26
Management of Change

Tracey Zarn and Aaron Hade

26.1
Introduction

Business today can be fast paced and challenging. A company and a corporation both have to be in tune with the market's demands and with the needs of their people, otherwise they may not remain profitable. All organizations need to be keenly aware of ''the bottom line,'' and simply maintaining the status quo is increasingly a long-term strategy for failure. See Figure 26.1 for an example of what may happen with unreviewed process changes.

When a change of any type is introduced into an organization, there is a window of time where certain actions can ensure a successful adaptation to the change. In the same time window, other actions or inaction can guarantee difficulty or, indeed, failure to adapt to the change. The way in which an organization views change and the implementation of change is thus one of the critical factors determining success or doom. Early and fairly recent reference books about safety and engineering give great consideration to how design engineers can impact the organization. ''Oversights in design lead to accidents for several reasons: the engineer's inexperience or ignorance, the engineer's attitude and the engineer's subjection to economic control . . . In the past, many errors might have been avoided if engineers had been early imbued with a greater awareness of safety principles . . . To permit repetition of oversights in design is hardly excusable, but they are repeated as each generation of engineers progresses to positions of administrative responsibility leaving in its wake a semi-vacuum of design 'know-how'" (Hammer, 1989). The very same philosophy can be said about all workers involved in the identification and management of change (MOC). More recently, reference books have begun to encompass all workers rather than rely wholly on design engineers. Workers and stakeholders at every level of the organization are likely to have felt the impacts of change and have suffered or benefited from the change implementation process.

Certain changes may cause minor confusion, business interruptions, errors, or irritation. These results will be, for the most part, recoverable loss or acceptable loss; minor enough that they do not warrant extensive pre-planning and execution

Handbook of Loss Prevention Engineering, First Edition. Edited by J. M. Haight.

Intact fire hydrant

Failure of fire hydrant

Figure 26.1 Failure of fire hydrant(a) Intact Fire Hydrant(b).

plans. Other changes can bring impacts that are far more severe, such as large financial loss, fatal injuries, long-term business interruptions, or unrecoverable impacts on the business. It can be difficult to predict the magnitude of these impacts – small changes do not always have small impacts.

For example, one seemingly small change is to move the location of a stop sign in an open pit mining operation. For the haul truck driver, who receives information every day about the traffic control changes within the operation, this change is routine and easily accepted. The driver inherently understands the impacts that this has on the daily operation of the fleet. Some of the other stakeholders who visit the operation, such as geologists, health, safety, and environmental (HSE) people, or maintenance personnel, do not receive the same traffic control information. As a result, these people may find themselves driving incorrectly in the new traffic pattern, among large haul trucks. The blind spots for a haul truck are large enough to encompass a pickup truck. This small change in the location of the stop sign, if not communicated well to all stakeholders, could result in a near miss or fatal vehicle incident.

Change can be seen in virtually all catastrophic events. An interesting case is in the book *Inviting Disaster: Lessons from the Edge of Technology* (Chiles, 2002). One illustrated case is from 4 December 1998 where a Minneapolis Holidazzle Parade had a tragic vehicle incident. It was reported that wigwag flashing lights had been added as a retrofit to a police vehicle and the unintended consequence was that

the added device energized the brake lights but also controlled the electric shift lock. ''NHTSA's Vehicle Research and Test Center found that the homemade relay made the brake lights go on for 390 ms, then go off for 516 ms, then repeated the cycle. Each time the brake lights came on, the shift lock went off . . . It concluded that Sawina had not pushed both pedals (brake and gas) simultaneously. The combination of Sawina's foot on the gas pedal and the deactivation of the shift lock by the wired-in wigwag had caused the crash'' (NHTSA, 2012).

Although no safety practitioner, engineer, or PhD scientist has a crystal ball to guarantee elimination of problems when introducing change, business leaders can maximize their results with a conscious effort to ''play it forward.'' This is a spin-off from the title of the movie *Pay it Forward* (Hyde and Dixon, 2000), where a young boy is inspired to make the world a better place by playing it forward; helping people in such a fashion that their lives are enriched and improved from his action. Playing it forward means that whenever possible, the initiator of a change should play it forward in their mind's eye to anticipate how the proposed change will impact and affect the business and the entire organization. Understanding these impacts, and planning the appropriate analysis and communications, will ensure the successful execution of the change. Playing it forward will help to minimize negative impacts, reduce losses, and empower employees to understand and adapt to changes.

Anyone can ''Google search'' MOC and all variations of the words to see what the world has to offer on the topic. This chapter is different from all of the information on the Internet because the first author offers her trials and tribulations regarding the changes she has initiated and survived in various organizations; she applies these concepts and procedures each and every day. MOC is not a marketing gimmick with dubious effectiveness. Managing change effectively is one of the most important business initiatives that will help maintain the bottom line and will help an organization exceed its health, safety, environment, quality assurance targets.

26.2 What Is Management of Change (MOC)?

At one time, the author was working with a small company, discussing the benefits of an effective MOC program. At one point, the senior leader said, ''I know we have some problems, but I can't just *change* all of my *management*.'' After back-tracking and explaining that the intent of MOC was not solely to terminate managers, the discussion took a more positive and constructive turn. Clearly, it is important for all stakeholders to understand what is meant by ''management of change'' and ''change of management.''

There are three main components of MOC:

- administrative changes
- engineering and technical changes
- organizational and staffing changes.

Administrative changes can include, but are not limited to:

- procedures, practices, standards, policies
- equipment and technical specifications
- purchasing controls and requirements
- computer software systems, authority levels, approval processes
- emergency response planning and preparedness procedures
- business continuity planning and preparedness procedures.

Engineering and technical changes can include, but are not limited to (CCPS, 1995):

- change in process design
- change in operating limits
- change in raw materials
- change in process targets or product specifications
- change of the metallurgy of a piping system
- a piping system change, including adding block valves, new flow paths, and so on.
- installing new pumps or compressors
- installing structural members to support heavy loads
- temporary piping systems
- adding or removing insulation to or from process equipment
- changing the control range of temperature and pressure instruments to exceed defined operating limits
- changing or bypassing alarms or permissive switches within an interlock system
- changing pressure safety valve (PSV) settings or configuration
- changing the method or control scheme of an instrument loop.

Organizational and staffing changes can include, but are not limited to:

- job roles, descriptions, and responsibility changes
- new hire, transfer, and termination procedures
- changes in the organizational structure within business units, regions, and countries
- reducing or increasing team or department size or structure
- changing physical locations of offices.

