considering and responding to that information (Johnstone and Tooma 2012). The number of total recordable incidents as a proportion of work performed provides little if any insight to that end since it reveals nothing about the reasons for the incidents, hazards and risks behind the number, which are at the heart of the due diligence exercise. By its very nature, the TRIFR is ill-suited to providing such insights since its purpose is to show a trend in lost production time and not the safety conditions, or the potential for the incident, that led to the injury. Furthermore, the TRIFR is a record of incidents resulting in injuries. An incident may have significant potential for injury but result in no injury. In that respect, the TRIFR would fail to facilitate due diligence.

A low TRIFR provides no assurance of legal compliance with local safety requirements (Johnstone and Tooma 2012; Tooma 2011), nor does it provide a defence against legal liability claims, as shown in jurisprudence.² Low numbers of injuries are not predictive of fatalities or accidents, so they do not constitute a safety measure (indeed, lost time injury and its derivations are originally productivity measures). Outcome measures are not the variables an organization should set out to monitor in order to achieve higher quality or safety outcomes (Deming 1982). In fact, in many fields this would be taken as fraud. Instead, the monitoring of the input variables (such as the capacities reported here) should be encouraged. Furthermore, because the TRIFR and similar measures are productivity and not safety measures, they do not offer an index of the suffering caused to, or experienced by, the worker (Dekker 2017; Ullström et al. 2014). The use of such measures and the kinds of rules that have sprung up around work

² See, for example, United States of America v. BP Exploration & Production Inc. et al., Civil Action No. 2:10-cv-04536, US District Court of Louisiana – the US Department of Justice suit against BP under the US Clean Water Act (1972) in relation to the Deepwater Horizon disaster of 2010, which occurred despite a prolonged period of operation with no reported injuries.

to manage them, have unsurprisingly generated widespread cynicism among workers (Collins 2013; Heather 2018; Leplat 1998; Bieder and Bourrier 2013).

In sum, personal injury rates are not good indicators of the effectiveness of an organization's safety and risk management (Long 2016), they offer no protection against liability, and they are not predictive of fatalities, accidents or disasters (Saloniemi and Oksanen 1998; Salminen et al. 1992; Sherratt and Dainty 2017). In fact, although it does not prove a causal relationship, a lack of injuries and incidents in organizations considered safe on the basis of consistent past injury and incident ratings (Amalberti 2001) has repeatedly been linked with an increased risk of process safety disaster and fatalities (United States, Department of Labor 2015; BP U.S. Refineries Independent Safety Review Panel 2007; Hopkins 2008; CSB 2007; Elkind, Whitford and Burke 2011). Similarly, there is evidence that the pursuit of "zero harm" is correlated with a *higher* rather than a lower company fatality risk (Sherratt and Dainty 2017). This is an important reason why such measures provide no protection against liability. At best, they are not indicative of legal compliance, and, at worst, they may even be indicative of a culture of non-compliance (Johnstone and Tooma 2012; Tooma 2011).

As pointed out above, the use of inappropriate metrics does not cause fatalities or disasters in and of itself. The causes for these are found in working conditions, the state of repair of assets, corporate strategic choices, organizational design, structural complexities, goal conflicts and lack of resources, among others (Le Coze 2021; Hopkins 2019). That said, a focus on metrics alone can function as a decoy, taking organizations' attention away from a build-up of risks and a possible drift into failure in other areas. Underlying risks can then be left to grow misconstrued or unnoticed, as models of organizational safety have been recognizing since the 1970s (Turner 1978; Vaughan 2005). Connecting financial bonuses or other incentives and rewards to low injury numbers exacerbates this trend (Hopkins and Maslen 2015), probably because it tends to encourage cultures of risk secrecy (Dekker and Pitzer 2016; Sharpe 2004; Edmondson 1999). Injured workers, supervisors or even safety managers can feel pressured not to report injuries because it will have a negative impact on the company's statistics and future contracts (Derango 2013; Frederick and Lessin 2000; GAO 2012). A link between a lack of transparency and openness to employee voice on the one hand, and organizational disaster potential on the other, was recently demonstrated by Blanton and Peksen (2018). Pursuing a low TRIFR becomes, in Lofquist's words (2010), "the art of measuring nothing". It seduces organizations into what is known as the fundamental regulator paradox: achieving zero incidents, control theory warns, could be a foolish aspiration in dynamic systems. Once zero is achieved, there is no longer a basis on which to correct or regulate system behaviour: no "error" in the system to work off, and the regulator (the manager or board) "goes blind".

