Driving Operational Excellence™

Managing Change

www.DrivingOE.com

Integral to Achieving Operational Excellence

Industry Challenges

Numerous companies have attempted to implement Management of Change (MOC) processes at their facilities, with few obtaining sustainable results. The onshore regulatory drivers for MOC have largely been OSHA's Process Safety Management (PSM) of Highly Hazardous Chemicals (29 CFR 1910.119) and EPA's Risk Management Plan (RMP), Program Level 3 regulations. More recently, Safety and Environmental Management System (SEMS), (30 CFR Part 250), has made MOC a requirement for offshore operations. These regulations offer little in terms of methods to effectively implement change management. Vendors offer some computer based tools but canned solutions do not generally possess enterprise required functionality. Enterprise electronic MOC (eMOC) solutions are systems requiring client and vendor team customization which is a cost and time commitment that exceeds the tolerance of most companies. The results of this are often paper-based or hybridized systems that impose undue hardship on the change initiators and or reviewers; and still do not meet all the enterprise requirements.

MOC has been a regulatory requirement for over twenty years and we are still struggling with it. However, this hasn't stopped the regulators from expanding the scope. Organizational change is hotly debated because PSM does not expressly require it to be part of the MOC process. Despite pushback from industry, OSHA now requires it through a March 31, 2009 memorandum that addresses the application of 29 CFR 1910.119 (l). Recent developments in the Gulf of Mexico now also require the oil and gas industry to address organizational change and workforce competency. While there are some differences in the onshore and offshore regulations the basics for MOC are the same. Changes must be properly designed, specified, approved, implemented and the associated documentation updated.

Figure 1 – MOC basics

Benchmarking is an important first step in determining the health maturity of an MOC program. Methods include reviewing work orders to audit if required MOCs for changes were completed. Reviewing operating procedures and logs for handwritten instructions is another source of information. Finally, taking a single MOC through all the associated touchpoints may reveal breakdowns where maintenance inspection schedules weren't changed, P&IDs not updated, procedures not updated, training not completed, PSSR incomplete or similar issues.

> **MOC is perhaps the most difficult business process to implement at a facility.**

MOC is typically implemented as a risk assessment tool from a process safety compliance perspective. It touches nearly every business process and employee at an operating facility. In advanced process cultures, MOC is extended beyond compliance to become an effectiveness and efficiency solution that can greatly improve profitability and drive down operating costs. All too often, MOC is vetted out in isolation without full business process integration. MOC is a lifecycle model and not just a compilation of workflows. For example, lack of integration with a Computerized Maintenance Management System (CMMS) is a common theme where procurement allows substitutions and orders a part of inferior materials of construction in order to save money. This is due to a lack of understanding of what constitutes a change. The supply chain implications typically involve a significant amount of capital tied up with unique parts that can never be used. Simple process design changes that incorporate administrative controls and systems integration can overcome these challenges. MOC, when done appropriately, prevents many safety and environmental accidents from occurring each year. MOC also averts needless rework and downtime by leveraging the varying disciplines and experiences available to the change initiator. Sometimes feedback from operations or other groups can shed new light on whether or not a proposed change is a good idea. The intent may be spot-on, but if the very same solution has been tried multiple times in the past with no success then other options should be pursued. This initial approval stage gate is very valuable in harnessing the institutional knowledge of a company. If the change progresses to the approved status then institutional knowledge is again utilized for implementation of the change. Finally, MOC is used to notify affected persons of change and keep all impacted documentation up to date. When fully integrated the MOC system serves as a cradle-to-grave analysis and communication platform that interacts with a number of business processes.

