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Reaching HIGHER

A QUARTERLY PUBLICATION BY SAMI

Winning the Battle with Entropy

en•tro•py
/ˈentrəpē/
noun
1. a thermodynamic quantity representing the unavailability of a system's thermal energy for conversion into mechanical work, often interpreted as the degree of disorder or randomness in the system.

2. lack of order or predictability; gradual decline into disorder.

Let's consider the second definition of entropy: the gradual decline into disorder.

Applied to the continuous process industrial setting, we might say there are three functions:

- Building a unit that may be sold for a profit
- Operating that unit
- Maintaining that unit

Building a unit, whether it's a concentrator for a mining operation, a reactor in a chemical plant, a paper mill or a power plant, creates order from disorder, and often on a massive scale. All the site preparations, the support systems, building and assembling the millions of parts that makes the products we sell, are a system into which we pump great energy and precision. As we assemble each piece, we test it to assure it will provide its necessary function. The industrial revolution and mass production capability have evolved over the past two centuries continue to build on the successes of the past.

The productivity of each industrial site we build continues to grow, as does the complexity of operations. Each piece of kit must do its assigned function, and each operator must do his assigned function to provide the value investors expect

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Operational Readiness....Who Needs It?

The answer seems obvious…anybody executing a major capital project. But sadly we have recently been involved with three international clients, who either realized the need for an Operations Readiness process way too late to be of any value, or weren't taking the Operations Readiness process seriously enough. Operations Readiness is not a one & done, tick the box kind of drill!

Operations Readiness can be defined as the process of preparing the custodians (operators & maintainers) of an asset under construction, and their supporting organizations, so that at the point of handover, they are fully ready to assume ownership of the asset. In other words, when Project Engineering tosses the keys over the wall to Operations (Production, Maintenance, Materials, etc.), they are all ready to drive the bus!

Ideally, Operations Readiness begins at project inception and runs in sync with Engineering & Construction…and Operations Readiness always begins with a "Baseline Readiness Assessment" of every single facet of operations that will be impacted by the project implementation process. The primary outputs of this assessment should include:

- Overview -- provides a view of readiness, and helps determine to what extent key elements are in place, or are being developed, roles and responsibilities defined, end state defined and understood, feedback plan created, alignment established among all stakeholders, etc., etc.
- Implementation Checklist -- precisely defines those steps required to successfully implement the end state in your specific environment…and serves as the basis for an Integrated Operations Readiness Plan & Strategy (IORP&S)
- Risk Assessment and Escalation Process -- illustrates clearly the assumptions, risks and related issues that can derail the project,

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inside

Winning the Battle with Entropy

from their investment. We invent new processes and methods that produce our products better for less cost.

No longer can people perform most of the necessary functions—we rely on computer controls and only ask humans to intervene when operations are outside of established operating parameters, representing the optimal combination of safety and productivity.

The systems to impose order can be divided into a few categories:

- Electro-mechanical systems
- Control systems
- Human systems and processes

Once we have commissioned the unit, and trained the operators how their jobs should be done, we immediately confront the effects of entropy. What do we mean by this?
Entropy, defined as a gradual decline into disorder, has these effects:

1. Machines begin to wear as soon as they are used
2. Pipes either become thinner over time, or encrusted with product
3. Catalyst loses effectiveness over time
4. Effects of the weather, heating and cooling, have some predictable and some unpredictable consequences on equipment
5. Instrument calibrations go out of range
6. Materials the site was made to process change over time, leading to different results in the units we are producing. Crude slates change, ore concentrations change, etc.
7. People and knowledge systems are constantly growing and decaying simultaneously. As we gain experience in equipment and operations, we can impose better order. But each time someone leaves to go elsewhere to work, our collective knowledge and abilities decline

Who is in the front lines fighting entropy? Maintenance and engineering! They receive a system of equipment, controls and human processes after commissioning. Maybe these are world class systems, maybe it takes two years to get the unit running at design capacity. Maybe maintenance routines and spare parts have been laid out prior to start-up, and maybe not.

They get what they get. In a relatively few cases, maintenance and engineering are part of designing the systems for maintainability, reliability, durability, and ease of learning. In most cases, the project engineers are under hard deadlines, and little time and money are allocated for Operational Readiness. So the path of future entropy effects, whether the deterioration over time is faster or slower, is most cases built in to the systems prior to ever selling the first unit made.

An investment into Operational Readiness is the first line of defense. SAMI has invested in methods and models to assure Operational Readiness is done ahead of time. Because sooner or later things won't work as we expected. The long term costs of entropy are largely baked into the cake before the first bite is ever taken.

Let's talk about what we can control in Maintenance and Engineering. After all, 90% of SAMI's clients are brown field sites. Our electro-mechanical kit we may be able to make some changes to, but short of major maintenance, and turnarounds, both of which are very expensive, we must work with what we have. Control systems too are upgraded over time, and are very expensive implementations. Which leaves us with Human Systems and Processes, which are far less expensive to change and improve.