The remainder of this article is organized as follows. The second section examines the literature on safety, resilience and cognitive engineering that argues for an alternative approach to safety, away from incident-based metrics, as well as the jurisprudence establishing the principles of due diligence. On the basis of these principles of due diligence, we put forward a capacity index and

elaborate on its indicators. The third section considers how research is gradually shaping the metrics of this index, while the fourth section discusses both the implementation advantages and challenges of the index. In concluding, the fifth section calls for the continued development of the index to provide legal compliance and safer workplaces.

2. A capacity index as an alternative

In line with moves to what is known as “Safety differently” or “Safety II” (Hollnagel 2014 and 2017; Dekker 2015), organizations are encouraged to see safety not as the absence of negative events (in a low TRIFR score, for instance) but as the presence of capacities to make things go well, even under variable and sometimes messy conditions (Roe 2013). The potentially measurable and certainly demonstrable capacities described below are not only consistent with existing and emerging research in safety and resilience engineering but they also exhaustively cover the due diligence requirements under typical work safety legislation in many Western countries (see, for example, Bahn 2012; Peace, Mabin and Cordery 2017). Because of the financial (and human) impact of safety accidents on companies, leadership and stewardship on safety issues is part of the care and diligence that directors are expected to demonstrate in the performance of their role. Their failure to do so has led shareholders to sue directors and senior management to recover losses in shareholder value in the aftermath of major disasters. For instance, the Deepwater Horizon case, *United States of America v. BP*, was settled by a payment of US\$175 million to the plaintiffs. In a number of jurisdictions around the world, the duty of directors and senior managers expressly requires them to exercise reasonable care or due diligence to ensure compliance on safety matters. This seeks either to protect them against liability for breach of a personal duty under safety laws (Canada, Hong Kong (China), Malaysia, Singapore and the United Kingdom) or to establish a proactive duty (Australia and New Zealand) (Tooma 2011).

The use of the TRIFR by organizations and boards is a prime example of them counting what they can count, but not what actually counts. But what are the things that do count? A review of the jurisprudence reveals that “due diligence” has been recognized as comprising a number of components, namely: (i) an active and ongoing interest in a knowledge baseline in relation to safety matters to enable effective decision-making; (ii) an understanding of the nature of the operations under the management’s responsibility and the risks arising from those operations; (iii) a commitment to address those risks through the provision of resources and processes to manage them; (iv) a proactive approach to receiving information in relation to incidents, hazards and risks and considering and responding promptly to that information; (v) a commitment to the provision and implementation of processes to meet relevant duties and obligations; and (vi) the vigilant verification of the implementation of processes and resources

deployed to address risks and ensure compliance.³ A capacity index that captures the requirements of exercising such reasonable care and due diligence would more readily reflect the legal requirements placed on corporate management and provide a better guide to compliance with such duties.

It is not, of course, that a record of incidents and injuries does not provide managers, board members and other stakeholders with some insights in terms of knowledge, capacities and understanding. However, the point that has been made repeatedly over the past two decades is that the experience base of what goes well – and an understanding of the capacities that make this possible – is (potentially) so much larger than the few instances of failure. The simplest reason for this is that much more goes well than goes wrong (Hollnagel 2014), though what makes work go well is often subtly different (in the sense of “work-as-done” versus “work-as-imagined”) from what managers, supervisors or boards believe or think is responsible for operational safety and success (Hollnagel 2012). Building one’s understanding of safety mainly on injuries and incidents is akin to trying to understand how to have a happy, life-long marriage by studying only a few cases of divorce. It misses much of the interesting data.

