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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 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/QS 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 can be extracted from practical application case studies, which might 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 (CFR 29 1910.119), Risk Management (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 industry. The paper also provides an overview on integrating management systems, including issues related to the following topics:

- Establishing a Management Systems Team and Objectives
- Assessing and Knowing your Organization
- Designing the Management System to Meet Site Objectives
- Developing System Documentation
- Effective Implementation of Management Systems
- Measuring Program Performance and Continuous Improvement

Introduction

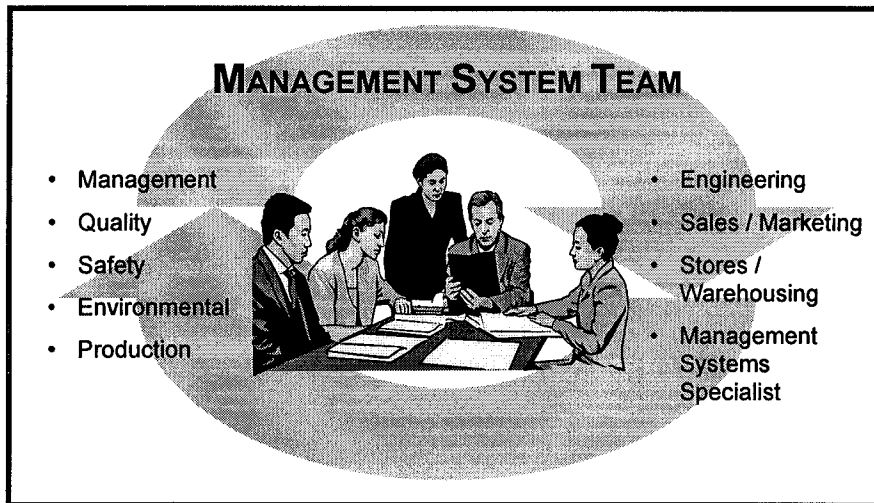
The recent surge of company mergers and acquisitions in the refining, oil and gas and chemical industries has forced many organizations to re-assess their management systems. Organizations have had to establish a means to integrate two or more systems that conflict or are burdened with redundant or out-of-date procedures and minimal controls to ensure compliance objectives are met.

Recent audit findings have found that management systems for EHS quality and Process Safety Management have resulted in a significant number of duplicated procedures. This is shown by the number of procedures established for quality that are also in place for process safety such as inspection and testing, contractor, training and others.

Audit findings have also indicated that a number of the procedures established for quality management system are in conflict with similar procedures established for process safety, safety and health and environmental 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.

1.0 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 to managing its operations to a more effective formal approach requires careful planning, organization and clear objectives. This transition is difficult, if not impossible, without a team effort. A Management System Team is brought together to direct management system activities and 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. Figure 1 illustrates an example Management System Team Structure.



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Figure 1. Example Management System Team Structure

Once the Management System Team is established the management system goals and objectives can be established. Figure 2 provides an example list of management system objectives.

1	<p>Eliminate Duplication/Redundancy:</p> <ul style="list-style-type: none"> • Use same administrative controls to drive all program elements
2	<p>Ensure Compliance with Applicable Regulatory Requirements Including:</p> <ul style="list-style-type: none"> • PSM • RMP • OSHA • EPA • DOT • TOSCA • Other as applicable
3	<p>Ensure Uniform Compliance to Company/Industry Standards</p> <ul style="list-style-type: none"> • ISO 9001 • ISO 14000 • QS-9000 • Responsible Care
4	<p>Clarify Responsibilities and Ownership for Managing, Performing and Verifying the Work</p>
5	<p>Maximize Cost Efficiencies / Business Results including the transition period for implementing change in the system</p>
6	<p>Achieve Goals / Objectives with Minimum Effort</p>
7	<p>Provide Flexibility / Adjustability within the New System to Continuously Improve</p>

Figure 2. Example Management System Objectives

To achieve the objectives established by the Management System Team and establish a management system where performance can be measured against documented actual practice, the Management System Team must first determine what management system standards apply to the organization and reach a consensus on how to format and structure the overall management system.

