

Pragmatic High-Reliability Organization (HRO) During Pandemic COVID-19

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Abstract

The COVID-19 crisis demonstrates the difficulty of translating a method of organizing developed for extreme hazards to organizations with similar demands to be failure-free but in a markedly less hazardous environment. Three central reasons for this, discussed in this paper, are 1) the incomplete translation of HRO theory into practice, 2) the characterization of HRO practice: The embedded problem and 3) the internalization of HRO practice. The purpose of this paper is to make that missing part of HRO more visible, to be of greater help to the neonatal community, and to introduce readily adopted measures that move an organization.

Keywords: COVID-19, HRO, High Reliability Organization, Neonatal.

Introduction

Despite the extreme and pervasive challenges to healthcare by the COVID-19 crisis, our healthcare system must not fail. Healthcare has borrowed the concept of the High-Reliability Organization (HRO), codified from organizations that cannot fail despite working with hazards or in hazardous conditions (Bourrier 2011). HRO derived from studies by the *High-Reliability Organizations Project* at the University of California, Berkeley, in the 1980s to study nuclear aircraft carriers (USS Enterprise CVN 65 and USS Carl Vinson CVN 70), the Air Traffic Control System (Federal Aviation Administration), and Electric Operations and Power Generation Departments (Pacific Gas and Electric Company (Roberts and Bea 2001; LaPorte 2011; Rochlin 2011)). Changing an organization to HRO has been attempted through leadership, a top-down approach, with little use of Bloom's Affective Domain of Learning (Krahtwohl 1964), how will HRO methods help individuals. This borrowing has been in a restricted manner, mostly from the normative frame for preventing system failure, the more salient and relevant principles are less visible and often unnoticed. The occasion for academic observers to participate in live-or-die operations is severely limited; thus, the ability to identify characteristics necessary in both dangerous and routine operations is absent and their necessity in routine operations unnoticed.

The Incomplete Translation of Theory into Practice

In the medical world, practitioners engage with a flux of contingencies in an effort to make them more orderly. Efforts to enact order sometimes succeed, sometimes fail, and most often, they produce both. And that mixing can threaten reliable functioning. As an example, after a hospital had worked through a difficult period, the CEO gathered leadership to thank them for coming together, working hard toward the resolution of the problem, and supporting the staff. A voice in the back, from a leader, softly said, "Suckers!" (an attendee, personal communication). Is that remark cynical or insightful or both? It depends both on whether it is top-down or bottom-up and on whether it is made by a spectator or an insider.

Undoubtedly there was order within the "difficult period," but it was likely more pragmatic than normative, and the nature of that order was rendered less accurately by the concepts of a spectator than by the detailed acquaintance of the insider.

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Notions of high reliability make a big deal of that difference. The high-reliability theory relies partially on that outside view in its reliance on codifying a framework of guiding principles. But when those principles are seen as the core to produce reliability, that is where the emphasis gets misplaced. Reliability is more assured when practical engagement dominates when practice adjusts to the flux of circumstances. And it is the constituents of that engagement that make higher reliability a property of neonatal work as well as with public health in general. Another way to say this is that High-Reliability Organizing (HRO), as a verb, describes this social action to threats. The High-Reliability Organization (also HRO), as a noun, describes the results of leaders who model HRO attitudes and behaviors while supporting staff to engage covert discrepancy or disruption. As a verb, HRO is ever-present and will spontaneously overlay the organization's structure. As a noun, HRO emerges long before it is needed.

The verb and the noun are intertwined, which means that they jointly shape reliability. As a young medic on the Los Angeles City Fire Department, I was often the first person to reach someone overwhelmed by events. In a comfortable place where they felt safe, they now were beyond uncertainty. Their eyes wanted to know. She is OK, isn't she? He will be fine, won't he? Their eyes searched to stop things, stop the pain, stop the grief, stop time, just stop. Their eyes searched for a future as they trembled for a lost future. We did not stop the heart. We did not put them in the pool. We did not drive the car. We could not return their home, their health, or their loved one. By our presence, we represented humanity. The moment of our arrival, you could see it in their face, the ripping apart ended. We saw what we had stopped. Without words, we could feel their relief. We had meaning in our efforts. It was not our emergency. It was our rescue. That was a pragmatic constituent of our practice.

