*Special Edition*

# MOC BEST PRACTICES

*Gateway Consulting Group, Inc.*
*a leader in Management of Change process redesign and Electronic Document Management systems implementation*

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## Upcoming Seminars:

Chem NEP Readiness
November 3, 2010
Marriott Hotel - Galleria
1750 West Loop South,
Houston, TX, 77027

MOC Best Practices
November 4 - 5, 2010
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1750 West Loop South,
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## Perspectives

Although this is the *MOC Best Practices* newsletter, I am taking a detour to a related topic this month: getting ready for the PSM Covered Chemical Facilities National Emphasis Program, commonly called "Chem NEP". There is a great deal of interest in the industry about this topic. This newsletter is a bit of a departure for me since it requires some speculation—you'll notice that prior newsletters are strictly fact-based—since the Chem NEP program is still in its pilot project state, and it's unknown when the full program will be announced. This required some reading of the proverbial tea leaves, but I provide as much documented evidence as I can, to support the case that it looks like it will be a "GO".

After discussing the current OSHA perspective on enforcement, I take a look at what an NEP inspection is like and what kinds of citations might be issued. This leads to two streams of activities:

1. Prepare the physical plant itself, by conducting inspections, correcting equipment deficiencies, and so on, and,
2. Prepare the supporting documentation, particularly Process Safety Information, including adequate consideration of RAGAGEP.

Pursuing the first stream involves fairly standard process safety management audit preparations. This is fairly well understood, and I provide a number of useful references. However, I don't repeat all the details that these other authors cover.

Pursuing the second stream involves improving your document management. I cover this in considerable detail since most plants don't have experts in document management, and the problems, the causes, and the solutions may not be obvious to all readers. Since my company, Gateway Group, has been active in the electronic document management domain, for chemical plants and refineries, for over two decades, I humbly submit that we have a lot to contribute to the understanding of issues in this problem space.

We end with a roadmap on how to move forward to Chem NEP prep. I'll get to the punchline: the roadmap basically states that you should use the standard engineering approach of (a) scoping the problem, (b) developing a plan, and then, (c) executing the plan. Not too difficult, right? Sure, but the devil is in the details on this one.

So, enjoy, "Preparing for Chem NEP"…

## What is Chem NEP?

For several decades, OSHA has launched Special Emphasis Programs, "SEP", which involve targeted inspections to address identifiable safety issues. The first, which covered aspects of process safety management, was the Chemical Special Emphasis Program, "Chem SEP", launched in response to the 1984 tragedy caused by the release of methylisocyanate at Bhopal, India [1]. The final report [2] identified "the quality of recordkeeping practices was questionable" as a major concern, as well as a number of items whereby OSHA standards diverged from industry standards or common practice.

More recently, National Emphasis Programs, "NEP", have been established to use the logic of a SEP, but conduct inspections across an entire industry over the entire country.

After the 2005 incident at the BP Texas City refinery, OSHA reviewed process safety incident data from several industries and concluded that petroleum refining had a higher than average incident rate. This led to the establishment of the Petroleum Refinery National Emphasis Program, "Refinery NEP", in 2007 [3].

**What is Chem NEP? continued...**

The intent of the Refinery NEP was to inspect all refineries, but exceptions were made for refineries that participate in the Voluntary Protection Program, "VPP", or OSHA's Safety and Health Achievement Recognition Program, "SHARP".

The Refinery NEP inspection protocol consists of a list of 95 "static" questions. The static questions were published by OSHA in the directive [4], and are a useful guide to preparing for the NEP inspections. In addition to the static questions, OSHA inspectors also asked questions from a smaller "dynamic" question list. The dynamic questions are not published. Moreover, the dynamic question list is changed by OSHA every 2 to 4 weeks, making advance preparation more challenging.

Based on the success of the Refinery NEP, OSHA continued the emphasis on process safety management by issuing a directive to begin the "PSM Covered Chemical Facilities National Emphasis Program" [5], often called "Chem NEP". The current directive instituted a pilot program, beginning July 27, 2009 and ending one year later.

Not all chemical plants will be inspected as part of this initiative. OSHA will target the following chemical plants for inspections:

1. Plants on the EPA's Program 3 Risk Management Plans list,
2. Plants where explosives are manufactured,
3. Plants in OSHA's IMIS database, which usually indicates a prior PSM citation,
4. Plants "of interest" to local OSHA Area Offices

In contrast to the Refinery NEP, where inspections were largely based on the 95 static questions, published in advance, the Chem NEP will rely entirely on a sample of 15 unpublished, dynamic questions [5, 6]. At first glance, this appears to make preparations difficult or even impossible; for instance, how would one perform an internal pre-audit without any idea of what the ultimate audit protocol looks like? However, at the AIChE 2010 Spring Meeting in San Antonio, an OSHA representative, speaking on his own behalf and not in his official capacity as an OSHA representative, opined that:

> *…we spent a lot of time coming up with the Refinery NEP static question list. I can't imagine someone coming up with a better question set. So, for all intents and purposes, the question set of Chem NEP is the same as it was for Refinery NEP, with the exception that questions specific to hydrocarbons will not be used.*

In a way, that's good news since it permits preparation for Chem NEP on the basis that it will be similar to Refinery NEP. Certainly this is a widespread assumption at this point, as plants are gearing up for Chem NEP based on its presumed similarity to Refinery NEP.

**DOL Emphasis on Citations and Fines**

OSHA appears to be very serious about the Chem NEP program.

Under the G.W. Bush administration, the Department of Labor tended to be more collaborative with industry. However, the current Department of Labor perspective is that:

> *After years of taking a conciliatory, "let's work together" approach to compliance with federal safety regulations, the new DOL [Department of Labor] emphasis is on citations and fines [7].*

That 2010 quote emphasizes a similar statement made by Secretary of Labor Solis in 2009:

> *Workplace enforcement and safety is not only our responsibility, it's our moral obligation…That means the DOL will once again be back in the enforcement business [7].*

Former OSHA head Edwin Foulke, author of various PSM-related interpretations [8], has also commented on the change in direction for OSHA:

> *They are very frank about saying they are focused on enforcement and rulemaking. They are putting their money where their mouth is [7].*

### DOL Emphasis on Citations and Fines, continued...

This increased emphasis on fines is evident in the preliminary results from the Refinery NEP program, as shown in Table 1 [6]. An average of 20.8 violations were issued per site; the average fine was $107,723 per site.

| Violation Classification | Number of Violations | Total Penalties |
|---|---|---|
| Willful | 10 | $ 561,500 |
| Repeat | 34 | $ 877,500 |
| Serious | 863 | $ 3,137,708 |
| Unclassified | 9 | $ 429,000 |
| Other | 63 | $ 57,287 |
| **Total** | **979** | **$ 5,062,995** |

Table 1. NEP violations, through Jan. 13, 2010.

### Fines Not Large Enough?

There is a sense at OSHA that the current fines are not large enough, and this has been a recurring theme in speeches by OSHA representatives over the last year: "OSHA's current penalties are not large enough to provide adequate incentives" [9]. This point is often supported with comparisons to fines levied by other federal agencies (such as the Department of Agriculture) whose fines are typically 10 – 20 times greater than those of OSHA.

A number of large fines have been proposed:

- $0.5 million proposed for a fall, which led to a fatality,
- $1.5 million proposed for a fatality at a chemical waste processing facility,
- the record $87.4 million in proposed penalties stemming from a 2009 re-audit at BP's Texas City refinery

, and these are usually presented as compelling evidence that OSHA is performing its role as regulator [10-12].

This paper is not prepared to argue the merits of large fines; the point is simply that fines are increasing as a result of a deliberate OSHA strategy.

