SAFETY & ENTROPY
A Leadership Issue

By Rodney Grieve and Tania Van der Stap

CURRENT ORGANIZATIONAL STRATEGIES and operational practices related to risk management seldom consider the cyclical nature of risk and the tendency for systems, organizational factors and behaviors to degrade over time. This can occur at the macro level, for example, through cost-cutting on infrastructure, plant or equipment maintenance, and workforce competencies, with potential consequences for productivity and safety performance. At the granular level, organizations can fail to effectively leverage the opportunities for their frontline leaders to build capacity, relying on technical and scheduled interactions to influence behaviors rather than meaningful, enduring engagement that articulates desired outcomes and builds the risk management culture.

This article is highly relevant to safety professionals and other disciplines involved in the management of organizational risk who are seeking to make a step-change from safety-based to risk-based thinking. It has been written with bookends, having the entropy loss causation model applied to systems at the front end and to organizational factors at the back end (Part 2, by Van der Stap). The central piece explains the practical application of the model in relation to building frontline supervisor and workforce leadership capacity (Part 1, by Grieve).

Part 1, by Rodney Grieve

The entropy model (Figure 1) as described in *Productive Safety Management* (Mol, 2003) and "Risk Leadership: A Multidisciplinary Approach" (Van der Stap, 2018) explores the occupational risks associated with four factors present in every organization: technology (plant/equipment); human resources (people); physical environment (workplace); and work process. Each factor presents occupational risk, which is minimized through the implementation of a systems approach. These factors are initially imagined in a perfect world designed to deliver an ideal level of production, quality and safety.

The model describes two types of risk: residual and entropic. Even with perfectly designed systems in each of the factors, residual risk (represented by the green bar in Figure 1) is the ever-present risk that systems are unable to reduce in the short-term due to technological, financial and knowledge constraints (Mol, 2003, pp. 21-22).

As systems degrade (shown by the dotted blue line), entropic risk (red line) starts to rise and move toward a state of chaos. These risk types (residual and entropic) hinder the organization from achieving the ideal state. To counteract entropic risk, the management team normally takes corrective action to regain an optimal level of safety, production and quality. The model indicates that a robust preventive maintenance program is the most effective way to minimize the impacts of degradation and resultant entropic risk. Catching the failure prior to it occurring minimizes losses to production, quality deficiencies and safety incidents.

In each of the four factors, organizations should strive to design preventive maintenance programs and scheduled corrective actions to mitigate catastrophic failures. To maximize efficiency and minimize costs, the management team must determine the optimal time for intervention to get most value out of the system. There is an organizational risk that leaders will accept a level of degradation if the system continues to provide performance that is acceptable. The ability to push a piece of equipment to the edge of failure prior to spending any money on downtime and preventive maintenance may be considered optimal. In addition, identical pieces of equipment tend to act in a predictable manner so they can be managed as a fleet. However, when working with people, pushing them to their breaking point is not effective and what works for one does not work for all. With little or no empirical data to support these decisions, managers often choose an arbitrary period (e.g., weekly, monthly, annually) in which to conduct safety preventive "maintenance" for employees.

Mol (2003) addresses some important systems that organizations must establish to give structure and balance to address

KEY TAKEAWAYS

- **Building on the entropy model (Van der Stap, 2018), there are two types of risk: residual and entropic. The latter is caused by degradation of systems and, as explained in this article, also by degradation of human behavior and organizational factors.**
- **To manage risk effectively, leaders must understand why degradation occurs in human behavior and how to support people to minimize entropic safety risk on a continual and consistent basis.**
- **Leaders can engage employees more effectively through interactions that develop new technical competencies while also building individual confidence and resilience through recognition and feedback, which gradually flows on to higher levels of organizational capacity.**
- **Leaders must understand the entropic risk associated with organizational factors such as leadership, competencies, management systems and resilience. These are also subject to degradation unless managed proactively.**