The examples of changes are endless. It can be said that the only thing constant in today's work and business is constant change required to maintain performance and profit.

Each organization needs to determine the scope of what shall be included as a change to be analyzed and managed. The scope may change and grow as the organization's MOC program develops and matures. Along with understanding what a change is, workers also need to be well versed and proficient in understanding the parameters of ''safe operating conditions'' for what they do. Understanding change and the associated hazards is much more effective when a crew understands safe operating conditions and can trigger specific evaluations and risk assessments

when conditions change outside these conditions. ''Management of change is also vital in the area of day-to-day operations where conditions move outside of their safe operating envelope during a period of process upset. Immediate action should be taken to re-establish safe operation, which may mean shutting down the process. Operators and their supervisors need to be totally familiar with the safe operating envelope for their process and the consequences of operating outside of it, and the need to be empowered to use their judgment and take immediate action when this becomes necessary . . .'' Atherton and Gil, (2008). The Chernobyl (Russia) power station explosion (see Figure 26.2) is a tragic example of how workers and supervisors unwittingly set the stage for a catastrophe because they did not completely understand the safe operating parameters. ''Experiments are a classic example of where management of change is vital, covering: risk assessment and management, training and awareness of all staff involved, and development of formal operating procedures'' (Atherton and Gil, 2008).

Determine the changes that are currently causing the most incidents or the most potentially severe incidents; business interruptions; or problems in your organization. Build your MOC program to encompass these changes first. In the first author's experience, once your program is integrated in the organization and stakeholders understand the process and see the value in analyzing the changes, you can determine the next level of changes to add to the program. One great thing about teaching your staff to ''think MOC'' is that even if you have proposed a change that is not included in your organization's formal program, your staff will begin to follow the general analysis and communication processes because the implementation of the change will be more successful.

Ensure that the scope of the MOC program includes the risk assessment and evaluation of abnormal conditions that may occur. These abnormal conditions may include changes that result from power failure, component failure, material changes, mistakes, and errors. If unevaluated, these types of abnormal conditions

Figure 26.2 Model of the inside of the Chernobyl nuclear power plant after the disaster (*http://en.wikipedia.org/wiki/File:Chernobyl_model.jpg*).

can have catastrophic consequences. This was the case on 25 November 1998, at the Equilon Enterprises Oil Refinery in Anacortes, WA. A power failure delayed a coking unit, causing changes in the process and resulting in a fire and six fatalities (US Chemical Safety and Hazard Investigation Board, 2001; see Case 1).

26.3 Why Is MOC Important

Business survival is one of the reasons why managing change is so important. In today's business environment, the profit margin can be small and easily eroded by mistakes, incidents, downtime, rework, and poor workforce morale.

As our world becomes more high tech, more digitized, with more emphasis on rapid results, there is an increased need for technical and engineering authorities to ensure that an appropriate depth and breadth of knowledge goes along with a well-developed and implemented MOC program (CCPS, 2008). Reflect on the Dutch State Mines Flixborough (UK) Nypro Plant explosion in 1974 that resulted from various maintenance modifications. ''Engineering Authorities – at the time of the accident there was nobody at the plant at senior management level with the technical knowledge and experience to ensure that the proper technical standards and sound engineering practice were applied to all engineering work carried out at Flixborough. The Laboratory Manager may well have felt that he could have dealt with administration and budget issues, but clearly he did not have the engineering knowledge and experience to fill a Maintenance Manager's role, which includes review and decision-making on individual engineer's recommendations. Plant Integrity – the whole process to ensure plant integrity was flawed. On the design side, the modification was installed with no account having been taken of the appropriate British Standards and the recommendations of the bellows manufacturers. During construction, there was no inspection and testing of the temporary arrangements to ensure that the finished assembly met proper construction standards'' (Atherton and Gil, 2008). The Flixborough Disaster Memorial is shown at *http://en.wikipedia.org/wiki/File:The_Flixborough_Disaster_-_geograph.org.uk_-_476616.jpg*.

A well-developed and implemented MOC program can help strengthen the profit margin, help you understand the internal workings of your business, and really improve workforce morale, by giving them an opportunity to participate in the identification, analysis, and communication of the change. An effective program also has a strong feedback loop so that when stakeholders see a problem or an opportunity with a change, they can report back and have their concerns addressed (CCPS, 2008). ''Monitor the period of change closely with people of sufficient knowledge and experience, and feed back any lessons learned for the benefit of future projects'' (Atherton and Gil,, 2008). Effective feedback loops may include informal conversations and verbal reports of problems in addition to formal post-change interviews and observations. They may also include unsatisfactory condition or incident reports, schedule delays, exceeding of operating metrics,

and so on. The feedback loop that is the most successful is dependent upon the particular type of change being implemented.

Many adjacent issues with contractors, subcontractors, vendors, and suppliers are identified and resolved before they become problems, reducing the risk of litigation.

26.4 Developing a Formal MOC Program

Depending on the size of your organization and your time, knowledge and resources, you can build a basic or advanced program, or have consultants involved in developing the program. Ensure that all applicable regulations and codes are researched for specific requirements. Examples may include the following:

- United States Occupational Safety and Health Administration (OSHA) 1910.119(l). This was enacted in 1992 as 29 Code of Federal Regulations 1910.119 – Process Safety Management of Highly Hazardous Chemicals issued under Section 304 of the Clean Air Act Amendments of 1990 (CCPS,2008).
- Canada National Energy Board Safety Plan Guidelines compile a selection of regulatory documents into one guideline; refer specifically to Section 4.6.8, Management of Change: *http://www.neb-one.gc.ca/clf-nsi/rpblctn/ctsndrgltn/rgltnsndgdlnsprsntthrct/drllngprdctnrgltn/sftplngdln-eng.html#s30*. The document is copyright; see *http://www.neb-one.gc.ca/clf-nsi/rcmmn/mprtntntc-eng.html#s1*

Some regulations may not have a clearly titled section for MOC requirements. Ensure that someone with the appropriate skills regularly reviews applicable regulations to identify requirements to consider in your program development.

Remember, the initial development of your MOC program is a change in itself. Follow the intent of the MOC program as you build it. You may choose to assemble a core group of stakeholders as the Development Team.