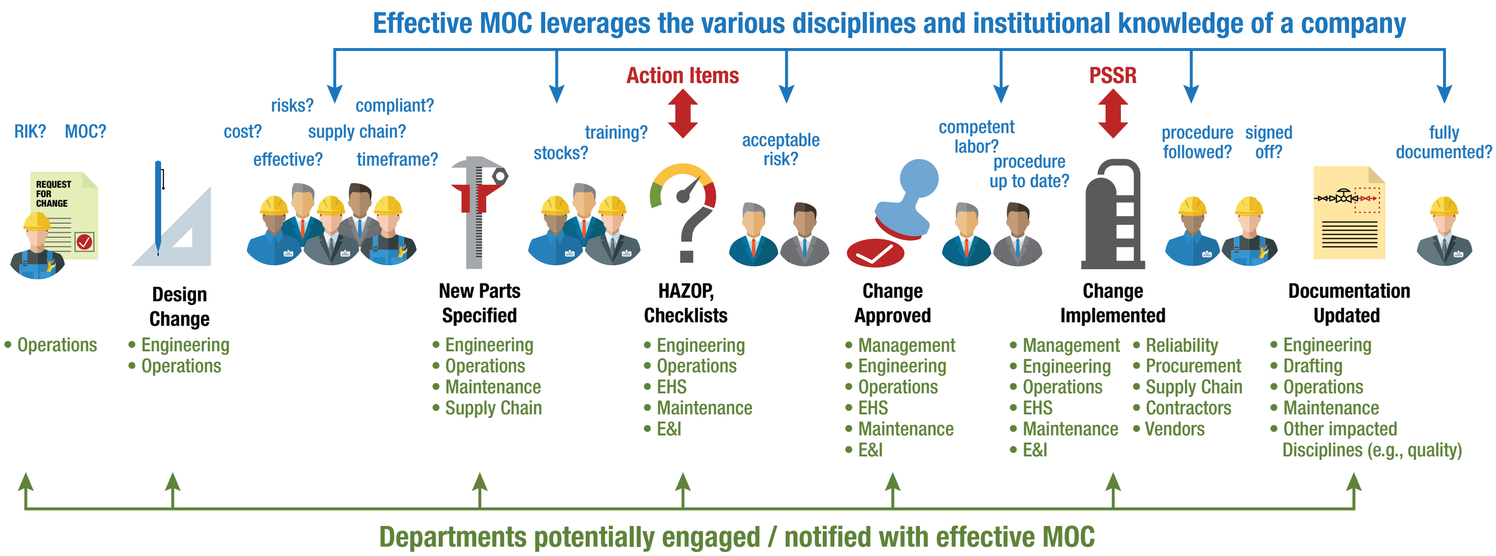

Figure 2 – Integrated systems include the full scope of business processes

Regulatory Overview

As of December 2008, the Alberta Boiler Safety Administration (ABSA) AB-512 requires that companies operating pressure equipment implement an MOC program that not only includes not-in-kind change, but defining replacement-in-kind. The American Petroleum Institute (API) Onshore Operations Safety Handbook recently cited MOC as a best practice process. API RP 75 is a recommended practice for Safety and Environmental Management Program (SEMS) for offshore facilities recommend establishing an MOC procedure to control operating hazards and maintain safety information. These are but a few of the suggested practices. Whether you are an upstream organization, you have a fleet of nuclear plants or are a regulated pipeline that is not *required* to do MOCs by a regulatory body such as OSHA, MOC is a reality that affects your efficiency and profitability. So, isn't MOC a good practice?

Be cautious of older rigid MOC solutions as these only focus on traditional PSM workflows and are not adaptable to other impacted business processes.

Leading Practices

MOC is a leading practice because of its criticality to safety and efficient operations. Whether regulated for MOC or not, it is a good practice to avoid costly repairs due to lack of administrative controls. A common concern in highly automated facilities is the need for controls on changes to alarm set points. Ideally, operators create and change alarm set points within an approved range set by qualified engineers. This allows the operator to respond to abnormal situations without jeopardizing safety or product quality. If not properly controlled, the outcome is costly alarm rationalization. Alarm rationalization typically costs upwards of $100,000 U.S. Dollars per process unit in a petrochemical or a refining facility. It is not uncommon for facilities to rewrite their operating procedures due to lack of proper MOC controls. For instance, as process and operations are debottlenecked and new equipment comes into service, the operating procedures need to be updated to reflect these changes. More advanced facilities use smart procedures technology that ties back to asset information so that equipment cascades back to related equipment and procedures.