In the light of the above, the index proposed in this article comprises the following six capacities and indicator capabilities:

- (i) *the capacity to acquire and maintain safety knowledge*, tracking capacity-building so that things go well even under variable conditions (Know);
- (ii) *the capacity to understand the nature of operations and their risks*, tracking anticipation through risk competence and risk appreciation at all levels of the organization (Understand);
- (iii) *the capacity to resource for safety adequately*, tracking the capability to make resources available and goal conflicts visible (Resource);
- (iv) *the capacity to respond to risks and unsafe events*, tracking the capability to monitor and identify issues through effective communication channels (Monitor);
- (v) *the capacity to demonstrate engagement and compliance*, tracking the capability of ensuring the effectiveness of monitoring (Comply); and
- (vi) *the capacity for assurance*, tracking the capability to learn from both failure and success (Verify).

These are not just capacities that any organization might wish to possess. They are, indeed, the hallmarks of due diligence that emerge from jurisprudence (see above).⁴ The remainder of this section develops the different elements of the index.

³ R. v. Bata Industries Ltd, [1992] O.J. No. 236, C.C.C. (3d) 394 p; R. v. Syncrude Canada Ltd, 2010 ABPC 229, [2010] A.J. No. 730; R v. Brisbane Auto Recycling Pty Ltd & Ors [2020] QDC 113. In Australia and New Zealand the definition of “due diligence” is codified in the legislation: for Australia see section 27 of the Work Health and Safety Act 2012, and for New Zealand see section 44 of the Health and Safety at Work Act 2015.

⁴ See also Inspector Ken Kumar v. David Aylmer Richie [2006] NSWIRComm 323.

2.1. The capacity to acquire and maintain safety knowledge

One of the functions of this capacity is the anticipation of future paths to failure, which requires the monitoring of conditions and threats associated with future scenarios that may arise within or around the organization. Anticipation is the expectation of what might happen in the future, which of course depends on how one thinks about the future – and on how knowledge of the present and past is leveraged (Hollnagel 2017). In its simplest form, anticipation is the use of pattern recognition and the application of recognition-primed scenario responses to actual or emerging situations (Klein 1993). Recognition requires sufficient similarity between features of known (past) situations and future or present ones, such that any deductions or inferences have current validity. This may not be possible in complex systems (Cilliers 2010). Furthermore, predictable kinds of errors intrude into this kind of anticipation, including so-called “cognitive garden-pathing” or “fixation errors” (De Keyser and Woods 1990), where courses of action are continued as if the scenario were what people anticipated it would be, when it has in fact subtly changed (Orasanu, Martin and Davison 2001).

Another means of anticipation is the deliberate construction of future scenarios and the preparation of responses to them, sometimes with the use of simulations of various levels of fidelity (Dahlström et al. 2009), which can help people and organizations “plan for surprise” (Weick and Sutcliffe 2007). Anticipation through scenario construction, however, is easier said than done. There is a considerable corpus of cases and literature on so-called “fantasy planning” (Hutchinson, Dekker and Rae 2018) and “fantasy documents” (Clarke 1999). Fantasy documents (including response plans and risk assessments) make optimistic and unrealistic claims (for example, based on positive audit findings) about how the organization can control highly uncertain risks, in an effort to convince stakeholders that the uncontrollable (or at least the very difficult to control) can be anticipated and bridled (Downer 2014). Fantasy plans are not usually written purposefully to deceive, although they may have that effect through selective assumption-making. Nevertheless, documents may sometimes be written with the full knowledge that the stated claims are not true or have little chance of being successful. Such claims may be produced by safety departments to assure a regulator or external auditor, or by organizations to assure public stakeholders. The existence or demonstration of a contingency plan is, therefore, not in itself sufficient evidence of the presence of relevant knowledge. A board’s ability to track and demonstrate that knowledge is a critical component in demonstrating that it is discharging its due diligence duty. Indeed, acquiring and maintaining knowledge of occupational health and safety matters is expressly required by law in some jurisdictions (see, for example, the legislation in Australia and New Zealand cited in note 2).