The first step in developing a formal MOC program is to evaluate your business or organization. Identify the following:

- Is the intent of the MOC program understood by the key stakeholders?
  - The key stakeholders for the MOC program development may initially be the Technical and Engineering Authority, Maintenance and HSE Managers, and the Area Manager/Vice-President. Determine the key roles that you require support from and ensure they understand the intent of the MOC.
- Do the key stakeholders see business value in the program?
  - Inherently key stakeholders at higher organizational levels see the business value in the program. Depending on the staffing and resources available you may need to show specific benefits in terms of what is important to your audience. Example:
    - Reduced damage and downtime costs due to significant incidents (highlight how changes were involved in the cases).

    - Scenario: Consider if a valve supplier purchased valve bodies with valve stem from a manufacturer in another country. As the valve is used there is wear and tear and the valve requires periodic refurbishing. The valve supplier uses a local machine shop to do the valve refurbishing. Part of this is the replacement in kind of the valve stem. This replacement does not fit the criteria for MOC. As the machinist is working on the stem he is required to drill a hole in the end of the stem for this particular valve. It is required to be precisely placed to fit in the completed valve. In one case, the hole is drilled incorrectly. Not understanding how the valve is used and the potential results of the mistake, the machinist gives the stem a quarter-turn and drills another hole in the appropriate location. The resulting ''change'' is not reported to a supervisor and evaluated. The change from the additional drilled hole causes stress concentrations and weakens the valve stem. The stem is installed in the valve and the valve is greased and returned to the company renting the valve. As the valve is used, the valve stem fails causing severe damage to the associated piping.
    - This scenario could result in the work crews for this particular company using this style of valve shutting down operations for an investigation until the reason for the failure is identified (an example of a failure is shown in Figure 26.3). This could cause operational impacts, schedule delays, and financial loss to the valve rental company, the company using the valves and to subcontract work crews. All of these factors combined can also easily result in litigation of some form.
- Will the key stakeholders actively engage and actively provide support for the program development?
  - Determine ahead of time who is your key supporter and who is your key challenger. Determine if they need interim reports or additional research provided. Adjust your strategy to keep them both appropriately informed and respond to any concerns well before any official presentations, reports, or roll-outs in order to ensure success.

Figure 26.3 Example of failure involving stress concentration.

If the answer to any of the above questions is no, then you probably need to change your strategy. Determine who your supporters are and build from that base. Identify the non-supporters and identify the key items that need to be educated or changed in order to win their support. Determine if there are any neutral stakeholders and identify a strategy to win their support. Leadership commitment is absolutely critical to having an effective MOC program.

Determine an appropriate depth of the MOC program that will be initially successful. Remember that this is a dynamic program and it can grow and mature over time. To help ensure early success and maintain leadership support, it is best to keep it simple at first. The considerations should include the following:

- What "changes" will be included in the scope of the program?
- How detailed and technical will the forms be?
- How involved will the risk assessment be?
  - Risk assessment is a critical component of the MOC program. The best case scenario is to have a well-developed risk assessment program and the MOC program can dovetail with it and strengthen both programs. Risk assessment includes a methodical process to identify hazards and risks, evaluate the options for eliminating or mitigating the risks, and determining the best solution for the proposed change.
- What systems or procedures are already in place that can be integrated into the MOC program? Example: if an adequate risk assessment program is already in place, the MOC program can work in conjunction with the extant procedures.
- What document or workflow systems are already in place that can be integrated into the MOC program? Example: will the MOC forms require hand signature authorizations and hardcopy filing or is there an electronic document system with a workflow such as Maximo (IBM, 2012), SAP (SAP, 2012), or other?
- What filing systems can be used to track and ensure that approved changes are completed and that the change worked as intended?

Develop the tools for the MOC program. These should include the following:

- Written MOC program outlining definitions, authority approval levels, and workflow processes.
  - Appropriate form(s) to identify the desired change and the required analysis. The analysis should include information about the existing or as-is state and the desired change highlighting the end-state. There should be a risk assessment component to identify the impacts of the change and a risk versus reward evaluation of the change. The form should include an approval signature section.
    - One can see from Figure 26.4 that a general risk assessment done with the right technical knowledge can be simple. There are more complex risk assessment tools that are available for more complex systems. These systems are not within the scope of this discussion.
  - The form(s) should identify the owner of the intended change, the key stakeholders who will be consulted for the analysis, and stakeholders who will be informed of the change as approved.

1. Determine the scope of the risk assessment. (What subject matter is to be considered and what subject matter is to be excluded).
2. Determine any external issues that may impact on the risk assessment such as legislation, industry codes or standards, etc.
3. Determine any internal issues that may impact on the risk assessment such as Company standards or procedures.
4. List assumptions that have been made for the purpose of the risk assessment.
5. Determine the required team for the hazard assessment. Are all key stakeholders represented? Should external experts be involved or consulted? The analysis should be carried out by a team of not fewer than three members, nor more than eight. The team should include: someone who can answer fairly detailed technical questions, someone who has a good idea about how the machine / equipment / process will be operated, and someone who has a good idea about how the equipment / machine / process will be maintained.
6. What resources are needed to carry out the risk assessment?Assemble all applicable documents, operating instructions, specifications and drawings.
7. What records will need to be kept as a result of the assessment?
8. What hazard identification methodology will be used?
    a. Brainstorming (don't prematurely screen at this stage)
    b.Checklists
    c. Process Hazard Analysis
        i. Haz ID
        ii. What if
        iii. HAZOP
        iv. Failure Mode & Effect Analysis (FMEA)
    d. Machinery Hazard Analysis
    e. Fault Tree Analysis
    f. Event Tree Analysis
    g. Human Error Analysis
9. What safety standard is to be achieved? I.e. Define the level of expenditure of financial or staff resources to be devoted to risk management.
10. Where will the risk assessment be held?
11. How long is the risk assessment expected to take? I.e. will attendees be available for the whole risk assessment?
12. Identify the potential impacts from the proposed change.
13. Complete (as required):
    a. Site walk-through or inspect a similar machine / equipment / process if possible.
    b. Document review
    c. Task observations of work in progress (current state)
14. Use the Risk Assessment Worksheet to record notes from the steps below.
15. Identify the potential hazards from the proposed change.
    a. Brief all team members about the machine / equipment process to be studied.
    b. Subdivide the machine / equipment / process into functional parts or mark up process and instrument drawings (P&ID's) into appropriate nodes for analysis i.e.
        i. Machine frame or equipment structure
        ii. Moving parts, subassemblies of moving parts, mechanisms, etc.
        iii. Power supplies
        iv. Control
    c. List the phases of the machine / equipment / process i.e.
        i. Erection or on-site assembly
        ii. Setting up and commissioning
        iii.Training of operators and maintenance people
        iv. Operation and routine cleaning
        v. Maintenance
        vi. Fault finding
    d. Undertake the analysis using the worksheet and each pre-identified key word from list below. Add as required.
        i. Possible hazardous situation
        ii. Potential causes of the hazardous situations
16. Identify "what can happen".
17. Identify "how and why it could happen".
18. Determine "credible worst case consequences" if risk controls fail or are ineffective.
19. List existing control measures.
20. Assuming the risk controls to be in place, estimate realistic consequences (note that realistic consequences will generally be less than credible worst case consequences.
21. Assuming the control measures to be in place, estimate the likelihood of the event occurring and yielding the realistic consequences.
22. Estimate the risk level using your company risk matrix. Refer to example matrix.
23. Determine if additional controls are required. If so, re-calculate risk taking the new controls into account.
24. Determine if the results are acceptable or manageable. If yes, plan to approve the proposed change. If no, provide feedback to the originator of the proposed change.

