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Integrating Human Factors Concepts into Improving Risk Management and Safety Performance

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Abstract

The international energy industry has made significant efforts over the last 10 years to improve risk management and safety performance. The industry continues to improve and increase emphasis on Occupational Safety and Process Safety programs in support of improving risk management.

Significant increases in work in areas of organizational development will help integrate human factors concepts into enterprise risk management frameworks and help improve safety and operational performance. Key elements of organizational development, including leadership and culture, require involvement across the entire organization.

The Society of Petroleum Engineers conducted several industry-wide summits and workshops to address human factors. The SPE Technical Report included in the list of references is one source for perspectives on future industry work on human factors. (Society of Petroleum Engineers - Technical Reports Committee 2014) Many organizations are working to integrate human factors. These include the National Academies, Chemical Safety Board, Ocean Energy Safety Institute, API, Center for Offshore Safety, military organizations, aviation industry, Chartered Institute of Ergonomics and Human Factors, and the Human Factors and Ergonomics Society. The range of activity considered for this analysis, while not a complete source of risk management activities, provides an thorough knowledge base of activities related to the application of human factors.

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Introduction

The perspectives presented in this paper reflect, to a great extent, the results of observing activities over the last decade to improve levels of safety in the oil and gas industry. Thought leaders and "power thinkers" across the industry continue to develop valuable ideas for a step change in improving performance. One new paradigm is *Getting to Zero Harm*. (Hinton, et al. 2018)

Getting to zero harm converges on two primary objectives:

- Nobody Gets Hurt
- The CEO never gets a phone call that "a major accident just happened." – an accident which destroys a major percentage of enterprise value for a larger corporation or bankrupts a smaller company.

These two objectives are not mutually exclusive. They reinforce each other. Addressing occupational safety, in general, helps ensure that nobody gets hurt. Effective management of process safety can prevent major accidents. The perspectives offered in this paper describe a framework in which application of human factors concepts contributes to both of these objectives.

Most companies have a well-developed Safety Management System (SMS). Continuous improvement is important. Periodic reviews of industry activities across the "Risk Management and Safety Space" by HSE leaders in individual companies help identify potential refinements and improvements to an existing company SMS.

As a result of the downturn in oil prices, attention to safety is sometimes reduced. Investments in safety are directly related to a company's bottom line. It is critical, even during industry downturns, to recognize that safety cannot be sacrificed by attempts to cut costs. The cost of recovering from the impact of accidents is simply too high.

General industry dialogues emphasize the need for closer communications between corporate and those "at the sharp end of the spear." This point emphasizes that the person on the front line must also accept ownership and responsibility for safety, especially within the realm of occupational safety. Whenever a serious accident or event occurs, inevitably some leader in the organization says, "We will put in place procedures to make sure it doesn't happen again!"

As Rex Tillerson put it in 2010:

> *"Written rules, standards and procedures, while important and necessary, are not enough…A culture of safety starts with leadership, because leadership drives culture and culture drives behavior. Leaders influence culture by setting expectations, building structure, teaching others and demonstrating stewardship…For a culture of safety to flourish, it must be embedded throughout the organization."*
>
> *(International Association of Oil & Gas Producers 2013)*

A key challenge in managing risk and safety performance is ensuring that safety leaders within the organization are able to identify potential risks for events which have not yet happened.

The paper extracts concepts from a broad range of industry activities related to risk management and safety. There are no "silver bullets." We must think in terms of range of "silver buckshot" from which to develop continuous improvements to safety management systems.

Defining Human Factors and the Human Element

According to IOGP Publication 368,

> *Human factors is the term used to describe the interaction of indidivuals with each other, with facilities and equipment, and with management systems. This interaction is influenced by both the working environment and the culture of the people involved. What may be a good system of work in one part of an organization, may be found to be less than ideal in a region where culturally driven attitudes to risk taking may be significantly different. Human factors analysis focuses on how these interactions contribute towards the creation of a safe workplace.*
>
> *(International Association of Oil & Gas Producers 2005)*

Human elements regarding facilities and equipment design and ergonomics are not included in this paper. This paper deals primarily with the interfaces between **management systems** and **people**, the two elements shown in the orange and green circles of Figure 1.

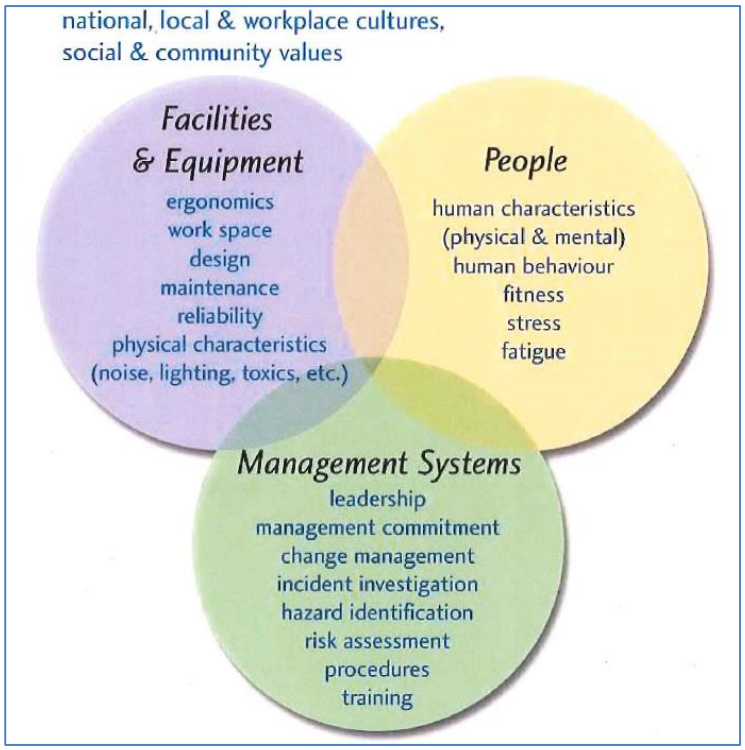

Figure 1: Culture and Working Environment (International Association of Oil & Gas Producers 2005)

Risk Management and Human Factors – A Knowledge Base

General Industry Sources

Table 1 lists a range of organizations and sources of information available for consideration in developing risk management systems.