2.2. The capacity to understand the nature of operations and their risks

Unsurprisingly, an understanding of the nature of operations and their risks is rooted in the locus of actual operations, where the risks arise and are managed from day to day (Rodrigues de Carvalho et al. 2009; Havinga, Dekker and

Rae 2018). Learning from routine work and from the people who perform it is key to building this capacity. There is always a gap between how work is imagined and how work is done (Hollnagel 2012), since work in practice has to deal with surprises, unanticipated variations, complications, unpredictable demands, goal conflicts and resource constraints. The people closest to the actual work environment have the most intimate understanding of where the gaps, messy details and operational nuances lie, and they have daily opportunities to develop and crystalize ideas about what can be done to bridge those gaps (Nemeth et al. 2005; Woods et al. 2010). The aggregate measures that boards and managers typically assess tend to mask the normal ebb and flow of the strains and shortages that parts of the system are locally under. As a result, when evidence of local adaptations to deal with such variations first comes to the fore – for instance, in a post-incident investigation – it tends to get characterized as non-compliance, which is singularly unfruitful in learning about how daily operations actually take place and how their risks are managed.

Learning from routine work requires boards and managers to provide opportunities for frontline employees to speak up about where, when and how that work could be improved. This can be done or facilitated, for example, by learning teams or learning reviews – regardless of whether work has gone badly, well or as usual (Pupulidy and Vesel 2017). Such activities and processes to learn about routine work in situ represent a key way of demonstrating the presence of the capacity to understand the nature of operations and their risks. The intended objective of this understanding is ultimately to bring about improvements in the design and organization of work and work environments. These need to happen and to be implemented in ways that align with the work as it is actually performed, and they should deal with the routine obstacles to people getting that work done (see, for example, Pew, Miller and Fehrer 1981). Such improvements represent a second way of demonstrating the capacity to understand.

It is becoming increasingly apparent that worker fatalities are not predicted by (higher) injury rates, but rather by a failure on the part of organizations to understand how success is normally created by their workers, and what sacrifices are necessary to get the job done. Failure to gain that insight has been at the heart of many major disasters, including the 2010 Pike River disaster in New Zealand (where 29 miners tragically lost their lives when the coal mine that they were working in exploded). The capacity to gain an understanding of the nature of business operations and the risks associated with them is a fundamental component of any board strategy designed to minimize the risk of safety disasters in their business and of shareholder class actions arising from such incidents. In New Zealand, this consideration has directly led to the adoption of a due diligence duty on company directors that expressly includes the requirement to understand the nature of business operations and the risks associated with them. However, this requirement is arguably implied in the duty of directors to shareholders and in their duties under numerous industrial safety laws worldwide.

2.3. The capacity to resource safety adequately

Most organizations do not exist to be safe: they exist to provide a product or service. Safety may be a precondition for doing so commercially, legally or ethically, but it is always just one of the many goals to be met. This means that resource battles for safety are likely. As Woods (2003) explains:

Goal tradeoffs often proceed gradually as pressure leads to a narrowing focus on some goals while obscuring the tradeoff with other goals. This process usually happens when acute goals like production/efficiency take precedence over chronic goals like safety. If uncertain “warning” signs always lead to sacrifices on schedule and efficiency, how can any organization operate within reasonable parameters and meet stakeholder demands? (Woods 2003, 4)

These goal conflicts work their way down to operational frontlines, where multiple, simultaneously active goals are the rule rather than the exception for virtually all domains where safety plays a role. Workers must cope with the presence of multiple goals, shifting between them, weighing them, choosing to pursue some rather than others, abandoning one, embracing another and so on. Many of the goals encountered in practice are implicit and unstated (despite stated priorities for safety). In fact, as Hollnagel (1993, 94) commented, “If anything is unreasonable, it is the requirement to be both efficient and thorough at the same time – or rather to be thorough when with hindsight it was wrong to be efficient.” As in the trade-offs between efficiency and thoroughness or safety, goals often conflict (Hollnagel 2009).

In some cases, these conflicts are easily resolved in favour of one or other goal, but in others they are not. Sometimes the conflicts are direct and irreducible, for example, when achieving one goal necessarily precludes achieving another – which might be safety (Woods et al. 2010). Understanding the nature of these goal conflicts and interactions is crucial if safety is to be resourced adequately in an organization. Having a clear line of sight of these trade-offs at an enterprise board level is crucial to proper decision-making. Resources for safety organization should ideally be independent of the organization’s economic performance, and no-jeopardy access to relevant decision-making levels should always be assured (Woods 2006b). However, rather than resourcing the work of safety (that is, the administrative occupational health and safety apparatus, paperwork, processes and systems), resourcing the *safety of work* (see subsection 2.2.) is a much stronger demonstration of commitment to this capacity (Rae and Provan 2019). It is also a legal requirement in many jurisdictions worldwide.