2.0 Overview of Management Systems Standards

There is a profound difference between regulatory process safety and risk management standards developed in the United States and quality and environmental management standards developed by the International Standards Organization (ISO) Standards that apply to managing quality, safety, and environment.

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 and risk management.

Table 1. PSM & RMP Program Elements

OSHA CFR 29 1910.119 (PSM)	EPA CFR 40 PART 68 (RMP)
<i>(Implied Mgt. System)</i>	Management System
Employee Participation	
Process Safety Info	Process Safety Info.
Process Hazard Analysis	Process Hazard Analysis
Operating Procedures	Standard Operating Procedures
Training	Training
Contractors	
Pre-Startup Safety Review	Pre-Startup Safety Review
Mechanical Integrity	Maintenance
Hot Work Permit	
Management of Change	Management of Change
Incident Investigation	Accident Investigation
Emergency Planning & Response	Emergency Response
Compliance Audits	Safety Audits
Trade Secrets	

The above 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 the above 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 in 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 International Standards Organization (ISO) standard program elements related to quality and environmental management that include administrative control elements.

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 Mgt. System Reqs.
Management Responsibility	General Requirements
Management Commitment	Environmental Policy(s)
Customer Focus	Planning
Quality Policy	Environmental Aspects
Planning	Legal and Other Aspects
Resp., Authority & Communication	Objectives and Targets
Management Review	Env. Management Programs
Resource Management	Implementation & Operation
Provision of Resources	Structure Responsibility
Human Resources	Training Awareness and Cpt.
Infrastructure	Communication
Work Environment	Env. Mgt System Doc's.
Product Realization	Document Control
Planning of Product Realization	Operational Control
Customer-Related Processes	Emer. Preparedness & Resp
Design & Development	Checking & Corrective Action
Purchasing	Monitoring & Measurement
Production & Service Provision	Non-Conformance & Corrective/Preventive Action
Control of Monitoring & Measuring Devices	
Measurement, Analysis & Improvement	Records
General	Env. Mgt. System Audit
Monitoring and Measurement	Management Review
Control of Nonconforming Product	
Analysis of Data	

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 sub-system by using the administrative controls established in the quality sub-system for other management sub-systems such as

responsible care, quality, process safety, health and safety, environment, materials transportation, etc. Integration of quality sub-system administrative controls will require that the quality sub-system controls be revised to include provisions to satisfy the needs of the other sub-systems, 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 if all programs and processes that should be in place are in place and whether they are adequate and effective.

3. 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 PSM, 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 of the existing systems, the new design models can be developed and reviewed to facilitate:

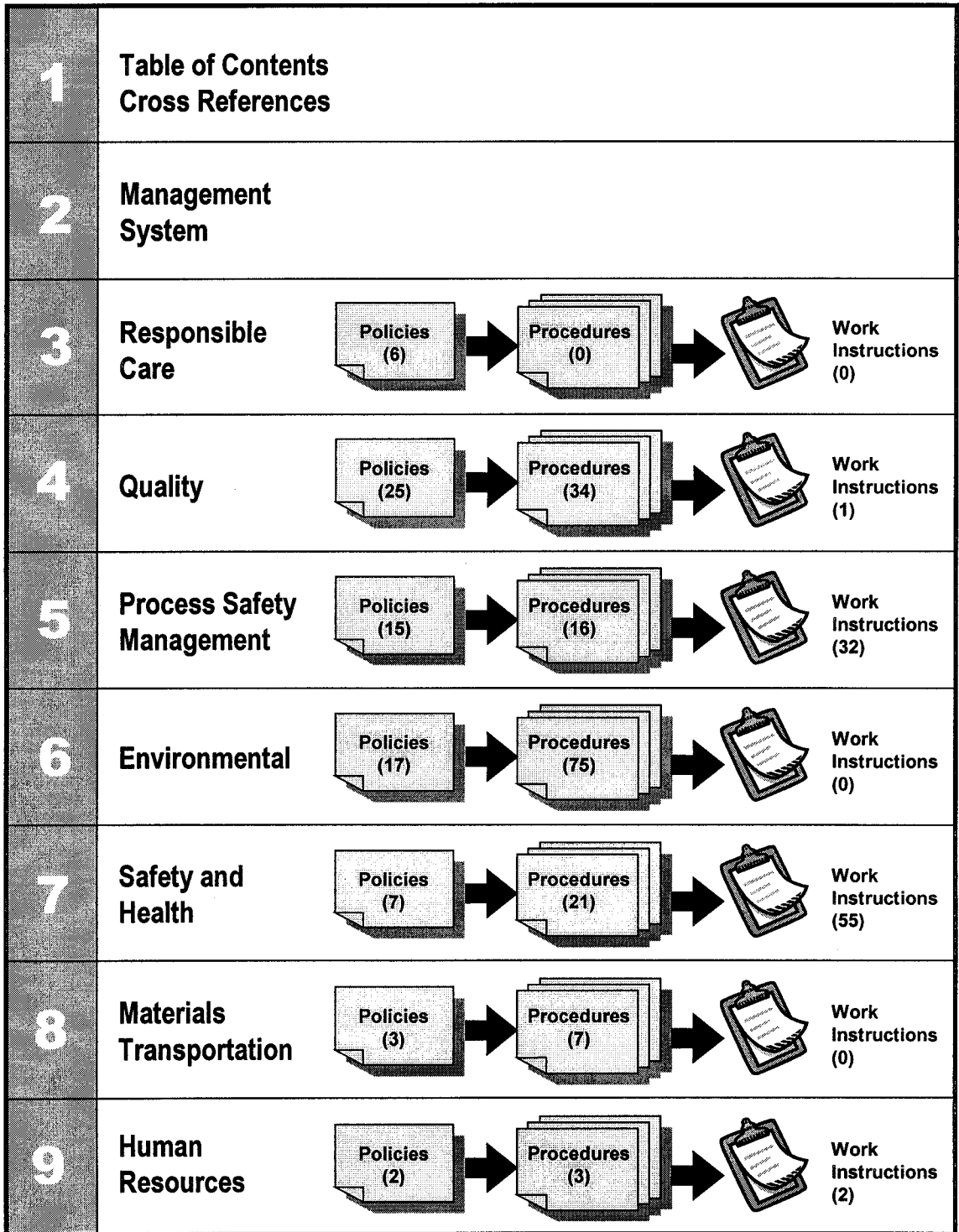
- Optimizing management system performance
- Standardizing document numbering and indexing
- Eliminating redundancy and duplication of effort
- Fully integrating all processes to include administrative controls

4. 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 to 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 sub-systems desired. An image of all the processes related to Responsible Care, Quality (ISO 9000), Process Safety (CFR 29 1910.119 and CFR 40 part 68), Environmental Management (ISO 14000), Safety and Health, Materials Transportation and Human Resources as shown in Figure 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.

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.



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Figure 3. Management System Design Model

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 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 sub-system 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.

5. 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 sub-system 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 sub-system should be established (e.g. Quality, Safety, Environmental, and Human Resources Departments respectively). Documents can then be prioritized for development in each sub-system using input from the sub-system owners, audit and assessment recommendations, employee feedback and corporate recommendations. Creating balanced work groups to develop each sub-system's policies, procedures and work instructions should then be finalized by the Management System Team. The representation structure for the work groups is shown in Figure 4 below.

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

Figure 4. Work Group Representation Structure

To ensure that all work group 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 System Specialist

The following rules should also be communicated to all teams:

- All decisions are to be made by consensus agreement
- 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 Figure 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.