Of course, larger individual fines are less fearsome to the industry if the probability of inspection is very low. So, let's look at the question of…

### What is the Probability of Being Inspected?

There were 141 operating refineries in the U.S. in 2009 [13]. Chemical plants have a much larger population, specifically, 13,247 chemical plants in the U.S., according to the 2006 survey conducted by the US Census Bureau [14]. In addition, users of common chemicals such as ammonia and chlorine in quantities large enough to be covered under the PSM regulations [15], are also part of the target inspection pool, even if these are not manufacturers of chemicals.

OSHA has had its budget increased [16] and is hiring nearly 130 additional inspectors [17] to meet the demands of a much larger number of inspections [18]. The target was revealed at the AIChE 2010 Spring Meeting in San Antonio when an OSHA representative stated that:

> *…we will have enough resources to inspect more than 50% of targeted chemical plants.*

Refineries that were approved participants in OSHA's Voluntary Protection Program, "VPP", were not inspected during the Refinery NEP [4]. Similarly, VPP sites shall be deleted from the target site list for Chem NEP "programmed" inspections [5]. VPP sites are not exempt from "unprogrammed" inspections—those that arise from a complaint, referral, accident or catastrophe—which comprise about 50% of the inspections performed during the pilot Chemical NEP [6].

**What is the Probability of Being Inspected? continued...**

The reader can draw his/her own conclusions about the probability of his/her site being audited, mindful of these facts:

- OSHA has adequate resources to inspect a majority of chemical plants with PSM-covered processes, and,
- having VPP status, while meritorious, provides no assurance that a Chem NEP inspection will not be performed.

## What's Involved in a Chem NEP Inspection?

The activities occurring during an NEP inspection are outlined in OSHA's inspection protocol [5]. Several authors have elaborated on the mechanics of the inspection process, and offered helpful advice [22-28].

**Opening Conference and Initial Walkaround**

The inspection begins with an opening conference.

The OSHA inspector may request the documents in the following list (the documents, marked with *, are specifically required by an OSHA regulation), either during the opening conference or after a unit has been selected for detailed inspection:

a. All contract employee injury and illness logs as required by 1910.119(h)(2)(vi).*
b. A list of all PSM-covered processes/units in the complex.
c. A list of all units and the maximum intended inventories* of all chemicals (in pounds) in each of the listed units.
d. A summary description of the facility's PSM program.
e. Unit process flow diagrams*.
f. Unit Plot plans*.
g. Unit Electrical classification diagrams*.
h. Process narrative descriptions*.
i. Descriptions of safety systems (e.g. interlocks, detection or suppression systems)*.
j. Design codes and standards employed for process*/equipment* in the Selected Unit (s).
k. A list of all employees (i.e., hourly and supervisory) presently involved in operating the Selected Units(s) including names, job titles, work shifts, start date in the unit, and the name of the person(s) to whom they report (their supervisor).
l. The initial process hazard analysis*(PHA) and the most recent update/"redo" or revalidation* for the Selected Unit (s); this includes PHA reports*, PHA worksheets*, actions to address findings and recommendations promptly*, written schedules for actions to be completed*, and documentation of findings and recommendations*.
m. Safe upper and lower operating limits for the Selected Unit (s)*.[5]

The OSHA inspector will request an overview of the PSM program at the site.

The OSHA inspector will be guided on an initial walkaround of the PSM-covered processes at the site.

During the initial walkaround, the inspector will select a unit for more detailed inspection based on several pieces of information:

a. Nature of the hazards present
b. Incident reports and other history
c. Lead operator's input
d. Age of the process unit
e. Factors observed during the walkaround
f. Employee representative input
g. Number of employees present
h. Current hot work, equipment replacement or other maintenance activities.

All contractors, working at or near the selected unit, shall be inspected as well.

### Detailed Inspection

The detailed inspection involves reviewing many documents. The average number of documents requested during a Refinery NEP inspection was about 10,000, which is sufficient to completely fill seven "bankers" boxes. The record, for the number of documents requested during a Refinery NEP inspection was 70,000.

In Refinery NEP, the plant teams were sometimes occupied with the audit for a full six months [6]. While Chem NEP inspections are expected to be less onerous, the resource commitment is still a concern.

## What Leads to Citations?

Current information on all OSHA inspections and citations is accessible from OSHA's Integrated Management Information System [19]. However, searching, filtering and grouping the data is somewhat tedious, so various authors have provided different summaries, based on this data.

OSHA provided its own summary of Refinery NEP citations, through June 2008 [20, 21]. Since then, others have provided their own summaries [1, 6, 22-24]. These summaries vary from paper to paper, since the Refinery NEP program is still ongoing (at the time of this writing), and each author accessed the data on a different date. Nonetheless, the top five PSM elements leading to 80% of the citations, ranked roughly in order of frequency, are listed in Table 2. The right hand column also characterizes each cited sub-element according to its predominant deficiency.

Interestingly, a large majority of the cited sub-elements deal with document deficiencies. A smaller number of citations deals with business process deficiencies (e.g. an MOC wasn't performed when it should have been) and equipment deficiencies (e.g. inspection not conducted).

No suggestion is being made that business process or equipment deficiencies can be ignored in preparing for Chem NEP. But, the evidence suggests that the greatest effort should go into addressing document deficiencies, which is the area most overlooked when preparing for an audit.

| PSM Element | Sub-Element | Predominant Deficiency |
|---|---|---|
| Operating procedures | ■ written operating procedures | |
| | ■ procedure review and certification | |
| | ■ emergency shutdown procedures | |
| Mechanical Integrity | ■ written procedures | |
| | ■ equipment deficiencies | |
| | ■ inspection and testing not conducted | |
| Process Hazard Analysis | ■ system to promptly address recommendations | |
| | ■ facility siting | |
| | ■ PHA to address hazards of the process | |
| Process Safety Information | ■ P&ID's up to date | |
| | ■ equipment complies with RAGAGEP | |
| | ■ relief system design and design basis | |
| Management of Change | ■ establish and implement MOC | |
| | ■ PSI not updated during MOC | |
| | ■ updated procedures in place prior to startup | |

**Legend**

Business Process deficiencies
Document deficiencies
Equipment deficiencies

Table 2. The top five PSM elements leading to Refinery NEP citations.

## How Should We Prepare?

### Tactical Preparations

A Chem NEP inspection is a process safety management audit—there may be a higher profile to these audits, there may be a greater probability of being inspected, there may be a more aggressive stance towards fines and citations—but, at the end of the day, it's still a PSM audit. There is almost two decade's industry experience in preparing for PSM audits, and a great deal of published information on how to prepare for a PSM audit [25, 26].

Recently, various authors have reviewed Refinery NEP citation data and highlighted certain items which may be helpful in an audit:

- leveraging a detailed pre-audit [27],
- upgrading specific elements of a PSM program [24],
- ensuring that the Process Safety Information adequately covers RAGAGEP [23],
- developing a multi-layer plan, which covers all preparation activities from initial planning through hosting the inspection [22],
- hosting the actual inspection [28].

These items have been labeled as "tactical" because all of them are or should be conducted in the normal course of business at a chemical plant. No new strategy is needed, just the time and resources (which is often a challenge) to do what is expected.

### Strategic Preparations

In contrast to tactical preparations, strategic preparations require a structured plan and precipitate activities that are not in the normal course of business. Like PSM problems [29], document management problems tend to be systemic.