Figure 26.4 General risk assessment.

Customize according to the type of change proposed

Personal Protective Equipment				
Impact	Penetration	Compression (roll over)	Chemicals	Thermal
Harmful Dust	Harmful Light	Contact with Moving Parts	Noise	Harmful Gas / Mist / Fumes
Radiation				
People				
Procedures	Training	Level of Alertness Required	Tools and Equipment Used	Ergonomics / Workflow Positioning
Physical Strength Requirements	Height Requirements			
Materials				
Compatibility (Erosion / Corrosion, etc.)	Container Packaging (sizes, shapes, warehousing, materials handling, etc.)	Waste Disposal	Transportation (Dangerous Goods, Emergency Response Plans, etc.)	
Flashpoint	Reactivity	Heat Flux	Toxicity	
Engineering Design and Hardware				
Equipment Data Sheets	Energy Consumption	Plant Layout	Piping & Instrument Diagrams	Isolation and Lockout
Wiring Diagrams	Static Electricity/ Lightning / Bonding & Grounding	Operating Guidelines	Power Supply & Backup	Electrical Classification
Material of Construction Specifications	Process Flow Diagrams			
Instrumentation and Controls				
Transmitters	Control Logic	Set Points	Safe Operating Limits	Alarms (Audible & Visual)
Labels	Visual Displays	Meters		
Loads on or Strengths of				
Foundations	Structures	Vessels	Pipeworks	Supports
Electrical Systems				
Emergency Systems				
Relief Valves	Alarm Systems	Fire Suppression	Ventilation	Isolation Valves
Emergency Shutdown Systems	Emergency Exits & Routes	Fire Separation (Walls / Doors)	Intrinsically Safe Lighting	Fail Safe Systems
Explosion Proof Systems				
Process Condition - deviations				
Temperature	Pressure	Flow	Phases	Deterioration
Process Condition – guide words				
None	More of	Less of	Part of	More than
Other than	Reverse			
Process – failure mode words				
Rupture	Crack	Leak	Plugged	Failure to open
Failure to Close	Failure to Stop	Failure to Start	Failure to continue	Spurious stop
Spurious Start	Loss of Function	Overfilling	Hose Bypass	Instrument Bypassed

Figure 26.4 (*continued*)

- There should be a communications plan included in the form(s) to outline to whom and how the intended change will be communicated and an appropriate timeline of communications.
  - One can see from the MOC form example in Figure 26.5 that the forms can be as simple or as complex as the organization requires them to be.
- There should be a MOC training plan to ensure that training is given to the different interest groups such as those who will initiate and approve changes and those who will be affected by the resulting changes. The training should include an explanation of the MOC program and associated documents and tools and also organizational details of roles, responsibilities, accountabilities, and who is required to be informed of specific changes.
- There should be a workflow process, either hardcopy filing or an electronic system, to track proposed changes, changes in progress, changes completed, and changes not approved. One can see from Figure 26.6 that a simple workflow can help new users see that the MOC program is not overwhelming.

Run the examples using the draft tools through the workflow process to ensure that all gaps are identified and resolved before the program is rolled out to the intended users.

Once the Development Team is satisfied that the program is ready for the initial rollout, develop the communications and training plan for the intended users. Build into the rollout program a feedback system to ensure that efficiencies and potential problems are identified for continuous improvement.

A formal MOC program is a logical program to have if you are involved in process safety, personnel safety, or engineering fields. In the first author's experience, most MOC programs that are developed involve the safety and engineering functions. In reality, change originates from many other functions. Determine how these functions will be educated about managing changes. These functions do not necessarily need to use the MOC program of checklists, forms, and risk assessments but they do need to manage change effectively by analyzing the potential consequences, developing communications and training plans, and having feedback loops. These functions can develop their own procedures for how their specific changes will be managed. Examples of these equally critical functions include information technology (IT), human resources/human services, security, records management/document control, training, procurement, contracts, and warehouse inventory.

Some additional forms that may help implement a sound MOC program include the examples shown in Figure 26.7 of a risk assessment table and worksheet.

26.5 Executing the Change

Change comes into play for many reasons and from many different places. Sometimes it is not even recognized as a change – it is dressed up as a wolf in

MOC Tracking

1	Complete the following.	
		MOC tracking number
		Date MOC submitted
		Location of proposed change
		Equipment or asset ID number
		Originator of proposed change
		Originator contact information
		Drawings, diagrams, specifications or regulatory requirements are attached. (List)

Request for Change

2	Identify current state.			
	Identify change(s) required. *Place an 'x' in the applicable boxes.*			
		Administrative		
		Engineering and technical changes		
		Organizational and staffing changes		
	Identify type of change(s) required. *Place an 'x' in the applicable boxes.*			
		Permanent. Complete full MOC.		
		Temporary (less than 60 days). Note that this change must be scheduled for a review within 60 days to ensure it does not become permanent.		
		Emergency. Note that this change must be scheduled for a review within 7 days to determine if a temporary or permanent MOC is required. Verbal reviews and approvals are acceptable for emergency changes.		
	2a	Describe proposed change.		
	2b	Describe benefits of the change / risks of not implementing the change.		
	2c	Describe risks of implementing change.		
	2d	Describe risks. (Interim and for the completion of the change).		
	2e	If the change is approved a complete documented risk assessment is required before the change is initiated. Identify the risk assessment team. Refer to General Risk Assessment.		
	2f	Describe the costs involved.		
		$	Engineering & Development	
		$	Materials & Supplies	
		$	Labour & Contracts	
		$	Estimated Project Total Cost	
	2g	Projected timeline:		
			Planning & preparation (hours or days)	
			Implementation (hours or days)	
			Commissioning & verification (hours or days)	
			Total projected time required (hours or days)	
	2h	Describe additional resources required.		
			In-house personnel	
			External (contractors, consultants, etc.)	
			Other	
	2i	Proposed start date and projected end date.		
	2j	Describe the communication plan for the change implementation.		
	2k	Describe the training required for the change.		
	2l	Describe any additional changes or updates required subsequent to the change (documents, notifications, etc.).		

