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Practical applications approach to design, development and implementation of an integrated management system

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Abstract

The introduction of quality, risk, safety, health and environmental management philosophies has significantly changed industry's view of company organization and controlling processes. Quality, risk, safety, health and environmental programs and systems, such as ISO 9000, ISO 14000, process safety, and risk management are impacting the way industry will meet the challenges of safety and environmental risks and the needs of the customer in the future.

A wealth of knowledge has been extracted from practical application case studies, which would otherwise be unobtainable without years of experience related to management systems design, development, implementation and control.

This paper discusses a practical applications approach to design, develop and implement an integrated management system encompassing quality (ISO 9000), process safety management (CFR 29 1910.119), risk management programs (CFR 40 part 68), environmental management (ISO 14000), and safety and health. This paper includes a discussion of management systems integration and an overview of management systems standards that apply to the petrochemical and chemical manufacturers industries. The paper also provides an overview on integrating management systems, including issues related to the following topics:

- Establishing a management system team and objectives.
- Assessing and knowing your organization.
- Designing the management system to meet site objectives.
- Developing system documentation.
- Implementing effective management systems.
- Measuring program performance.
- Continuous improvement.

Keywords: Management system; Team; Standards; Assessing; Designing; Developing documentation; Training implementation; Measuring performance; Continuous improvement

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1. Introduction

The recent surge of company mergers and acquisitions in the refining, oil and gas and chemical industries has forced many organizations to re-assess their management systems. Organizations have had to establish a means to integrate two or more systems that conflict or are burdened with redundant or out-of-date procedures and minimal controls to ensure compliance objectives are met.

Recent audit findings indicate that management systems for environment, health, and safety (EHS), quality, process safety and risk management have resulted in a significant number of duplicated procedures (e.g. inspection and testing, contractor, training, auditing and others).

Audit findings have also indicated that a number of the procedures established for quality management are in conflict with similar procedures established for process safety, risk and EHS management and that existing documentation is often not aligned with the requirements. Additionally, the results of the audits show there are mixed formal/informal systems or semi-formal systems in place that are difficult to implement. Some elements of management systems are not handled consistently, compliance with the requirements of other elements are not adequately documented, and formal systems meant to ensure compliance in some cases are not in place.

2. Establishing a management system team and objectives

Many organizations that wish to establish a management system do not fully understand that formal management systems are just that: “formal” or “documented”. For an organization to transition from an informal or semi-formal approach of managing its operations to a more effective formal approach requires careful planning, organization and clear goals and objectives. This transition is difficult, if not impossible, without a team effort. A management system team is brought together to direct management system activities. The team is typically made up of representatives from key departments and areas of the organization that work together to establish management commitment and employee ownership. The management system team should be small enough to facilitate the transition process without the constraints that hamper larger teams, but large enough to adequately represent the organization, its departments and corporate interests. The management system team should also include a management systems specialist to provide guidance and input needed to design, develop and effectively implement and control the system. Fig. 1 illustrates an example management system team structure.

Once the management system team is established, the management system goals and objectives can be established. Fig. 2 provides an example list of management system objectives.

To achieve the goals and objectives established by the management system team and establish a management system where actual performance can be measured against documented practice, the management system team must: (1) determine what management system standards apply to the organization; and (2) reach a consensus on how to format and structure the overall management system.

Fig. 1. Example of management system team structure.

1	Eliminate duplication/redundancy: • Use same administrative controls to drive all program elements
2	Ensure compliance with applicable regulatory requirements Including: • OSHA PSM • EPA RMP • OSHA Safety and Health • EPA Environmental • DOT Materials Transportation • Other as applicable
3	Ensure uniform compliance to Company/Industry standards • ISO 9001 • ISO 14000 • QS-9000 • Responsible Care
4	Clarify responsibilities and ownership for managing, performing and verifying the work
5	Maximize cost efficiencies / business results including the transition period for implementing change in the system
6	Achieve goals / objectives with minimum effort
7	Provide flexibility / adjustability within the new system to facilitate continuous improvement
8	Develop a management system where performance can be measured against

Fig. 2. Example of management system objectives.