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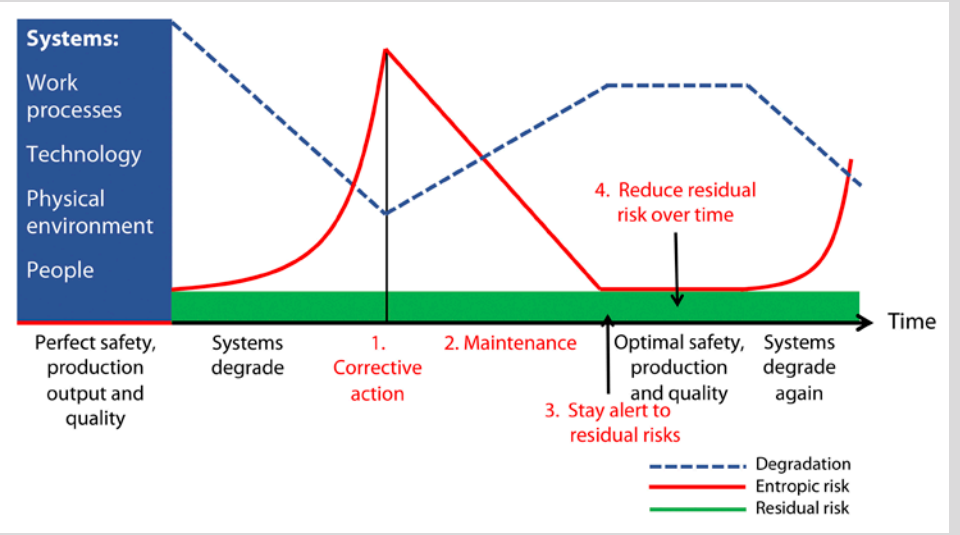
degradation of the human resources factor. Overarching behavioral drivers (e.g., vision, mission, core values, defined culture), systems (e.g., technical training, rules/regulations, policies/procedures) and decision-making tools that ensure compatibility of production and safety provide a fully integrated, systematic approach to risk management. To maintain the quality of these systems, management teams try to calendarize their support with annual training, monthly inspections and weekly tailgate talks. The behavioral drivers that lead to optimal human achievement may be eroded by routine communication that lacks heartfelt commitment or misses the mark of effective engagement. Structure and systems are necessary and set the framework, but it is important to understand why degradation occurs in human behavior and what leaders need to do for their people to minimize resultant rising entropic risk on a more continual and consistent basis.

The entropy model "does not explicitly illustrate the benefits of continuous maintenance and monitoring because it depicts maintenance as occurring in a block of time" (Mol, 2003). To overcome this, other versions of the model, discussed in this article, have been developed to depict that entropic risk can be held down in a low and steady state using a proactive approach to the maintenance of system factors. Specifically, this article discusses the critical leadership behaviors of continuous maintenance and monitoring that will keep entropic risk at this low and steady state in the human resources factor. [Note that the original entropy model is a high-level, graphical representation of observable cycles related to individual and organizational behaviors/states and is not intended to be calibrated on empirical data. It was used in *Productive Safety Management* (Mol, 2003) to develop the risk management system enabling safety and production to be pursued concurrently.]

Before looking at the continuous maintenance and monitoring of an individual's performance, the causes of degradation must be appreciated. Figure 2 shows the never-ending cycle of degradation, recovery, optimization, degradation, recovery, etc., as phases. Phase 1 is the ideally designed system: a system without emotion, history or interpretation. Phase 2 is the initial degradation, which begins almost immediately. In Phase 3, there is recovery from degradation to a period of optimization (Phase 4) before heading into Phase 5 (cultural degradation). After Phase 5, the cyclical nature of the process is recognized by entering Phase N.

In Phase 1, with the implementation of any change, whether starting new or making changes in an existing situation, the initial degradation starts as soon as the change is put into practice. This initial degradation is most likely caused by a lack of knowledge, skills and abilities (KSAs) as well as a lack of confidence or motivation to implement the change as designed. This lack of competence does not imply that the person affected by the change cannot do the work as described, it is that the person has not successfully completed that work in accordance with the change. The person may quickly adopt the change and commit; in such case the initial degradation in Phase 2 will be minimal. If the worker struggles with the new way or does not believe in the

FIGURE 1
THE ENTROPY MODEL



Note. Adapted from *Productive Safety Management* (Figure 1.5, p. 13), by T. Mol, 2003, CRC Press.