Figure 26.5 Example of a MOC form (author developed).

Review Workflow

3	Identify reviewers. Mark an x for required reviewers. Mark an o for optional reviewers.			
	Low Risk / Low Cost / Low Impact Changes			
	X	Next-level Supervisor (mandatory): Name: Phone:		Peer Reviewer: Name: Phone:
		Health, Safety, Environment Rep.: Name: Phone:		Engineering / Other: Name: Phone:
	Medium Risk / Medium Cost / Interdepartmental Impacts			
	X	Next-level Supervisor (mandatory): Name: Phone:		Peer Reviewer: Name: Phone:
		Health, Safety, Environment Rep.: Name: Phone:		Engineering / Other: Name: Phone:
	X	MOC Coordinator (mandatory): Name: Phone:	X	Manager: Name: Phone:
	High Risk / High Cost / Interdepartmental Impacts			
	X	Next-level Supervisor (mandatory): Name: Phone:		Engineering / Other: Name: Phone:
		Health, Safety, Environment Rep.: Name: Phone:	X	Manager: Name: Phone:
	X	MOC Coordinator (mandatory): Name: Phone:	X	VP: Name: Phone:
	Date reviews must be completed by:			

Review Acknowledgement

4	Required reviewers sign and mark as appropriate. Provide Comments as appropriate.					
			Not Approved	Approved with Required Changes	Approved with Recommended Changes	Approved
		Title: Name: Phone: Date: Comments:				
		Title Name: Phone: Date: Comments:				
		Title: Name: Phone: Date: Comments:				
		Title Name: Phone: Date: Comments:				

Figure 26.5 (*continued*)

Final Approval to Execute Change

5	Required approvers sign and mark as appropriate. Provide date and comments as appropriate.					
			Request Denied	Approved with Required Changes	Approved with Recommended Changes	Approved and Authorized to Proceed
		Title: Name: Phone: Date: Comments:				
		Title: Name: Phone: Date: Comments				

Closure

6	MOC Originator is responsible to complete verification that the change has been completed as planned and verify that the results are as intended. Identify follow up actions required to finalize the change implementation.			
		Title: Name: Phone: Comments:	Date of Verification & Validation:	
		Follow Up Actions Required		
		Action:	Assigned to:	Target Completion Date:	Actual Completion Date:
	Date MOC is closed: Authorized by MOC Originator (sign):			

Figure 26.5 (*continued*)

sheep's clothing, as an ''improvement opportunity.'' Many incident investigations, in the first author's experience, have shown that good intentions are notorious for having unintended consequences. The MOC process, formal or otherwise, can reduce the negative effects of unintended consequences.

Senior leaders receive information with a variety of methods and formats. Instructions are given to subordinates to take to the workforce. Senior leaders can show active support for the MOC program by doing a few simple things, such as:

- Question subordinates and front-line supervisors to clarify the current process, procedure, or state.
- Verify with the appropriate technical staff if the desired instruction or directive is in fact a change from the current process, procedure, or state.
- If it is a change, determine if it fits the criteria requiring additional analysis, risk assessment, communication, and training.