3. Overview of management system standards

There is a profound difference between regulatory process safety and risk management program standards developed in the US and quality and environmental management

Table 1
PSM and RMP program elements

OSHA CFR 29 1910.119 (PSM)	EPA CFR 40 part 68 (RMP)
Implied management system	Management system
Employee participation	Employee participation
Process safety information	Process safety information
Process hazard analysis	Process hazard analysis
Operating procedures	Standard operating procedures
Training	Training
Contractors	Contractors
Pre-startup safety review	Pre-startup safety review
Mechanical integrity	Maintenance
Hot work permit	Hot work permit
Management of change	Management of change
Incident investigation	Accident investigation
Emergency planning and response	Emergency response
Compliance audits	Safety audits
Trade secrets	

standards developed by the International Standards Organization (ISO) that apply to managing quality, safety, and environment as further described further.

Table 1 contains a list of program element requirements introduced by the Occupational Safety and Health Administration (OSHA) and the Environmental Protection Agency (EPA) related to process safety management and risk management program.

The earlier listed program elements assist industry in planning and organizing what must be established and implemented to reduce risk and assist owners, as well as regulators, in measuring performance to specified requirements. What these standards do not address are the minimum administrative control program elements required to effectively implement each program element. In other words, establishing written risk management programs that are compliant with regulatory requirements in and of itself is not enough to reduce risk. The management system must be used to facilitate the management of each program. This is difficult without administrative controls to ensure all programs reach their intended objectives.

Table 2 contains a listing of ISO standard program elements related to quality and environmental management that include administrative control elements.

Administrative controls are programs that help to administer management system programs such as document control, records control, identifying non-conforming conditions, corrective/preventive action, etc. Risk management programs without administrative controls are subject to fail unless administrative controls are an integral part of each program. The management system team can integrate controls into the structure of each subsystem by using the administrative controls established in the quality subsystem for other management subsystems such as responsible care, process safety, health and safety, environment, materials transportation, etc. Integration of quality subsystem administrative controls will require that the quality subsystem controls be revised to include provisions to satisfy the needs of the other subsystems, not just quality.

To begin building the management system foundation, the management system team must assess all existing documented practice established by the organization to determine

Table 2
ISO standards program elements

ISO 9001 2000 quality management standard management standard	ISO 14000 environmental
Quality management system	Scope
General requirements	Normative references
Documentation requirements	Environmental management system requirements
Management responsibility	General requirements
Management commitment	Environmental policy(s)
Customer focus	Planning
Quality policy	Environmental aspects
Planning	Legal and other aspects
Responsibility, authority and communication	Objectives and targets
Management review	Environmental management programs
Resource management	Implementation and operation
Provision of resources	Structure responsibility
Human resources	Training awareness and complaints
Infrastructure	Communication
Work environment	Environmental management system documents
Product realization	Document control
Planning of product realization	Operational control
Customer-related processes	Emergency preparedness and responsibility
Design and development	Checking and corrective action
Purchasing	Monitoring and measurement
Production and service provision	Non-conformance and corrective/preventive action
Control of monitoring and measuring devices	
Measurement, analysis and improvement	Records
General	Environmental management system audit
Monitoring and measurement	Management review
Control of non-conforming product	
Analysis of data	

if all programs and processes that should be in place are in place and whether they are adequate and effective.

4. Assessing and knowing your organization

To assess the combined systems of two or more merging organizations, processes, process constraints, company and regulatory requirements must be reviewed. Analysis of existing systems should include the status of:

- Integration of systems needed to optimize performance.
- Standardization of document numbering needed to facilitate management system flow and navigation.
- Level of policy level documentation needed to ensure alignment with regulatory and corporate requirements.
- Gaps between existing documented programs and regulatory and corporate requirements.

