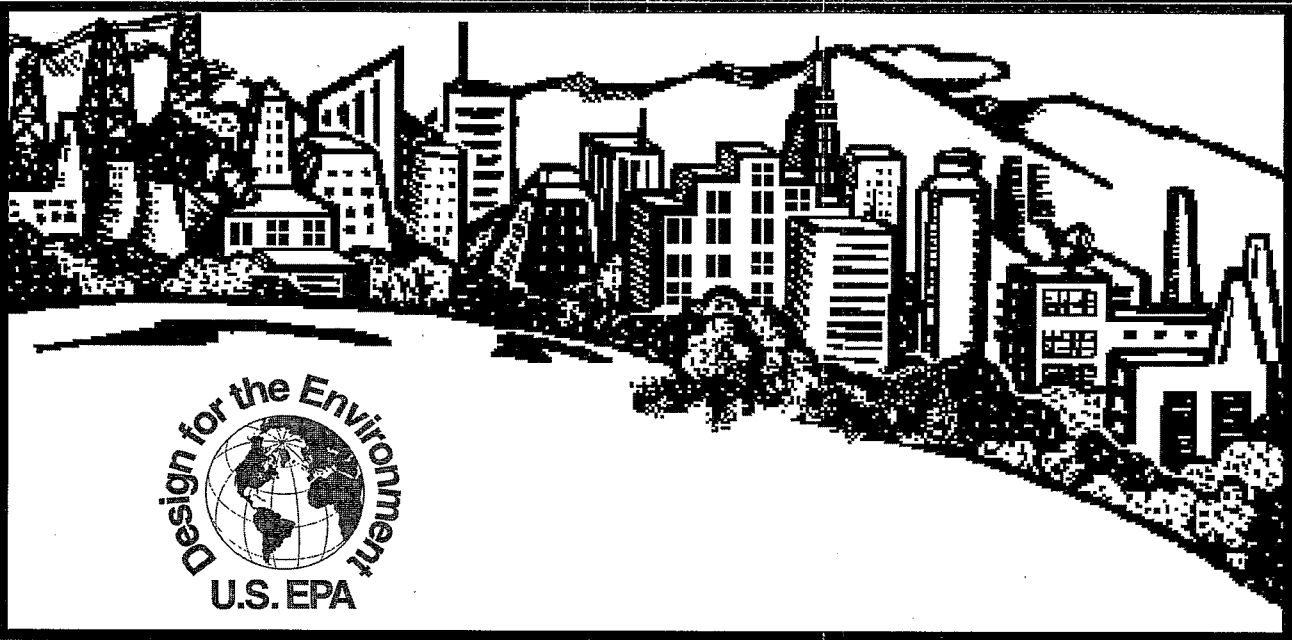
United States Environmental Protection Agency
Office of Pollution Prevention and Toxics (7406)
EPA 744-R-00-011
October 2000

Integrated Environmental Management Systems

Implementation Guide



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Design for the Environment
U.S. EPA