2.4. The capacity to respond to risks and unsafe events

Research suggests that a capacity to deal with risks and unsafe events does not typically come from centralized, directed responses, but rather from devolving decision-making authority to the points of action and from interaction with the safety-critical process (Loukopoulos, Dismukes and Barshi 2009). The adaptive capacity required to deal with risks and unsafe events as they emerge from actual operations can, by its very definition, barely be captured in standard protocols or pre-written guidance (Rochlin 1999). Monitoring this capacity offers a key insight into safety resilience and is an important part of the role played by

boards in overseeing safety. When coupling between system components and processes tightens and interactive complexities escalate (as the saying goes, “in a crisis, all correlations go to one”), devolving decision-making authority is known to yield better results in real-time – even where horizontal co-ordination is key to preserving overall system safety and integrity (Snook 2000). Research shows that adaptive capacity can be increased by drawing on a diversity of influential and decision-making voices (Janis 1982; Page 2007); by letting decisions gravitate toward expertise, not power (Farrington-Darby and Wilson 2006; Deming 1982; Weick and Sutcliffe 2007); by instituting and rewarding a willingness to say “stop” even in the face of acute pressures to continue (Edmondson 1999; Woods 2003; Rasmussen 1997); by allowing operational and design improvements to develop on the frontline without relying on audits or inspections to trigger them; and by encouraging a concomitant pride in workmanship (Deming 1982). These all constitute measurable or at least demonstrable aspects of the capacity in question.

Another aspect concerns organizations’ treatment of people who are involved in an unsafe event. It has long been known that sanctioning and learning are mutually exclusive: organizations can do either, but not both at the same time (Dekker 2016). Retributive responses that are organized around rules, violations and consequences have a way of impeding openness, honesty and learning. They also fail to address the deeper causes of trouble and tend to fight symptoms instead. The alternative are restorative approaches, where all stakeholders impacted by an incident or safety event are involved so that they can, together, figure out what should be done and by whom, to repair the harm done and prevent recurrence (Dekker and Breakey 2016; Barton 2003). Because restorative responses consider the various impacts of an incident or safety event, the needs that arise from those impacts, and whose obligation it is to meet those needs, the kind of accountability they generate is *forward-looking* (Sharpe 2004): what needs to be done by whom, by when, and how will we know that it is being done? People involved in, and affected by, the incident collaboratively decide on what needs to be done. This can help restore trust among stakeholders, empower victims and reintegrate practitioners. Restorative justice deals with the consequences and causes of an event. It is not just a matter between the “offender” and the “judge”, and it does not pursue narrow facts to secure, for example, a dismissal. This kind of response facilitates a dialogue to identify the many sides of an event and its complex causal web. Together with a deep understanding of how success is normally ensured, and how a negative event could come about, restorative justice can create a fair response and identify improvements.

2.5. The capacity to demonstrate engagement and compliance

One of the biggest obstacles to demonstrating compliance is the extent of miscalibration in boards and management (and often even among supervisors and workers) regarding what needs to be complied with (and by whom). Complying with applicable legislation is actually a minor part of all the compliance demands that organizations typically place on themselves and their people. The majority

of compliance demands are internally generated and enforced, or they are expected from business to business (for example, in a client–contractor relationship), without the relevant regulator ever knowing or caring (Deloitte 2014). Many of these rules typically have no correlation with actual legal obligations or safety outcomes but contribute significantly to worker frustration, productivity declines and, ironically, front-end non-compliance (Dekker 2018). The number of such rules and their putative authority tends to muddle the organization's ability to demonstrate compliance with legislation because people inside the organization (including boards and executives) have a hard time knowing with what they are actually complying, and for whom. Boards should focus on processes that facilitate engagement, and on compliance with rules or precautions that influence safety outcomes. For example, aside from the numerous self-imposed rules that exist, there are risk-based processes mandated by regulations that have evolved through bitter experiences – rules around working in confined spaces, working at height and working with hazardous chemicals, among others. These are the matters that should command attention.