- Use of administrative controls used to manage and control process safety management, risk management program, safety and health and environmental activities.
- Documents related to the same subject matter.
- Documents that are outdated.
- Documents no longer in use but still maintained in the management system.
- Accessibility of existing documentation.

Information gathered for the assessment should include:

- Process safety information (e.g. hazards, technology and equipment in the process).
- Organizational structure.
- Design codes and standards applied.
- Applicable regulatory requirements (e.g. OSHA, EPA, DOT, etc.).
- Corporate and site process quality, safety, health and safety and environmental requirements.
- Formal/informal process overview and flow information.
- Other related processes (e.g. human resources, legal, etc.).

After identifying the constraints inherent in the existing systems, the new design models can be developed and reviewed to facilitate:

- Optimizing management system performance.
- Standardizing document numbering and indexing.
- Eliminating redundancy and duplication of effort.
- Fully integrating all processes to include administrative controls.

5. Designing the management system

A number of audits have shown that management systems evolve, not by design, but over time based upon process specific, regulatory and company needs and or requirements. To optimize performance, management systems should be established in accordance with a design that has been developed to optimize quality, process safety, safety and health and environmental performance to specified requirements. A merger of two or more companies within an organization constitutes a radical change in an organization's management system structure. Constructing a model of the existing systems helps to bring the organization's management system structure into perspective by identifying gaps and weaknesses in the forward and backward flow of information and communication. An optimized model can then be created based upon the existing systems assessment findings and integration of subsystems desired. An image of all the processes related to responsible care, quality (ISO 9000), process safety and risk management (CFR 29 1910.119 and CFR 40 part 68), environmental management (ISO 14000), safety and health, materials transportation and human resources is shown in Fig. 3.

Policies are identified in the design of the management system to facilitate communicating the requirements and ensure that all process safety, safety and health, environmental, quality, responsible care, materials transportation, human resources and risk management objectives are aligned with applicable regulatory and corporate requirements.