Upgrading the plant's document management system is certainly a candidate for a strategic approach. It has all the hallmarks of an initiative requiring a proper strategy:

1. Importance: Table 2 indicates that document deficiencies were the major cause of Refinery NEP citations.
2. Cross-functionality: Many people in a plant create documents; many more people use them. The creators and users of the documentation are not usually in the same organizational unit (e.g. department, area).
3. Duration: Dealing with document deficiencies and upgrading a plant's document management system both require time—these are not tasks that can be done during the week before an audit. It is important to start early and plan effectively.

The remainder of this paper will focus on understanding document deficiencies relevant to PSM compliance, provide a strategic vision, and conclude with a roadmap to achieving the strategy.

## What are the Root Causes of Document Deficiencies?

There was a time, many decades ago, when quality "control" simply consisted of an inspector who checked a shipment on the loading dock to make sure it was "OK". Since then, progress has been made in the quality movement, following the work of luminaries such as Deming [30] and Juran [31], and widely-adopted programs such as Six Sigma and ISO 9000 [32, 33]. All quality programs recognize that quality is a systemic issue and must be addressed at all stages of design, production and delivery.

Similarly, document management is a systemic issue and calls for a comprehensive response.

### Document Management – pre-1992

Prior to 1992, plant documentation was largely in paper form. Electronic creation existed, especially for creating drawings, but the archival copy tended to be plotted on velum, and stored in "flat files". Supporting documentation, such as equipment files, tended to be well organized and stored in filing cabinets. Document storage was often in a locked file room, under the supervision of a "file room" or "drawing vault" administrator. Documents and drawings, when needed, were formally checked out of the file room—late returns were often met with a surly comment.

**Document Management – pre-1992, continued...**

The file room clerk was unquestionably the document "custodian"—a custodian being the person that looks after the physical well-being of a company asset.

The "ownership" of the information varied depending on the type of document: process engineers owned P&IDs, maintenance owned the equipment files, inspection owned the inspection files.

Everything worked rather well.

The two recessions, in 1981-2 and 1990-1 according to the National Bureau of Economic Research [34], forced many plants to cut costs. Regrettably, a short-sighted, but common area for cost cutting was to eliminate the staff in the drawing vault. Drawing vaults and records centers across the country turned into "self-service centers" where people could take whatever documents they needed, when they needed them.

Without the discipline of a proper check-out/check-in mechanism, plant documentation quickly deteriorated:

- much of it went missing
- copies were made, as needed, and redlined with changes, without the changes ever being reflected in any "master" set of documents
- arguments ensued about who actually owned the "master" documentation, especially in cases like equipment files where several groups (engineering, maintenance, inspection, capital projects, turnaround planning) use the data
- revision control was suspect because one was never certain what redlines existed for a particular document.

The rise of electronic creation tools, CAD, word processors, spreadsheets, etc., made all of these problems worse, since it became very easy to create copies, modify documents, and store them on personal hard drives, and departmental file shares—again, without any discipline regarding who owns the documents and how information would be consolidated.

**The Initial PSM Initiative**

When the PSM regulations took effect in 1992, plants were often overwhelmed with the effort needed to get into compliance—PSM was sometimes jokingly referred to as the "Chemical Engineers Full Employment Act".

The strategy most commonly employed was to "divide and conquer". As shown in Figure 1, for example:

- Process Engineering was told to get the drawings, especially the P&IDs, updated,
- Operations was told to get the procedures updated, and make sure everyone is trained on them,
- Process Safety was told to pull together the information needed to do PHAs,
- Inspection was told to update all the drawings with inspection points, and ensure wall thickness measurements were up to date,
- Maintenance was told to ensure that equipment files were updated with all the changes that had previously taken place,
- Design Engineering was told to update all the engineering standards in order to demonstrate RAGAGEP,
- Instrumentation and Electrical was told to make sure the instrument data is all updated and put in a database,
- and so on…

**The Initial PSM Initiative continued...**

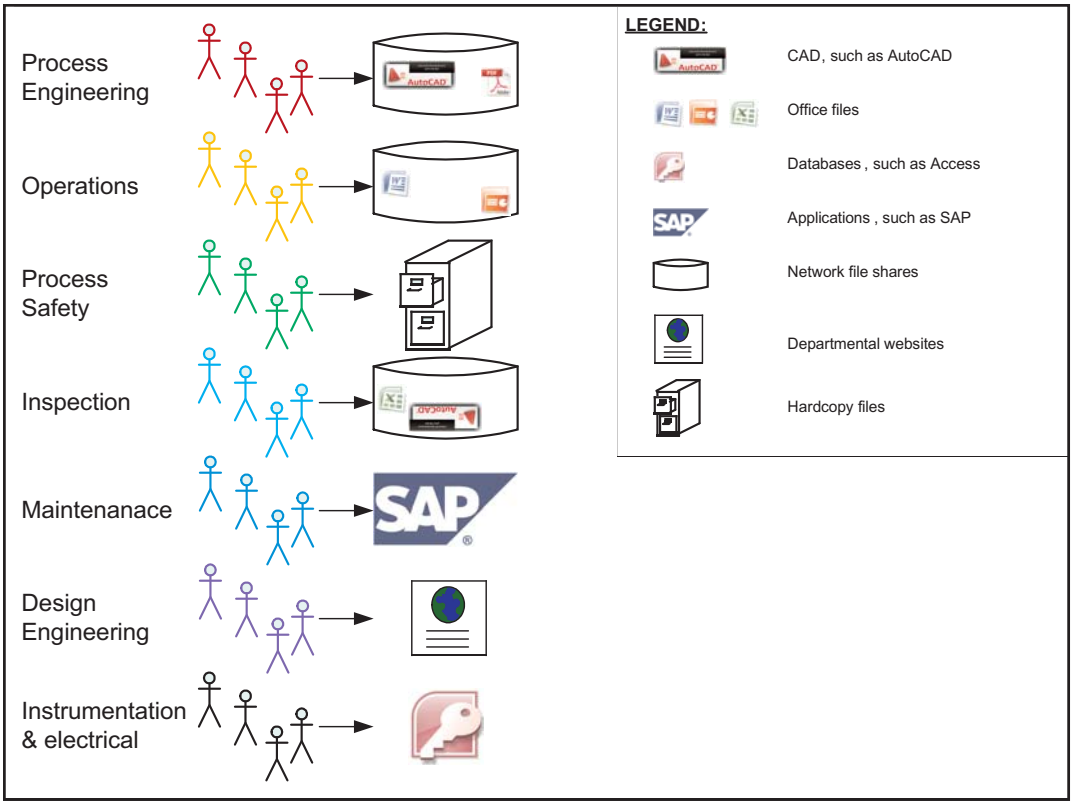


Figure 1. Getting information ready for an audit, using "divide and conquer".

How much did it cost?

Suppose 10 people were taken away from their jobs for a year to conduct this information clean-up. At a burdened cost of $100k/year, this yields a $1 million cost. For even a moderately-sized chemical plant, it's hard to imagine that PSM prep was done in anything as small as 10 person-years of effort.

**A Fragmented Collection of Documents**

The initial round of PSM preparation was conducted under extreme time pressure. So, each department looked after their own information, and stored it in whatever medium was convenient for them. As a result, some documents were stored on network file shares (departmental websites came along later, as well), other documents were stored in hardcopy files, tabular data was often put into local databases (such as Access™) or larger applications (like maintenance management applications).

With all this effort, PSM compliance was achieved.