Yet the human systems and processes give us the greatest puzzle to solve. Engineers and equipment vendors find upgrading hardware to be solvable problems. Changing human behaviors to combat entropy is often the most difficult step. This deals with the complexity of the cultures that were established at the plant site, individual human motivations and desires, ability to work constructively as a team, etc.

Just as there are complex systems to create and control unit production, there are highly complex interconnected human systems to combat results of entropy. SAMI recognizes these states of performance:

- Reactive
  - The plant will determine hourly priorities, emergent by nature
  - "I know what I will do when I drive in by the color of smokestack"
- Planned (compliance)
  - "We have a process and follow it because it makes us better"
  - All systems are installed and follow SAMI Pyramid Stage 1
  - Systems are integrated by design
- Objective (proactive)
  - SAMI Pyramid Stages 2-4
  - Data-driven decision-making, continuous improvement
  - Intent of 6 Sigma, quality programs, lean manufacturing, etc.

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Operational Readiness.... Who Needs It?

and the mitigation steps necessary to address those issues. Also, defines a clear governance process to escalate emerging issues and barriers for resolution.

A focus on Operations Readiness early in a project…helps organizations achieve their OR schedule & Budget. The Integrated Operations Readiness Plan & Strategy links Engineering & Construction schedules with all parallel Operational preparation requirements. A completed IORP&S ensures:

- Understanding of what Operations Readiness status is day-by-day…provides objective measurement (KPI's) of OR progress
- Identification of any omissions in current readiness plan
- Provides a roadmap to be ready on Day 1 of operations
- Understanding of resources and organization required to be operationally ready
- Effective communications, which minimizes silos among the Operational Functions
- An ongoing end-to-end process review, throughout the life of the project

Key Operations Readiness Success Prerequisites:

- Senior Management Commitment… Operations Readiness requires a constant high-level focus throughout the course of a major capital project
- Robust Integrated Operations Readiness Management Plan & Strategy, which provides the required visibility & focus
- Leadership Team Competencies / Accountability:
  - To identify and manage critical path & prioritize efforts
  - Provide timely risk mitigation & reduced impact through better identification, communications, & immediate response to risks
  - Ensure reduction in cost overruns due to increased visibility of progress data & its linkage to cost

Major stumbling blocks that could be faced without IORP&S are:

- Lack of qualified personnel being hired & trained on time
- Required MRO materials & critical or long lead-time maintenance spares not on hand at start-up
- Lack of basic maintenance elements (asset registers, BOMs, PMs) and reliability processes for start-up
- Inability to achieve planned operations capacity due to lack of required functions and systems integration
- Non-compliance to HSE policies leading to delays in start-up & penalties
- Ineffective management reporting due to poor communications and/or documentation
- Not discovering "We don't know what we don't know" before it is too late.
  - How do you uncover these totally unknowable problems? Usually, it comes from experienced people who have been there, done that & gotten the T-Shirt.
  - It can also be uncovered by using probing questions: "Have you considered how x will impact y & z"….using questionnaires, interviews, and workshops.

A late startup or slow ramp-up to stable operations of capital assets can easily cost tens of millions of dollars in lost revenue. IORP&S methodology focuses on identification of critical operations and business requirements, to provide a smooth transition of the facilities from the project team to operations.

A flawlessly executed Operations Readiness process will deliver a well prepared, reliable facility with an operational focus that ensures consistent performance by all members of the organization. The result is an event free startup and a smooth transition to stable, reliable operations.

A final word... if you are already into a major capital project, and have not yet planned for Operations Readiness, you need to consider the advice offered by an old Turkish Proverb: "Zararın neresinden dönülse kardır." (Meaning: No matter how far down the wrong road you have gone, turn back.)

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Winning the Battle with Entropy

- Inspired
    - With everything under control, people are free for creativity

The reactive state is a very simple and uncomplicated state. Fix something when it breaks. Anyone can understand this system, and it's prevalent throughout industry. It thrives on chaos and natural disorder. If it's that simple why change it?

Reactive maintenance might be compared with the simplicity of early days of coal mining. Find a vein of coal, and send in hundreds of miners to get it out by hand. Nothing wrong per se, but very inefficient, and inherently unsafe. We increased the complexity and interconnectivity of all the systems underlying manufacturing, but the order in our maintenance activities are straight from a hundred years ago.

We've tried applying engineering principles to improving maintenance: reliability-centered maintenance. Let's make a science of knowing what goes wrong and what could go wrong with our equipment. Great knowledge, but then it's applied within the systems of reactive maintenance. Reactive maintenance is so inefficient there's never time to get to preventive maintenance, much less implementing the complex changes coming out of an RCM study. Implementing RCM requires an advanced system of work management to implement, and that's exactly what reactive maintenance hasn't got.

In our next issue we will discuss the ideal human systems to minimize the costs and effects of entropy.

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News & Events

SAMI has been selected to present "The Financial Return of the Performance Culture" at Offshore Middle East held from January 26th - 28th 2015 at the Qatar National Convention Centre in Doha.

SAMI has been selected to present "The Financial Return of the Performance Culture" at AIST held from May 4th - 7th 2015 in Cleveland Ohio, USA.

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