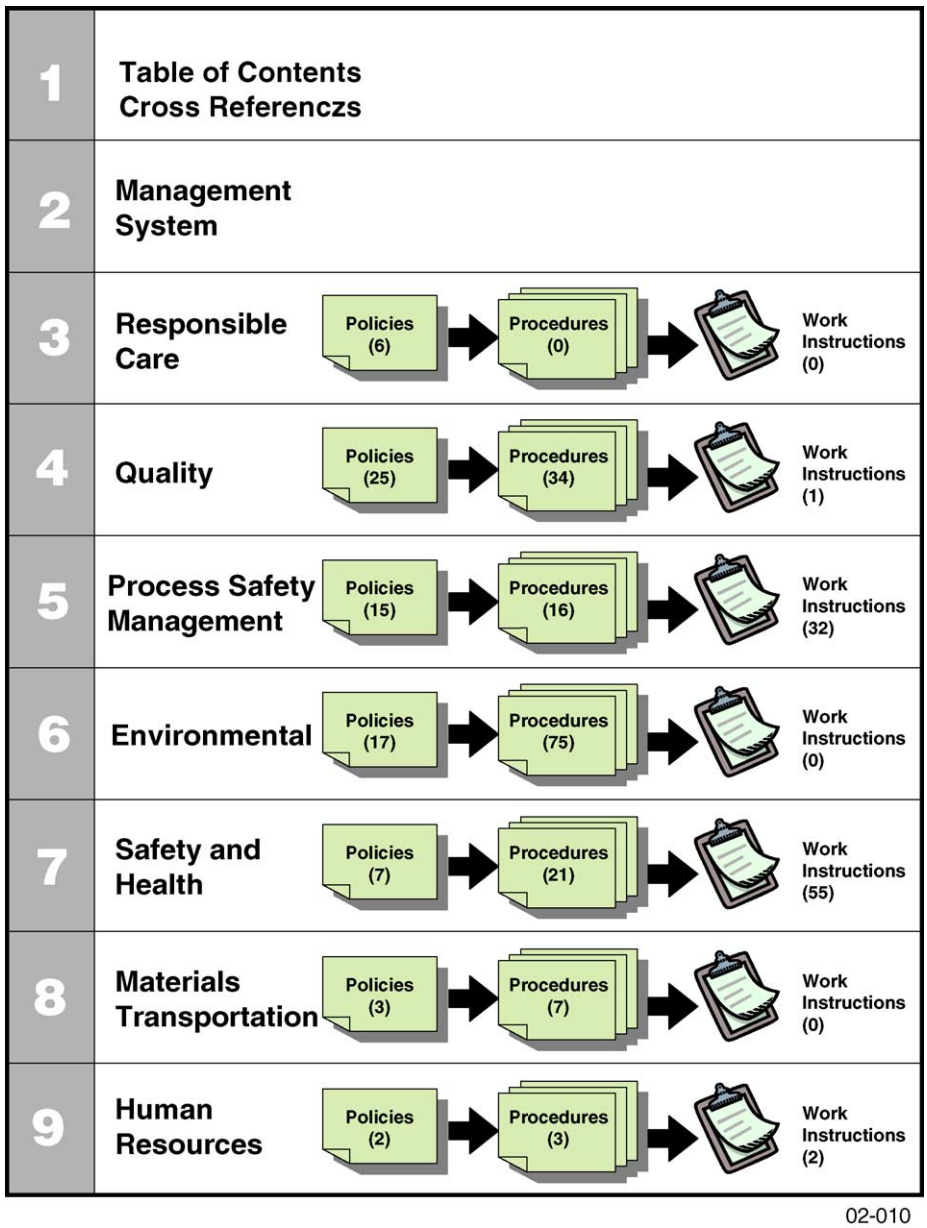

Fig. 3. Management system design model.

Procedures are identified to communicate the approach to meeting the policy requirements. In many cases, more than one procedure is required to document the approach to meeting all policy requirements.

Work instructions are identified to communicate how specific activities are carried out with regard to related procedures. Work instructions in the form of technical manuals and guidelines are typically not formally listed in the management system design. However, these documents may later become a part of the management system by reference in the system documentation.

To optimize management system performance, careful consideration of the management system design must be reviewed by the management system team with input from management and the employees. A number of management system design models may have to be reviewed, analyzed and modified until a final design is selected. The management system model should also consider utilizing the same administrative controls created for the quality system to administer and effectively implement each subsystem program and other elements as anticipated. To facilitate management commitment and employee ownership, the final design should be evaluated and approved by both management and employees. Consideration should be given to process applications and the type and number of available resources.

6. Developing system documentation

Once the final management system design is completed, the management system team can begin the work of developing the documentation for each subsystem by first planning and scheduling the document development process. Availability of resources will restrict or limit the number of documents that can be developed. To begin the process, owners of each management subsystem should be established (e.g. quality, safety, environmental, and human resources departments, respectively). Documents can then be prioritized for development in each subsystem using input from the subsystem owners, audit and assessment recommendations, employee feedback and corporate recommendations. Creating balanced work groups to develop each subsystem's policies, procedures and work instructions should then be finalized by the management system team. An example representation structure for the work groups is shown in Fig. 4.

To ensure that all work groups use the same approach to develop their assigned documentation, training should be provided to all work group members and should include:

- Purpose of the management system and work group.
- Definition of a process.
- Work flow for the document creation process.
- Work group goals and the members' responsibilities.
- "Do it right the first time" approach for developing documents.
- Need for preparation prior to team meetings.
- How alternates can *and must* be used when needed.
- Roles of work group work group leader and management system specialist.