Numerous incident investigations cite lack of proper MOC as a root cause. A large portion of incidents occur during startup, shutdown or malfunction. As such, Pre-Startup Safety Review (PSSR) is a crucial component of an effective MOC program. OSHA requires that you conduct a PSSR for new facilities and for modified facilities when the modification is significant enough to require a change in the Process Safety Information (PSI) (e.g., engineering drawings, safe limits and equipment lists). A similar management system should also exist for Replacement-In-Kind (RIK) work since improper bolt torqueing and other such failures can also result in loss of containment. A leading practice is to consider a document management system for managing PSI that is linked to an electronic MOC tool. This helps ensure that valuable time is not spent looking in file cabinets and the actual source document is maintained with check in and check out controls. If you change product data without proper controls, you leave yourself susceptible to off-spec product leading to recalls, rework and wasted product. This type of MOC requires integration with parts specifications, engineering and manufacturing change orders, materials information, product testing, and a bill of materials.

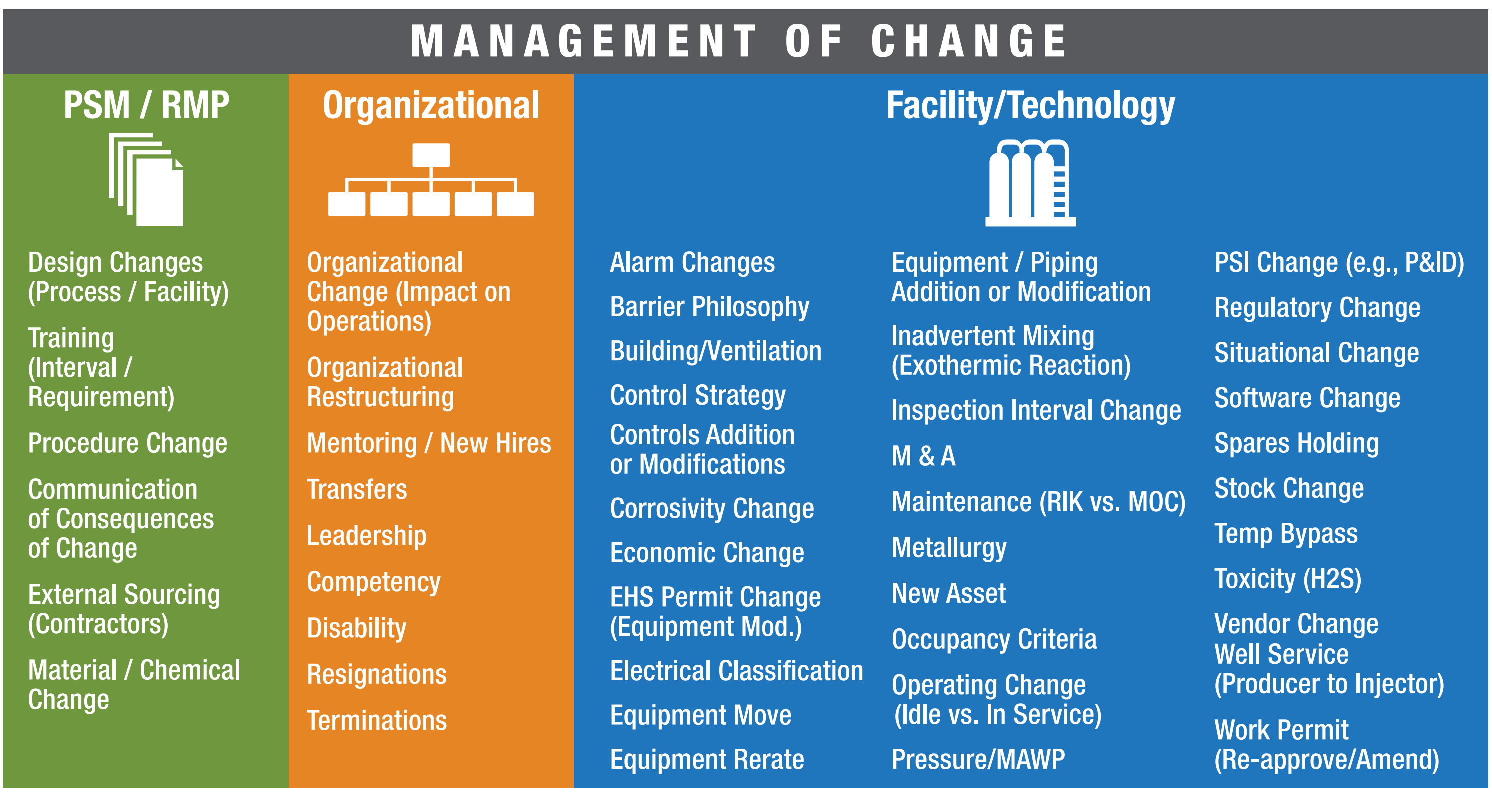

Figure 3 – Management of Change Landscape

A Responsible, Accountable, Consulted, and Informed (RACI) chart should be managed as part of the MOC process. This should also track the training status of the employee since a change initiator, engineer responsible for reviewing the change, and all others need formal instruction on what to do. Also, the MOC should have a structured means to determine the risk level of the change. A risk level methodology that is assessor dependent will have high variability such that two identical changes at the same plant may result in a HAZOP for one change and be approved for installation with no further review for the other.

Figure 4 – Types of MOC

TEMPORARY *Timeframe specified for permanent implementation?*	EMERGENCY	PERMANENT

Change Observations

There are three types of MOCs typically implemented at a manufacturing facility: temporary, emergency, and permanent changes. Temporary change is not commonplace in an upstream organization given the way assets are managed, whereas, it is almost the norm in onshore assets (e.g., refining, chemicals, power plants). One sure way to determine the effectiveness of an MOC program is to audit temporary changes to see if resolution is per company requirements. The temporary change category can become a laundry basket that is more convenient to use than a permanent change as it is easier to enact. There is also a tendency to forget about temporary changes (e.g., pipe clamp) once in service. If you have a large number of temporary changes hanging around for a year or more, consider establishing a maximum allowable duration (e.g., 9 months). This ensures the change is evaluated and either made permanent, reverted back to the original design, or re-engineered.