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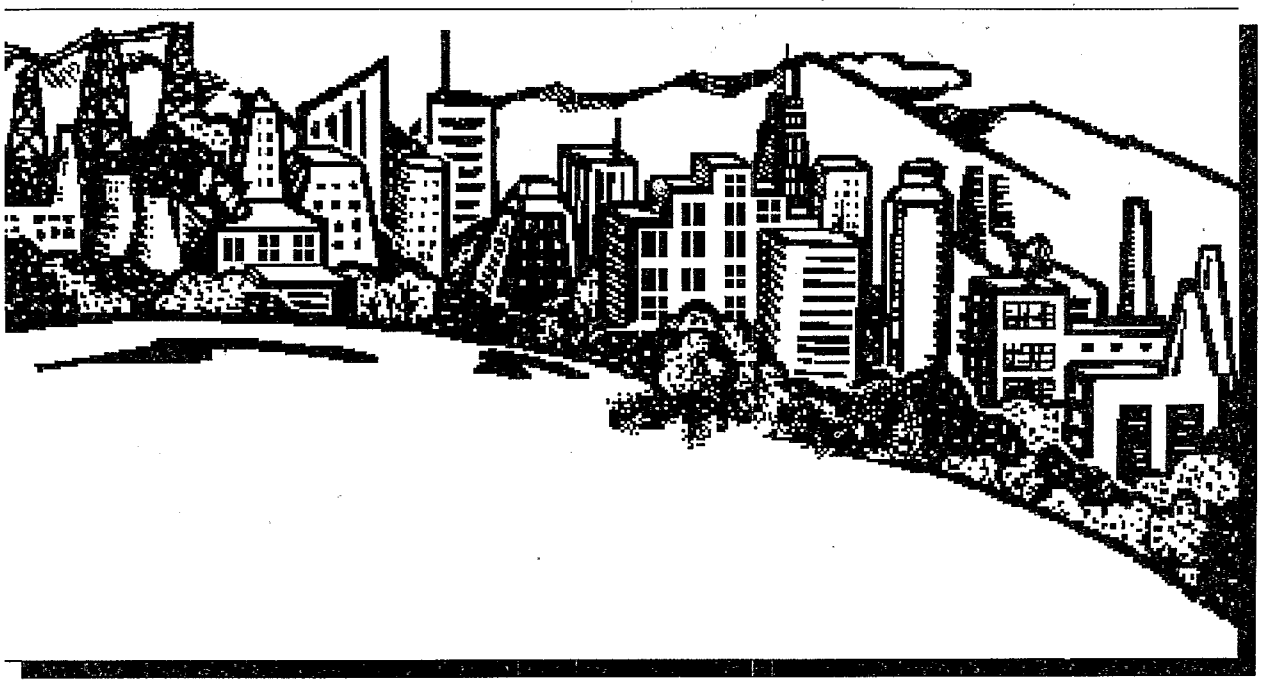
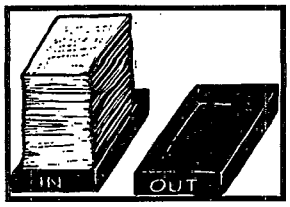


Acknowledgments

This Guide was prepared by Abt Associates Inc., Cambridge, MA, with Jean E. (Libby) Parker as lead author. It is part of an effort to show how Design for the Environment (DfE) technical work can be used to support development of an **Environmental Management System (EMS)**. This Guide is based primarily on EMS reference documents acknowledged in the references section, and on DfE guidance documents such as the Cleaner Technologies Substitutes Assessment Methodology. The EPA Project Manager was Karen Chu, with the Design for the Environment Program in the Office of Pollution Prevention and Toxics. Bill Hanson is Director of the Design for the Environment Program. Important contributions were made by Carol Hetfield, Heather Tansey, Ted Cochin, and Jenny Fisher, EPA. The Abt Associates project team included Cheryl Keenan, Dennis Chang, Susan Altman, and Jonathan Greene. Important contributions were received from the Eastern Research Group, Inc. (ERG), Lexington, MA, and from the University of Tennessee, Knoxville Center for Clean Products and Clean Technologies. The ERG project team included Jeff Cantin, Dave Galbraith, and Owen Davis. The University of Tennessee project team included Lori Kincaid, Mary Swanson, and Kerry Kelly. Valuable contributions were provided by Marci Kinter and Dan Marx of the Screenprinting & Graphic Imaging Association International (SGIA), Fairfax, VA, and by Foster Knight and Bob Ferrone of The Lexington Group, Lexington, MA. Useful comments were received from William T. Engel, Jr. of the Strategic Environmental Management Institute at the University of Florida's Center for Training, Research and Education for Environmental Occupations (UF/TREEO), Gainesville, FL.



