Chemical Engineer's Template for Maximizing Performance of a Process Facility

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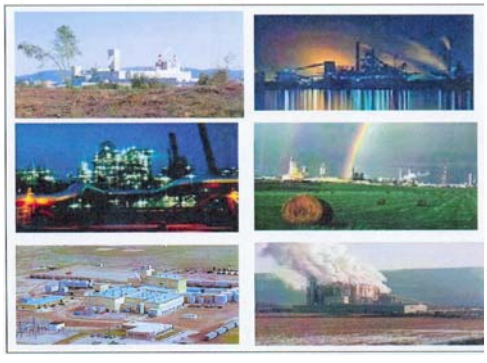
Abstract:

Process Safety and Loss Management (PSLM) is the application of solid management principles and systems to the control of process loss. It has evolved from development of purely technical solutions to application of crisply focused management. The same channeling of focus can form the launching pad for overall improvements in process performance and equipment reliability. This, in turn, yields advances in customer service, environmental impact, human safety and manufacturing cost.

Chemical engineers in industry gravitate naturally towards operations management positions in process facilities. In many countries, chemical engineering societies provide the structure for institutionalizing the leadership in PSLM. The third edition of CSChE 's "Process Safety Management" guide can provide an effective structural approach to applying chemical engineering discipline and methodology to all aspects of increasing performance efficiency of a pulp and paper operation, specifically and to manufacturing process facilities in general.

Introduction:

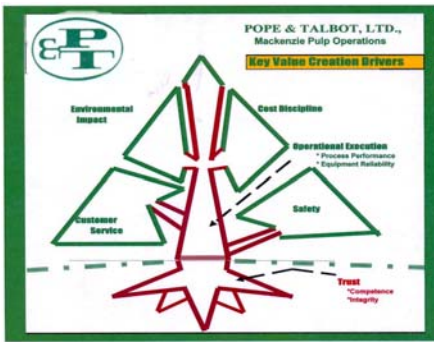


Canada's economy is highly dependent on the resource industries, including forestry, mining, metallurgy, energy, petroleum, agrichemicals, pharmaceuticals, food and beverages, energy products, paper, steel, cement, paints and varnishes, rubber and plastic and soaps and detergents. Primary manufacturing facilities are systems of chemical reactors, mass transfer devices and unit operations assembled to convert natural resources in the form in which they exist to the finished product in the quantity and quality characteristics required by the customers.

The amount of value added must be enough to justify sustained operation. That means the value generated must be more than the cost of technology and labour

and generate enough return to the owners to attract their ongoing investment. From the human standpoint, an employee's only assurance of long-term employment is to work for a profitable employer.

The Performance Tree:



Achieving top performance from a process operation takes human creativity and energy; it takes management and it takes leadership. There are some fundamental indicators of the success of such as facility. These are shown is this tree diagram. Three of them are so universally recognized as to be subjects of respective ISO standards: quality (9000), environment (14000) and safety (18000). The other universally recognized prime indicator of operational effectiveness is manufacturing cost. Notice that these four criteria are all shown as branches on the tree. That is because they really are all the outcomes of some even more fundamental considerations as shown on the tree diagram; they are shown as branches. There are considerations that are even more fundamental.

What fourteen years as plant manager has taught me about factors that drive performance has evolved. What began as a numeric table of key performance indicators was supplemented with verbal characterization of all aspects of exceptional performance and finally the "Performance Tree" graphic representation. The tree characterization is particularly insightful because although all aspects are important, some are prerequisites for others. Branches cannot be held in place without a tall and strong trunk and a firmly established stump and root system. I've seen improvement teams burn themselves out on cost reduction, for example, without looking at the impact of decreased equipment reliability, current or future. They prune the limbs without fertilizing the root.

At face value, Process Safety Management involves the application of management principles and systems to the identification, understanding and control of process hazards to prevent process-related injuries and accidents. As you dig into it, you will see it is more than simply chemical safety. More generally, it is a guide to applying chemical engineering discipline and methodology to increasing the performance efficiency of a process operation, in all its aspects. As the discipline has developed, it encompasses twelve elements. I would like to show you how six of these, in particular, have much broader potential application.

The Tree Trunk:

Think about the trunk of the tree. Keeping the process and auxiliary equipment operating reliably is essential to achieving best performance. The same applies to optimizing the performance by adjusting temperature, pressure, reagent dosage and retention time as required to deliver optimum degrees of conversion, stage by stage throughout the operation. Excellence of operational execution is the result when performance integrity of the chemical process converges with equipment reliability.