When pragmatics such as these are translated into more abstract

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normative statements, nuances and fine-tuning and subtle but important cues tend to be lost. Nuances get restored by action. Jim Denney, Capt., LAFD, himself a veteran of two Vietnam combat tours, would remind his crew, "The emergency has a vote. In the face of a void, move forward." A Los Angeles City firefighter, arriving on a confusing, volatile scene to assist me on the Rescue Ambulance, uttered a powerful version of a pragmatic stance: "I don't know what's happening, but I know what to do." Bill Corr, my fire captain, and WWII US Navy veteran, South Pacific Theater, gave meaning to our rescue work, "What we do is help people when they cannot help themselves."

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What's relevant here for the COVID-19 crisis is that key leaders from an outside position, misread subtle, recurrent cues and failed to alter their practice in ways that took those cues more seriously. High reliability is seldom a heavy-handed intervention. Instead, it gets worked out during activity, by means of small activities that have larger consequences. For example, a rescue ambulance responds with a team of two (except for shootings), both of whom were trained literally to protect the other's back. If we both faced the same direction at any time, it was a fail – you watched your partner's back and, if a threat approached, you took care of it, allowing your partner to treat the patient. I learned 1) the most important person on the scene was the firefighter on the hose or the medic treating the patient, they knew what was needed, and 2) there was no need to protect myself while treating a patient since that was my partner's job. One person could watch the backs of 3-5 people while effectively focusing on his or her task at hand. That's the secret of firefighters entering a burning building while others run out. They are safe because 3-4 people are watching their back. Treatment is possible because the team can focus on their task and help people when they cannot help themselves.

A further dimension of a pragmatic stance toward high reliability in rescue work is grounded in the belief that "When you go 'on scene,' you become part of the problem." 1) You may need to be rescued, keep where you can escape, or be reached. 2) Your countenance, stance, and voice change the scene. 3) You can only solve these problems from within. As neonatologists, physicians, nurses, respiratory care practitioners, social workers, dietitians, people need to become part of the problem so they can figure out solutions. Professionals cannot return life to what it was, but they can stop the destruction.

If we translate pragmatics of rescue protection and awareness into sensitivities in neonatal units, then it is clear that such units are more exposed to disruptions from the virus. COVID-19 can impair operations when experienced staff become infected due to life outside or movement within the hospital. COVID-19 can enter the NICU, infecting babies with unknown consequences. Safety from the virus has become more like safety from ionizing radiation in nuclear propulsion and nuclear power. Both are (1) invisible, (2) the damage is delayed, and (3) the disease is untreatable (supportive care is the only option).

Similarities between virus spread and radiation are not just a convenient metaphor. HRO originated in the context of nuclear reac-

tor operations when researchers tried to explain a surprisingly low rate of incidents and errors, even of aircraft incidents and errors, on a nuclear-powered aircraft carrier, CVN 70, Carl Vinson. In this setting, 'the nuclear way' of training. Safety awareness, and reliability of operations, permeated the ship.

The initial investigators, Rochlin et al. (1987; see also Bourrier 2005), coined the phrase HRO to describe an organization that "appears to succeed under trying circumstances, performing daily a number of highly complex technical tasks in which they cannot afford to 'fail.'" They elaborated that description in the very next sentence where they highlighted the notion of error: there is a "devotion to a zero rate of error [that] is almost matched by performance." Initially, reliability was interpreted to mean a zero rate of error. Less clear is the direction of causality. Do specific HRO practices reduce error, or does error reduction, for whatever reason, shape a more constrained routine for reliability? Whether HRO practices prevent errors or it is the prevention of errors that creates an HRO, the idea of error continues to dominate and to draw attention away from a more detailed look at how HRO is deployed on the front line.

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A preoccupation with error and with HRO as a remedy is found in several standards for healthcare. HRO is endorsed by the Joint Commission (Chassin and Loeb 2013), the US Agency for Healthcare Research and Quality (Hines et al. 2008), the US Military Health System (Department of Defense 2014), and the Institute for Healthcare Improvement (Nolan et al. 2004). These organizations introduced HRO into healthcare through leadership, a top-down approach, with error reduction becoming a standard for safety and reliability. A lingering question is what is the practical essence of HRO? The COVID-19 Crisis has refocused attention away from the top-down normative strategies toward more bottom-up pragmatic tactics. That reorientation has grounded high reliability more firmly in operations, less preoccupied solely with error, and less fully in the managerial language of design, human factors, leveraging, anticipation, rules, root causes, and problem-solving.