Table 1

O&G Industry Standards & Practices & Other Studies	Standards & Risk Management Practices Outside O&G Industry

• IADC
• Health and Safety Executive – UK (HSE)
• Center for Chemical Process Safety (CCPS)
• DNV-GL
• ABS
• NORSOK
• OESI
• MKOPSC
• UK O&G Association
• IOGP
• Center for Offshore Safety
• Chemical Safety Board
• National Academies (NASEM)
• Society of Petroleum Engineers
	• ISO
	  ○ 17776 Guidelines on Tools and Techniques
	  ○ 31000 RM Principles & Guidelines
	  ○ 31010 RM – RA Techniques
	  ○ 45001 Occupational Health Safety Management Systems
	• Military
	• Aviation - CRM, High Reliability Organizations
	• Nuclear Industry
	• Insurance Underwriters
	• Financial Sector
	• Human Factors Societies

Many of the risk management and human factors concepts within these sources overlap and reinforce each other. A comparative reading of the various sources will provide valuable insights into improving an existing corporate safety management system.

The Society of Petroleum Engineers

Report: The Human Factor: Process Safety and Culture
(Society of Petroleum Engineers - Technical Reports Committee 2014)

This SPE report, based on input from 70 subject matter experts from throughout the international oil and gas industry, defines the scope of human factors and discusses safety culture, training and certification, operational control of work, decision making, and application of information technology (IT).

In civil aviation, a series of major accidents led to the introduction, mandatory requirement, and acceptance of human factors methodologies called Crew Resource Management (CRM). Similarly, the nuclear power industry identified and acted upon the concept of its safety culture after a small number of major incidents. The challenge is whether the E&P industry can achieve a similar breakthrough by confronting the human factor as an issue in process safety both onshore and offshore. The recommended changes include moving to an organizational culture in which process safety is as well managed as personal safety is currently managed.

Report: Assessing the Processes, Tools, and Value of Sharing & Learning from Offshore E&P Safety-Related Data
(Society of Petroleum Engineers - Technical Reports Committee 2016)

This SPE report provides guidance on an industry-wide safety management data sharing program. The overall objective of the effort is to eliminate or reduce risk of harm through industry sharing of data, including information on near misses.

Report: Getting to Zero and Beyond: The Path Forward
(Society of Petroleum Engineers - Technical Reports Committee 2018)

This SPE report identifies and evaluates elements that can aid the industry in removing obstacles to achieving zero harm. It explores current thinking and views; incorporates experiences and learnings from other industries that are mature in the application of human factors; and suggests the next steps that will enable the oil and gas industry to meet an expectation of zero harm.

Summit Paper: November 2012
(Hudson and Thorogood 2012)

This SPE report highlights the critical requirement for participation by individuals in achieving a successful safety culture. CEOs and company management alone cannot create the culture. **All persons on the front line have a responsibility for making "safety culture" happen.** See Figure 2 below.

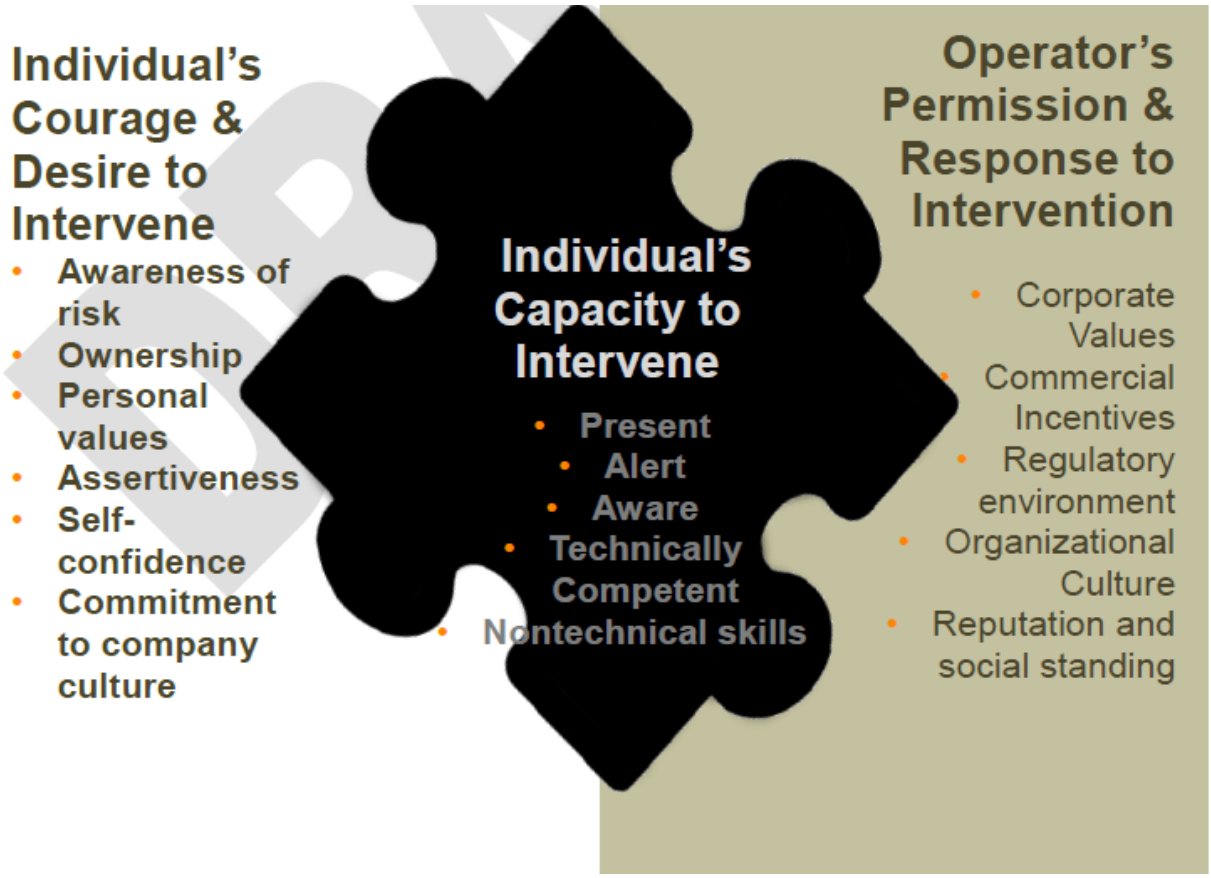

Figure 2: Human Intervention Model

National Academy of Science Engineering and Medicine/Gulf Research Program

Report: Strengthening the Safety Culture of the Offshore Oil and Gas Industry
(National Academies of Sciences, Engineering, and Medicine 2016)

This 240-page report issued in 2016 provided a detailed analysis of opportunities for achieving an effective safety culture within the industry. According to this report, critical success factors for an effective safety culture in the nuclear industry include:

- Management commitment to safety. Leadership safety values and actions, decision-making, and respectful working environment.
- Individual commitment to safety. Personal accountability, questioning attitude, and effective safety communication.
- Management systems. Continuous learning, problem identification and resolution, environment for raising concerns, and work processes.