Work Group Structure	Resp. Care	Quality Mgmt. Sys.	Process Safety Mgmt.	Environmental Mgmt. Sys.	Safety & Health	Material Transportation	Human Resources
Production	X	X	X	X	X	X	X
Maintenance	X	X	X		X		X
Quality	X	{#}					X
Site Environmental	{#}	X	X	{#}		X	X
Corp. Environmental				X			
Site Safety	{#}	X	{#}		{#}	X	X
Corp. Safety			X		X	X	
Plant Engineering	X	X	X	X	X		X
Corp. Engineering			X	X	X		
Human Resources	X	X			X (1)		{#}
Corp. Purchasing		X					
Tech. Compliance	X	X	X		X		X
Logistics						{#}	
Est. No. of Documents	**7**	**54**	**62**	**75**	**75**	**15**	**5**

{#} = Group responsible for leading document development
{1} = Medical representative from Human Resources

Fig. 4. Work group representation structure.

The following rules should also be communicated to all teams:

- All decisions are to be made by consensus.
- Substitutes are mandatory when members must be absent.
- Team members are responsible to solicit input from the groups they represent.

The work groups should begin developing documentation following the document hierarchy, shown in Fig. 5, beginning with documenting the organization's policies based upon established values and principles related to process safety, health and safety, environment, quality and other concerns.

Procedures developed by the work teams should document the approach to meeting the organization's policy requirements. This is accomplished by documenting the input requirements, desired outputs, resources required, steps needed to plan, organize, implement and control the processes and documenting the responsibilities of personnel who manage, perform and verify the work for each process. Work instructions, describing how specific activities are performed, should be developed where existing instructions are not adequate or do not exist as captured in the finalized system design model.

Employee ownership is established by providing a formal means for all employees to provide direct input into the development of all management system documents. Posting all documents electronically and encouraging all employees to comment and provide input on what was documented by the work teams can accomplish this.

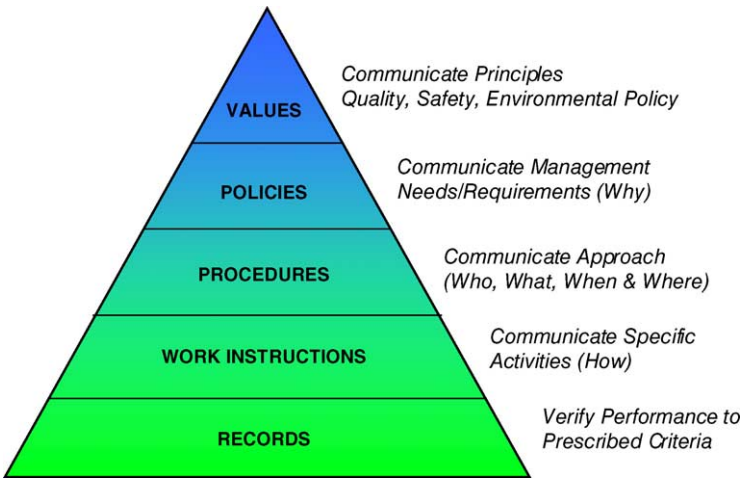

Fig. 5. Document hierarchy.

Employee ownership of each program is the single most critical element needed to ensure the final documentation is in keeping with actual practice, that the organization's overall management goals and objectives are met and that each subsystem upon implementation provides optimal performance, as well as business results.

7. Effective implementation of management systems

Implementation can begin as subsystem program documentation is finalized. Subsystem program documentation should be posted for employee review and the assigned work groups should resolve all employee comments. The management system team, which is also responsible for ensuring that a balanced team was used to develop the documents, should approve all documents. The flowchart shown in Fig. 6 outlines the overall process.

Before any program can be effectively implemented, pre-implementation training needs to be made available to all effected personnel through either classroom, area-specific training, read and acknowledge or computer training. To facilitate the training personnel require, a matrix should be developed by each subsystem owner along with a schedule of training to be performed. The training matrix and schedule should be approved by the management system team to ensure all categories of personnel are addressed and that the training schedule is reasonable considering the amount of available resources and production needs.