Well-meaning professionals overlook or leave behind the practical, bottom-up nature of HRO that produces its pragmatic strength. Responsiveness to rapid, nuanced, or subtle changes in the environment occur at the level of the individual, hence the bottom-up characteristics of HRO (van Stralen 2008, van Stralen et al. 2008, van Stralen and Mercer 2015).

Captain Chesley Sullenberger has been especially eloquent on the importance of reliance on bottom-up, pragmatic processing, as a core property of HROs. "During a crisis, there is not time to think about each specific bit of knowledge or experience that we depend on to make sense of imperfect information and ambiguity. But having those resources immediately accessible in our minds,

we use them in a conceptual decision-making process to frame the decision. We essentially quickly come up with a paradigm of how to solve the problem. It is after the fact that we retrospectively begin to attribute specific reasons for the decisions that we made. Capt. Chesley “Sully” Sullenberger (personal communication).”

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The Characterization of Practice: The Embedded Problem

COVID-19 disrupted healthcare systems that had incorporated robust, responsive patient safety programs intended to absorb regional disasters. The magnitude of the COVID-19 crisis overwhelms healthcare systems worldwide, yet we must continue with routine healthcare demands while accommodating the system impairment and increased healthcare demands caused by COVID-19. Healthcare, other than public health and occupational medicine, tends to occur in controlled medical environments. A disease creating an epidemic is an ill-defined problem that has challenged societies in the past. COVID-19 has changed the environment, embedding itself to reduce healthcare assets such as people, equipment, buildings, and medication. HRO, as codified from US Naval aviation, emerged from the embedded problem. Normative HRO, an abstract representation of HRO, has replaced Pragmatic HRO.

The first and most susceptible assets are our healthcare personnel. HRO for individuals and small groups increases strength, effectiveness, self-efficacy, and resilience to identify, engage, and continue to engage novel, emergent, and unexpected situations. The demands will continue to assault personnel, but to do nothing or to continue the normative stance will increase the harm to those who work in this environment and impair medical care. We cannot return personnel to their pre-crisis state during or after the COVID-19 crisis, but we can ensure they are supported, given meaning to their efforts, and that the inevitable damage is not gratuitously allowed to increase.

For organizations, personnel and executives will become alert to subtle and nuanced disruptions, early heralds of failure, and covert compensated states to engage early and more effectively. Improvisation and learning by doing, components of Pragmatic HRO, generate solutions, and reduce damage in unforeseen ways. HRO values and attitudes support personnel in their natural drive to find what works to help people who cannot help themselves. HRO, as the verb form, describes a scale-free network approach that overlays organizations and systems to increase sensitivity to early heralds of failure to increase the effectiveness of interventions. While HRO methods move the organization toward a more

desirable end-state, it does not, except for mental performance, increase resources

In a disruptive, confusing, and volatile situation, the analysis of the situation, the search for patterns, and attempts to create structure teaches people how to engage and create stronger designs to prevent system failure effectively. Traveling backward in time to attribute specific reasons for an incident develops sturdier structures for our future but with a hidden bias directing individuals to pursue pathways that make sense rather than have authentic causality. The pragmatic stance frames the incident with “that could be me,” a personal stance for introspection, an examination of our personal capabilities, asking what early heralds we should be attentive to, the actions we might take, responses we could expect, and whom we could turn to for help. Framed as a normative incident, the water landing applies to engineers, pilots, flight crews, and passengers. Framed as a pragmatic incident, the water landing applies to all of us because unexpected incidents are a part of living.

Capt. Sullenberger was trying to increase the angle of attack as much as possible just prior to touchdown before the aircraft stalled, in order to maximize the flare and thus minimize the airplane’s downward velocity when it impacted the water. His effort was frustrated because the phugoid damper prevented him from getting the last 3 1/2 degrees of nose-up pitch that would otherwise have been available before the stall. Consequently, the sink rate was higher than it otherwise would have been, and the rear fuselage structure was breached to the extent that a flight attendant seated in the rear was injured and water entered the airplane. Automation that was intended to improve safety and comfort actually hindered the most adaptable part of the system, the human pilot. *Sully was not aware of this until we discovered it in our investigation.* (Emphasis added) Christopher A. Hart, former Chairman NTSB (personal communication).

