High Reliability Organizations: Managing Risk in Complex Operating Environments

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Abstract

Over the past two decades the environment companies operate in has become increasingly complex, and the pace of change continues to accelerate. With increased complexity, comes increased risk for high consequence/low probability events. At the same time, society's expectations for performance have never been higher. Injuries to personnel, impacts to the environment, and disruptions in production will no longer be tolerated. In other words, achieving excellence in safety and operations is both more important and more difficult than ever before. Yet there are a select few High-Reliability Organizations (HROs), such as the U.S. Nuclear Navy, that have defied this trend. Their culture and organizational practices allow them to consistently demonstrate extraordinary levels of excellence while operating in complex, high-risk environments. This paper will examine how these HROs leverage management systems and culture to thwart the impacts of complexity and achieve safety and operational excellence.

Introduction

The world has changed dramatically over the past two decades. Email, the Internet, and now social media have dramatically increased the interconnectedness of the world. Globalization has led to increased competition, forcing companies to expand product portfolios and design increasingly complex manufacturing processes and supply chains. Government regulations have become progressively more active, forcing companies to create new organizations and processes to ensure compliance. All of these changes have dramatically increased the complexity of the environment in which companies operate, and the pace of change continues to accelerate.

Complex systems have several characteristics that make them especially susceptible to high consequence/low probability events. First, complex systems have many interdependent inputs that do not act in linear or predictable ways. Second, they have feedback loops that act to amplify reactions. As these interdependent variables are amplified by feedback loops, complex systems often exhibit emerging properties causing them to behave in ways that are impossible to predict.

Traditional approaches to risk management are not well suited to preventing the high consequence/low probability events that arise from complexity. First, traditional approaches rest on the ability to predict potential failure modes and acting to prevent or mitigate the risks. The emerging properties exhibited by complex systems make this virtually impossible. Second, the amplifying feedback loops present in complex systems cause circumstances to change so fast there is not adequate time to identify the risk. Finally, these events happen so infrequently, and with so little notice, there is not ample opportunity to study and learn from them.

Unfortunately, recent history is evidence of this trend. High consequence/low probability events are becoming more and more frequent. Disasters of the scale of BP's Deepwater Horizon, Fukushima Daiichi, and the West fertilizer plant are becoming all too common.

However, a select few organizations have been able to defy this trend. These High Reliability Organizations (HROs) have been able to demonstrate extraordinary levels of performance even in highly complex operating environments.

The United States Navy Nuclear Propulsion Program

The United States Navy Nuclear Propulsion Program is an outstanding example of a High Reliability Organization. For more than 60 years the U.S. Nuclear Navy has operated more than 150 mobile nuclear reactors onboard submarines and aircraft carriers in remote locations and under dynamic conditions. They have crews with an average age of 22 years old, and those crews turn over every 3 years. Despite these challenges, the Nuclear Navy has never had a release of radioactive material. This is an astonishing record when compared to that of civilian nuclear reactors that are stationary, operated by more experienced employees, and not burdened with high personnel turnover. This paper will examine three lessons from the U.S. Nuclear Navy that companies can apply to better manage increasing complexity and prevent high consequence/low probability events.

Lesson 1: Safety is not a goal!

For the U.S. Nuclear Navy, safety is not a "goal" or a "priority". It is a mandate. Incident rates are not tracked and used as a means to measure performance. Likewise, officers and sailors receive no compensation or bonus based on improvements in safety performance. This is because even one incident is truly considered unacceptable. The reward for being safe is getting to go home to their family. Behaving safely and performing tasks that eliminate hazards are prerequisites for continued service.

When leaders state they want a workplace free from incidents, but then track safety as a goal or declare it the #1 priority, they send conflicting messages to the organization. Goals and priorities can change, especially in a complex operating environment. If leaders truly want to

build an organization that is incident free, they need to stop hedging their bets and declare zero incidents the only acceptable outcome.

Lesson 2: Simplify your management system!

A management system is simply the collection of processes and procedures a company uses to manage its operations in order to achieve a particular outcome. For instance, a safety management system is a collection of processes a company uses to ensure its operations are conducted safely. A compliance management system ensures that a company's operations comply with applicable regulations. Unfortunately, many companies do not think very deliberately about their management systems. As a result individual management systems grow organically over time to address multiple outcomes, often resulting in a complex, inefficient, and ineffective collection of overlapping and inconsistent processes and procedures.

Management systems have seen prolific growth over the last several decades. The International Organization for Standardization (ISO) alone has issued more than a dozen management systems in which a company can be certified. These management systems include safety, environmental, compliance, risk, quality, and asset management. ISO is not alone in prescribing management systems. The Occupational Safety and Health Administration (OSHA) requires companies that deal with high hazard chemicals implement a chemical process safety management system. The Environmental Protection Agency (EPA) recommends implementation of an environmental management system. In addition to these management systems, there are also continuous improvement methodologies such as Lean, Six Sigma, Total Quality Management, and Total Productive Maintenance that contain many of these same management system processes.

Unfortunately, because most management systems today are designed to achieve a single outcome (safety, compliance, quality, etc.), many companies have fallen into the trap of implementing multiple management systems. What they have not realized is the vast majority of these systems contain exactly the same processes. For instance, most management systems require processes for setting goals and targets, identifying risks, implementing procedures, training employees, and conducting audits. Implementing multiple management systems, each with its own unique way of performing these processes, results in significant non-value added complexity.