Training of all effected personnel is critical to ensure a clear understanding of formal system requirements prior to implementation. Training is also useful as a means to solicit more input and feedback from all levels of personnel who had not been able to review the new documentation prior to training. It is recommended that old systems not be archived or removed by new formal system documentation until 30 days after the last training session is completed on each subsystem program. This allows additional time to resolve any issues

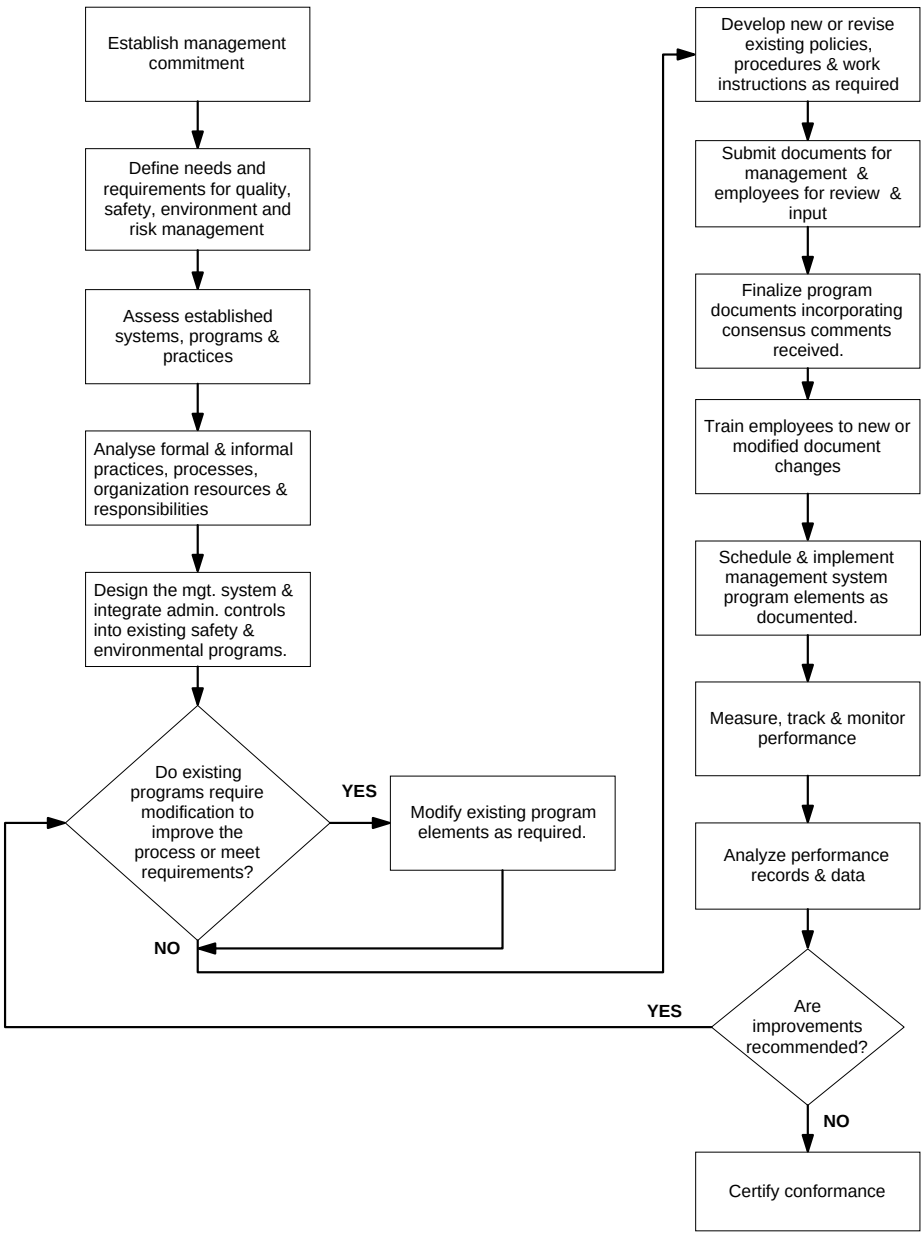

Fig. 6. Management system development and implementation process.

that may arise during the training and a gradual transition to effectively implementing the new program documents.