Workshop: The Human Factors of Process Safety and Worker Empowerment in the Offshore Oil Industry
(National Academies of Sciences, Engineering, and Medicine 2018)

This January 2018 workshop, a product of the 30-year, $500 million Gulf Research Program, included 80 participants representing a broad cross-section of the domestic and international energy industry. Topics of discussion included:

- Differences between U.S. and international practices, both in regulatory frameworks and operating practices within the industry.
- Best practices and lessons learned from other high-risk, high-reliability industries.
- Differences resulting from union and nonunion work environments.
- Getting CEOs engaged.
- Perspectives from organizations outside the core oil and gas industry and especially the Chemical Safety Board.
- Defining the word, *empowerment*.

Professors Rhona Flin and Christiane Spitzmueller discussed the integration of organizational development and human factors concepts, as seen in Figure 3:

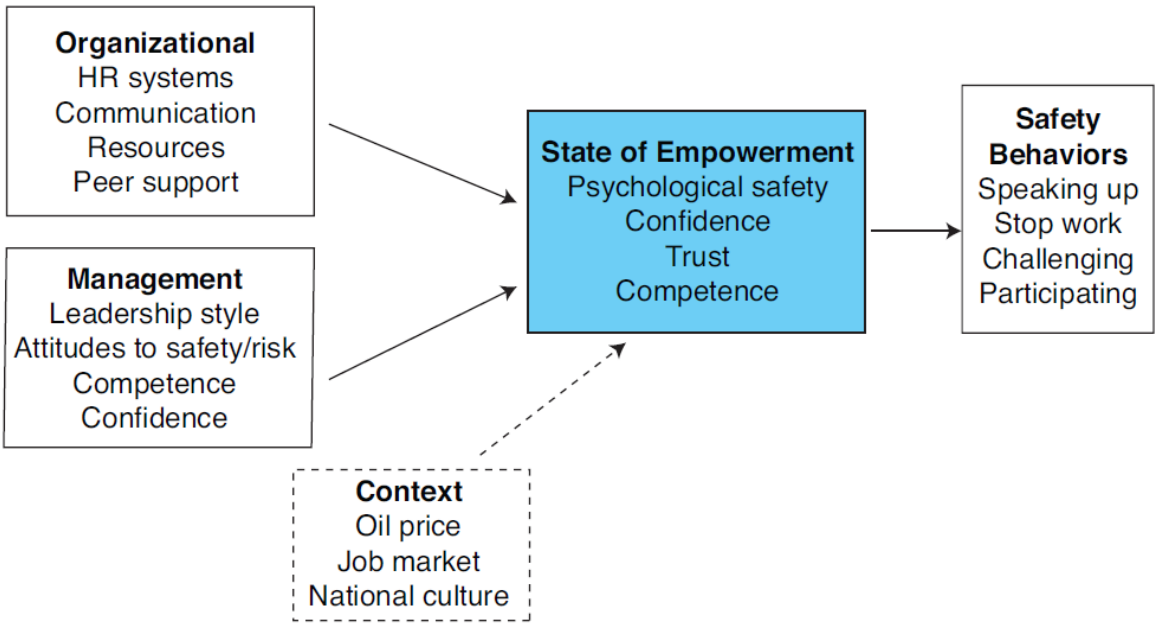

Figure 3: The state of empowerment links organization, management, and context to safety behaviors.

Bill Hoyle of the Chemical Safety Board emphasized another key point: When an audit report says everything is fine, "that's a bad report." You are getting no value from that. Reporting bad news is a good thing. People need to be trained to, "put bad news forward and push it up."

Andrew Imada, an Organizational Development Consultant and member of The National Academies Board on Human-Systems Integration, recommended a strong relationship between organizational safety culture, leadership, and voluntary safety performance. Voluntary performance is at the heart of empowerment. Also, empowerment requires a commitment to a safety culture that goes beyond compliance.

Summit Paper: Safer Offshore Energy Systems
(Society of Petroleum Engineers 2018)

This NASEM/SPE Summit engaged a broad set of industry experts to develop ideas on areas where the Gulf Research Program or jointly-funded research is needed to minimize and manage risks for both people and the environment by minimizing the possibility of a major incident. The scope included include both technical and human performance opportunities.

- Improving collaboration among industry, regulatory, and academic communities to advance understanding and communication about systemic risk.
- Fundamental scientific and technological research to spur innovation aimed at reducing or managing risks.
- Exploring how to create robust and resilient organizations that minimize major incidents with improved management of change, sim-ops management, decision support, and operational procedures that support safe work.

- Identifying educational or training programs to promote a skilled and safety-oriented workforce and to retain that workforce through economic cycles in the oil and gas industry.

The analyses and brainstorming activities were organized to span the full lifecycle of industry activities including: Pre-drilling, drilling, construction, and production phases of activity. The summit identified 144 opportunities to improve safety.

Enterprise Risk Management Frameworks

We operate in a high risk industry. Companies (and individuals) must consider their perspectives with regard to risk. Is it a risk averse/risk avoidance framework, or is it one of taking risks with appropriate risk management? The following figure provides a broad, qualitative perspective regarding taking or avoiding risk. A goal of zero risk is a recipe for negative returns.

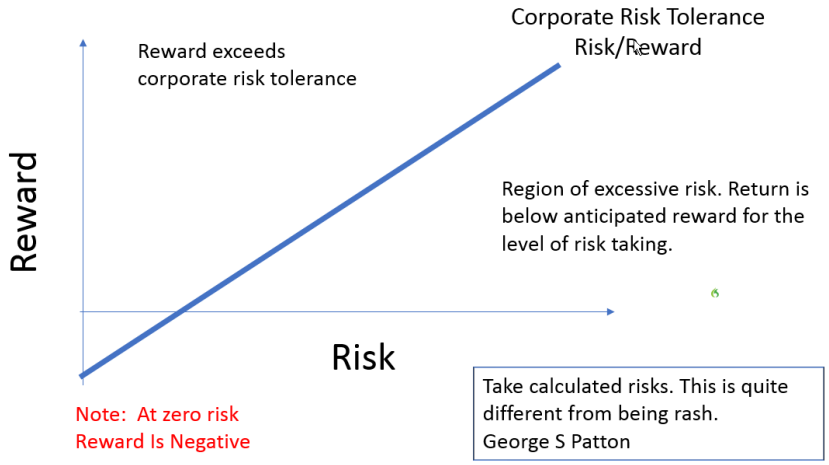

Figure 4: Strategic Positioning Risk/Reward

With the relationship between risk and reward in mind, companies can assess whether their projects or activities have sufficient reward to compensate for the risk exposure. Activities in the upper left region provide enough reward to justify taking the risk. Activities assessed in the lower right region should be avoided since the return is not enough to cover the risk exposure.