And you need both reliable availability of equipment and optimally tuned operating conditions to minimize both variable and unit fixed costs, minimize product variability, minimize exposure to safety risks and minimize environmental impact.

Process Knowledge and Documentation is where you have to opportunity to institutionalize your organization's collective experience and wisdom. Operating procedures must be readily accessible and up-to-date! They must cover startup, normal shutdown, emergency shutdown and safe restart as well as normal operating conditions, reasons for them and how to correct deviations.

There's a growing tendency for this management of information to be performed electronically, making knowledge readily accessible from computer terminals at critical locations throughout the mill. Centralized common access makes it easy to provide updates on a timely basis. The caution however is that you must use hard copies very prudently since there is no assurance they are current!

Capital Projects and Design Procedures, on an operational level, represent your one chance to get things absolutely right in the first place. Go right back to basics, looking rigorously at the design intent for each component. Your review must then loop back to the company's project management system to communicate identified hazards and suggested improvements to process development/design teams. These same methods are also applicable to modifications of existing facilities including what must be done as you debottleneck an operation and push throughput to 130% of the original rating. Don't think of it as running at overcapacity; think of it as modifying your operating specifications.

Process and Equipment Integrity includes reliability engineering, materials of construction, fabrication and inspection procedures, installation procedures, preventive maintenance and pre-start safety reviews. Preventive maintenance efforts must identify critical units, establish frequency, ensure discipline in performing the schedule as developed and ensure proper keeping of records!

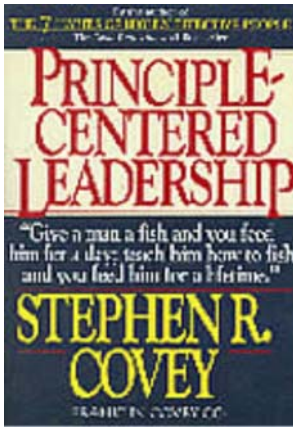
Alarms and instrumentation are often overlooked because they do not necessarily show up as reportable lost tonnes. But they do represent potential losses in process efficiency through quality variability and chemical consumption and they do pose safety implications! It is essential to identify what's critical and to apply control to possible changes. There must be a regular check and test discipline.

Excellence of operational execution is the result when process performance and equipment reliability converge. Now let's talk about the stump and root system.

The Stump and Root System:

Steven Covey, in his book "Principle-Centered Leadership"[5], says there are two fundamental principles to developing the trust that is essential to being successful as a leader: integrity, which comes from character, and competence which is what you can do. Trust is essential: between union and management, between support staff and line, between production and maintenance, between manufacturing and marketing and between corporate and the operating location. Without it, you are in

a mess, big time! Trust is the roots of the tree! You can overcome a lack of competence by training and practice but lack of integrity can be a fatal flaw.



As much as integrity is essential, there is more to it than simply telling the truth. People have to see that you are being honest. Work at making yourself a more effective knowledge broker. Become better than average at translating jargon into terms the "average person" can understand; help other people express their views. Learn to relate to the people you are talking with when gathering information and sharing knowledge. Work at developing your big picture thinking.

Most North American corporations today are overmanaged and underled. Although companies pay some attention to development of their managers, only the truly successful companies actively nurture their leaders at every level. The fundamental purpose of management is to keep the current system functioning. The fundamental purpose of leadership is to produce useful change, especially continuous change. You need a healthy balance of the two, just as every successful company must balance stability with change to thrive in both the short- and the long-term.

Accountability in successful process safety management makes senior managers accountable for being accessible to their people for support and guidance in decision making and for resolving priority conflicts among safety, production and cost control. Managers must communicate process safety accountability so there are no gaps in coverage. You have to lead from the front, not from the top. Management must communicate philosophical and specific aspects of process safety management and make it compatible with constraints and availability of resources.

Management accountability, at all levels, is where you put the "teeth" into your best intentions. One place to lock in this commitment is to translate those intentions into standards in each renewal of performance plans, annually or more often. This makes it possible to commend or correct accountability performance at salary review time.

Process Risk Management tackles the reality that if threats and opportunities are not identified, they are not addressed! This covers hazard identification and operational risk analysis and alternative approaches to risk reduction. Management of residual risk, process management during emergency situations, supply chain risk management and the concept of tolerable risks all must be considered. Hazard identification is the most important aspect of risk management.