2.6. The capacity for assurance

Practical experience and research on resilience dictate that neither the monitoring of critical risks, human behaviour, nor incident or injury numbers are sufficient to assure safety in a complex system. Safety in such systems clearly does not arise from centralized control and standardization (which, in the extreme, would outlaw variability), but from acknowledging that variability is inevitable. Guided adaptations to local conditions and challenges are likely to generate greater safety improvements than greater centralized control will. Organizations that manage to grow and expand their adaptive capacity in order to handle unknown (or even unknowable) disruptions, are those that are capable of recognizing, absorbing and adapting to harm that falls outside its experience or knowledge base (Roe 2013; Woods 2006a; Sutcliffe and Vogus 2003). In other words, an adaptive capacity is critical: it is the ultimate demonstration of assurance.

Large organizations contain so many interacting components that the number of things that can go wrong is very high. Small events can trigger larger failures: outages, leaks, poor performance and other undesirable outcomes (Dekker 2011). In practical terms, the most effective legal strategy for risk minimization remains avoiding serious incidents in the first place. Although controlling critical risks and preventing all possible failure modes is a rather hopeless endeavour in these complex systems, it is possible to identify rigorously at least some (if not many) of the weaknesses in the system before these are triggered by small failure events. This can provide assurance that the system is resilient or can identify the areas of weakness. Chaos engineering has been developed as a method of experimentation (in computer infrastructures) that brings systemic weaknesses to light (Rosenthal et al. 2017). It is an empirical process of verification that can lead to more resilient systems and builds confidence in their operational behaviour. Chaos engineering can be as simple as causing one component to fail (even if in a simulated setting) and testing how its failure cascades through

the organization. But it can be much more sophisticated: designing and carrying out experiments in a production environment against a small but statistically significant fraction of live operations in a safe-to-fail way. Engagement with these novel kinds of pathways to assurance, let alone their testing and implementation, provides a strong signal of this capacity.

3. A capacity index: Work in progress

The translation of the elements of the index above into quantifiable measures is collaborative work in progress as part of a multinational initiative,⁵ but the research has already suggested the initial means of quantifying each capacity:

1. *The capacity to acquire and maintain safety knowledge* – In order to acquire and keep up-to-date knowledge on health and safety matters, organizations and their leaders need to instil an abiding desire for learning. This entails being minutely apprised of the organizations' safety and health capabilities and challenges and the suitability of their approach at a systems level when compared with the reality of work in practice. The best way to do this is by listening directly to the workers who perform the work, their supervisors and their managers, measuring this activity by the number of worker insights obtained as a proportion of hours worked. Workers are best placed to understand the hazards and risks in the organization's work and, as a result, to tell the organization whether its approach is working and provide practical and innovative solutions to address any unresolved challenges. This may well lead to the discovery of "safety clutter" – unnecessary rules, procedures and processes that increase the burden of the "work of safety" but do very little to enhance the "safety of work" (Rae et al. 2018; Rae and Provan 2019).
2. *The capacity to understand the nature of operations and their risks* – Leaders of organizations need to understand how operations are performed in their organizations in order to identify potential critical hazards and risks. This understanding, in turn, provides an important context for the appropriate resourcing of health and safety in an organization. Traditionally, health and safety system designers will set out what they believe to be the case in this regard. Little emphasis is placed, or assurance given, on whether the assessments are accurate or what real-world view has been considered in determining critical hazards and risks. Learning teams enable the engagement and continuous learning outlined under the first capacity in the index. They bring operational personnel together with technical experts to look at how work is both designed and performed and to build better connections between the two. In this way, they can be powerful mechanisms to inform the organization and its leaders about how work is conducted and the hazards and risks that it entails, and about how work design and methods may be improved through the insights of those who perform the work on a daily basis. Learning teams thus provide more focused and detailed types of

⁵ See <https://www.duediligenceindex.online/>.

worker insights, enabling greater understanding of the operational context. An initial measurement of this capacity can be provided by the number of learning reviews carried out as a proportion of hours worked.