This framework should be considered from both a qualitative and quantitative perspective. The collective judgment of corporate leadership can provide an instinctual, qualitative perspective on whether to take or avoid risks. Quantitative tools can be used, when appropriate, for detailed evaluations of risks in any specific project or activity.

Thinking from the framework of "High Reliability Organizations" is critical. The objective is not to get to zero risk. The energy industry requires taking calculated risks, managed effectivly.

The industry is increasing emphasis on integrating knowledge and perspectives from outside the core oil and gas industry.

In an article published in Harvard Business Review, Nassim Taleb, author of the book, *The Black Swan*, discusses risk management issues relevant to the oil and gas industry and identifies additional ideas worth considering. "Black Swan events are almost impossible to predict. Instead

of perpetuating the illusion that we can anticipate the future, risk management should try to reduce the impact of the threats we don't understand." (Taleb, Goldstein and Spitznagel 2009)

He continues on to detail six mistakes executives make in risk management:

1. We think we can manage risk by predicting extreme events.
2. We are convinced that studying the past will help us manage risks.
3. We don't listen to advice about what we shouldn't do.
4. We assume that risk can be measured by standard deviation.
5. We don't appreciate that what is mathematically equivalent is not psychologically so.
6. We are taught that efficiency and maximizing shareholder value do not tolerate redundancy.

It is important to emphasize how to manage low probability, high impact events.

API RP 75 - Framework for the Safety Management System

API is updating Recommended Practice 75, *Recommended Practice for Development of a Safety and Environmental Management Program for Offshore Operations and Facilities*. The release of the updated RP 75 is scheduled for year-end 2018. The preamble for this update states:

> *This document is intended to describe a **performance-based management system** focusing on the purpose and expectations for each element of a safety and environmental management systems (SEMS). It is not intended to be prescriptive in defining how to achieve the purpose and expectations of each element; rather, **it allows flexibility appropriate to the size, scope, and risk of a company's assets and operations**.*

This revised RP 75 addresses the human element only in general terms. Applying and integrating the "human element" or "human factors" within the overall framework of the risk management system can be challenging. Where does the human element fit in? Generally everywhere. A keyword search of the term, *human,* within the draft update to API RP 75 shows that the term appears only a few times.

The following is a list of the required elements of an SMS in the updated RP75.

1. General
2. Safety & Environmental
3. Hazards Analysis
4. MOC
5. Operating Procedures
6. Safe Work Practices
7. Training
8. Mechanical Integrity
9. Pre-Startup Review
10. Emergency Response
11. Incident Investigation
12. Auditing
13. Records & Documentation
14. Stop Work Authority (SWA)
15. Ultimate Work Authority (UWA)
16. Employee Participation Program (EPP)
17. Reporting Unsafe Working Conditions

Guidance on human performance which impacts most of the elements within the SMS is included in the draft document under Section 3.2.4, *Human Performance*:

> *Achieving effective human performance results from the systematic application of knowledge and learnings to improve the interactions of individuals with each other, equipment, and systems. The SEMS influences human performance by incorporating the following concepts:*
>
> *a. Leadership Response: Leaders commit to responding to failures and successess in a way that improves human and team performance.*
>
> *b. Resilient Design: Systems are designed to account for the variability and error-likely situations that occur in the interactions of individuals with each other, equipment, and systems.*
>
> *c. Human Feedback: It is recognized that human input and adaptability enables effective HSSE performance and continual improvement in SEMS.*
>
> *d. Functionality: An effective SEMS considers human factors, the end user, the interfaces, the work, and the decision-making processes in the design, implementation, and maintenance of the management system.*

Within this high-level framework for a performance-based SMS as defined by API RP 75, organizations have significant flexibility regarding which potential standards or practices to use in developing an SMS. The following progression suggests one potential framework which relies heavily on IOGP and ISO standards. This framework also recommends expanding an SMS which meets the minimum regulatory requirements to an enterprise risk management framework with performance goals beyond compliance. *Note: Insert at right in figure below from IOGP.*

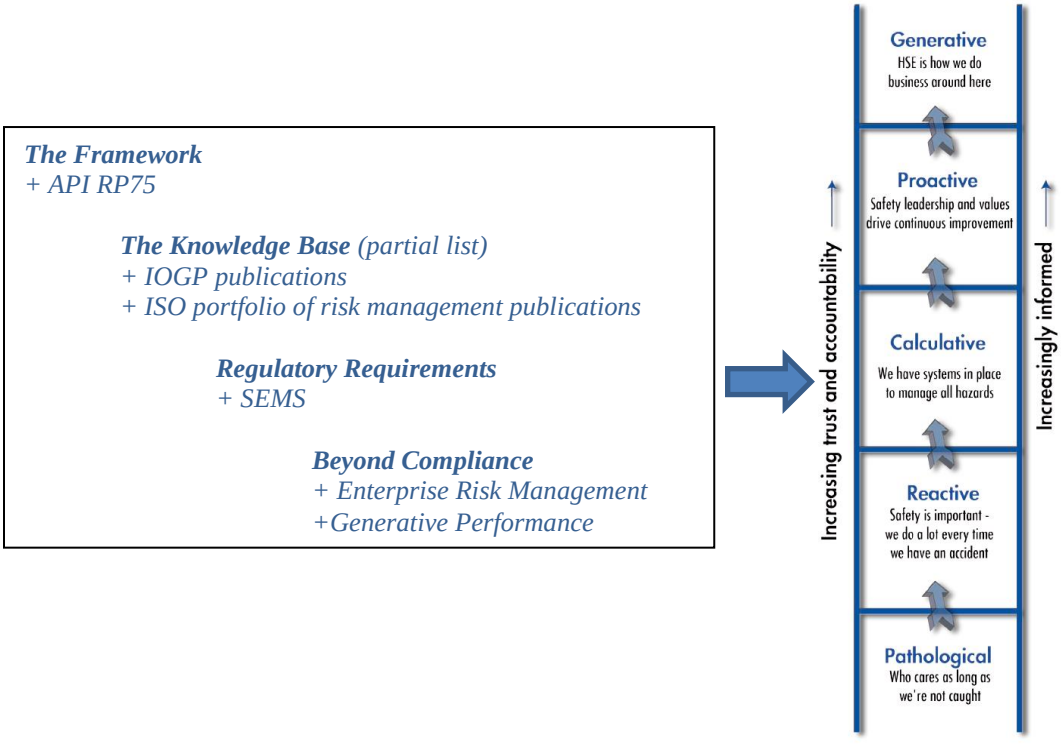

Figure 5 (International Association of Oil and Gas Producers 2010)

The Risk Matrix – A Key Tool

The paper, *Anatomy of the Risk Matrix*, (Van Scyoc and Hopkins 2012) provides an excellent framework for developing a risk matrix and is suggested as one of the best starting points for developing an overall assessment of corporate enterprise risk. This paper provides significant insights and perspectives on risk tolerance, the balance between intuitive and quantitative approaches, key pitfalls in developing and applying risk matrices, the level of granularity appropriate in a risk matrix based on the size of the corporation, and emphasis on analyzing risks with potential major impact on enterprise value.