FIGURE 2
CAUSATION OF ENTROPIC RISK IN THE PEOPLE FACTOR

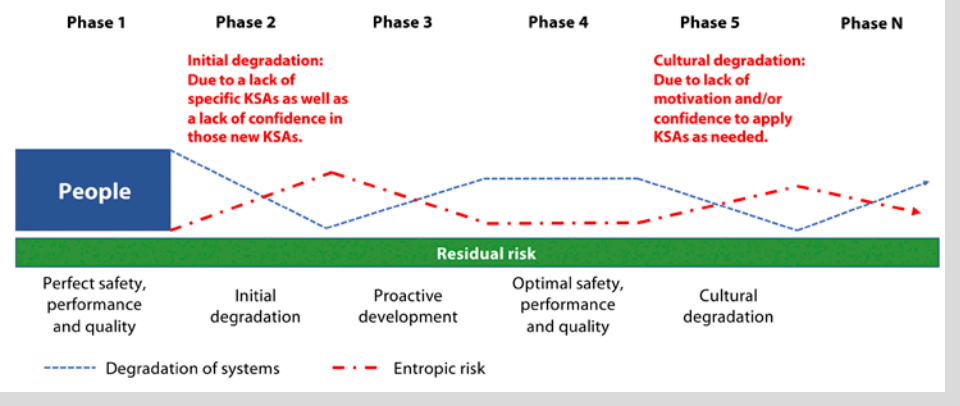


FIGURE 3

LEADERSHIP BEHAVIORS NECESSARY AT EACH PHASE

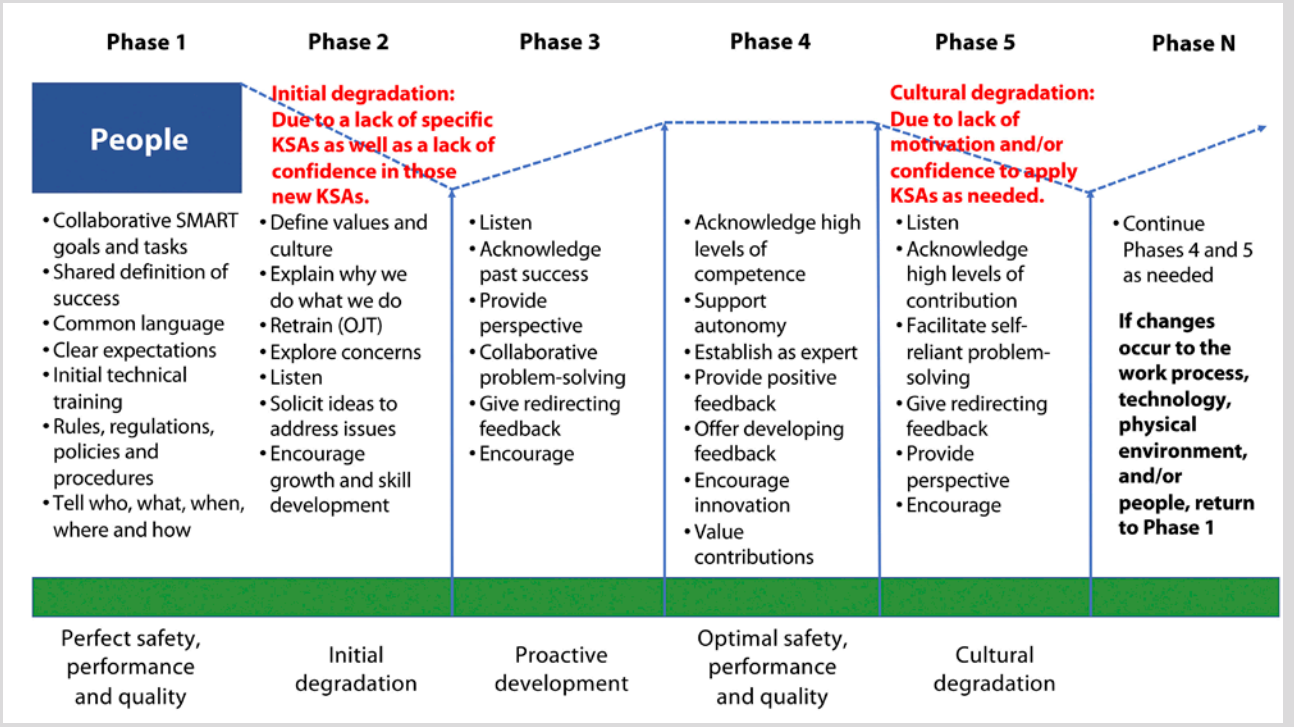
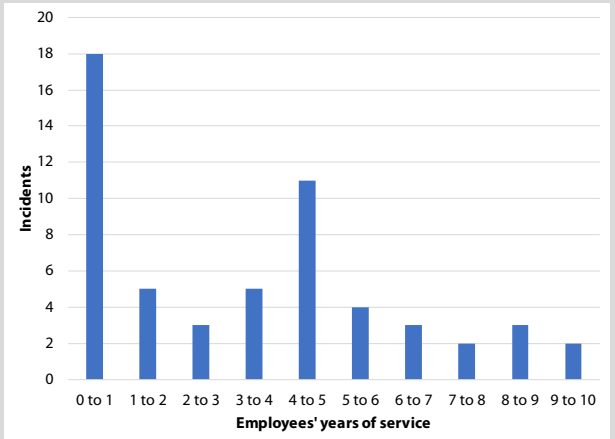