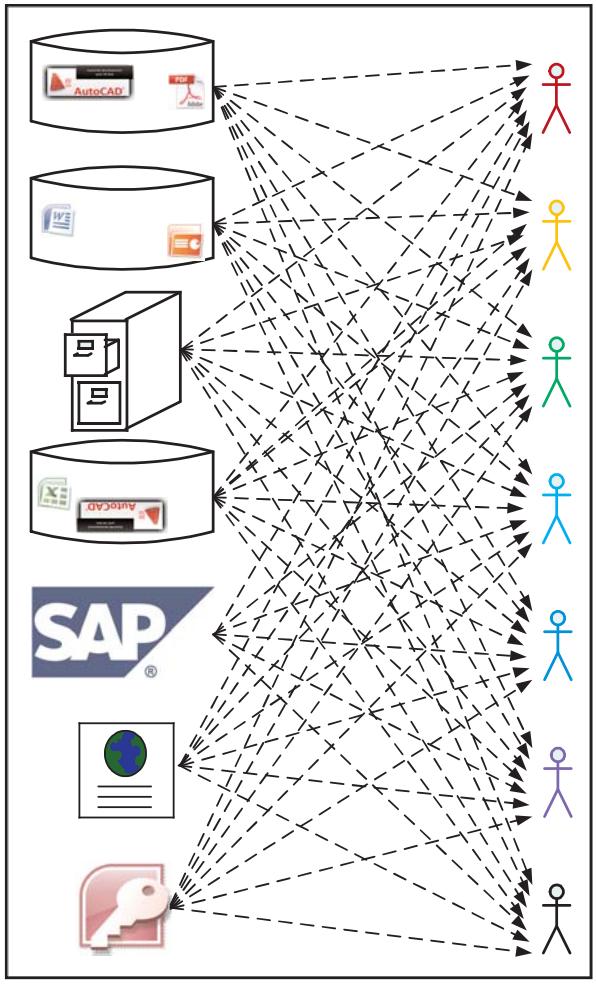

Figure 2. "Divide and conquer" document updates create fragmented document storage, and very complex document access.

**A Fragmented Collection of Documents continued...**

However, no one thought about what impact this would have on users of the documentation. Any user, would have to access each of the document and data collections, in order to get the information to perform his/her job. Using the example shown in Figure 2, this means that each user must have access to 3 network file shares, one file room, the maintenance management application, a departmental website and a database. In reality the number is much larger, since Figure 2 represents only a subset of all the data stored at a plant.

### The Emergence of Shadow Repositories

The effort involved in getting information from so many different sources, caused a change in behavior. Once someone had data or a document, they kept it, and stored it in a local filing system: electronic documents were typically copied to a local hard drive, printed copies were typically put in a folder in a desk, tabular data (maintenance, instrument database, etc.) was downloaded to spreadsheets and stored on a local drive.

Not only did this create a situation where these "shadow" copies weren't updated when the source information was updated, but the shadow copies often took on a life of their own. For instance, inspection points were often redlined onto shadow copies of piping isometrics.

As shown in Figure 3, the shadow copies quickly deteriorate in accuracy and become a risky source of information.

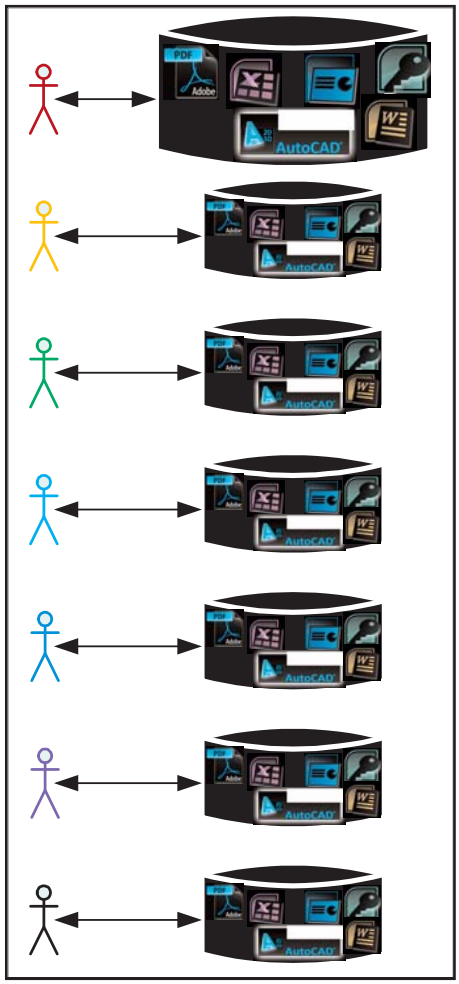

Figure 3. Various individuals, in different departments, making private or "shadow" copies of documents, and storing them locally.

### Further Initiatives and the Vicious Cycle

Plant management may or not be aware of the gradual deterioration in document accuracy depicted in Figure 3. It is presumed that the employees at the plant are talented and knowledgeable, so their experience can compensate for document inaccuracies to some extent. However, as soon as the next initiative comes along, say, preparing for ISO 9000 registration, it becomes obvious that the state of documentation is poor and cannot withstand a rigorous audit. Plant management is typically ambitious, so "failure is not an option" is the governing mantra.

As part of the overall initiative, funding becomes available, and document updates begin. How, does the document update proceed? Well, "divide and conquer" of course! And so the vicious cycle begins again, as shown in Figure 4.

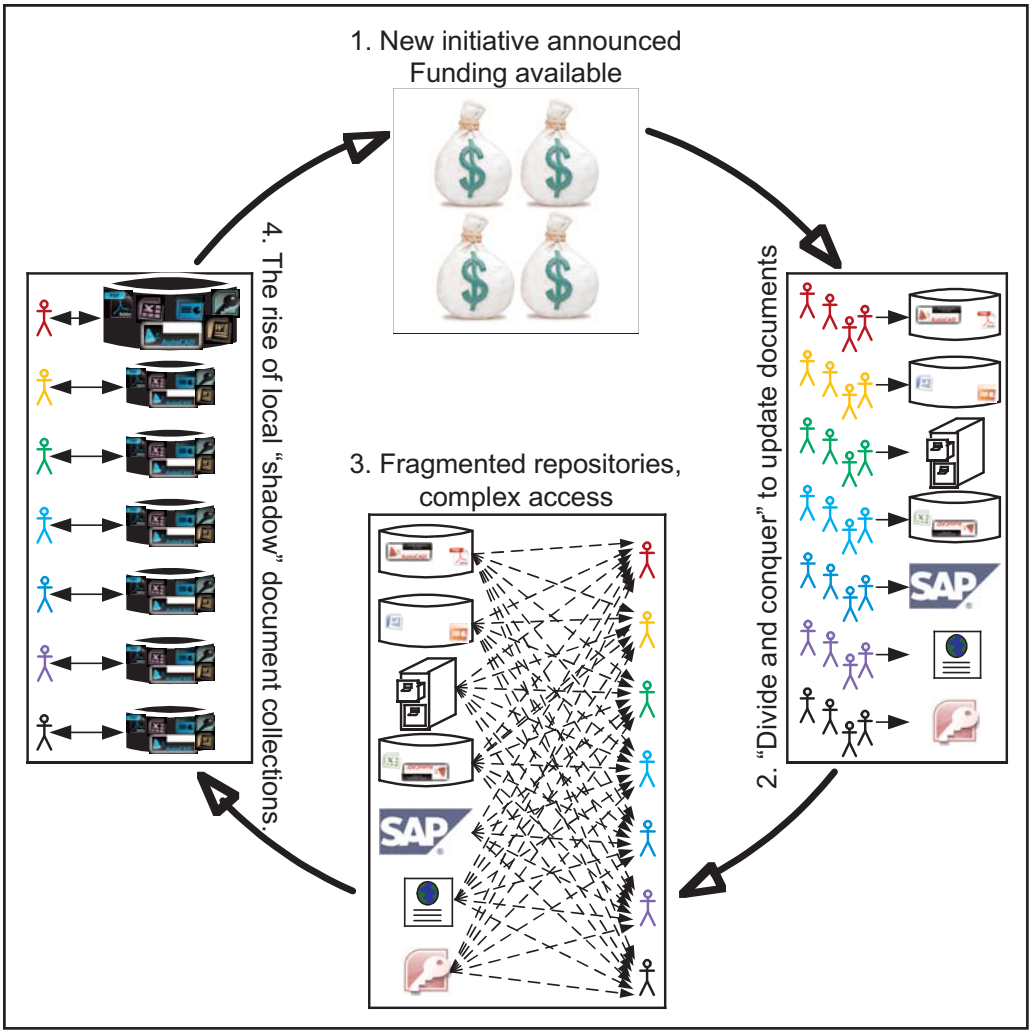


Figure 4. The vicious cycle of document updates.