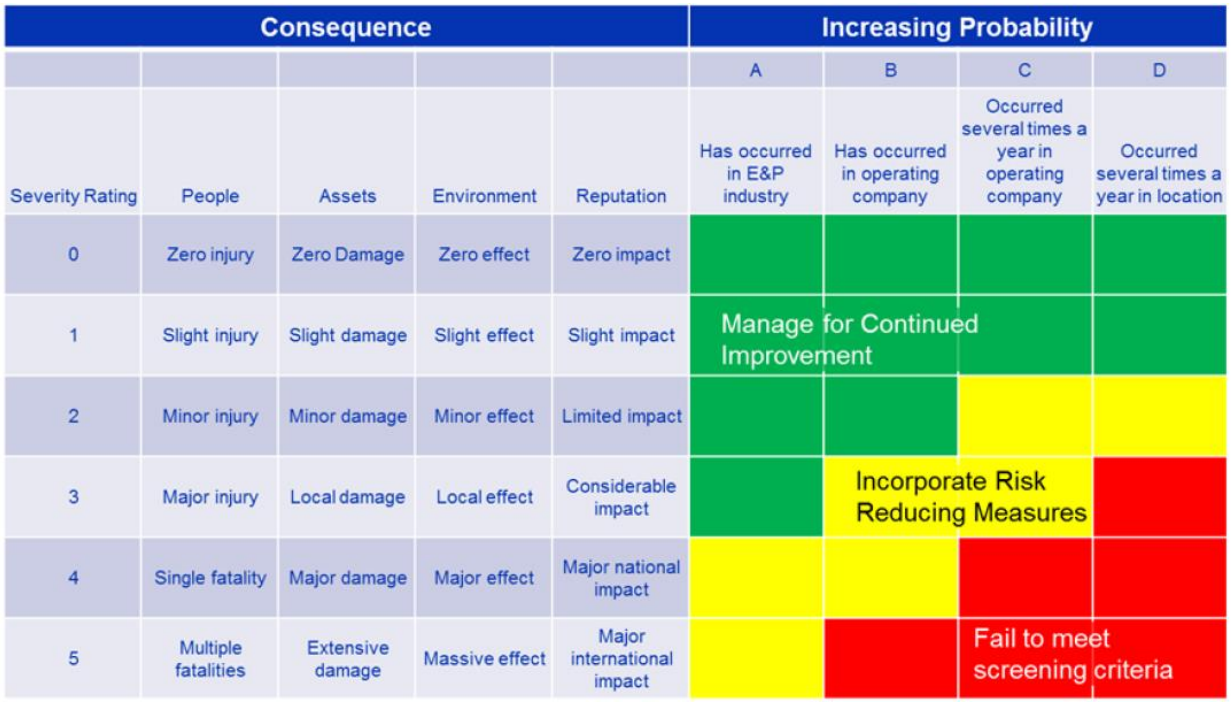

Figure 6: Generic Risk Matrix based on ISO 17776

Rigorous application of this risk matrix provides the basis for:

- Identifying and prioritizing the hazards across the spectrum from risks to major enterprise value to less serious risks.
- Analyzing the impact of the hazards with and without mitigation.
- Selecting the critical safety activities for high priority treatment.
- Selecting and managing barriers to mitigate the risks including procedures, generally within the framework of a "bowtie."

Extreme Operational Excellence

Achieving compliance with procedures is one of the critical success factors in preventing accidents. How can an organization ensure compliance with procedures? High reliability organizations such as the nuclear submarine service have experienced proven success.

Trevor Kletz, author of the book, *What Went Wrong*, writes:

> *The 1988 explosion and fire on the Piper Alpha oil platform in the North Sea, which killed 163 people, was also caused by poor isolation. A pump relief valve was removed for overhaul and the open end blanked. Another shift, not knowing that the relief valve was missing, started up the pump. The blank was probably not tight, and light oil leaked past it and exploded in the confined processing area. The official report concluded "**that the operating staff had no commitment to working to the written procedure; and that the procedure was knowingly and flagrantly disregarded**." The loss of life was greater on Piper Alpha than on the other two incidents because oil platforms are very congested and escape is difficult.*
>
> *(Kletz 2009)*

Conclusions in the Piper Alpha Accident Report by Lord Cullen included: "**The operating staff had no commitment to working to the written procedure; and … the procedure was knowingly and flagrantly disregarded."**

Problems with procedures are linked to numerous incidents and are frequently cited as one of the causes of major accidents. Ineffective management of procedures has not only contributed to disasters such as Bhopal, Piper Alpha, Exxon Valdez, and Bp Texas City, but also to most accidents which have resulted in fatalities and personal injuries. The main causes are too much reliance placed on procedures to control risk; a failure to follow safe working procedures; or the use of inadequate procedures.

Lessons from Bp Texas City (U.S. Chemical Safety and Hazard Investigation Board 2005):

- A work environment that encouraged operations personnel to deviate from procedure.
- Acceptance of procedural deviations during past startups.
- Failure to ensure the procedures remained up-to-date and accurate.
- Management did not ensure that unit operational problems were corrected over time, allowing operators to deviate from established procedures.
- The startup procedure lacked sufficient instructions for the Console Operator to safely and successfully start up the unit.

Risk management systems must clarify the difference between *empowering* and *engaging* all workers so that the organization is able to achieve operational discipline. Empowering workers does not mean companies should allow workers to choose which procedures to follow and which not to follow.

Multiple layers of protection are needed against human error. The following are just a few protections:

- Process engineering design
- Basic controls and alarms
- Operational excellence ownership/supervision
- Critical alarms and manual intervention
- Advanced controllers and automatic action (SIS or ESD)
- Physical protection (relief devices, dikes, or blast areas)
- Plant emergency response to community emergency response
- Procedures

Experience has proven that when people think of a production platform or process facility, they tend to focus on the equipment—the vessels, pumps, compressors, instrumentation, and controls. EPC firms, as well as the Owners, often fail to conisder the entire system, particularly the end users, the people who operate and maintain the facility. These people will have different competencies, training, and experiences, and will perform differently under various operating conditions, organizational structures, equipment configurations, and work scenarios.

The probability that the total system will perform correctly after it is commissioned is the probability that the hardware/software will perform as designed, times the probability that the operating environment will not degrade the system operation, times the probability that the end user will perform correctly.

By defining the total system this way, human performance is identified as a component of the system. By increasing the probability that operators and maintenance technicians can perform tasks effectively in the appropriate environment, the total system performance will increase significantly.