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Foreword

EPA's Design for the Environment (DfE) Program has over eight years of experience building voluntary partnerships with industry, public interest groups, universities, research institutions, and other government agencies to develop cleaner, safer alternatives to existing products and processes and to manage change in the systems businesses use to address environmental concerns. The DfE Program has developed technical methodologies that provide businesses with environmental, economic, and performance information on traditional and alternative manufacturing methods and technologies. These approaches help businesses integrate environmental concerns into their daily business activities so they can reduce cross media impacts, use energy and other resources efficiently, better manage the risk associated with using hazardous chemicals, practice product and process responsibility, and integrate environmental and worker safety and health requirements. In addition, DfE has gained valuable experience in communicating with a wide variety of people with varying degrees of technical knowledge, and in establishing and maintaining diverse stakeholder groups. The DfE Program is offering this experience to support the development of **Integrated Environmental Management Systems** in companies.

An Environmental Management System (EMS) is a set of management tools and principles designed to guide the allocation of resources, assignment of responsibilities and ongoing evaluation of practices, **procedures**, and processes that a company needs to integrate environmental concerns into its daily business practices. The EMS developed and outlined by

☞ **Tip**

Words or phrases in **bold type** are defined in the Glossary (Appendix A).

☞ **Tip**

The IEMS process described in this Guide will help you develop a results-oriented EMS, but it may not include all steps or core elements necessary for ISO **certification**.

☞ **Tip**

An Environmental Management System provides a systematic way to review and improve operations for better **environmental performance** and improved profitability, by setting up **procedures** that ensure the work gets done. An EMS requires both administrative and technical work.

the International Standards Organization (ISO) in their standard ISO14001 is one such example. The ISO 14001 EMS provides a widely recognized set of principles and standards for integrating environmental management into quality control and other business activities. Although the principles discussed in this document can apply to any EMS based on a plan-do-check-act approach, this document uses ISO14001 as a starting point. In addition to administrative procedures, steps to implement an EMS involve some technical work, such as identifying and prioritizing environmental concerns, evaluating options for addressing those concerns, and measuring the success of implementing those options. The ISO14001 standard does not specify *how* to carry out the technical work.

The DfE Program's approach to creating an EMS provides the DfE Program's technical methods to carry out the technical work of developing the EMS. The technical methods to integrate cleaner technology business methods with the management methods required for an EMS are presented in the DfE Program's Integrated Environmental Management System (IEMS). This approach emphasizes reducing **risk** to humans and the environment, pollution prevention, and wise resource management. The DfE Program principles follow this section. Those elements of the EMS that require strictly management or administrative expertise will be presented so as to demonstrate how the management and technical elements fit together. More detail on the management elements will be found in other referenced sources. This Guide takes you and your company through the IEMS creation process, step by step.

In January 1999, the DfE Program teamed with the Screenprinting and Graphic Imaging Association International (SGIA) to conduct a pilot project with seven screenprinting

companies who wanted to develop IEMSs. The pilot project was designed to enable both the DfE Program and SGIA to further develop these training materials. This Guide has undergone major revisions, and the *Company Manual Template* was developed in response to lessons learned during the pilot project.

DfE Program Principles

A goal of the DfE Program is to create healthier environments for workers, communities, and the ecosystem. The DfE Program accomplishes this goal by promoting system change in the way a company manages environmental concerns. The DfE Program principles and approaches are useful in meeting regulatory requirements and augmenting environmental protection beyond compliance. Using the DfE Program's approach can help a company integrate environmental protection by:

- managing the risk associated with using regulated and unregulated hazardous chemicals,
- considering cross-media impacts of activities and products,
- using energy and other resources efficiently,
- practicing extended product and process responsibility, and
- integrating environmental and health & safety requirements.

Approach

The DfE approach to creating an IEMS has six main steps:

- Identify and compare alternatives to evaluate trade-offs and information gaps.
- Use the DfE Substitutes Tree outline (see Figure A) to evaluate alternatives.
- Use the Pollution Prevention Hierarchy (Figure B) to evaluate and rank approaches.
- Integrate environmental considerations into daily business decision making that includes performance and cost to provide environmental solutions that promote

competitiveness.

- Recognize need for a commitment to continuous improvement.
- Work in partnership with **stakeholders**; engage participation and support of employees; encourage open communication.