3. *The capacity to adequately resource safety* – Better-performing organizations have a range of capacities that contribute to their better outcomes. Resources and proactive processes for health and safety risk management require organizational capacity. That is, having the right resources, training, skills and capability to meet organizational demands. Organizations and their leaders need to understand the organizational capacity in that regard, which is why this third capacity requires organizations to invest in capacity assessments. Building on the guidance under the second capacity in the index, organizations need to invest in the capacity of people and processes to achieve desired outcomes in order to enable more things to go right. Measuring the organization's capacity-building is therefore useful in giving its management assurance as to organizational resourcing and help it identify any areas where further capacity needs to be created. An initial measure of this capacity is thus the number of capacity assessments carried out as a proportion of hours worked.
4. *The capacity to respond to risks and unsafe events* – Monitoring health and safety performance is not about simply evaluating failure. Indeed, more powerful lessons can be learnt from investigating success. Success in operations happens far more frequently than failure but organizations typically take this success for granted, paying little attention to how or why it is achieved. Reflecting on work undertaken in a successful manner can provide opportunities to understand the true health and safety capacity and performance of the organization as assessment is not dependent on the absence of health and safety (that is, an incident). This provides a truer picture of health and safety performance in day-to-day operations than relying on the minority of instances when an incident occurs. An initial measure of this capacity is the number of investigations of success as a proportion of hours worked.
5. *The capacity to demonstrate engagement and compliance* – The requirement for leaders of organizations to ensure that there are processes in place to comply with all legal obligations relating to health and safety is essentially a requirement to resource health and safety legal compliance audits. Accordingly, the initial measure under this capacity requires reporting on the number of such audits as a proportion of hours worked. Legal compliance on health and safety is not just a bureaucratic exercise but there are good reasons for it from a health and safety perspective. This is because specific health and safety regulations essentially codify the relevant health and safety control measures. The latter have been identified through lessons learnt in industry practice as being the control measures that prevent negative (particularly fatal) health and safety outcomes and can ensure success (particularly in relation to matters of high/known risks). However, legal compliance audits on health and safety are not the place to start: building effective health and safety systems and processes should begin with engagement with, and trust in, workers and solutions found by and with the

Table 1. Capacities, indicator capabilities, due diligence and metrics

Capacities	Indicator capabilities	Matching due diligence requirement	Initial measure	Developing measures
The capacity to acquire and maintain safety knowledge	<i>Know</i> Capacity-building so that things go well even under variable conditions	Acquire and keep up-to-date knowledge of health and safety matters respectively to role and responsibility	Number of worker insights per million hours worked	
The capacity to understand the nature of operations and their risks	<i>Understand</i> Anticipating through risk competence and risk appreciation at all levels of the organization	Understand the nature of the operations of the organization and the risks associated with those operations	Number of learning reviews per million hours worked	Resilience control score Control implementation assessment Control improvement assessment
The capacity to resource safety adequately	<i>Resource</i> Making resources available and goal conflicts visible	Ensure the organization has appropriate resources and processes in place to eliminate or minimize risks to health and safety	Number of capacity assessments per million hours worked	Resiliscore – measurement of resilience state
The capacity to respond to risks and unsafe events	<i>Monitor</i> Monitoring and identifying issues through effective communication channels	Consider information regarding incidents, hazards, and risks, and measure critical control performance	Number of investigations of success per million hours worked	Severity rate Significant event rate Cost of loss
The capacity to demonstrate engagement and compliance	<i>Comply</i> Ensuring the effectiveness of monitoring	Ensure that the organization has processes in place to comply with all work health and safety duties and obligations under legislation	Number of legal compliance audits per million hours worked	Safety plan implementation
The capacity for assurance	<i>Verify</i> Learning from both failure and success	Personally and proactively verify the provision and use of resources and processes outlined in the other steps	Percentage of worker insights effectively integrated per million hours worked	Engagement rating Safety net promotor score

Source: Authors' compilation.

workers who must implement them (as per the focus of the metrics under the first and fourth capacities in the index). Verification processes to ensure that those worker- and operationally driven solutions are legally compliant can provide additional support towards enabling health and safety.

6. *The capacity for assurance* – As this capacity is essentially concerned with verification, it is prudent to measure the extent to which the organization and its leadership is taking into account the lessons from the mechanisms established to learn from its people. As such, the initial measure for this capacity is linked to the measure for the first capacity in the index, since it captures worker insights as a proportion of hours worked and is the broadest measure of the capacity index relevant to operational learning. It assesses the establishment of mechanisms to gain insights from workers, and thus enables an assessment of the extent to which learning occurs through the worker insights provided.