FIGURE 4

TOTAL INCIDENTS BY YEARS OF SERVICE FOR INDUSTRIAL SERVICES COMPANY, 1995-2000



change or their ability to implement it, then the initial degradation will be severe as the person begins to revert to old habits.

Phase 3 is where the individual employee has developed the KSAs and the commitment to successfully complete the task. This phase may be long lasting or may start to quickly degrade again. How long this phase lasts depends on the culture (i.e., "the way we do things around here"). A culture that strongly supports that KSA through recognition and feedback maintains a low level of entropic risk and prevents further degradation.

Many frontline leaders, particularly in highly technical environments, believe that once an employee moves into Phase 4 the leader's work is done, and the employee will maintain that level of performance. This can be true in cases where the change (i.e., behavior) is self-satisfying such as productivity. However, when looking at safety performance, where the benefit is not as obvious, the level of commitment and motivation will eventually wane (Phase 5) as cultural degradation creep begins again. The organizational risk is that leaders who believe their work was done once the employee moves into Phase 4 now see any failure (i.e., an incident) as the employee's fault, which leads to discipline and retraining as the corrective actions of choice. Cultural degradation is not because of a lack of KSAs, but a lack of recognition and feedback to ensure that the KSAs are applied consistently.

As a professional observation, most organizational systems are designed to support frontline leaders with an employee in Phase 1. These employees could be new to the organization or current employees facing a change in one of the other three factors (work process, technology, physical environment). Figure 3, Phase 1, illustrates leadership behaviors necessary for the development of the KSAs and control systems. Frontline leaders struggle in a couple of areas: Collaborative specific, motivating, attainable, relevant, trackable (SMART) goals and tasks, and a shared definition of success.

Collaborative SMART goals and tasks: A 2015 Gallup article states, "Based on Gallup's work with companies worldwide, only about half of employees strongly agree that they know what is expected of them at work" (Nink, 2015). No matter how SMART is defined, the collaborative piece is often missing. Leaders seem to think it is their job to define the goals and tasks that employees complete. If the thinking is changed to focus on the results that need to be delivered (e.g., productivity, safety, quality) and then engage each employee in a collaborative manner to determine the specific, trackable, and achievable goals and tasks necessary to attain those results, those desired outcomes will automatically become much more relevant and motivating to the employee. Relevance is critical in getting an employee to commit to the process.