**Further Initiatives and the Vicious Cycle continued...**

A few years later, a turnaround is planned for the unit. Most plants have sufficient engineering staff for normal operations and small projects, but engage engineering contractors to support turnarounds. The external contractors rely on information provided by the plant. Quickly, the realization ensues that, while the documentation accuracy may be "good enough" to allow continuing operation, errors in the information will cause problems. "Problems" in this case should be read as "costs". In order to mitigate the costs, one of two strategies is employed:

1. Field verify "everything": All the critical documentation provided to the engineering contractors is extensively verified by walking the lines, redlining and updating the documents. This is expensive.
2. Don't field verify, and take your chances: Without field verification, discrepancies are discovered while turnaround construction is taking place. Whenever a discrepancy is discovered, not only is mitigation more expensive, but scheduling becomes impossible in the face of so many, significant unknowns.

To avoid these problems, most plants conduct a rather substantial document update prior to, or at the start of turnaround planning—yet another loop through the cycle of Figure 4.

Further examples of initiatives leading to major updates include:

- capital projects
- and, most importantly, Chem NEP.

## The Strategy for Moving Forward

In order to break the vicious cycle of Figure 4, we simply trace the process backwards and remove the motivations for destructive behavior.

The shadow repositories, Figure 3, are a result of the complexities of accessing information from so many different locations, shown in Figure 2. If information were available from a single location, then the motivation for creating shadow repositories disappears.

**Leveraging Chem NEP to get Started**

As plants prepare for Chem NEP, most will conduct internal audits, discover document deficiencies, and then begin the process of updating documentation. Rather than keep fragmented repositories, as shown in Figure 2, it's more cost-effective to store the documentation in a single PSI vault, as shown in Figure 5.

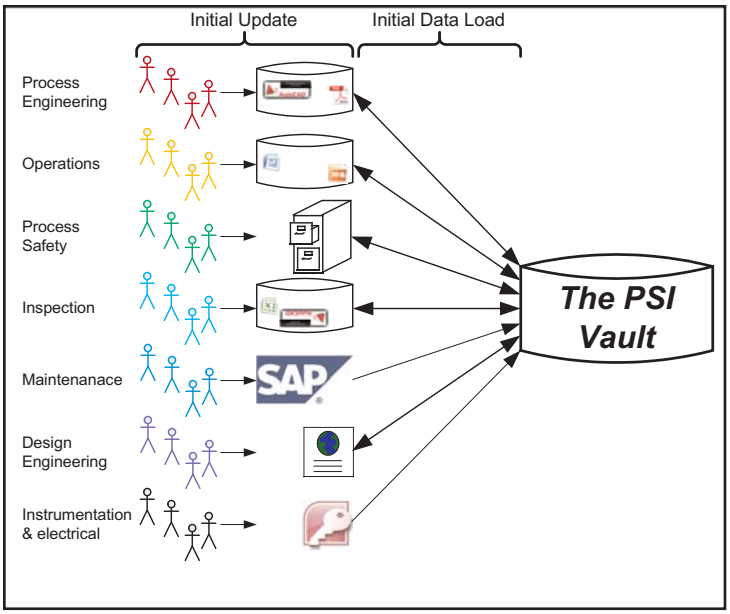


Figure 5. Establishing a consolidated PSI vault.

**Leveraging Chem NEP to get Started continued...**

The document updates will need to be performed anyway, for Chem NEP compliance. The only additional tasks are to:

1. Establish a single electronic PSI vault,
2. Load the process safety information into the vault.

Once the data is loaded into the vault, the effort to conduct the initial update and loading is over. And, the resources used to do the initial update can go about their normal business.

The steady-state business process is shown in Figure 6. The key features of the steady-state process are:

- All the process safety information, needed to perform one's job, is available from the PSI vault.
- Information is "used" by many people, as indicated by the many stick figures on the right in Figure 6. In contrast, information is only created or edited by a few people, as shown on the left.
- The individual file collections, shown to the left in Figure 5, are gone. The source documentation is all stored in, and edited from the PSI vault by appropriate persons with proper access rights.
- Tabular and transactional data, from maintenance management systems, instrument and other databases, is periodically loaded into the PSI vault for reference purposes. Transactional data cannot be edited in the PSI vault—it must be edited in its source application—but it is available to all users without the need to search multiple applications for the data.

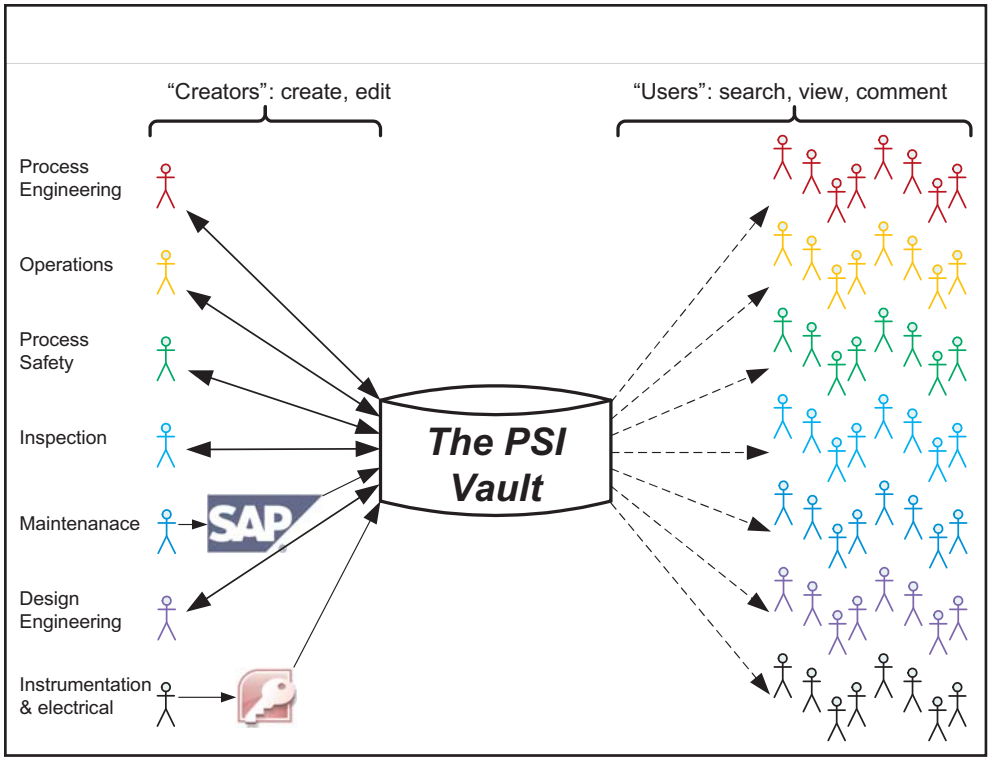


Figure 6. Users outnumber the creators of process safety information.