Figure A: DfE Substitutes Tree

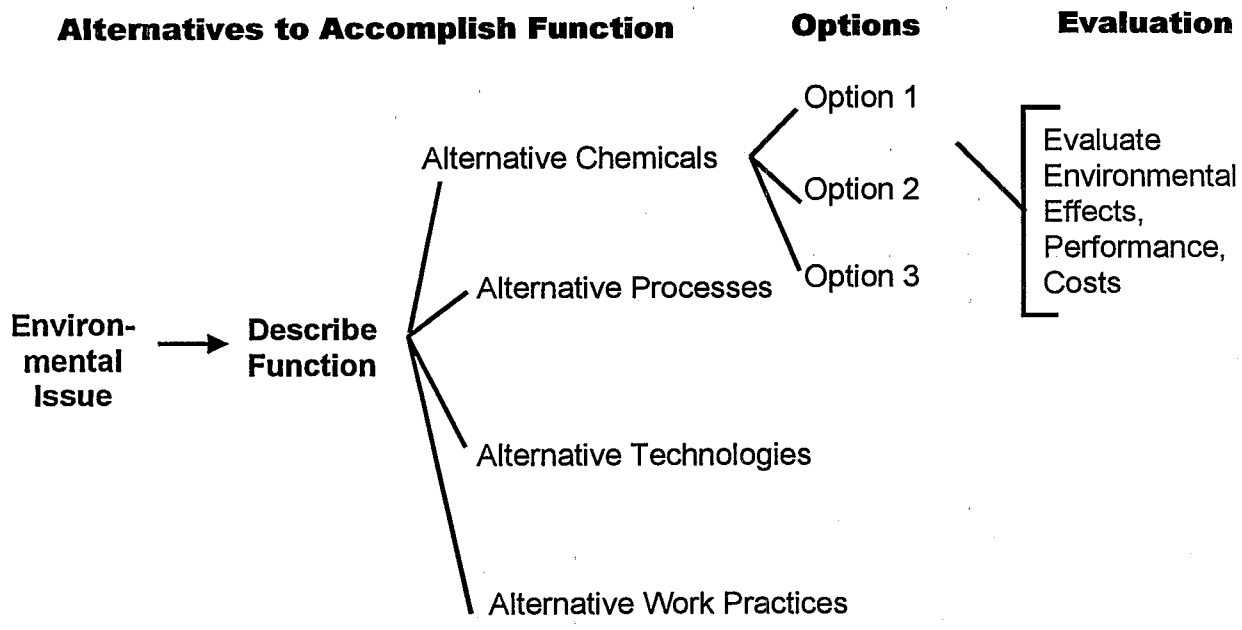
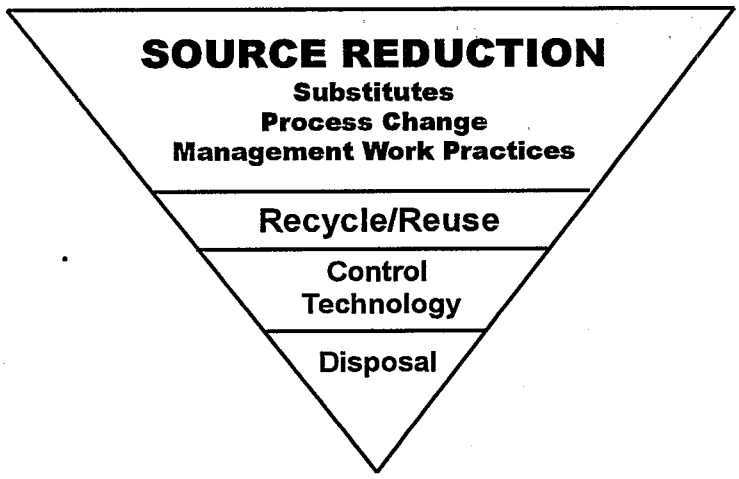


Figure B: Pollution Prevention Hierarchy



How to Use This Guide

This Guide has been designed to help companies integrate environmental concerns into business decision making using the DfE Program's Integrated Environmental Management System (IEMS). This Guide follows the guidelines of ISO14001, an international standard for EMSs, and it is designed to help businesses set up and implement a simple, straightforward EMS. This Guide does not intend to give guidance for ISO14001 certification.