8. Measuring performance

Formal management systems are introduced to better facilitate measuring performance and reaching objectives established by an organization. Performance measurement is typically broken down into two categories: (1) the management system; and (2) individual processes that make up each program element of the system.

Performance measurement tools need to be established to facilitate verifying that each program is in place, is adequate and effectively implemented. Performance standards or checklists need to be developed, as well as a schedule for monitoring the progress of each program and audit criteria for measuring the effectiveness of each program. An audit schedule should randomly select different areas over time and measure program effectiveness by comparing the completion of each process to documented criteria. Each area should measure process performance by identifying process variations that effect, or have the potential to effect, quality, safety or environmental performance within the area based upon established process control limits prescribed and documented criteria. Audits and assessments should provide a report with findings and recommendations that should be shared with all area management to assist in avoiding common pitfalls, achieving objectives and compliance through corrective and preventive action.

9. Establishing and maintaining a framework for continuous improvement

To establish a framework for continuous improvement, the management system team should establish a formal means for all employees to communicate concerns, recommended ways to improve each program or process, and aspects of a given program or process that are not working. This can be done by establishing an electronic or manual directory for each program and using the organizations communication system to facilitate receiving and sending input and feedback from all employees. When a sufficient number of comments are gathered for a given document to warrant reconvening the work group, the work group can be reconvened and all comments considered and resolved.

Administrative controls, established in the quality subsystem and integrated with all subsystems, can also help to administer and improve all programs. Continuous improvement is maintained by providing a means for all employees to identify non-conforming conditions needed to trigger corrective and preventive action, improving performance, achieving compliance requirements and applicable recommended practice.

For processes to continuously improve, an analysis of processes must be performed at various levels within the organization. To measure process variations relating to safety, environment and quality, management systems rely on process analysis and statistical process control techniques to provide the data required to make adjustments or improvements to processes that are not functioning to specified requirements.

Conversely, each process relies upon the management system to facilitate changes required for each process to operate consistently and uniformly within specified requirements through incremental and breakthrough improvements and problem solving over time.

10. Summary

Regulatory, industry and corporate requirements for managing responsible care, quality (ISO 9000), process safety and risk management (CFR 29 1910.119 and CFR 40 part 68), environmental management (ISO 14000), safety and health, materials transportation and human resources is a moving target. New requirements are presently under evaluation and will continue to be introduced as industry and regulatory agencies better understand the management of actual and potential risks.

Managing processes within an organization typically "evolve" over time, as needs arise, and most often are based on informal or semi-formal practice. Because the informal/semi-formal, evolution lacks structure, companies are often left thinking "We should have done this differently". Clearly a more formal, structured means to manage processes is needed to reduce risk, control processes, manage organizational/process changes and meet new requirements as they are introduced.

Formal management systems provide the means for an organization to manage and control risk. Knowledge of regulatory expectations is critical for compliance, Knowledge of internationally accepted practice (e.g. ISO 9000 and ISO 14000) is recommended for guidance in administrative control elements needed to effectively implement each process safety, risk management, environmental or EHS program. Shared audit findings prove valuable to avoid common pitfalls and continuously improve.

11. References

The following guidelines were used in the management system assessment, design, development and control activities outline:

- *Guidelines for Implementing Process Safety Management Systems*, CCPS/AICHE, 1994.
- *Guidelines for Integrating Process Safety Management, Environment, Safety, Health and Quality*, CCPS/AICHE, 1996.
- *Technical Management of Chemical Process Safety*, CCPS/AICHE, 1989.
- *Guidelines for Process Safety Documentation*, CCPS/AICHE, 1995.
- *Safety by Objectives*, second ed., Dan Petersen, 1996.