Shared definition of success: Too often the definitions of success are related to a number. In production, it is throughput,

product, batches and uptime. In safety, it is injuries, audits and violations. In quality, it is defects and customer complaints. When the definition of success is tied to a number, managers and supervisors start to chase the number. Unfortunately, this leads to conflict between desired results (e.g., be safe but hurry up and get it done). Therefore, the definition of success must be about the culture created. Reframing current mindsets, this culture should be based on collaboration and continuous improvement centered on effective risk management. To achieve this, each decision can be passed through the filter: Will this support the desired culture? This is the rationale behind the "reasonableness test" in *Productive Safety Management*, which defines the culture as driven by "managing risk to achieve production/productivity/schedule, quality work and safety performance concurrently" (Mol, 2003). The premise is if a culture of success is the primary modus operandi, the organization will have the flexibility, trust and resilience to deliver on whatever numbers are placed before managers and supervisors.

In Figure 4, it is during the initial degradation (Phase 2) that leaders struggle when it comes to maintaining safety performance. From 1995 to 2000, the author tracked safety incidents for an international industrial services company based on years of service for the employees involved (Figure 4). According to Trotto (2016):

> Employees in their first month on the job have more than three times the risk for a lost-time injury than workers who have been at their job for more than a year, according to research from the Toronto-based Institute for Work and Health.

Further evidence is provided in Figure 4. This chart is a poignant example on the macro level of employment time, and it can be equally applied to any change in the workplace (e.g., new task, new process, new client, new equipment, new management). This chart can also be explained by the entropy model and addressed with more effective leadership, as explained by progressing through Figure 3, Phase 2.

In Phase 2, the frontline leaders play significant roles as teachers and supporters (Figure 3, Phase 2). The leader's interaction with the employee as that person starts to apply their new KSAs in a new environment must not only be about the technical work, but about the employee's confidence in completing that work.

Phase 1 usually occurs in the training room while Phase 2 occurs in the work environment. The frontline leader's words and actions must be aligned with what the employee was told in the training room when it comes to the company's values and work process. It is the frontline leader's opportunity to demonstrate the work, listen to concerns, answer questions and explain why we do what we do. By improving the employee's KSAs and confidence, the operational leader minimizes the entropic risk presented in this phase. Note that this process is not limited to new employees. An experienced employee who is asked to take on a new role, to operate a new piece of equipment or perform at a new client's location goes through the same initial degradation due to a lack of KSAs accompanied by lack of confidence or motivation.

As the leader works to recognize and minimize the initial degradation, there are strategies they can employ in Phase 3 to help the employee move back to that optimal level of performance, as shown in Figure 3, Phase 3. The focus is building the confidence and motivation for the employee to adopt the required changes to produce the desired results. The leader can do this by acknowledging and reaffirming the employee's past success in applying transferable KSAs that will help the person be successful. The leader can also provide perspective so the employee does not become frustrated as that individual struggles to apply the new skills. For example, if productivity is not going as planned, a frustrated worker may consider bypassing a safety feature to get caught up on production. A leader's empathy, collaborative problem-solving and redirecting feedback can stop this from happening. Collaborative problem-solving allows the employee to continue to build technical competencies and confidence with the leader's guidance. This enables solutions that are consistent with the company's values and applicable safety rules.

As noted, moving into Phase 4, many leaders think their development work is done and now all they must do is manage the workload. This is an erroneous assumption, as a spike in undesirable results will occur eventually, as indicated by the entropy model. To minimize the eventual cultural degradation due to a lack of motivation or complacency, the leader must maintain purposeful contact with the employee. Too often, that contact devolves into two categories: technical topics (the work) and social topics. What is missing is the contact about the person and that individual's engagement in the work process. This should include specific positive feedback on the high levels of competence and autonomy that the employee demonstrates. Carnegie (1936) advises us to "give a person a fine reputation to live up to." This is great advice that is applicable in Phase 4 (Figure 3). The leader should recognize the employee as the expert and encourage the individual's innovative input while providing developing feedback, defined by Grieve and Greenwood (2008) as "positive feedback with an idea or suggestion attached," in creating continuous improvement across all system factors. Employees are thereby praised for their efforts, valued for their abilities and motivation, and allowed to be optimal (within a system perspective) rather than perfect.