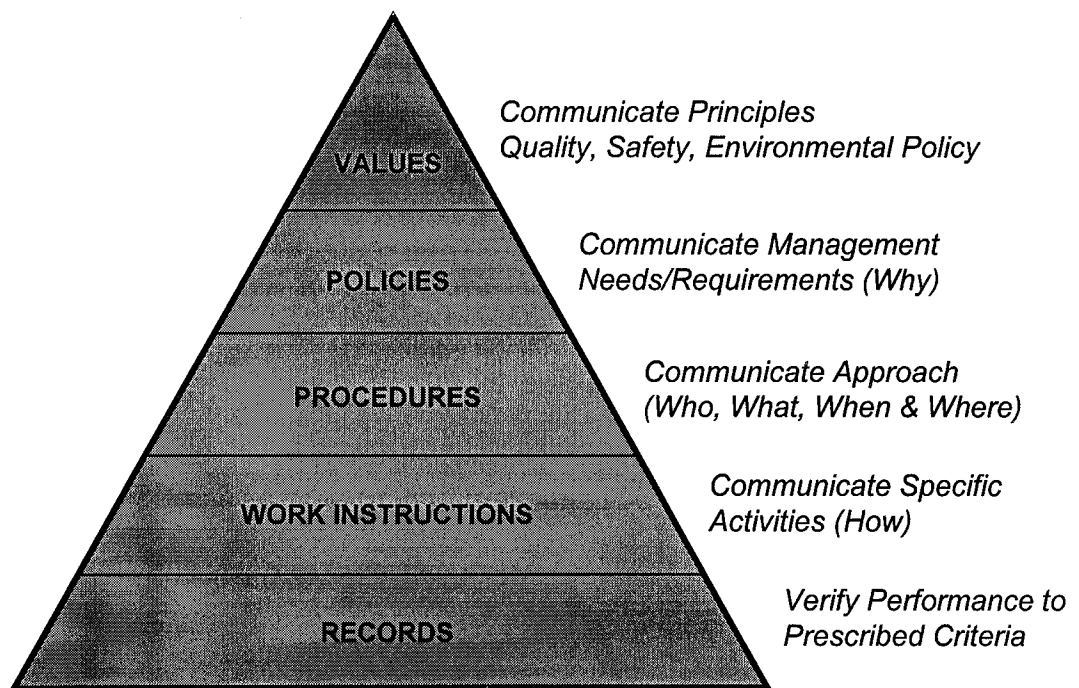


Figure 5. Document Hierarchy

Procedures developed by the work teams should document the approach to meeting the organization's policy requirements. This is accomplished by documenting each of the processes 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. Work instructions, describing how specific activities are performed, should developed where existing instructions were not adequate or did 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 process documents. This can be accomplished by posting all documents electronically and encouraging all employees to comment on what was documented by the work teams on the employees behalf.

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 sub-system upon implementation provides optimal performance as-well-as business results.

6. Effective Implementation of Management Systems

Implementation can begin as sub-system program documentation is finalized, posted for employee review, comments resolved by the work groups and approved by the Management System Team System. The flowchart shown in Figure 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 sub-system 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 thirty days after the last training session is completed on each sub-system program. This allows additional time to resolve any issues that may arise during the training and a gradual transition to effectively implementing the new program documents.