A convergent, deductive, analytic approach drives the search for facts and information which will guarantee our conclusions. The security offered by structures we create and actions we take reinforces the normative frame, but that is narrowing and increasingly confining, destined to cascade into destructive failure when the environment intrudes into the problem. As in Sullenberger’s water landing, a pragmatic frame enhances our capability to solve problems linked to deeper, unidentifiable structures.

Structuring a problem enhances our ability to teach and develop solutions. We describe problems with numerical variables and quantities, goals, objectives, protocols, and rules – these are well-structured problems (Simon 1973). The presenting situation identifies the well-structured problem; it is readily observed, categorized, and defined. The most trivial well-structured problem contains the defined elements of the situation, intervention, and objective (Dieterly 1980), a common source for protocols and rules. For other defined problems, we select from a limited array of interventions and/or identify a limited number of objectives.

The well-structured problem supports planning and risk analysis and reinforces the normative frame, creating complacency toward the organization’s capability to respond to crises. Some problems, however, are not well-structured, such as the *ill-structured problem* (Simon 1973), the environment modifies or creates problems, and the environment will precipitate failure with a visible symptom: unacceptable performance in the field (Von Hippel and Tyre 1995). More likely, we encounter problems with symbolic or verbal variables, vague or nonquantitative goals, and no available protocols or algorithms – the ill-structured or ill-defined problem (Simon 1973). Information is in the problem space; if the problem space is modified, then the problem-solver must draw upon long-term

memory, modify instructions, and obtain information from the environment outside of the problem space (Simon 1973).

The ill-structured problem presents as an undefined situation, a discrepancy observed or disruption experienced, with the operator unable to clearly define or readily identify the situation for engagement. Between the rules and protocols, interventions will be uncertain and multiple, and objectives vague, multiple, in parallel, or serial (Dieterly 1980).

Disturbances and disruptions occur in the world of practice, not theory. COVID-19 is such a disruption. Because concepts are discrete, interruptions in a process can break the causal chain of classical logic and rationality. Continuous perceptions do not match discrete concepts; our grasp of events challenges the accuracy of our concepts with the consequence of misidentification and misunderstanding (Schulman 2004). Used rigidly, problems become linear, puzzle-solving processes, utilizing only the concepts we could conceive, which has carried grave consequences at the international level (Wolfberg 2006). To Boyd (1976), though, the analysis served to differentiate concepts, a trait particularly useful during disruptions or for complex situations when he would combine analysis, a destructive cognitive force, with synthesis, a constructive cognitive force, for his model *Destruction and Creation* (Boyd 1976).

Theories follow the law of the excluded middle from classical logic, which ensures discrete concepts, not permitting facts or concepts to overlap. Properties and concepts that are discrete, coherent, and congruent will tightly couple with other properties and concepts. This tight coupling results in tightly coupled principles and concepts that lack interstices or overlap between other principles and concepts. Tight coupling permits design and interpretation for research, development of algorithms and rules to integrate systems, and the creation of procedures and protocols to guide people carrying out complex tasks. The tight coupling, however, comes at the expense of being congruent with the operational environment, an environment which commonly comprises multiple systems that incorporate diverse models.

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Practice does not follow the law of the excluded middle. In practice, nonlinear interactions generate properties that are unpredictable because of the combination of various characteristics of the source elements. Boundaries between properties are fuzzy and in flux and will overlap with properties of other principles and concepts. Though the concepts within a specific system are tightly coupled, interactions of diverse concepts and systems are loosely coupled. That is, interactions within the environment generate

new concepts that are imprecise and superimposed on and/or disconnected from other concepts. Loosely coupled concepts are the general experience in the operational environment.

The operational environment influences perceptions, interacts with situations, and, ultimately, affects solutions. Problems emerge or appear as disruptions in processes, or they become noticed as discrepancies in the environment, either must be identified and interpreted. The perceptions of individuals are continuous, yet the frame for identification and analysis is established through organizational or social norms and discrete concepts. Paul Schulman (2004) observed, “Discrete concepts simplify and lag behind continuous perceptions, which means that our grasp of events is subject to misspecification, misidentification, and misunderstanding.” The danger of these occurrences is not only failure from reliance on normative frames and discrete concepts ineffective for the situation, but it is also from that failure appearing or accepted as a success.