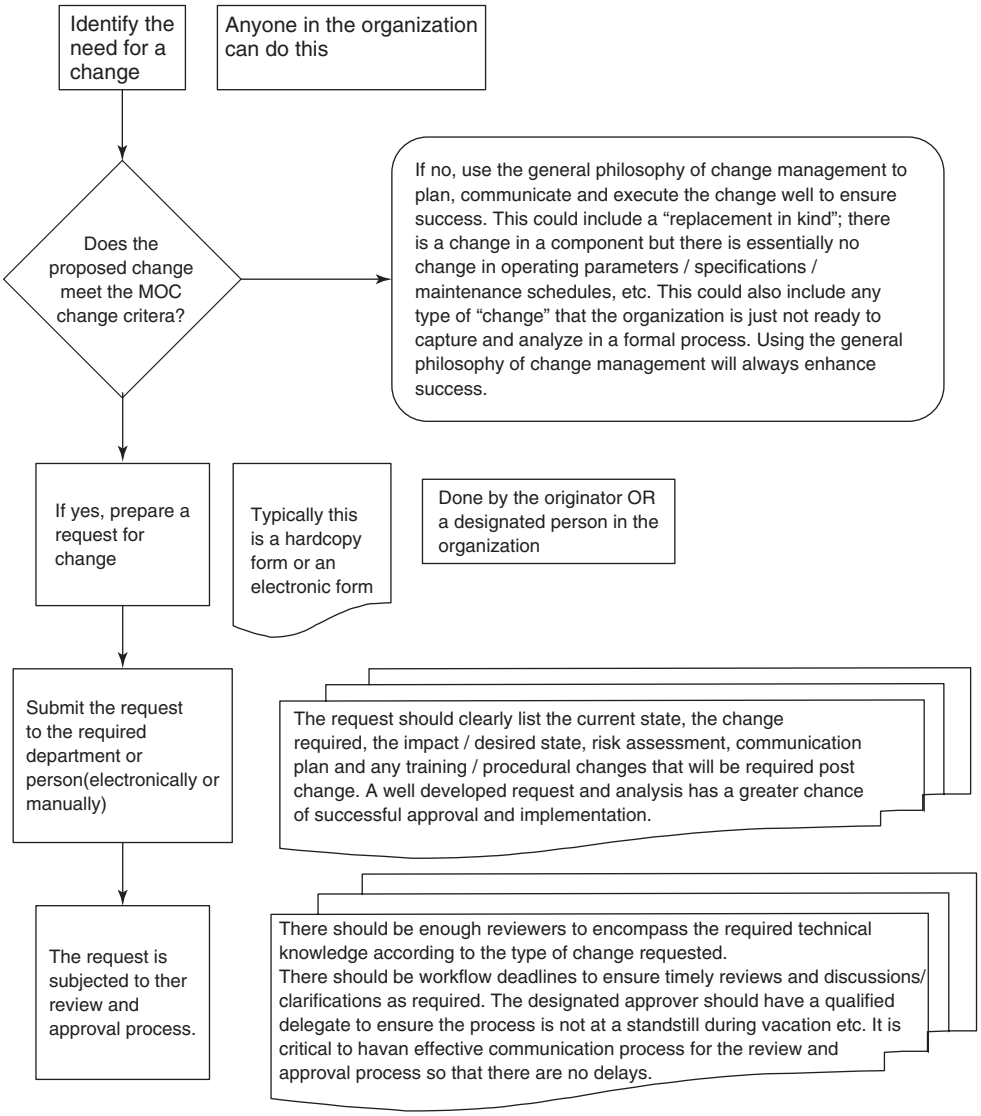

Figure 26.6 Generic flow diagram of a typical MOC process.

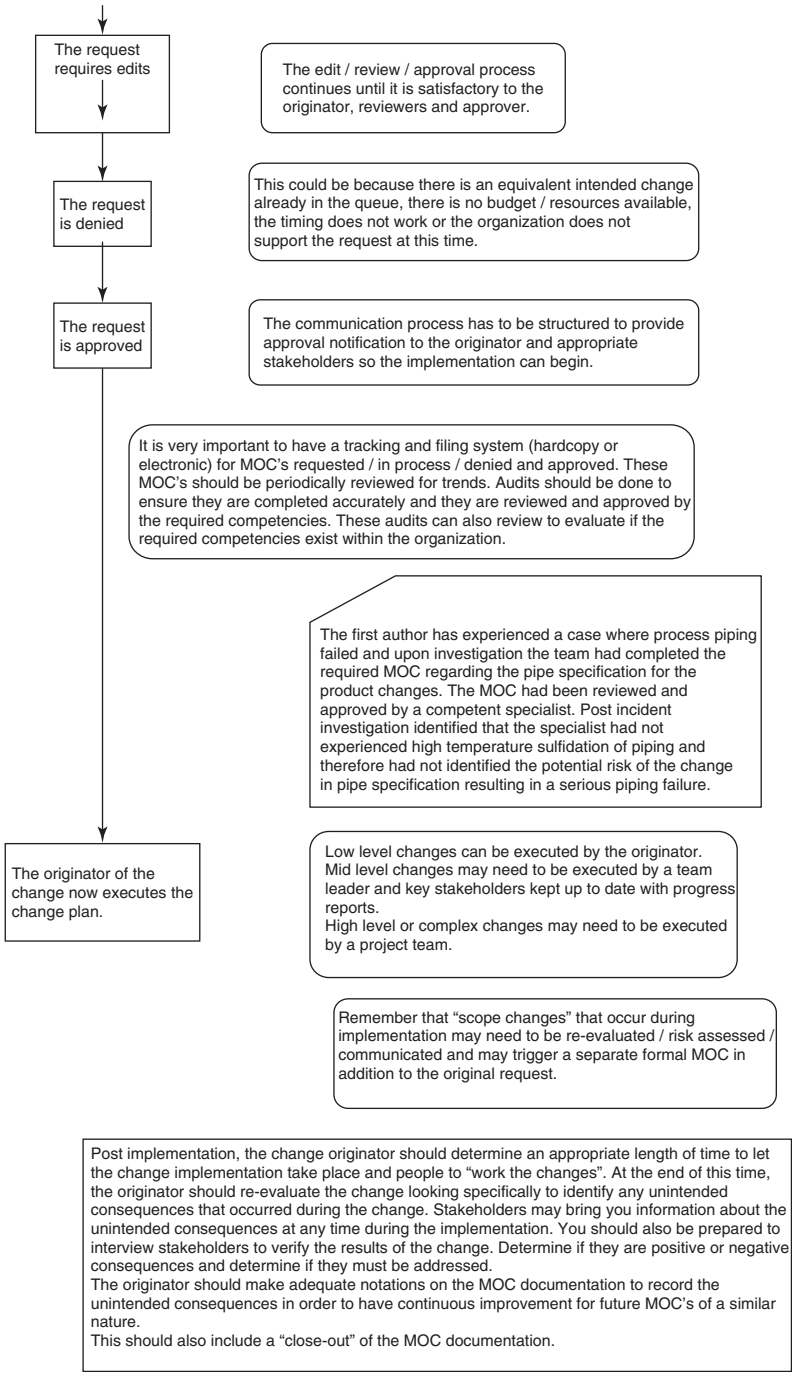

Figure 26.6 (*continued*)

	JOB TASK	ACTIVITIES	HAZARDS / THREATS / UNWANTED EVENTS	POTENTIAL CAUSES OF UNWANTED EVENT	RISK SCORE BEFORE CONTROLS
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

	EXISTING RISK CONTROLS				
	TRAINING	PREVENTION	MONITORING	CONTINGENCY	RISK SCORE WITH EXISTING CONTROLS
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

	PROPOSED RISK CONTROLS			
	DEFICIENCIES	RISK SCORE AFTER DEFICIENCIES COMPLETED	ASSIGNED TO	TARGET DEADLINE FOR IMPLEMENTATION
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

(a)

	EXAMPLE of Risk Category and Criteria: SAFETY		Severity		Probability A	B	C	D	E		
1	Close call, substandard act or condition, minor first aid, damage less than $100	1		1	1A Low	1B Low	1C Medium	1D Medium	1E High	1	Low
2	Medical treatment, modified work less than 14 days, damage less than $500	2		2	2A Low	2B Medium	2C Medium	2D High	2E High	2	Medium
3	Modified work 14 days or greater, damage less than $1,000	3		3	3A Medium	3B Medium	3C High	3D High	3E High	3	High
4	Lost time injury, damage less than $5,000	4		4	4A Medium	4B High	4C High	4D High	4E High	4	
5	Fatality	5		5	5A High	5B High	5C High	5D High	5E High	5	
					A Rare, practically impossible	B Unlikely, not likely to happen	C Moderate, possible, it might happen	D Likely to happen at some point	E Almost certain to happen		

Manageable with existing controls

Implement additional controls & monitor

Evaluate alternate options / defer or share risk

(b)

Figure 26.7 Example of a risk assessment worksheet.