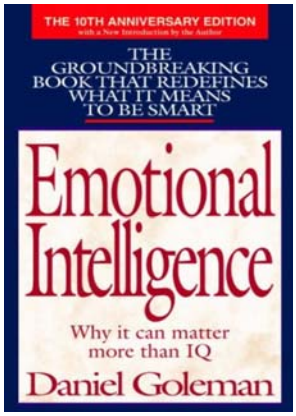
Risk optimization requires that you understand the experience, culture, systems and environment aspects of your total risk situation. Early on you must acknowledge the utter impossibility of eliminating all risks. You must optimize by clearly stating objectives, identifying threats and opportunities, and assessing impacts and abilities. Then the strategy must start/stop, maximize/minimize, retain or share the risks.

Incident Analysis is the term I use rather than the more traditional "incident investigation". Analysis implies a process less judgmental and more likely to foster trust since it signals more openness to learning from experience. Learning from incidents means you must analyze even the potentials, the near miss situations. Do the analysis promptly and involve competent knowledgeable people; use third party participation if appropriate.

The resulting report must include sound, root-cause identification and following up with action to prevent recurrence. If the analysis report does not clearly state who is going to do what by when, it simply has not done the job. Communication of the outcome is essential so that all parties involved and interested know what is going to be done differently from now on. Then walk the talk and do it!

Enhancement of Process Safety Knowledge addresses the need to design for continuous improvement so you have a system to proactively seek out new process knowledge and documentation from internal and external sources. Knowledge of technology and systems is growing and concurrently safety requirements are becoming more stringent. So the need for ready access to relevant information is crucial.

Managers now must be effective leaders, capable of implementing decisions, aligning resources, reconciling and resolving, stressing common ground rather than areas of difference; skillful collaboration, coaching and empowering persuading and motivating, representing other peoples' ideas, giving expert advice effectively enabling other people to use information. Earlier approaches to process safety management did not include increasing process knowledge as an explicit element, although some addressed the general intention through overall policy statements.



Big picture thinking and the ability to see patterns in what is going on around you is not as closely linked, as you might think, to pure rational IQ. That is because it comes from a different area of the brain than rational thought does. Daniel Goleman, in "Emotional Intelligence" states that top performance under pressure is largely attributed to a considerably above average ability to detect and recognize patterns and trends unfolding. This capacity grows stronger with life experience. The classic term for this phenomenon is wisdom, as opposed to pure intelligence. People respect wisdom when it is coupled with honesty.

Convergence

The evolution of process safety from a purely technical issue to one that demands no-nonsense management approaches was essential to continued process safety improvement. Although the roots are in chemical process safety and for facilities handling hazardous materials, the discipline is more broadly applicable to the optimization of risks, through crisply focused management discipline, particularly when it is reinforced with a professional background in chemical engineering.

I am sure you will find the structured and disciplined approach to improving equipment reliability and process performance will enhance your level of customer service, environmental impact, cost competitiveness and of course safety and the level of trust of all stakeholders. We all gain, as professionals, as citizens and as human beings, when we can make the operational facilities where we work and the communities where we live safer for everyone.

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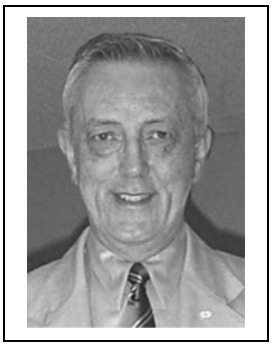
Biographical Information on the Writer



Tom Boughner was born and raised in Charlotteville Township on Lake Erie where he graduated from elementary school in Walsh and high school in Port Dover before receiving a B. A. Sc. degree in Chemical Engineering from the University of Waterloo in 1970. He is a registered Professional Engineer in British Columbia and Ontario. His pulp and paper industry career spans roles with ever-increasing levels of responsibility, from Process Engineer and Production Area Supervisor through Maintenance & Engineering Manager, Pulp Production Manager, Paper Production Manager, Capital Projects Manager and, for the past fourteen years, at the General Manager level.

He has pulp and paper management experience in Ontario, New Brunswick and British Columbia. In April 1999, he assumed his present position in which he is responsible for all operational aspects of the Mackenzie, British Columbia 220,000 ADt/yr bleached kraft market pulp mill manufacturing both premium NBSK and also specialty sawdust pulp. He is a member of pulp and paper industry technical associations in Canada, the United States and Brazil and also the Canadian Society for Chemical Engineering, which he serves as the senior pulp and paper industry representative on the Process Safety Management Division.