Of all the protections a company can employ, procedures are critical to operational excellence. Procedures, including work instructions, job aids, etc., are agreed safe and best ways of doing things. They usually consist of prerequisites, safety precautions, workflow sequences, action item series, consequences of deviation, and related information needed to carry out tasks safely. Procedures may include flowcharts, decision trees, step-by-step instructions, checklists, diagrams, and other types of job aids.

Key principles in procedure design:

- Risk assessment should clearly establish when procedures are an appropriate control measure. The results of the risk assessment should inform development of the procedure.
- In O&G, for a production platform or a process unit to be operated in a safe manner, a hazard analysis and the pre-startup review ensure that provisions made in final design and subsequent modifications are reflected in system operating limits. A major contributor to compliance with system operating limits is made by the development and use of operating and maintenance procedures.
- Consider the links between procedures and competency—they should support each other (e.g., on-the-job competency would include training on frequent, important, and critical procedures). Procedures do not replace competency. Procedures do not replace training.
- Have a system for managing procedures—job task analysis (e.g., how to decide which tasks need procedures based on frequency, importance, and difficulty of the task to be performed, how these procedures are developed, complied with, and reviewed/updated).
- Use a format, style, and level of detail appropriate to the user, task, and consequences of failure. Procedures should be fit for purpose. One size does not fit all. Support compliance with procedures through user involvement and by designing the task, job, environment, equipment, etc.

The exact strategy to reduce non-compliance will depend to a large extent on the reasons why procedures are not followed in the first place, for example:

- If not following a procedure or instruction has become the normal way of behaving within a facility, employees see little value in them. Consider explaining the reasons behind the procedure; change the procedure if it becomes inappropriate; or consider rationalizing work systems to reduce the number of unnecessary rules. If the rule is critical, then increase the probability of detection.
- If an instruction is impossible or extremely difficult to work in a particular situation (e.g., conflicting requirements or physically impossible to perform the activities in the specified manner), then improve job design, the human-machine interface, and the working conditions; implement a suitable reporting system; and provide more appropriate supervision.

The following will help ensure procedures more likely to be used:

- Ensure the "right" way to do the job requires less time and effort. Eliminate tendencies to take shortcuts.
- Use a procedure format that suits the task and the end user (e.g., checklist, flowchart, diagram, decision-aid, charts, photos).
- Involve end users in the development and implementation of the procedures (to help close the gap between "work as engineered" and "work as done").
- Design the task, job, environment, equipment, etc. to support the end user in following the procedures. Design the job so that the correct procedure is hard to avoid.
- Balance the level of detail in procedures with the experience and competence of the end user. Generally, procedures should be written for a "qualified" operator or technician.

As noted in the recent Gulf Research Program workshop summary, "Procedures have to be appropriate for the context in which they are being used, and employees need to know when they can and cannot follow them based on the situation." (National Academies of Sciences, Engineering, and Medicine 2018). Later in the report it is noted that it is important that employees, "should be empowered to slow down, shut down, stabilize, and get the right procedure before advancing" in any given situation.

Barrier Management

IOGP defines a *barrier* as, "A risk control that seeks to prevent unintended events from occurring, or prevent escalation of events into incidents with harmful consequences." (International Association of Oil and Gas Producers 2014)

During the recent updates to API RP 75 and within the Human Element Working Group there was significant debate and discussion as to whether the human element should be considered a barrier within an overall risk management system. The following comments and clarifications, based in part on IOGP Report 456, were discussed:

> *Human barriers rely on the actions of people capable of carrying out activities designed to respond and act to manage the potential cause or threat of an event. Human barriers include:*
>
> - *Operating in accordance with procedures*

- *Surveillance, operator rounds, and routine inspection*
- *Authorization of temporary or mobile equipment*
- *Acceptance of handover or restart of facilities and equipment*
- *Response to process alarm and upset conditions (e.g., outside safe operating envelope)*
- *Response to emergencies*

Human barriers require a set of individual and collective behaviors that ensure the barriers remain effective (e.g., not short-cutting procedures, honoring the full Management of Change process, and staying within the safe operating envelopes). Sometimes these behaviors are referred to as 'operating discipline.' Without these desired behaviors, resilience of human barriers will be very low. Strong, energetic and consistent leadership will always be required to maintain acceptable human barrier health.

(International Association of Oil and Gas Producers 2011)

For safety critical activities, a framework such as this is essential to reduce the possibility of major accidents to the lowest possible levels. In a recent white paper published in December 2016, the Chartered Institute of Ergonomics and Human Factors details rigorous ways to apply human factors in barrier management with emphasis on achieving resilience in the barriers. (Chartered Institute of Ergonomics & Human Factors n.d.) See the following figure:

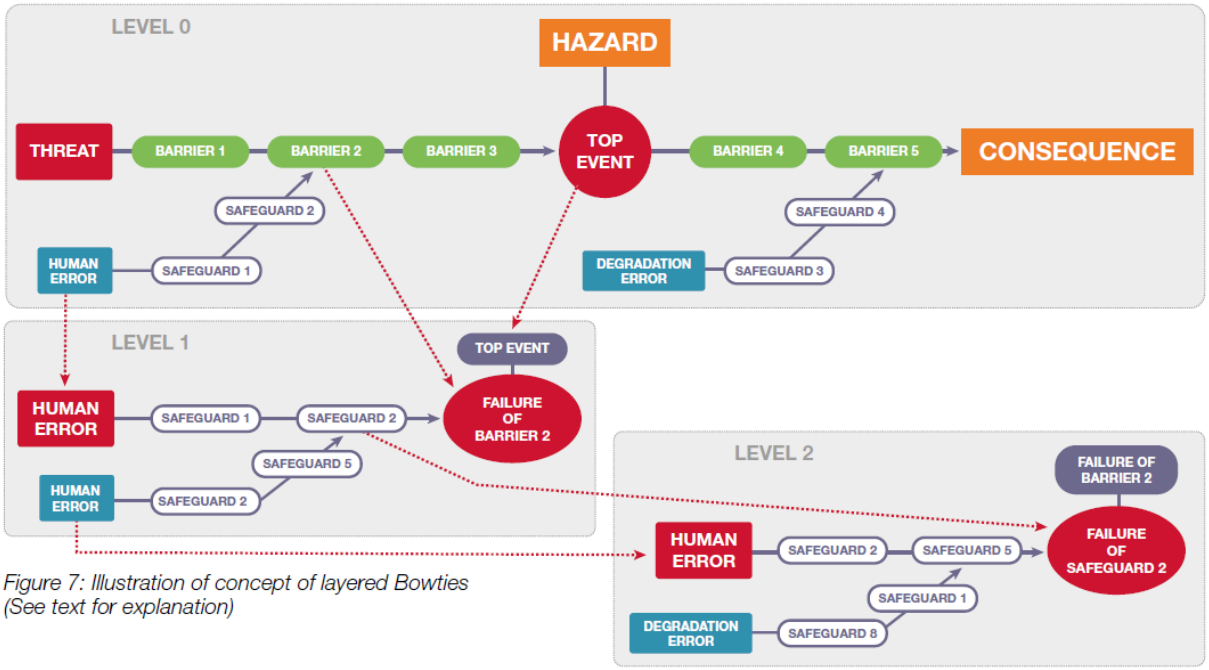

Figure 7: Illustration of concept of layered Bowties (See text for explanation)

Figure 7: A Layered Bowtie - Integrating the Human Element into Barrier Management

HSE professionals and technical and operational managers are encouraged to use the concepts, guidelines, and detailed recommendations in this white paper as a basis for integrating the human element as one of the key barriers in a risk management system.