This Guide is laid out in nine modules designed to be completed through group discussions with your IEMS team members and other managers and employees as appropriate. Most modules can be completed in several hours, but some may take longer. Sessions may be held once a week, once every other week, or once a month until the job is done. Use whatever time these modules require for your company. It is more important to complete each module than to finish in any particular time frame. Most companies find that it takes about a year to work through the EMS development process. And it generally takes up to three years for the EMS to be fully understood and implemented. Developing a company IEMS is a commitment to change, and change takes time.

☞ Tip

Every choice you and your employees make can affect the environment. Involving everyone helps produce cost-effective long-term results.

Best results will be achieved by involving everyone in the company in some way. There are two benefits to involving all employees: first, they will be more likely to take ownership of managing environmental concerns; second, they often have valuable insight into how improvements can be made.

☞ Tip

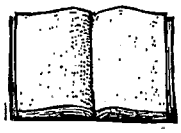
You should not try to perfect each step on your first attempt. Many of the steps will need to be revisited as you proceed with developing the IEMS.

You should consider regular sessions as suits your schedule to complete the work in each module. You will need to appoint a responsible person and a committee to lead the development of

your IEMS. The committee members could also meet regularly with other employees to provide progress reports and solicit input. The importance of regular communication and involvement cannot be overemphasized. Getting people to think about environmental concerns in their daily work is as important a process as any step in setting up your IEMS.

Some of these modules will have to be revisited during the process. For example, it is useful to develop a communication plan in the beginning, but you will need to add to it as environmental concerns are identified and as other parts of the IEMS are developed. Some modules may not be completed at the outset, but may be revised as needed throughout the process.

Finally, you don't need to do everything at once. This Guide will help you identify possible projects and then help you prioritize these projects, given your resources and time. You may, for example, want to start out by developing the IEMS for only one part of your company or operation. You can expand later as your resources permit. It's important to start small with projects that will achieve success, so that you and your employees gain experience with the process and build confidence in your ability to make changes.



☞ Tip

A companion document, *A Company Manual Template,* contains sample procedures and formats to help you document important components of your IEMS. Refer to this Guide frequently as you develop your IEMS. This document is available on the DfE website (www.epa.gov/dfe). See Appendix G for details about the Template.

What are the Steps in Developing an IEMS?

Each module in this Guide explains a step in the IEMS development process. The modules contain worksheets to assist you in completing this work. Figure C is a flow chart showing the steps in the process. Figure D is a "roadmap" showing how the IEMS modules relate to the components of the ISO 14001 standard. The Appendices contain a Glossary, example questions to ask your suppliers about chemical risk, an alternatives evaluation worksheet and performance evaluation

worksheet from the DfE Printing Project, resources for more information, and blank forms that correspond to the worksheets in each module. In addition to the Appendices, more tools and guidance can be found on the DfE's website at www.epa.gov/dfe. In particular, there is a more extensive Risk Guide and Cleaner Technology Substitutes Assessment Guide.

Module 1: Laying the Groundwork

This module provides a general discussion of what an IEMS contains. It will help you build understanding of and support for your IEMS among your company's managers and employees, about what an IEMS is and why the company is developing one. This module also will help you understand how your company currently impacts the environment by identifying environmental impacts of your company's products, processes and services.

Module 2: Creating an Environmental Policy

An early step in the process of developing a IEMS is reviewing your company's current methods for managing environmental concerns. Next you will write your company's environmental policy statement and decide on the scope of your IEMS. The environmental policy will be based on what is important to your company. This module contains some sample principles and policy statements.

Module 3: Determining Significant Environmental Aspects and Setting Objectives

You will need to determine which environmental aspects are significant, and prioritize them to determine what you want to address first. This module provides a method to estimate environmental risk to help you prioritize environmental aspects. The module then helps you to translate those priorities into objectives to reduce environmental impact.

☞ **Tip**

Environmental aspects are elements of your business, such as air pollutants or hazardous **waste**, that can have negative impacts on people and/or the environment.