Cultural degradation occurs slowly over time as behaviors inconsistent with the values and the rules start to become part of the culture. The incident trend line for the industrial services company, referenced in the Phase 2 discussion, showed another rise in the incident rate when employees reached about 5 years of experience. In safety, it sometimes starts with a "be safe" mentality to separate safety results from production results. The traditional safety measures of OSHA recordable injury rate and experience modification rate drive leaders and employees to adopt the "be safe" mentality. This mentality is demonstrated by statements such as "as long as everyone goes home with all their fingers and toes."

This culture accepts safety failures if those failures do not result in an injury. When an employee repeatedly works without proper PPE or implementing lockout/tagout, those behaviors become ingrained in the culture and are often ignored, in the author's opinion, by the leadership until someone gets hurt. So, as an employee enters Phase 5, the leader must quickly demonstrate behaviors that minimize the degradation. Unfortunately, consistent with the "be safe" mentality, the frontline leader does not intervene until an injury occurs. With a lack of understanding of cultural degradation and few tools in their tool belt of leadership skills to address the situation, operational leaders revert to the same old responses: retrain and discipline. Neither of these so-called corrective actions address the underlying issue of cultural degradation and both further

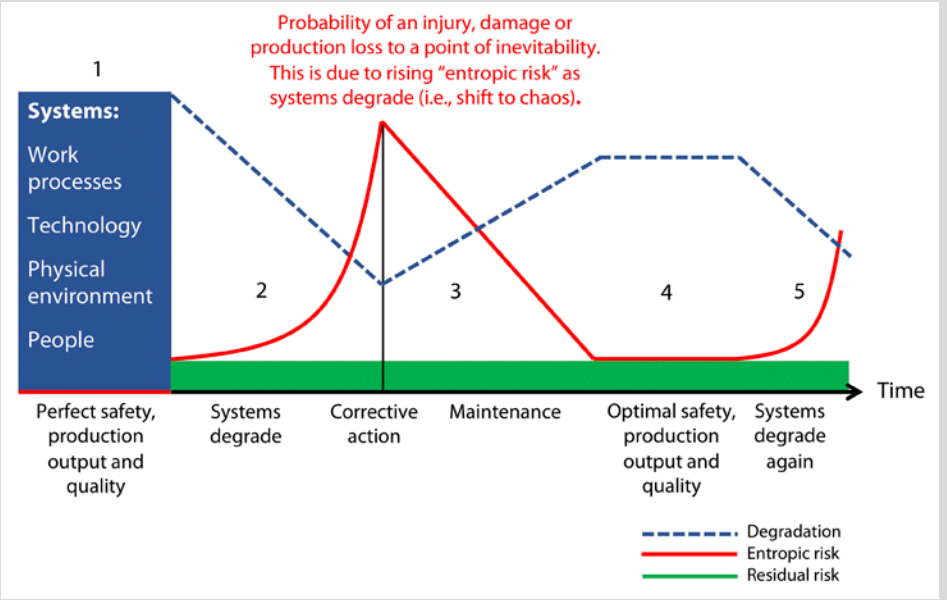
impact organizational trust. Before getting to the point of failure, the frontline leader must listen with purpose, particularly around engagement. With the employee, the leader must acknowledge high levels of contribution and facilitate self-reliant problem-solving. Too often, leaders believe they know all the answers. This over-supervision of someone in Phase 5 can quickly lead to micromanagement and further disengagement. As in Phase 3, here it is also important to address unacceptable behaviors with redirecting feedback and providing perspective so that neither the employee nor the leadership team overreact.