Given the prescriptive nature of the Occupational Health and Safety Administration (OSHA) National Emphasis Program for Petroleum Refining, regulators are signaling their desire to move away from a guideline based standard to a prescriptive standard. As such, industry is going to need to document and defend Recognized and Generally Accepted Good Engineering Practices (RAGAGEPs). One such RAGAGEP is the 2007 Center for Chemical Process Safety Guidelines for Management of Change for Process Safety book. As a result of this shift, companies need to consider a *compliance management* mindset with PSM similar to Title V compliance management. Further best practices suggest an integrated approach for "Replacement-In-Kind" and "Not-In-Kind" (or MOC) recommendations.

Based on the 2005 BP Texas City incident, industry is moving toward defining leading indicators for PSM. Although this is an improvement over the traditional lagging indicators that many companies have used (e.g., open, closed, past-due MOCs), the Baker Panel Report cites the "leading is arguably lagging." Companies who focus on compliance based MOC programs may not be able to achieve sustainable programs. To get to performance-based operations, companies need to leverage *efficiency and effectiveness* based approaches for Operational Risk Management (ORM). Without integrating key business processes and information to MOC, timely risk informed decision making is difficult to obtain.

Many companies still leverage paper-based MOC systems that are fraught with inefficiencies. Often times, the status of an MOC is hard to determine in a paper-based system that entails door-to-door routing. A client once stated that with paper or spreadsheet systems "you know what's open and what's closed, but where it lies in between, nobody knows." These systems can be expected to result in MOC MIAs (missing in action). This happens whenever a person in the approval is on vacation, the intra or interoffice mail fails, or any number of similar breakdowns. There are so many corrective actions and PSSR items nested in a complex MOC, that robust software systems are almost a requirement. Many companies tend to customize a CMMS or use tools like Lotus Notes to create custom applications for MOC, incident management, etc. The problem is that the MOC flexibility and needed rigor will suffer due to CMMS rigid design. If you build MOC into a CMMS or an email system like

Lotus Notes you risk losing your applications when you move from one software vendor to another (e.g., merger and acquisitions, migrating to Microsoft Exchange).

Many MOCs tied to incidents have been the result of them getting lost in the routing process. One argument against electronic solutions is that it makes it difficult to "go backwards" in the workflow. For example, it is usually not possible to sign-off on the PSSR pre-commissioning step of the MOC process before the next step in the process is taken. It is not uncommon to observe PSSR commissioning questions that are left blank after the unit has been started back up. Again, isn't PSSR an audit and control used to avoid incidents? Another common observation during audits is that capital project MOCs are created with no review or approval while equipment is literally being installed in the field. While some of these issues can be tackled with training and adoption of a common MOC program (e.g., when multiple engineering constructors are involved in a project), you need to ask how do you get consistent inputs and results from short-term projects, especially if paper-based systems are used?