More likely is the problem that is embedded within the environment. In this conception of the ‘embedded problem,’ the environment contains information while influencing the structure of the problem. Reliance on a normative frame suffices in the majority of instances, but some embedded problems will not respond, objectives cannot be reached, or desired goals cannot be met. In those cases, a pragmatic frame can move the situation toward a more desired end-state. The ability to fluently utilize a pragmatic frame, where the sciences are brought to bear on the particular, is a form of practical wisdom.

I was a Los Angeles Fire Department paramedic working in Watts when I treated a patient on the side of the road. A police officer stood next to me. An older model car drove by, heavy blue smoke from the tailpipe clouded the street. Los Angeles struggled with smog, it was the mid-1970s, and vehicle emission controls had increased. “Don’t you give tickets for that?” I asked. He replied, “Well, I can give him a ticket. When he can’t pay the fine or ‘fix it’ costs, he loses his car. He can’t drive to work; he loses his job. His family has no income. What have I solved?”

The Gap Between Theory and Practice

The COVID-19 crisis demonstrates the gap between theory and practice is far deeper and more troubling than a discussion of the [normative] science and [pragmatic] art of medicine. Using a more accurate distinction, the normative stance and pragmatic stance will align the objective, decontextualized normative stance with theory and *scientific rationality*. The subjective, contextualized pragmatic stance would align with affective judgment and *practical rationality*. A science of practice can emerge.

The Limits of Scientific Rationality

Scientific theory and rationality assume discrete a priori themes and concepts that are outside of the human mind (Sandberg and Tsoukas 2011; Zundel and Kokkalis 2010). The goal is to represent an “outside” view of the world, a dispassionate, objective representation that is disinterested in personal experience and practical concerns. Two principles of classical logic also define concepts for scientific rationality: 1) *bivalence* is a statement that is either true or false, and 2) *the excluded middle* states that entities are discrete with distinct properties. With facts, deductive reasoning guarantees the truth of the conclusion. The application of classical logic, which emphasizes truth, with deductive reasoning provides top-down analysis of new concepts, whether they are within the originating theory. Scientific rationality ensures the integrity of theory by isolating theory from practice and context

Operators in the field develop their own logic of practice built upon contextual relations entwined with people and work (Sandberg and Tsoukas (2011). For Zundel and Kokkalis (2010), the absence of practice within the theory is how theoreticians see theory making, as themes in terms of a priori scientific assumptions, the *scientific subject domain*. By including engagement of practice, the theory would move into the practical world, closing the gap between theory and practice to create the *practical domain of engagement*. The significance of engagement of practice derives from the attitudes taught to rookies in the military and public safety – always engage, in some way, engage even if to evacuate the area.

A practical domain of engagement recognizes the overlapping and loose coupling of concepts necessary to complete a task, also the pragmatic stance, and illuminates the study of the problems of transferring academic work to organizational practice. Engagement is the active learning by doing in context, not an outcome of rational deliberation, and cannot be objectified for theory making (Zundel and Kokkalis 2010). Engaged action comes from insight and immediate feedback, with negative feedback marking the safe boundary of performance and positive feedback generating growth. All feedback generates information. “Mistakes” indicate a change in circumstances (Paget 1988) or interference from the environment (Von Hippel and Tyre 1995). But mistakes are observable, and therefore correctable (Weick 1979, 148). Effective responsiveness brings strength through change, allostasis.

Impaired engagement develops from motivated reasoning and failure to act. Motivated reasoning biases one to reject information that conflicts with closely held belief, a dangerous proposition during the COVID-19 crisis. Failure from not acting is not detectable, therefore not correctable and becomes organizational knowledge. The attitude toward error, mistakes, and failure, either as a generation of knowledge and safety or as intellectual failings, will leave

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The COVID-19 Crisis shattered system qualities, attributes, and operations while creating further interrelated problems and contextual and influential factors, the reason for full-spectrum analysis (Wolfberg 2006). “There are valuable perspectives to be gained from diverse contexts,” Roger Bush, Chair “Achieving High-Reliability Task Force,” The Joint Commission (personal communication). Information in one area may address limitations in another, and the findings in a different area may explain the results elsewhere (Pawson et al. 2005). Between domains, ‘boundary objects,’ arrangements, or common objects in the shared boundary allow collaboration without consensus giving groups flexibility and shared structure (Leigh Star 2010).