**Barriers to Entry**

Is this idea, of a consolidated collection of process safety information, actually a new idea? Absolutely not! This approach has been used to manage plant information for decades. This author led a number of initiatives, including those at Monsanto, Chevron and Citgo, to realize this single PSI vault vision, in the early 1990's.

So why isn't each and every plant in the U.S. managing its process safety information effectively and efficiently?

There have traditionally been 4 barriers which prevented plants from moving forward with proper information management. All of these barriers can be overcome, but it may be worth describing them, since they may linger in the minds of certain readers:

1. Diffuse costs become identifiable costs
2. Magnitude of the costs
3. Fragmented vendor landscape
4. Lack of a strategy

***1. Diffuse Costs Become Identifiable Costs***

Establishing a proper electronic PSI vault, Figure 5, has an inescapable up-front cost associated with it. In order to do it properly, a plant may have to engage a consulting firm who specializes in plant information management. And that requires an identifiable budget. If every department were permitted to create their own document collections, Figure 1, then the costs diffuse into many departments, and no identifiable budget is ever needed. Of course, the plant didn't escape the costs. In fact, the costs are higher, since many groups of inexperienced individuals (inexperienced in the creation of document management systems, that is) are more costly and less efficient than specialist resources.

The same thing is true for data loading. When an electronic document management system is set up, a critical amount of PSI needs to be loaded into the system to make it useful. To the extent that external resources are engaged, this becomes an identifiable cost. To the extent that internal resources are used, this is a higher, but now, diffuse cost.

The "New initiative funding" shown in Figure 4, indicates that the document update costs are experienced time and again, in the absence of a single PSI vault. But, again, since these costs are spread over many departments, they never seem to get noticed. When they are noticed, they are seen as "a cost of doing business". No one questions the fact that the same tasks are done repeatedly—an obvious clue that something is wrong.

***2. Magnitude of the Costs***

The creation of a single PSI vault relies heavily on electronic document management technology. While this technology was available in the early 1990's, the costs of the software and initial set up were about 10 times what they are today. The previously cited examples, Chevron and Citgo, operate refineries. Refineries tend to be large, the problems are big, and the costs of an electronic document management system could be more easily absorbed in the plant operating budget. Continuing with the previously cited examples, Monsanto was a well-run company who tended to use centralized approaches to technology deployment. Specifically for PSM compliance, Monsanto created a "common-core" electronic document management system, which was syndicated to the operating plants—again leveraging the size of the company to spread the costs.

Today, with the dramatic decline in the cost of electronic document management technology, an electronic system for process safety information management is within the reach of every chemical plant.

### *3. Fragmented Vendor Landscape*

Resistance to the cost of electronic document management cannot fully explain why the chemical industry has traditionally been slow to adopt this technology. After all, every chemical plant has even more expensive software in its distributed control system, so cost can't be the only consideration.

DCS software is available from a handful of large, established vendors: Honeywell, Emerson, etc. While there may be lively technical debates about the merits of one vendor versus another, there's little concern that the DCS products will be orphaned due to a vendor bankruptcy.

That wasn't always the case with electronic document management technology. In the 1990's, there were several dozen vendors of electronic document management capabilities, and predicting which ones would persist in the long run was difficult, even for people in the industry.

Today, the industry has consolidated to 4 large established vendors[35]. Products from any of these can be used as the basis for a single PSI vault strategy.

### *4. Lack of a Strategy*

In the absence of a strategy to move the organization towards a consolidated PSI vault, each department manages its own documents using local resources as shown in Figure 2. Occasional requests are made to fund the purchase of point solution software to manage a specific kind of document, or some small subset of all the PSI documents. This gives plant management the mistaken impression that electronic document management is "all looked after", when, in fact, only a small subset of PSI can be managed by the proposed technology.

The impression that document management has been addressed, makes it increasingly difficult for anyone to propose a comprehensive solution to process safety information management.

**Breaking Down the Barriers to Entry**

The previously identified barriers to entry:

1. Diffuse costs become identifiable costs
2. Magnitude of the costs
3. Fragmented vendor landscape
4. Lack of a strategy

, are not insuperable. Once the problem is understood, the appropriate strategy can be put in place.

## Consolidated Task Management

The previous discussion focused on ensuring that documentation is up-to-date. The recommended solution was to create a consolidated process safety information vault. This would address all the information management aspects of the top five PSM elements cited during the Refinery NEP, as listed in Table 2.

Table 2 also highlights some business process deficiencies, the key one being the proper management of PHA follow-up items. The concept of a process hazards analysis, "PHA", is generally well-understood at PSM-covered sites. Different methodologies, are identified by OSHA in the PSM regulation[36]:

> *(e)* ***Process hazard analysis.***
>
> *(2) The employer shall use one or more of the following methodologies that are appropriate to determine and evaluate the hazards of the process being analyzed.*
>
> *(i) What-If;*
> *(ii) Checklist;*
> *(iii) What-If/Checklist;*
> *(iv) Hazard and Operability Study (HAZOP):*
> *(v) Failure Mode and Effects Analysis (FMEA);*
> *(vi) Fault Tree Analysis; or*
> *(vii) An appropriate equivalent methodology.*

## Consolidated Task Management continued...

A great deal of effort goes into performing proper process hazards analyses. An entire process unit, or a proposed change may be analyzed during a PHA and found to be fully compatible with the site's risk criteria. Or, the PHA may produce a list of tasks that need to be undertaken to remedy the shortcomings discovered during the PHA. These tasks are termed by OSHA to be "PHA follow-up items".

Management of PHA follow-up items would be easy, if these were the only tasks that a plant needed to manage. The reality is not so simple, since a plant must manage at least the following tasks which all have regulatory impacts:

1. PHA follow-up items: general
2. PHA follow-up items: from HAZOPs
3. PSSR punch list items
4. Incident investigation recommendations
5. Audit findings, from all manner of audits: PSM, environmental, worker safety, records management
6. Consent decree items
7. Field verification items
8. As-built items
9. MOC follow-up items: things needed to complete an MOC, but not required prior to start-up like painting, insulating, and minor labeling.

**Traditional Task Management**

The previous list is simply a classification of tasks, by task source. These same tasks are spread over all the units and departments at a plant, which makes their management somewhat challenging.

Years ago, tasks created during an MOC were listed on the MOC form. The MOC couldn't be closed out, until all the associated tasks were done. Similarly, tasks generated during a pre startup safety review appeared on the PSSR form. PHA follow-up items were documented on the PHA form, or in the HAZOP report, in the case of HAZOPs. And so on.

As shown in Figure 7, determining the answer to the simple question, "what PHA follow-up items are overdue?" or, more generally, "what tasks are overdue?" was impossible, since all the tasks were contained in individual documents. The answer to another common question, "what tasks am I responsible for?" was also impossible to determine, without exhaustively looking at each document.