Figure C: IEMS Process

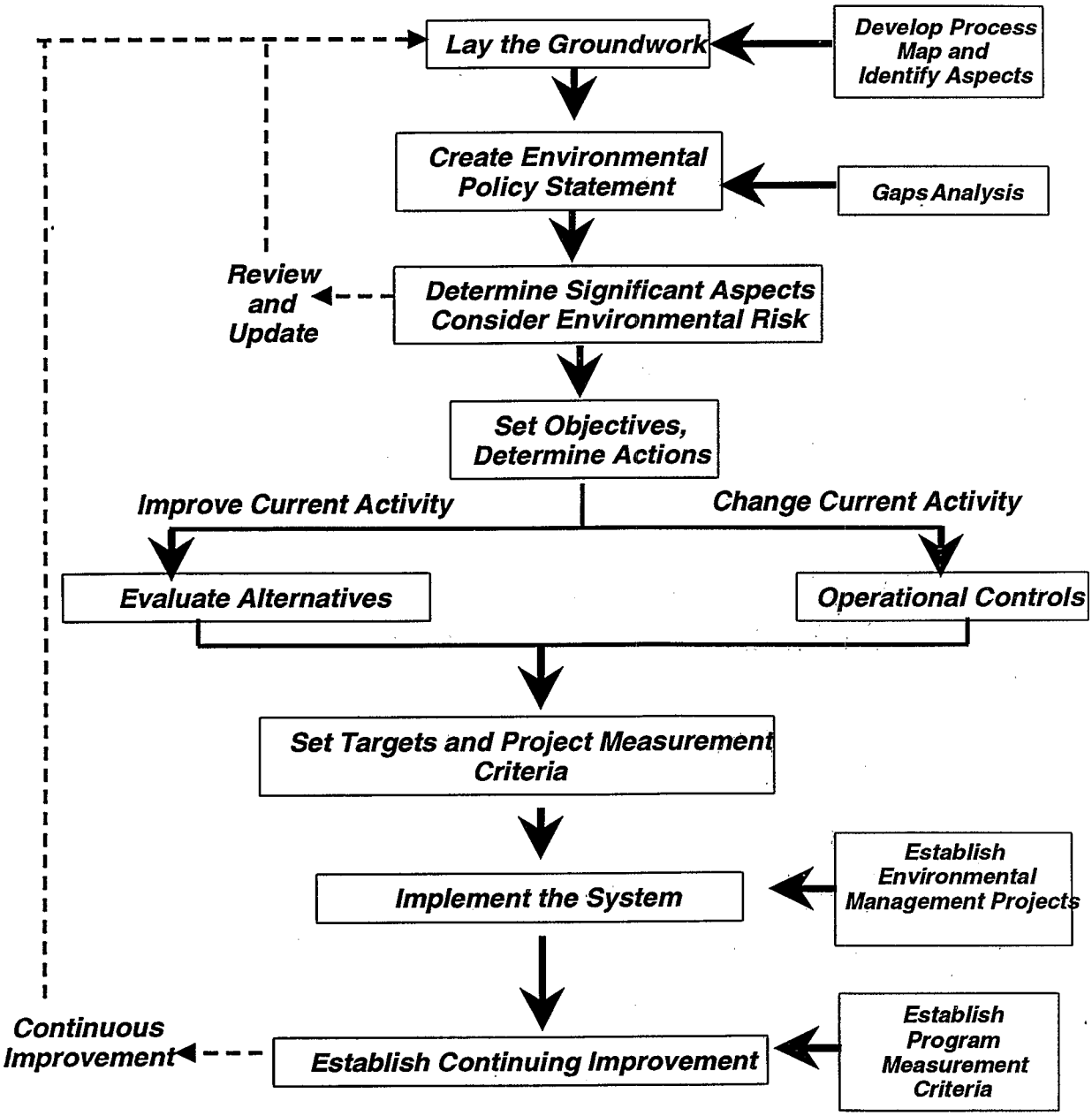


Figure D. Road Map between ISO 14001 and IEMS Approach

ISO14001 EMS COMPONENTS	IEMS GUIDE MODULES
Commitment and Policy	Module 1: Laying the Groundwork Module 2: Creating an Environmental Policy
Planning	Module 1: Laying the Groundwork Module 3: Determining Significant Environmental Aspects and Setting Objectives
Implementation	Module 4: Evaluating Alternatives Module 5: Setting Targets and Measuring Success Module 6: Developing Operational Controls Module 7: Implementing Your IEMS Module 8: Building Organizational Support
Evaluation	Module 5: Setting Targets and Measuring Success Module 8: Building Organizational Support
Review	Module 9: Establishing Continuing Improvement