What Does Good Look Like?

The typical petrochemical plant or refinery generates 200-2000 MOCs per year. This of course will vary with how many categories of change are tracked, the complexity of the MOC process, the cultural buy-in and other variables. If you are at a 100,000 barrel refinery and only generate 50 MOCs per year that should be a red flag that your MOC process has gone underground.

The typical payback period of a good MOC solution is less than 6 months in a facility.

PSI typically lags. You aren't going to delay a unit startup just because the P&ID redlines are sitting in the CAD person's inbox. The redlines are perfectly legal but at some point the official P&ID copies need to be revised. Prior to commissioning the change needs to be walked down to verify that the change specified was actually installed as such in the field. Any changes found must again go through the MOC process prior to startup. There are still many instances where readily available but non-specified equipment from stores gets installed. Many companies target getting PSI updated within 90 days of commissioning a change to avoid issues with P&IDs needing to be walked down before a PHA study. In some cases, P&ID updates can take 2-3 years and are discovered to contribute to incidents during root cause analyses.

The Total Recordable Incident Rate of mature safety cultures for onshore assets approaches 0.4 total recordable incidents per year. Even in mature cultures, incidents can occur unexpectedly as the Baker Panel cites "incidents are not diagnostic in nature." As such, many refining and chemical companies see 30-50% of their incidents emanating from startup / shutdown / malfunction. Effective PSSR is key to reducing incidents during these operating phases. Best-in-class companies implement robust PSSR systems integrated with Control of Work to obtain sustainable reductions in incidents. In the field, craftsman often de-isolate pumps for routine maintenance and should consider PSSR before commissioning equipment.

Since risk is never totally removed from manufacturing, companies must continuously strive to aim at *zero* incidents, while making sure they don't become too complacent. A key MOC component is workforce training, accountability, and involvement to combat complacency. The workforce from top management down the line employees have to recognize the value and necessity of the MOC process. A common barrier is the mindset that MOC is an exercise of limited value. You will have agreement that MOC is needed for major changes but often the belief that it is a waste of time for *minor changes*. These minor changes have in fact resulted in many industry incidents and that mindset needs to be changed to assure adequate review for all changes.

Leading companies now recognize MOC should be linked to emissions. For example, if you increase the size of a rotating piece of equipment that is covered under the new EPA Greenhouse Gas (GHG) standards, the MOC checklist should also reference the change in the emissions. As such, an effective Environmental Management Information System (EMIS) will also need to include an MOC module. In more advanced systems, energy consumption can be reduced on pumps, compressors, and other rotating assets using Condition-Based Monitoring (CBM) to justify the cost of the change. The resultant changes across the fleet of assets need to be managed to avoid master data challenges.

Automation of Change

The key is to find a software package that handles equipment, facility, procedural, technology, organizational, and alarm changes in a single, cohesive Commercial Off-The-Shelf (COTS) solution. There is a lack of comprehensive COTS process safety products in the marketplace today. A typical COTS solution covers a very limited subset of the overall process safety standard that is generally documenting the change in a database with approvals, email notifications, and attachments. In addition, most of the MOC packages are limited to traditional process safety thinking and don't address the majority of the other areas that are impacted by change management. The most likely synergy exists between process safety and vendors who offer the Enterprise Resource Planning (ERP) and Enterprise Asset Management (EAM) functionality. To date, these have not developed to offer any substantial functionality, so you are still faced with small niche providers of PSM modules. Often, niche COTS vendors of process safety software downplay the importance of integration due to lack of subject-matter expertise and the ability to offer out-of-the-box integration. In reality, this often makes it hard to get beyond a *compliance-based* MOC system, and performance benefits are limited. This behavior is often the result of a software sales person wanting to avoid layering in costs that would tank the software sale, not knowing how that decision hampers the solution's Return-On-Investment (ROI).