Perspectives on Organizational Development

Organizational development is a critical activity impacting all the key elements of a successful enterprise risk management structure. It is not simply a background activity to be "handled by human relations." Executive leadership should be directly involved in and lead activities in organizational development.

The "mental model" in Figure 8 depicts Organizational Development as an overarching activity essential to tie together the key elements of occupational safety, process safety, and human factors.

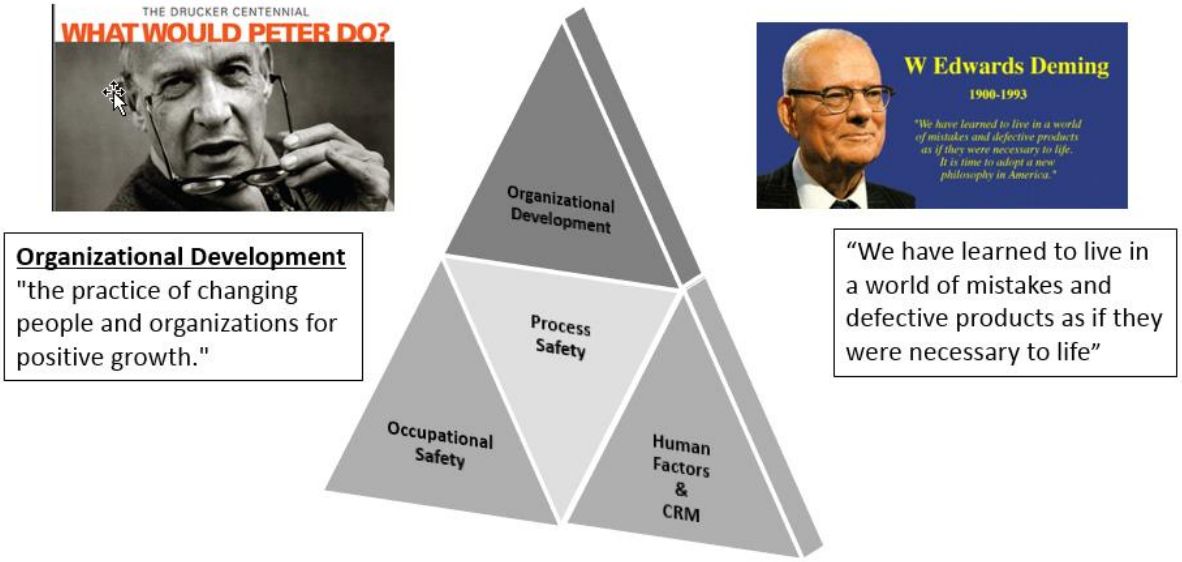

Figure 8: Expanding Risk and Safety to a Broader Framework of Organizational Development of High Reliability Organizations (Grossweiler 2015)

Two thought leaders with major impact and influence on organizational development concepts over the last several decades were Peter Drucker and Edward Deming.

Drucker noted that a company culture can prevent attempts to create or enforce a strategy that is incompatible with an existing culture. Culture must be driven by corporate leadership. It is a critical success factor for successful management of enterprise risk.

Deming was noted for advancing concepts for measuring performance as a key element in improving performance and a framework for continuous improvement in enterprise performance.

Leadership and Safety Culture

Leadership has many different definitions! It is not be necessary or possible to get a consensus definition of *leadership* or *safety culture*. Reading biographies of several famous leaders helps develop a broad perspective on leadership.

General Kelly, The Secretary, Department of Homeland Security gave two pieces of advice on leadership in a keynote address at the USCG Academy graduation in May 2017:

> ***Take care of your people.*** *Train them. Mentor them. Defend them. They will do anything you ask them to do. They'll show up to work on time. They will put their lives at risk, on the*

high seas interdicting drugs in tons, dealing with the most dangerous men on the planet, or they would jump out of a helicopter in the middle of the night into raging seas to save someone's life. All you have to do is lead them.

Tell the truth. *Tell the truth to your seniors even though it is uncomfortable, even though they may not want to hear it. They deserve that.*

(U.S. Department of Homeland Security 2017)

The point with regard to "truth" noted by some industry leaders, i.e. ***"An audit which does not find something which can be improved concerning actionable aspects is not a good audit."*** is worth emphasizing. Leaders expect and accept information critical to improving operations.

Achieving "safety culture" is also challenging. In some organizations, when the *"safety policeman/woman" is present (this could be an HSE safety representative), everyone acts in the right way and does the right thing. As soon as the safety policeman/woman leaves, performance returns to "business as usual."*

In the SPE Distinguished Lecturer Program, Kenneth E. Arnold outlined the following activities that help build a culture of safety:

From an organizational level there must be:

- *Mechanisms establishing structure and control – To specify what is needed to operate safely and check that it is being done.*
- *Actions establishing safety norms – To encourage people to act properly even when no one is looking or when it is not in their immediate best interest.*
-

From an individual perspective there must be:

- *Mechanisms establishing competency – Knowledge and ability of the structure, control, and behavioral norms.*
- *Actions establishing motivation – So a totally selfish person would act in accordance with behavioral norms.*

(Arnold n.d.)

"**Safety culture is doing the right thing, even when nobody is watching."**

Over the last decade, several sources, including IOGP, have introduced the characterization of performance within an organization along the progression of: Pathological, Reactive, Calculative, Proactive, and Generative Performance. Advancing enterprise performance on this path requires a strong contribution from organizational development.

IOGP 435 provides a framework within which a company can assess the overall quality and effectiveness of its risk management system. Organizations should strive to climb the ladder all the way up from *pathological* to *generative* performance.