Occasionally, subordinates identify that a directive is a change but they do not want to rock the boat or point this out to senior leaders. If the organizational culture can be created such that it is safe and encouraged for subordinates to point out ''changes'' that need to be evaluated, and where senior leaders truly question and identify the current state, then managing change will become part of how the organization does business. The risk to the senior leaders is that if these changes are not identified there may be unintended consequences such as incidents, injuries product degradation, schedule delays, reputational deterioration, and many others.

Mid-level managers and front-line supervisors have a great opportunity to influence how change is managed within their functions. They can be the watch-dog to make sure that their team is using the existing MOC program as intended. They can ensure that other procedures, practices, and standards are developed using the intent of evaluating change. They can inspire their teams to see the value in well-executed change strategies. Empower these leaders so that they can execute and be a key component of the feedback loop. This is how continuous improvement is achieved.

Front-line workers initiate authorized and unauthorized changes. Workers fundamentally want to do a good job and they want to have production. Incident investigations show that workers routinely use more context than official policies, slogans, or mission statements to infer what their immediate supervisor really wants. If the supervisor rewards a short-cut behavior that achieved desirable results, and the supervisor recognizes the worker for the results (but not the short-cut), the worker's brain has reinforced that it was a good thing to do. Supervisors and managers have to work diligently to understand how the results are achieved. Production means a variety of things in different industries but the basic intent is that the workers do not want to be on the spot for trucks not hauling, gas not being processed, the widgets not being made, and the bottom line not being met. In this inherent desire to have production, workers make daily decisions when they encounter problems. For example, a plant operator runs his circuit and monitors the production. The circuit keeps tripping and production stops until the operator returns and adjusts/evaluates and gets it going again. This operator will research and do whatever he has to do to keep his circuit running. Occasionally this may mean adjusting set points or operating limits of his equipment, or blocking relief valves, or adjusting how he follows a certain procedure. It is done with good intentions but he may not fully understand the impacts of what he has changed.

A good training program outlining the MOC program can help prevent this. Certain tasks and equipment may require written training, certification, or authority levels to be able to perform the task. Procedures and task observation programs help verify that workers are not performing unauthorized deviations.

Front-line workers also initiate many authorized changes. All potentially unauthorized changes such as what was discussed above can easily be flipped to problem identification and then the front-line worker can be the initiator of the change. This is particularly successful when the front-line worker knows that he has many facets of technical expertise to help with the analysis and solutions.

Often, the middle management or front-line supervisor receives the initial instructions for starting the change. These leaders often foresee potential problems with a change or execution plan, but the red tape involved in stopping and re-evaluating is seemingly insurmountable. There may also be personalities above them who do not want to hear the warning message. Ensure that the feedback loop is such that these warning messages can be heard and analyzed. This is the only way that appropriate action can be taken to improve the chance of a successfully implemented change.

If a MOC analysis has involved the appropriate technical people including the trades or workers who will be performing the change, or those who are directly affected by the change, the execution of the change will be a validation that the analysis was thorough and effective. If the MOC analysis has not been thorough, the analysis may miss this last control point to identify potential problems and address them before there are unintended consequences. Front-line workers who are empowered to identify potential problems and be part of potential solutions can be a very positive part of the execution process. On the flip side, in the first author's experience, front-line workers who are not heard can be hot spots triggering disenchantment with leadership and poor morale.

Processes that clearly identify technical authorities or originators can help to support the feedback loop for change execution. The best case scenario is to have a specific name and not just a title or a department so that potential problems can be communicated to the appropriate authority and level for analysis. One caveat to this is that as staff changes occur, a process must be in place to have all associated documents such as procedures, telephone lists, and organizational charts updated with new or interim names. When workers try to communicate a potential problem and encounter obstacles, many give up and let the problem take its course. The age-old saying ''I told you so'' or ''I knew that was going to happen'' is heard around the coffee room. We need to make sure that we hear the messages about potential problems early in the process.

26.6 Scalable MOC

Build the change management philosophy so that it is scalable. Keep it simple enough to be used at the local level and have the processes broad enough to encompass regional and global changes. As the magnitude of the change grows, so do the systems required to keep the analysis and communication plan pertinent to the required stakeholders.

Local changes can include area or departmental changes to materials such as substitutions based on environmental impact, changes to specifications such as piping or electrical, or changes to procedures and training documents. These changes may be initiated from inspection or investigation findings or task observations and procedure reviews.

Regional changes can encompass all local changes and also tools and processes that may be different between regions. These may include regulatory compliance procedures and reporting requirements; corporate requirements for northern regions or countries may be considerably different to those for southern regions or countries. In many cases where corporate requirements cannot be met, a variance procedure is followed. This variance procedure should mirror the intent of the MOC program in order to ensure that any unintended consequences are identified and addressed before problems arise.

As organizations change in size and operating locations, the workforce moves around. Many of these changes are addressed through project planning and follow the same philosophies as MOC. The remaining changes should still be addressed through the development of departmental procedures, risk assessments, and MOC program implementation.

26.7 Pitfalls to Avoid

Often large catastrophic examples are used to illustrate the potential results of inadequate MOC. When building education packages and proposals, do not focus only on the large ''breaking news'' cases; often the audience cannot relate their organization or department to those extreme examples. Often, large cases can be broken down into understandable pieces, with many instances of where things went wrong on individual or team levels. These examples can resonate closer to the heart with stakeholders and the people performing these tasks and you will get more active engagement into the process.

Clearly understand the current state of your organization and your Development Team. Determine achievable and clear objectives for the staged development of your MOC program. Do not try to boil the ocean in one try, otherwise you are doomed to fail. As the program is developed and as the workforce sees value in the program momentum will gather and then the Development Team can stage the next set of clear and achievable objectives.

Where there are people there are opinions, conflicts, champions, and feet draggers. Identify potential champions and potential challenges and use both to your advantage. Often the people who complain and present roadblocks have valid reasons. They may be used as a sounding board or should be involved as appropriate in the development or rollout.

Set realistic deadlines based on your resources. Clearly identify milestones that can help gauge the successful implementation of the program. Communicate clearly and regularly with your key stakeholders so that you have their continued support as the Development Team navigates the implementation.