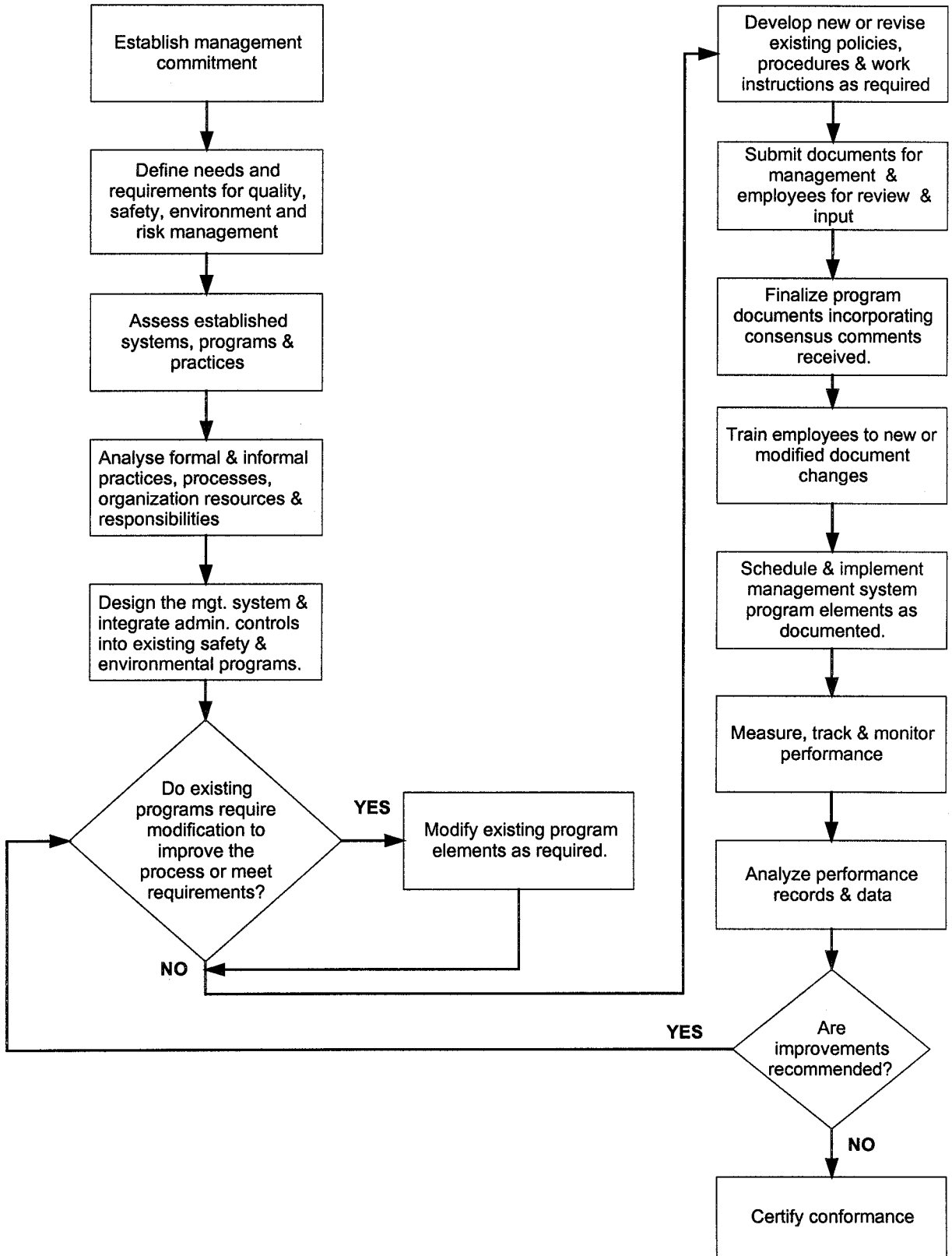


Figure 6 - Management System Development and Implementation Process

7. 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, 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.

8. Establishing and Maintaining a Frame Work for Continuous Improvement

To establish a frame work for continuous improvement, the Management System Team should establish a formal means for all employees to communicate concerns, recommended ways to improve each program, and aspects of a given program 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 sub-system and integrated with all sub-systems, 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.

9. Summary

Regulatory, industry and Corporate requirements for managing Responsible Care, Quality (ISO 9000), Process Safety (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.

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

10. References

The following guidelines were used in management system assessment, design, development and control activities outlined.

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 Edition, Dan Petersen, 1996.