In contrast, the U.S. Nuclear Navy does not implement separate management systems for safety, sustainability, reliability, and regulatory compliance. Rather, it has a single management system to deliver all of those results. For instance, there are not different processes for identifying safety, reliability, or environmental risks that arise from equipment failures. By implementing a single management system, the U.S. Nuclear Navy reduces complexity and focuses the crew's time and energy on performing tasks that mitigate risks and improve performance.

Lesson 3: A different kind of culture is required!

In the wake of World War II, then-Captain Hyman Rickover was the first to recognize the enormous potential of nuclear-powered submarines and surface ships. He embarked on a quest to build the U.S. Nuclear Navy before there were commercial nuclear power plants on the drawing board. As a consummate engineer, Rickover was keenly aware of the enormous

technical challenges standing in his way—this would be the most technologically complex undertaking of its day.

But Rickover's real genius lay not in his understanding of the engineering challenges, but of the significant organizational challenges involved: *how do you put something as complex as a nuclear reactor on a boat, under the ocean, and operate it safely with a crew of young sailors?* He recognized that doing so meant eschewing the traditional military culture that had existed for centuries: follow orders, do what you are told, and don't ask questions.

Rickover knew that to achieve the U.S. Nuclear Navy's dual objectives of continuity of power and reactor safety, his sailors would have to operate in a different way. He would have to build a different culture, one founded upon what has come to be known within the Navy as the *Pillars of the Program*: Integrity, Level of Knowledge, Questioning Attitude, Formality and Forceful Watch Team Backup.

Integrity

The U.S. Nuclear Navy is built on individual and organizational integrity, meaning individuals can be relied upon to do what they say, and to do what is right, whether or not someone is looking. Individuals must be able to rely on each other and their word—among peers, from subordinates, and from supervisors, managers, and executives. Knowing how people will behave and what they will do leads to a safer work environment, allows accurate planning, reduces waste, harmonizes activities, and drives higher productivity. Without Integrity, there is no reliability, there is no confidence, and there is no trust.

Level of Knowledge

The U.S. Nuclear Navy prizes organizational and individual knowledge; it continually seeks greater knowledge. Individuals must have sufficient knowledge to determine what the right thing is to do and how to do it. In a complex operating environment, this requires a Level of Knowledge that extends beyond their immediate work areas and beyond just knowing work procedures or where to find information. Sailors must understand the broader systems and environments they work in to a deep enough level that they can identify abnormal conditions and potential hazards, react effectively to unanticipated situations, and be able to back each other up.

Questioning Attitude

In the U.S. Nuclear Navy, sailors constantly ask themselves: What could go wrong? Has something changed? Am I sure things are as they seem? What do I not know? What might others be missing? This proactive questioning is critical to surfacing issues, learning, and backing others up. Having a Questioning Attitude does not come from a lack of trust of others or a belief that you or your fellow employees are ill-prepared to complete the task at hand. Rather, it comes from vigilance and a sense of chronic unease: a belief that there may be better ways of doing things and that the best way to manage/mitigate risks is by proactively identifying and addressing them.

Formality

Recognizing they are entrusted with something larger than themselves, sailors respect their roles, follow procedures, act with professionalism, communicate and report information in exact, prescribed terms, and respect rules. They recognize they are part of an organization made up of other people, facilities, equipment, processes, and procedures that must work in concert. If something can be improved, they use the appropriate channels to formally make those changes; they do not develop "work-arounds." They communicate with one another in a consistent, defined manner to ensure information is reliable and understood. They treat each other with respect and value the roles others play. They respect the facilities they work in and the equipment they use. Housekeeping is important as it represents respect for the facility, equipment, and other workers. When employees understand that they have a responsibility to others, they are mindful of the task at hand.

Forceful Watch Team Backup

The U.S. Nuclear Navy expects commitment from all sailors not only to themselves, but also to one another. The concept of Forceful Watch Team Backup is rooted in everyone's understanding that they are part of something larger than themselves, they must work in concert to be effective, and that no one person is ever perfect. Recognizing the seriousness of the jobs that they do, everyone relies on one another to look beyond their own activity to back each other up and ensure that the team as a whole is doing the right thing, the right way, every time. They actively look for what a co-worker may have missed and expect others to do the same in return. They have the courage to step in—the courage to care.

Note that the 5 Pillars of the U.S. Nuclear Navy do not describe its "safety culture". Much like its management system, the Nuclear Navy does not distinguish between a safety culture, quality culture, or reliability culture. There is only one united culture rooted in the 5 Pillars. The U.S. Nuclear Navy recognizes that the values and behaviors necessary to achieve extraordinary performance across all operational measures is not different. As is the case with having a single management system, this dramatically simplifies the organization.

Conclusion

Over the last several decades, the environment that companies operate in has become dramatically more complex. As a result, companies are more susceptible to high consequence/low probability events than ever before. There are a few high reliability organizations, like the U.S. Nuclear Navy, who have been able to reverse this trend. Those organizations manage to achieve extraordinary performance even in a highly complex environment by treating safety as a mandate rather than a goal, implementing a single, simple management system, and creating a culture based on integrity, level of knowledge, questioning attitude, formality, and forceful watch team backup.