Use your communications plan to bridge between the known processes and procedures that are vital to the MOC program and the unknown components of the MOC program. Present the information to show how much people already know about managing change and how much they already do to manage change effectively so that the perception of the change that is coming is not that huge.

An effective MOC program touches all facets of the organization and virtually all of the people – particularly if the program fully encompasses administrative, organizational, and engineering changes. This could include human resources, HSE, maintenance and operations, engineering, right down to the janitor using chemicals, and contractors hired. Do not become inflexible as you negotiate the details. Keep your eye on the prize and work with the stakeholders. Show that if they succeed, the program succeeds.

Once the MOC program is implemented, use the validation and verification or audit programs to ensure that the right people are involved in the analysis and in the approval stages of the process. Often the steps can be followed but without the knowledge and understanding of the information, a change can be authorized and completed only to resurface later as a finding in an inspection or incident investigation.

26.8 Success Stories

Everyone wants to be part of the winning team and you cannot do it without them. The Development Team should communicate the milestones before they occur so that people know what the desired behavior is, tell the people the results when each milestone is met and share success stories and learning opportunities. Functional leaders and teams can show active engagement by talking about the benefits to the organization from well-executed change management in their regular meetings.

Thank people for their efforts. Even with all of the world's automation and digitization, we are still human beings. Everyone wants to feel they are part of the community and that they contributed to the overall success.

26.9 Conclusion

Many of an organization's internal workings can positively or negatively impact how well change is managed. This is why managing change has to be an inherent philosophy on how to do business successfully and not just a safety and engineering program.

Develop solid verification and validation processes such as audits, inspections, task observations, and procedure reviews to help support the feedback loop and continuous improvement. Performance indicators can help keep the program sustainable and on the radar for leaders. Many organizations track performance indicators, such as:

- number of changes proposed
- number of changes approved
- number of changes completed
- number of incidents where ineffective change management is identified as a contributing factor or near root cause.

The MOC program can be a key driver of the success of your organization or business because it is so widely applicable. It does not have to be difficult or onerous; it just has to be a philosophy of how the organization does business.

Play it forward. Think about the things that you do, the things that you change and visualize, analyze, and risk assess the effects. If you are satisfied with what you see, continue. If not, go back and address the potential problems.

26.10 Tools and Resources

- Forms and checklists – best developed specific to the organization.
- Incident investigation methodology – such as TapRooT© to identify changes that resulted in a problem or incident and determine smarter corrective actions.
- LinkedIn® discussion groups.

26.10.1 Web Sites

- *http://en.wikipedia.org/wiki/Change_management_(engineering)*
- US Chemical Safety Board Investigation web site for the BP America Refinery Explosion at Texas City, *http://www.csb.gov/investigations/detail.aspx?SID=20*.

26.10.2 General Interest Books

There are many large-scale examples that can illustrate why an effective MOC program is critical, two of which are outlined in Chapter 8: the disasters at Chernobyl (Russia) on 26 April 1986 and the Dutch State Mines Nypro Plant at Flixborough (UK) on 1 June 1974 (Atherton and Gil, 2008).

26.11 Accreditation Groups

- Association of Change Management Professionals, *http://www.acmp.info/index.asp*.
- Change Management Institute, *http://www.change-management-institute.com/*.

References

Atherton, J. and Gil, F. (2008) *Incidents That Define Process Safety*, John Wiley & Sons, Inc., and American Institute of Chemical Engineers, New York.

CCPS (Center for Chemical Process Safety) (1995) *Guidelines for Safe Process Operations and Maintenance*, John Wiley & Sons, Inc., and American Institute of Chemical Engineers, New York.

CCPS (Center for Chemical Process Safety) (2008) *Guidelines for the Management of Change for Process Safety*, John Wiley &

Sons, Inc., and American Institute of Chemical Engineers, New York.
CCPS (Center for Chemical Process Safety) (2008b) *Incidents the Define Process Safety*, John Wiley & Sons, Inc., and American Institute of Chemical Engineers, New York.
Chiles, J.R. (2002) *Inviting Disaster: Lessons from the Edge of Technology*, HarperCollins, New York.
Hammer, W. (1989) *Occupational Safety Management and Engineering*, 4th edn, Prentice Hall, Englewood Cliffs, NJ.
Hyde, C.R. and Dixon, L. (2000) Pay It Forward. DVD, directed by Mimi Leder, Warner Bros, Los Angeles.
IBM (2012) Maximo Asset Management, *http://www-01.ibm.com/software/tivoli/products/maximo-asset-mgmt/* (last accessed 12 March 2012).
NHTSA (National Transportation Safety Administration) (2012) *http://www.nhtsa.gov/* (last accessed 1 April 2012).
SAP (2012) SAP Organizational Change Management, *http://www.sap.com/services/portfolio/program-project-quality assurance/servicedetail.epx?context=%5b%5bt%3d32e374b%5d%5d%7c* (last accessed 12 March 2012).
US Chemical Safety and Hazard Investigation Board (2001) Safety Bulletin No. 2001-04-SB1, *http://www.csb.gov/assets/document/moc0828011.pdf* (last accessed 30 April 2012).

Further Reading

Anderson, D. and Anderson, L.A. (2010) *Beyond Change Management: How to Achieve Breakthrough Results Through Conscious Change Leadership*, 2nd edn, Pfeiffer, San Francisco.
Andler, N. (2012) *Tools for Coaching, Leadership and Change Management*, John Wiley & Sons, Inc., Hoboken, NJ.
Cameron, E. and Green, M. (2004) *Making Sense of Change Management: a Complete Guide to the Models, Tools and Techniques of Organizational Change Management*, Kogan Page, Philadelphia, PA.
Chang, R.Y. (1999) *Mastering Change Management: a Practical Guide to Turning Obstacles into Opportunities*, Pfeiffer, San Francisco.
Cohen, D.S. (2005) *The Heart of Change Field Guide: Tools and Tactics for Leading Change in Your Organization*, Harvard Business Review Press, New York.
Finch, E. (ed.) (2011) *Facilities Change Management*, Wiley-Blackwell, Oxford.
Floyd, P. (2002) *Change Management*, Capstone, Oxford.
Heldman, K. (2005) *Project Manager's Spotlight on Change Management*, Harbor Light Press, Alameda, CA.
Kotter, J.P. (1996) *Leading Change*, Harvard Business Review Press, New York.
Watkins, M. (2003) *The First 90 Days: Critical Success Strategies for New Leaders at All Levels*, Harvard Business Review Press, New York.