There are numerous viable COTS software solutions for MOC. However, most of these applications have very limited enterprise functionality and do not integrate with existing systems. Furthermore, changes to these systems are often not possible or extremely difficult. The key is to ensure that it handles Replacement-In-Kind and Not-In-Kind change along with the ability to audit the effectiveness of the system. In addition, adherence to the MOC management system and the ability to create adaptive risk assessment processes is important. One of the short-comings of current COTS products is the inability to conduct standalone PSSRs. Many companies chose to leverage workflow-based solutions to take advantage of the variability of MOC requirements in an integrated company (i.e., upstream, midstream, downstream operations). Some MOC vendors tout a customizable system, but those often become custom software solutions that are extremely difficult to support and take years to master as the tools are too complex to build without a long-term consulting engagement. It is necessary to have proper testing procedures and documentation in the event you chose to build or buy custom software solutions to reduce the total cost of ownership and ensure long-term cultural acceptance. Often times, companies try to extend their functionality to task management. Look at the EAM and EMIS systems to see if they are already handling this function as this avoids creating an additional redundant information silo. While spreadsheets are still commonplace, they are not able to meet the security requirements to pass Sarbanes-Oxley compliance.

It is necessary to have proper testing procedures and documentation in the event you chose to build or buy custom software solutions to reduce the total cost of ownership and ensure long-term cultural acceptance.

Systems integration is crucial in creating proper administrative controls (i.e., MOCs linked to work orders to avoid inadvertent ordering of spare parts). Numerous examples of the value of integration are mentioned above. Out-of-the-box integration to mainstream CMMS solutions is critical to avoid costly supply chain challenges. Many eMOC tools have email agents with mail application programming interfaces to alert and escalate to MOC stakeholders impending deadlines, past due items, etc. Do not create too many email alerts until you get used to the eMOC tool and can understand the proper balance to seek with your culture. Also, the more categories of change you opt for, the more MOCs you will create to manage.

The key to successful implementation projects is to properly design a work process that fits your culture while identifying roles and accountabilities. This is especially critical in identifying constraints that COTS vendors may impose on your organization due to lack of functionality or rigid architecture. In addition, be sure to budget plenty of money for training and post deployment change management. All too often companies find eMOC tools falling out of use due to poor post-deployment change management after going to production a year or two later.

These eMOC implementations are not a “one-and-done.” They require proper care and auditing to ensure you can diagnose areas of need. In particular, training will be especially important over the next few years as you turn over your baby boomers. Your metrics should evolve as you grow into your MOC software, collect data and enable predictive analytics through systems integration. Data aggregation tools are key to simplifying and reducing costly integration. They are also great for plug and play of modules to insulate end users from changes to the underlying transactional tools. A well-designed “to be” process for Operational Performance Management (OPM) will enable metrics not readily envisioned through typical transactional deployments of MOC tools. This approach allows you can move away from leading and lagging to semi-predictive state.

Change – What is the Size of the Prize?

The value of a good eMOC solution is self evident with the payback period typically being less than 6 months. Moving from paper to an *effective* eMOC solution will give you a 50-60% time savings. This does not consider all the other variables mentioned in this article such as systems integration and supply chain management. We suggest you conduct a thorough business case as the tangible and intangible benefits are often surprising.

On October 30, 2009, OSHA released its most significant fine to date at $87 million. You don’t have to look back in history too far to see other key incidents that lead to significant financial losses. MOC was specifically listed in the citation as a contributing factor.

Numerous energy and chemical companies have realized a significant cost for an inefficient MOC business process. In moving from paper to electronic state, a properly designed eMOC solution should obtain a 50-60% time savings amount to $90,000-$135,000 for every 100 MOCs conducted annually. The typical chemical plant or refinery does 200-2000 MOCs per year, so the savings add up. One major chemical company estimated that moving to an electronic tool would save them nearly $40 million per year just for facility and technology changes.

[100 MOCs X Avg. of 32 hours/MOC X Avg. cost of $70/hr] X Time reduced by 50%

~$90,000-$135,000 Savings / 100 MOCs

For companies that chose to integrate eMOC solutions with other core plant systems and business processes, the ROI increases as more administrative controls and types are enabled. For instance, CMMS integration can save a large manufacturing facility millions of dollars. In conducting warehouse inventories, it is not uncommon to see excess inventory due to poor change management governance. The challenge is to avoid vetting out processes in isolation to get an effective assessment of the real cost of poor MOC.