Figure 3 (p. 38) reinforces that the normal cycle leading to future degradation (Phase N) is mitigated by continuing the leadership behaviors discussed in Phases 4 and 5 as needed.

During safety leadership development workshops, frontline leaders often try to dismiss these leadership KSAs with the following reasoning: "My team is a great group who have been here a long time and know exactly what they are doing." The entropy model warns that every time there is a change in one of the system factors (e.g., technology/equipment, work process, work environment) that impacts an employee, that person starts back at Phase 1. Collectively, if the whole team is undergoing the change, the risk to continuity of production, quality of the work and safety performance can have serious impacts on the business.

Unfortunately, many organizations fail to develop these critical leadership KSAs in their operational leaders relying instead on technical competencies, rules, regulations and hope that it will be enough to keep their employees safe. The upside is that these leadership KSAs are learnable and that both initial and cultural entropy in the human factor can be minimized by effective continuous leadership at the frontline and middle management levels.

FIGURE 5
CYCLE OF FAILING, MENDING, OPTIMIZING, FAILING



Note. Adapted from *Productive Safety Management* (Figure 1.5, p. 13), by T. Mol, 2003, CRC Press.

Part 2 by Tania Van der Stap

Thus far, the focus of this article has been the critical role of the frontline supervisor in providing leadership at the operational level to address the impact of change on employees. This is particularly important because of the potential for degradation of KSAs and the organizational culture. In the big picture, senior managers need to be concerned about two macro-level issues. These are degradation of systems and organizational capacity.

Preventing Leadership & Cultural Degradation

Figure 5 illustrates the cycle of failing, mending, optimizing and recurrent failing using the original entropy model, which aligns to the discussion in Part 1 but at an organizational level. Area 1 shows the nonexistent, perfect world where risk is absent. At Area 2, the degradation of systems leads to rising entropic risk and inevitable, evident failure. Area 3 is synonymous with post-incident or loss reaction with mending of broken systems through maintenance practices. Where such practices become robust, the organization achieves optimal safety, production and quality in Area 4. Complacency over time then results in degradation again as shown in Area 5 and so the cycle is repeated (shown in previous figures as Phase N).

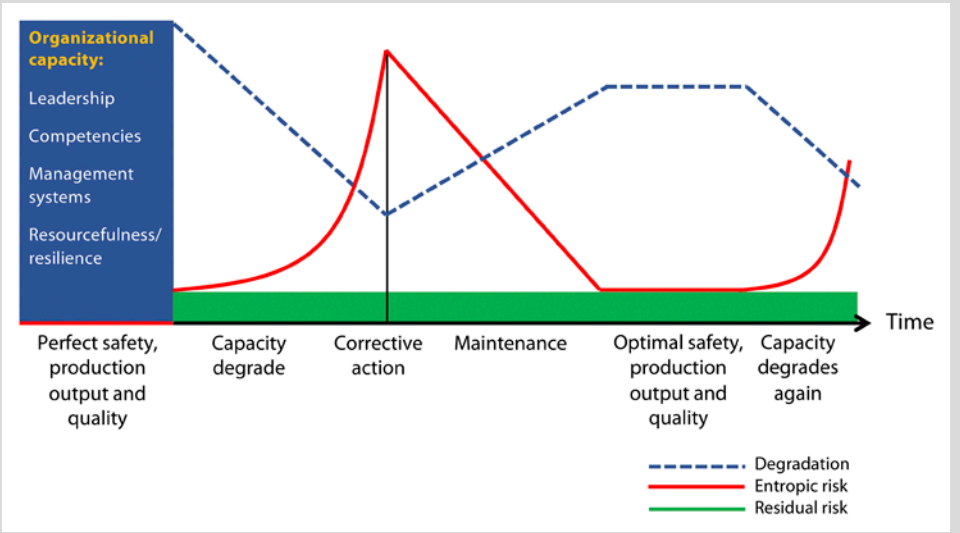
Figure 6 ties the entirety of the discussion into a single illustration of the cycle of entropic risk as it relates to organizational capacity, with the primary matters of concern being leadership, competencies, management systems and resourcefulness/resilience. Management systems are included in this suite highlighting the need for alignment of values, goals and objectives in the written form, with work as understood in the verbal form communicated by leaders.