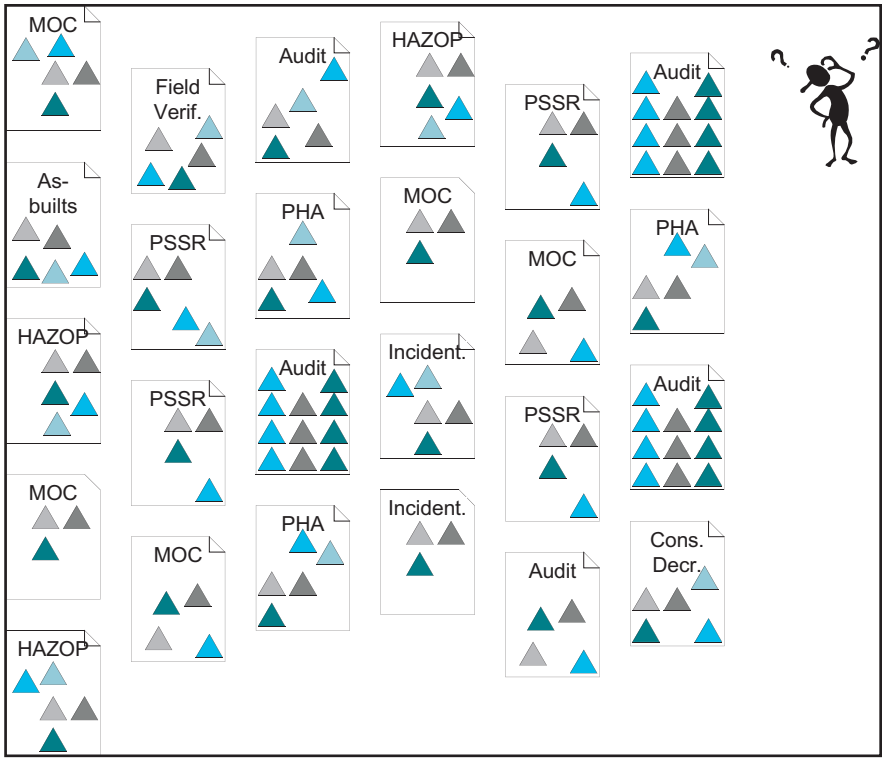


Figure 7. Tasks, generated in many places.

## A Fragmented Collection of Tasks, But Now Electronic

As plant personnel became more comfortable with electronic tools such as word processors, spreadsheets, and desktop databases (like MS-Access), similar tasks were often grouped and tracked in a desktop application, as shown in Figure 8.

The grouping was largely done for convenience. But, logically and reasonably, PHA follow-up items were grouped, PSSR punch list items were grouped, and so on. This is a "divide and conquer" approach, and that is why Figure 8 is eerily similar to Figure 1.

While this is an improvement over the configuration shown in Figure 7, the task management is still fragmented. Figure 9 shows that accessing tasks from all of these fragmented desktop tools and local databases created the same complexity that was shown in Figure 2 for accessing fragmented document collections.

And…a cautionary note…

There are many vendors willing to sell applications that assist in performing one or more functions, like generating HAZOP reports, or automating incident investigations. While these applications normally provide a benefit, such as making the creation of HAZOP reports easier, they do little for the site-wide management of all action items.

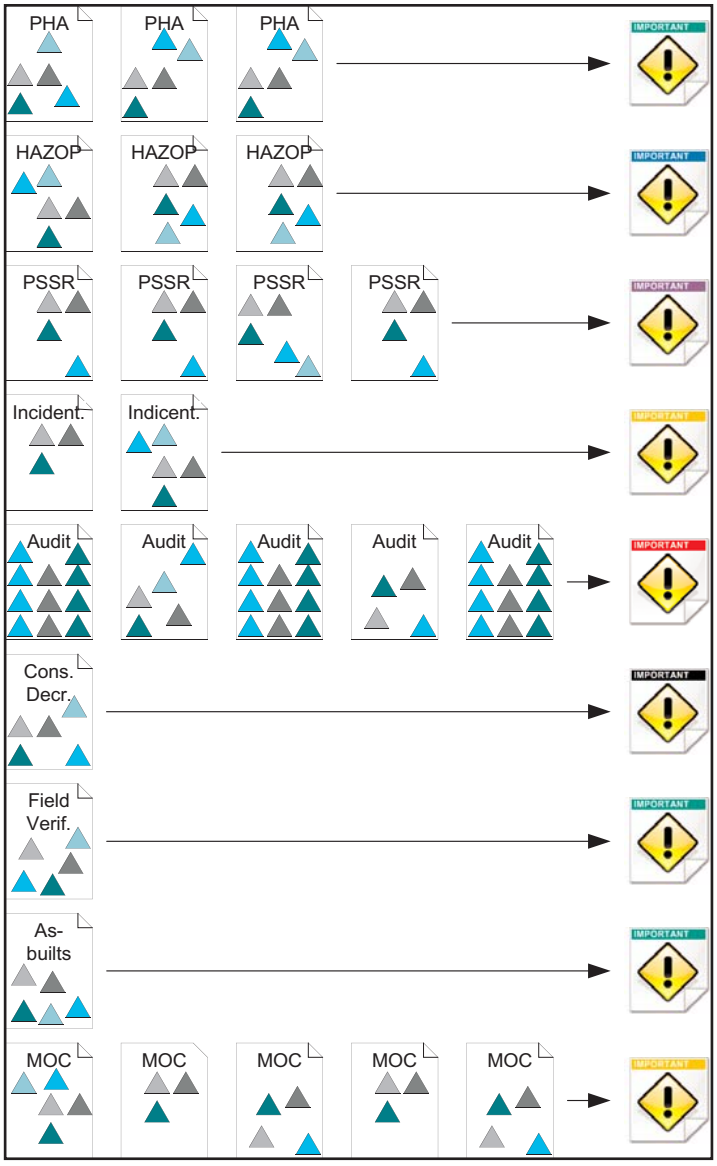


Figure 8. Tasks organized into desktop tools, but still fragmented overall.