While compliance-based business cases yield an ROI much of the benefits are soft and intangible. The most significant ROI comes from leveraging integration. This in turn enables semi-predictive metrics not obtained in traditional compliance-based MOC systems. As an example, regulated pipelines are often constrained on their return on capital. The only way to drive out costs is through MOC-based on efficiency and effectiveness based strategies coupled with asset-based loss prevention.

Managing Change – Integral to Achieving Operational Excellence

The table below demonstrates the interoperability of MOC with other Risk-Based Process Safety (RBPS) elements.

MOC Inputs and Outputs		
RBPS Element	**Inputs to MOC from the Element**	**Outputs from MOC to the Element**
Process Knowledge Management	• Chemical / process hazard information • Drawings • Equipment Specifications • Electrical classification • Relief system design • Maximum intended inventory • Material and energy balances • Safe operating limits • Safety system definitions	• Update to all relevant process safety information, knowledge and records
Hazard Identification and Risk Analysis	• Indication of process / activity risk • Risk tolerance criteria • Safety systems • Recommendation needing to be managed as changes	• Results of MOC hazard evaluation
Training and Performance	• Job qualifications • Staffing (number, composition, and required competencies)	• Information on changes to inform or train potentially affected contractor personnel • Changes to all process safety knowledge and documentation
Operating Procedures	• Operating procedures	• Changes needed to affected operating procedures
Organizational Change	• Personnel changes • Staffing levels • Staff experience (including contract) • Policy changes (e.g. budget cuts)	• Personnel, staffing or budget changes that can impact PSM
Asset Integrity and Reliability (Mechanical Integrity)	• Maintenance procedures • ITPM frequencies • Personnel qualifications	• Updates to affected maintenance procedures, frequencies and personnel
Safe Work Practices	• Safe work practice procedures • Criteria for applying procedures	• Updates needed to affected procedures, application criteria and personnel
Operational Readiness (PSSR)	• Items discovered during a PSSR that require change to the process prior to start-up	• Change situations requiring PSSR • Results of MOC hazard evaluation • Risk control measures mandated by MOC review process
Contractor Management	• Qualification requirements • Training requirements	• Information on change to inform or train potentially affected contractor personnel • Changes to all process safety knowledge and documentation • Change implementation timing
Emergency Planning / Response	• Emergency Response Procedures • Response to a new chemical / hazard • Qualification requirements • Training requirements	• New or update procedures • Information on change to inform or train affected responder • Changes to all process safety knowledge and documentation

Questions to ask include:

What is the cost of recalling a product due to engineering and manufacturing defects?

How does lack of MOC expose you to the risk of material incompatibility or wrong metallurgy?

What is the impact of a seal failure on a critical compressor due to material incompatibilities when product changes occur?

How long will unplanned outages last when pumps fail from being improperly sized to convey flow?

If you have a catastrophic failure and need new parts are you spared adequately or do you need to send the equipment to a maintenance, repair and overhaul (MRO) facility to be rebuilt?

What is your equipment defect rate and do you include a quality assurance process in your MOC program to address this?

All these have tangible costs you can find by looking at the data at your facilities.

For more information email us at info@DrivingOE.com or call (713) 355-2900.

Driving Operational Excellence™

Operational Sustainability® makes operational excellence simple.

Succeeding in today's complex, highly-regulated industries depends on how well your company manages **operational risk** and enables **operational discipline**. Our world-class advisory services and our industry-leading cloud-based, highly configurable software work together to enable your company to achieve **operational excellence**, including OE 4.0 tenets, and sustained **operational integrity**. We identify and help you solve any issues to move to a real-time, mobilized risk-aware culture. With an average of more than 30 years of industry experience each, our advisors can design a solution tailored to your company's culture and needs.

Learn how Operational Sustainability can advise your workforce through our consulting services and support your journey to operational excellence through our OESuite® software platform. See our full slate of free webinars, white papers, detailed module information, and scheduled workshops online at **www.DrivingOE.com**.

Schedule your free consultation and demo today.

11490 Westheimer | Suite 280 | Houston, TX 77077 | info@DrivingOE.com