In the ongoing development of this index, one of the things to be constantly aware of is that it is easier to measure the “work of safety” (the bureaucratic, back-office busywork associated with counting and tabulating) than it is to measure the “safety of work” on the frontline (Provan et al. 2020; Rae and Provan 2019). In this regard, initial measures are progressively being replaced by new measures under development, such as a resilience control score and assessments of the implementation and improvement of controls to measure the index’s second capacity, and the resilience state score to measure the third. To measure the fourth capacity, the severity rate (something never included in the traditional TRIFR) is a straightforward and relatively easy-to-develop metric, as is the significant event rate. The cost of loss is more difficult to agree on and standardize but it is an important data point for management and boards to use, for example, to adjust their resourcing decisions. Measuring worker engagement and asking for a safety net promotor score are both also straightforward and can easily be added to measures under the capacity to verify (sixth index capacity). Table 1 shows the capacities, indicator capabilities, matching due diligence requirements, initial measures and measures under development for the index.

4. Discussion

Each of the above capacity measures can be numerically represented by capturing the productive activities that underpin them. In the case of the capacity to understand the nature of operations and their risks, an effective way of building the capacity is for directors and managers to develop leadership insights by speaking to line workers and getting their perspective on how work is done and the state of safety in the company. Those insights must be meaningful, measured through a double feedback loop from both the director and the workers. As the initial measures outlined above indicate, the frequency of insights (or other measures) must be commensurate with the work activity. That can be done by measuring the number of worker insights as a percentage of work hours. The net result is a frequency rate that reflects meaningful activity aimed at providing directors and officers with the capacity to understand the nature of

the operations and the risks arising therefrom. The initial frequency measures for each of the capacities can be aggregated to produce a single measure: the safety capacity index.

By engaging with how work is done and its safety conditions rather than measuring injuries, the index better reflects the objective of due diligence, which is to gain an insight into how to make work safe. By establishing consistent definitions and objective measures, the index allows comparability between companies. The aim is not to monitor changes in data and adjust behaviour but rather to promote an increase in positive activity. In that respect, the capacity index for worker safety is directly aligned with the legal obligation to exercise due diligence.

The problems with injury- and incident-based metrics are insurmountable and increasingly undeniable. The capacity index presented in this article as a replacement is a small step towards making “Safety II”, or “Safety differently” more measurable. The measurements that it taps into are to a certain extent still about the “work of safety” rather than the actual “safety of work” on the frontline, and they may lead to the same sorts of numbers games found in incident and injury metrics. These are substantive and significant challenges that are common in early stages of adoption and development. What speaks for a capacity index, though, is its low level of difficulty given that many or all of its measurements are already routinely used by organizations, and many of them truly are relevant to the safety of work as actually performed, as opposed to work as imagined in policy documentation, systems and process. Given that the capacity index couples known due diligence requirements with the literature on Safety II and resilience, it could be an achievable step in the right direction.

5. Conclusion

Legislation and the threat of legal liability has played a major part in the propagation and elevation of injury data such as the TRIFR in board reporting, cross-organizational and sectorial comparisons, and in (impossible) attempts to predict accident and worker fatality risks. These measures have the veneer of simplicity and comparability, which is in part responsible for their dubious but continued popularity. In reality, though, they offer no useful insight into the state of safety in organizations. They also offer no assurance of legal compliance or liability protection. This article has put forward a comprehensive index of six capacities and indicator capabilities that together provide insight into the state of safety within an organization:

- (i) the capacity to acquire and maintain safety knowledge – capacity-building so that things go well even under variable conditions (Know);
- (ii) the capacity to understand the nature of operations and their risks – anticipating through risk competence and risk appreciation at all levels of the organization (Understand);
- (iii) the capacity to resource safety adequately – making resources available and goal conflicts visible (Resource);

- (iv) the capacity to respond to risks and unsafe events – monitoring and identifying issues through effective communication channels (Monitor);
- (v) the capacity to demonstrate engagement and compliance – ensuring the effectiveness of monitoring (Comply); and
- (vi) the capacity for assurance – learning from both failure and success (Verify).

It is the hope that further developing this index will provide boards and their regulators with better data to enable the achievement of legal compliance and safer workplaces.

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