“The airline industry collaborative safety improvement process, CAST, which greatly improved airline safety beyond expectations, contains all the major HRO elements and effectively implemented HRO at an industry level (as opposed

to a company level), and they did so without any reference to or knowledge of the concept of HRO.” Christopher A. Hart, former Chairman, NTSB (personal communication).

“To comprehend and cope with our environment, we develop mental patterns or concepts of meaning” (Boyd 1976). We reconstruct order and meaning through analysis of the mental patterns to discard and synthesis of new mental patterns, iterations of unstructuring and restructuring that create concepts and meaning, changing our perception of reality (Boyd 1976).

Why Does this Matter? The Pragmatic Stance

Forging our way through this embedded, ill-defined problem of the COVID-19 crisis, we will receive many recommendations from specialists in diverse fields. The stance we take now, whether the normative stance with Normative HRO versus the pragmatic stance with Pragmatic HRO, influences whom we will accept recommendations from and the relevance of what they offer. The stance we take will have long-lasting effects, including the perceptions and faith of the families we provide care for and the public in general. The gap between theory and practice can be closed by informed practice, that is, to understand the theory and scientific rationality to support practice rather than guide practice. Neonatologists, by engaging situations in context, bridge the gap by using theory to improve care for practical outcomes (Zundel and Kokkalis 2010.)

Discrete categories establish a basis for research. Disregarding subjective mental responses supports objective empirical measurement. Common sense forms a basis of judicious, practical decision-making. The environment can constrain or endanger operations. From these premises, academicians generate concepts and theories, creating bodies of knowledge others can master and teach. Concepts are discrete, coherent, congruent, organized mental models that contribute to research and understanding. The discrete nature of a concept follows from the rule of the excluded middle in classical logic, either the proposition is true, or its negation is true. Coherence describes how a concept, following a logical sequence or building from deeper structures, integrates with established models. Congruence describes how the concept represents, agrees with, or relates to established concepts and the real world.

What makes a discipline socially and politically relevant influences the agenda for research, education, and training. A normative frame is orderly, measurable, amenable to research studies, and able to be mastered. A pragmatic frame comprises continuous and overlapping perceptions with degrees of truth and contingent principles, a difficult area for academic scholarship. The public is more accepting of discrete, well-accepted concepts. The model of a domain, driven by theory or practice, is a social action with the public and government but also senior leaders in the field, producing a long-lasting influence on scholarship and practice (Sherman 1996). It also influences credibility, visible during the COVID-19 crisis as healthcare professionals engage an unseen virus with stochastic effects on patients, from mild symptoms to rapid death following a short illness. Inductive reasoning causes frequent

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adjustments in knowledge as the strength of evidence changes. Branching time and updated beliefs have symbols as propositions and operators, but not in classical logic. They come from temporal logic and doxastic (belief) logic, respectively, two of a number of modal logics that qualify the truth of judgment, like 'necessarily' or 'possibly.' Modal logics depend on the mode of the logic system, for example, epistemic logic (knowledge) and deontic logic (duty or obligation). How we develop practical rationality for our respective disciplines has long-acting implications for the public's trust and faith in healthcare.

Moving HRO into predictably stable environments relaxes pressure that had selected for HRO characteristics. Traits once necessary for survival may disappear, with some breaking down quickly while others linger (Lahti et al. 2009). Normative HRO represents a release from environmental pressure and constraints.

Behaviors and beliefs come in suites. For example, local response to the environment means you accept and respond to the actions of others who are also responding. When members share the same intent, this self-organizing action becomes adaptive improvisation. Imposing rigid hierarchy or rank, or blaming members, distracts from responsiveness and degrades team formation and performance. Adopting the normative form of HRO while continuing rigid enforcement of rules or authoritarian structures, such as obedience without initiative or conformity without creativity, degrades HRO. The qualities that make HRO a powerful method against severe adversity or operations in hostile environments are lost in the moment they are needed most.

"HRO, as an abstract representation of work that is done out there, a representation by academics, is the very object that has been turned into a normative frame, a frame you want to replace with a more pragmatic frame." Personal communication from Karl Weick

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