An extensive dissertation could be written on the practical implications of Figure 6. It is enough for this article to emphasize the need for continuous attention to and maintenance of leadership capability, of employee competencies and the organization's modus operandi as driven and captured by business management systems. In 2003, Van der Stap coined the term "resourcefulness" to visualize the overflow from the organization's learning potential resulting from investment in leadership and competency development. This is likened to the contemporary term "resilience." Resourcefulness/resilience leads to:

- better systems review and therefore management of risk
- improved problem-solving and decision-making
- effective safety risk leadership at all levels
- system factors raised to optimal safety, production and quality

FIGURE 6

THE ENTROPY MODEL, CAPACITY & A STRATEGY FOR RESILIENCE



Note. Adapted from *Productive Safety Management* (Figure 1.5, p. 13), by T. Mol, 2003, CRC Press.

Rodney Grieve, founder of BRANTA Worldwide, has worked with clients throughout North America, Europe, Asia and Africa to help their leadership teams deliver outstanding safety results. With more than 25 years of safety and leadership experience, he provides a new understanding of the leader's role in creating a culture of success that balances productivity, quality and safety. Grieve is author of ***Defend Your Profits: Safety Tools for Bottom Line Improvement*** and ***SOAR: A Gate-to-Gate Journey of Leadership Essentials.***

Tania Van der Stap, principal director for ALIGN Risk Management, is a thought leader in the OSH profession, having written ***Productive Safety Management*** and contributed a chapter to ***Safety Leadership and Professional Development.*** Van der Stap has extensive experience in OSH management in construction, mining, gas, transportation and other sectors. Her expertise in integrated management systems and culture development focuses particularly on the impact of production pressure on workplace safety.

The ability to leverage resourcefulness depends, however, on the strategy to ensure embedded high-quality management systems, competencies and leadership, with the know-how to identify, correct, honestly discuss and proactively maintain these inputs. The gap is often that managers and supervisors are unable to visualize and articulate this vision. An organization's management team should be concerned if the benefits and returns on investment start to degrade. In contemporary terms, this relates to erosion of the organization's resilience and capacity to adapt to change and potentially the business's sustainability.

Some of the major industrial disasters that have occurred over the past 50 years indicate that organizations had not recognized their exposure to entropic risk. For example, at BP's Texas City refinery, which exploded in 2005, CSB explained that production pressures and cost-cutting programs were the cause of the incident. Management had relied on injury data as evidence of safety performance and were not aware of the poor safety culture at the plant (Isiadinso, 2015). In 2014, a DuPont chemical release killed four workers. The CSB chair indicated, "What we are seeing here in this incident in LaPorte is definitely a problem of safety culture in the corporation of DuPont" (Hosier, 2015). In both cases, the entropy model would prompt an investigation into degraded states (e.g., the presence of critical levels of entropic risk) within systems and also, importantly, organizational factors (e.g., considering how the organization manages risk not just safety). Clearly, safety can be too easily pigeonholed into a set of key performance indicators and a silo rather than being fully integrated into management systems, practices and the true organizational culture.

In these and other cases, senior managers were not aware of the degraded state of the business's systems or organizational capacity until an inevitable catastrophe occurred. Well ahead of such disasters, organizations may be suffering losses in production or productivity, quality deficiencies or safety incidents as a result of degradation. The first step in creating positive change is to recognize this risk at the operational level.

The frontline supervisor has a critical role as a risk champion, seeking to optimize production, quality and safety, in consultation with and in support of the workforce. Understanding the nature of risk, not only in terms of physical inputs, but also behaviorally and culturally, is a crucial element in building this capability. The opportunity for the safety profession is to lead a step-change by initiating a transformation from safety-based to risk-based thinking whereby safety performance, production/productivity and quality work are pursued as compatible organizational goals. **PSJ**

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