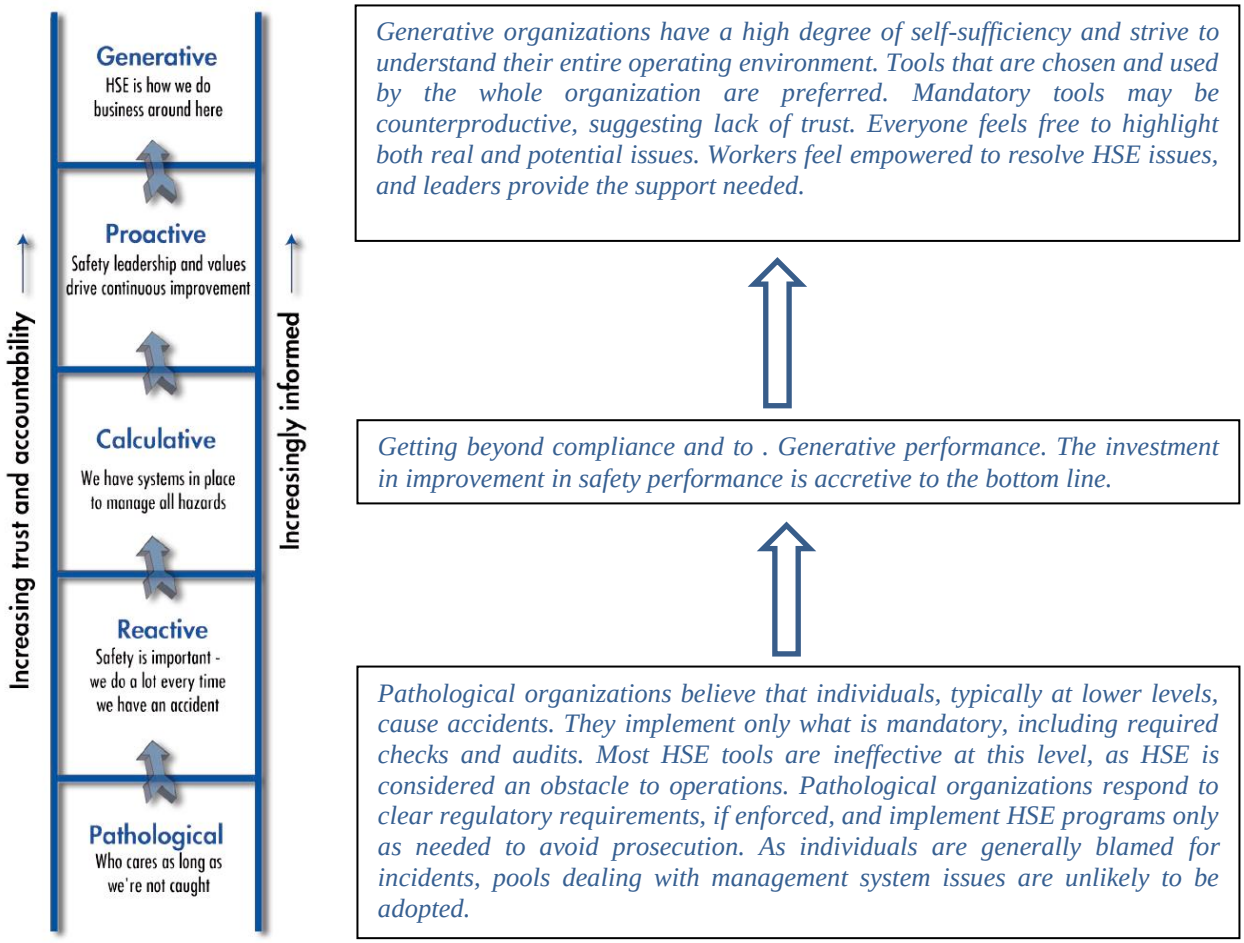

Figure 9 (International Association of Oil and Gas Producers 2010)

Path to Generative Performance – A Learning Organization.

The matrix in the table below was presented in the September 2015 SPE webinar. A framework such as this suggests approaches for a Learning Organization to ensure that persons at all levels throughout the organization have the appropriate background and perspective for managing risk and safety. Most organizations realize that appropriate training should be provided for front line workers. This framework outlines levels of education and training for everyone throughout the organization, including executive level management.

Organization Level	Retreats	Individual Coaching	Seminars and Symposia	Training in CRM Concepts and Implementation	Procedures	Simulators	Table Top Exercises	Support from CRM Consults	Periodic Audits
Executive / Senior Management	X		X						
Operating Management	X	X		X			X	X	
Senior Risk and HSE Professionals			X	X	X	X	X	X	
Front Line Operations				X	X	X	X	X	

Ref: (1) Guidance on CRM and Non-Technical Skills Training Programs – Energy Institute, London
(2) IOGP Publications Including 501 & 502
(3) Guidelines by Consulting Companies, CVAs, and Class Societies (Ex: ABS, DNV-GL, etc.)
(4) Book "Crew Resource Management" – Kanki et al

Figure 10: Potential Framework of Organizational Development and CRM Education and Training for a Learning Organization (Grossweiler 2015)

Activities at executive and senior management levels in a Learning Organization might include corporate retreats, industry seminars, and symposia. Emphasis would be on major enterprise risks, leadership development, and achieving commitment to corporate vision. Several leading business schools provide seminars on these topics.

Learning activities for operating management might include similar activities but with more specific training directly related to a persons current operational positions and responsibilities.

The HSE professionals continue to participate in industry sessions to maintain a "state of the art" competency of best practices in Occupational Safety and Process Safety.

Recommendations

Most companies already have safety management systems in place and should strive for continuous improvement. The approaches for continuous improvement established by Charles Deming in the 1990s are still relevant today.

Companies should strive for an appropriate balance between managing risks to personal safety and preventing major disasters. Within corporate risk management, companies should concentrate on the major risks. Personal safety in accordance with well-established corporate and industry guidelines should be the primary responsibility of all individuals throughout the organization.

Companies should set a goal of Beyond Compliance and Zero Harm for the organization. IOGP Report 435 provides a roadmap for categorizing and assessing an organization's level of performance across all elements of operations and risk management. Organizations performing at

the “Generative” level set performance targets beyond compliance. The SPE Technical Report, *Getting to Zero and Beyond*, reinforces this goal.

Continuing efforts to improve leadership or safety culture are important. However, a consensus on approaches to these concepts applicable to all companies across the industry is not possible or necessary. Ultimately, leadership is taking care of your people and safety culture is doing the right thing when no one is watching.

Conclusions

The discussions in this paper combine:

1. An overview of industry and regulatory activity over the last decade to improve risk management and safety performance, and
2. An outline of ideas for increasing emphasis on human factors to improve safety performance in the future.

The industry is strong in addressing occupational safety and process safety. The biggest improvements in managing risk can come from comprehensive approaches to applying organizational development concepts throughout the organization and especially at executive levels.

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