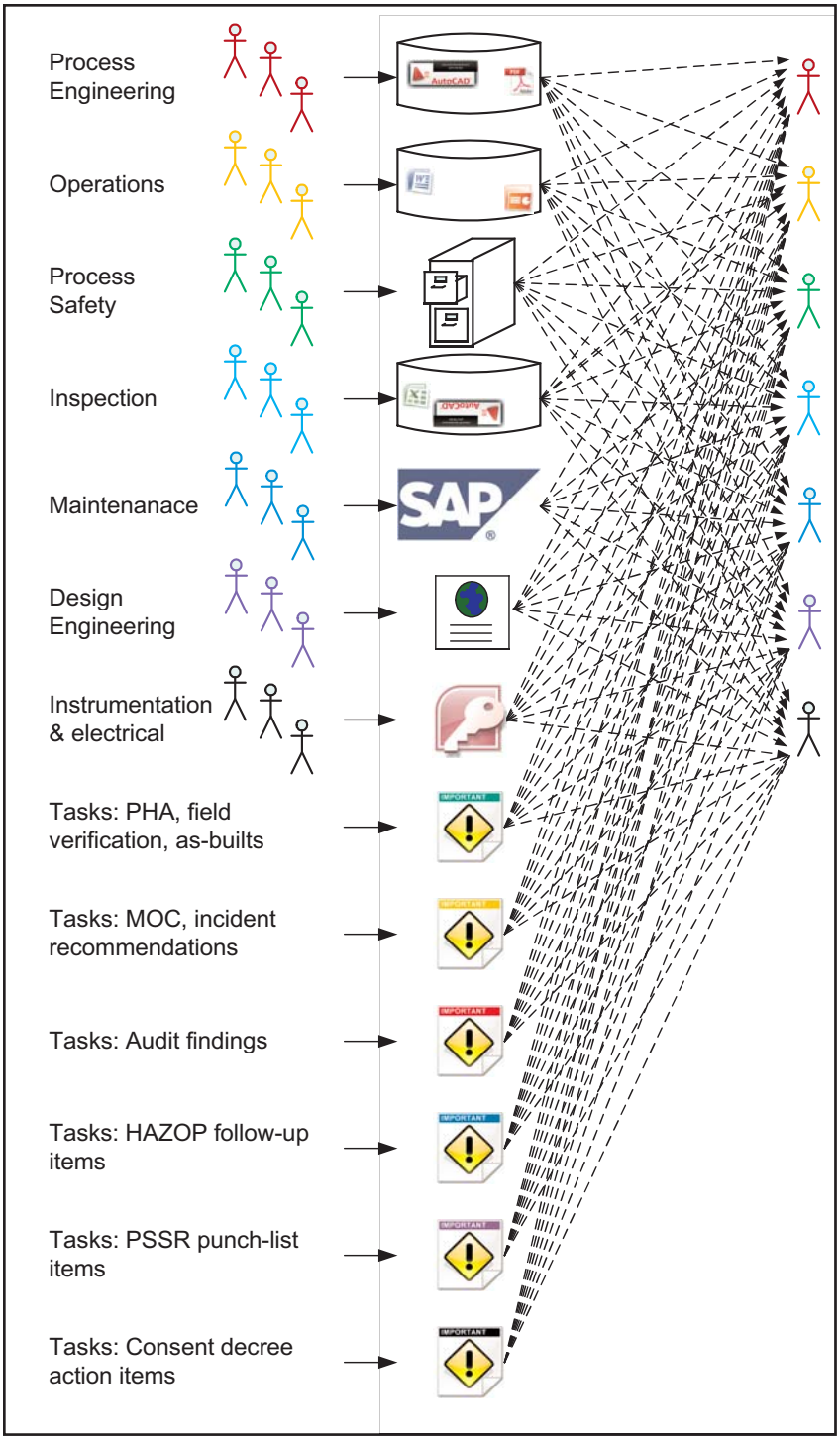


Figure 9. Fragmented task management, just like fragmented document management, is very complex for the user.

## Consolidated Task Management

Figure 6 showed the benefits of consolidated document management. The same logic applies to task management. So a consolidated view of document and task management is as presented in Figure 10.

When a single source manages all the tasks, it is immediately possible to perform the following critical functions:

1. Determine the status of all PHA follow-up items, a critical NEP concern
2. Determine the status of all other tasks, needed for regulatory performance,
3. Allow queries such as "what tasks is my department responsible for?", which allows work to be properly prioritized and allocated,
4. Allow queries like, "what tasks am I responsible for?", which allows work prioritization at the individual level.

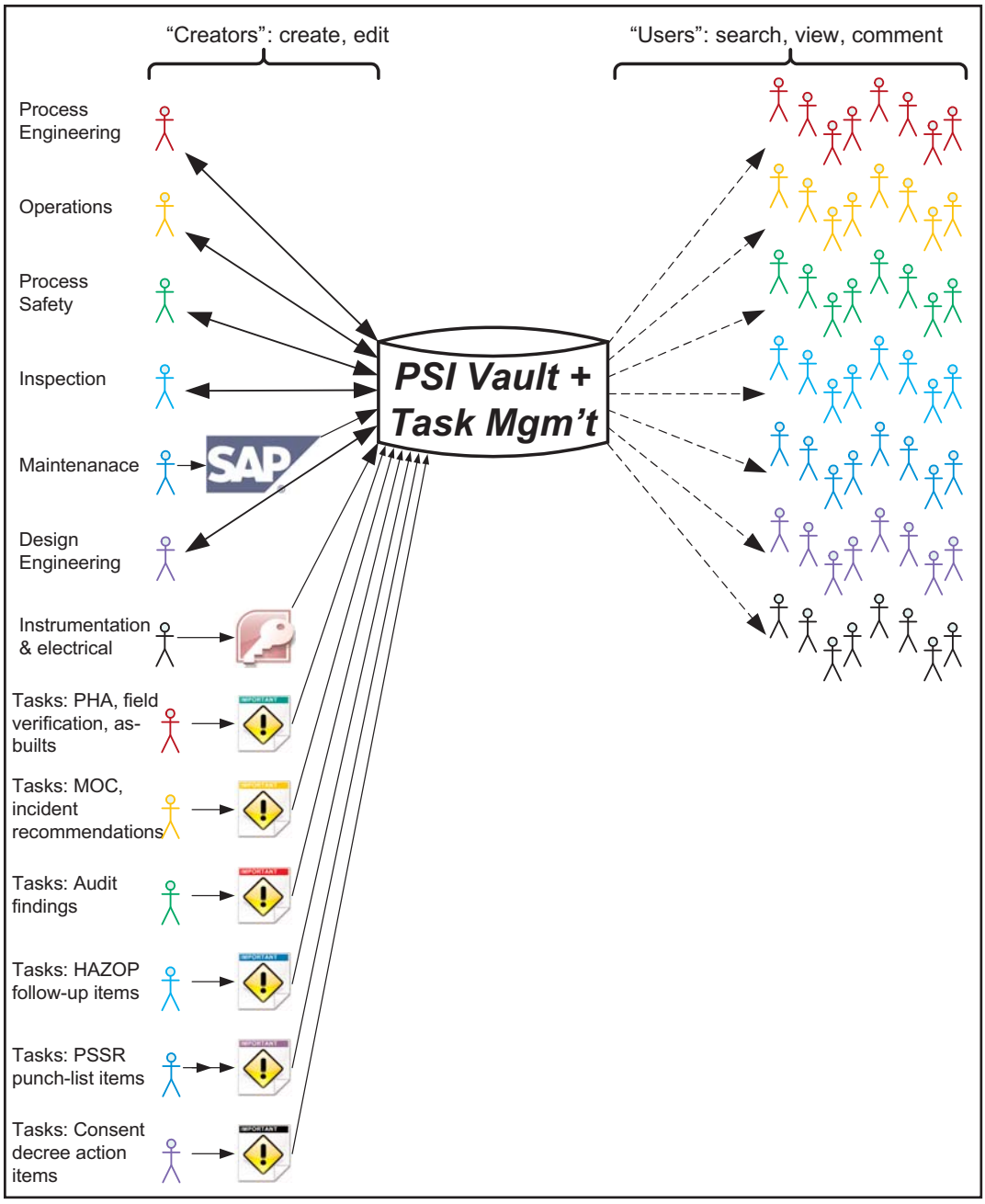


Figure 10. Documents, tabular data and tasks, all available from one source.

## The Roadmap

This paper has exposed the fact that if Chem NEP preparation is to have longevity, and maximize the return on investment, then it is critical to pursue two streams of activities:

1. Prepare the physical plant itself, by conducting inspections, correcting equipment deficiencies, and so on, and,
2. Prepare the supporting documentation, particularly Process Safety Information, including adequate consideration of RAGAGEP.

The steps to achieving compliance are similar for each stream:

| **Plant Preparation Stream** | **Document Management Stream** |
|---|---|
| Conduct a pre-audit, to identify deficiencies | Conduct an initial or scoping study to identify key document and task repositories. |
| Plan to correct the deficiencies, often by considering each PSM element, in turn, in order of priority. | Plan to correct document and task management deficiencies, by providing a platform for information management (if it doesn't already exist) and migrating each document and task collection, in turn, in order of priority. |
| Execute the plan | Execute the plan |

In both cases, Chem NEP preparation begins with an assessment to identify shortcomings and scope out the work.

Very competent specialist resources are available to assist with these tasks, if a plant doesn't have adequate internal resources to pursue the assessment. Besides, a "fresh set of eyes" is usually seen as a benefit in doing any assessment.

Leading companies are ramping up Chem NEP preparation at the time of this writing (June 2010). Once the Chem NEP program is officially announced, then the majority of plants will begin Chem NEP preparation. But, as is typical, when "everyone wants to do the same thing at the same time", even the specialist resources will be difficult to engage at that point.

The best advice is to begin early. How about today?

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