Module 4: Evaluating Alternatives

Before deciding how you will meet your objectives, it is important to consider a wide array of approaches. This module shows how the IEMS methodology considers a hierarchy of alternatives, which include substitutes, pollution prevention, and wise resource management.

Module 5: Setting Targets and Measuring Success

For those significant environmental aspects where you have set an objective, you will need to develop specific targets that describe how you will achieve your goal and you need to develop ways of measuring that achievement.

Module 6: Developing Operational Controls

For some environmental aspects, you will need to write procedures to ensure that activities are performed in a way that reduces environmental impact. This module lays out how to develop operational controls, measure for success of those controls, and provide corrective action when necessary.

Module 7: Implementing Your IEMS

Effective implementation is essential to getting your IEMS off to a good start. This module helps you plan the IEMS development process and set up environmental management projects for your objectives.

Module 8: Building Organizational Support

The long-term success of your IEMS will depend on solid organizational support. Such support includes developing documentation, meeting training needs, and implementing effective communication and stakeholder involvement processes.

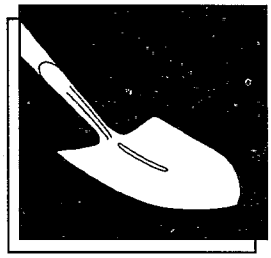
Module 9: Establishing Continuing Improvement

To ensure success and continuing improvement, regular reviews

of your overall IEMS are needed. These reviews include progress made in communication, documentation and developing stakeholders as well as the specific environmental targets. The reviews provide critical information to ensure continuing improvement.

How much work each of the steps entails depends entirely on the scope of work that you decide to undertake. It is not necessary for your IEMS to include all your operations, especially for your first effort. As you gain experience in managing environmental concerns along with your daily operations, you will develop your IEMS further.

MODULE 1: LAYING THE GROUNDWORK



This module contains an overview of Environmental Management Systems, suggestions for how to build internal support for your IEMS, ideas for developing your IEMS management team, and a process for understanding how your company impacts the environment.

Overview of Environmental Management Systems

An **Environmental Management System** (EMS) provides a systematic way to review and improve operations for better **environmental performance**. An EMS can help a company better meet its compliance requirements. It can also help a company use materials more efficiently and streamline operations, thereby reducing costs and becoming more competitive.

☞ **Tip**

An **EMS** is a framework for managing those significant **environmental aspects** you can control or influence.

A commonly used framework for an EMS is the one developed by the International Organization for Standardization (ISO) for the ISO 14001 standard. *Although the EMS described in this Guide is based on the ISO 14001 approach, the process outlined in this Guide may not provide for meeting all the requirements of ISO 14001 certification.* The purpose of this Guide is not to give advice towards certification. It is to demonstrate a technical means of integrating environmental concerns into company management so that businesses can become more effective in reducing their impact on the environment.

☞ **Tip**

Words in **bold type** can be found in the Glossary (Appendix A).

In addition, other guides on the market provide useful

approaches. Developing an IEMS based on this Guide does not imply endorsement by the U.S. EPA.

The five main stages of an EMS, as defined by the ISO 14001 standard, are as follows.

- *Commitment and policy* — top management commits to environmental improvement and establishes a company **environmental policy**.
- *Planning* — the company conducts a review of its operations, identifies legal requirements and environmental concerns, establishes objectives, evaluates alternatives, sets targets, and devises a plan for meeting those targets.
- *Implementation* — the company follows through with the plan by establishing responsibilities, training, communication, documentation, operating control procedures, and an emergency plan to ensure that **environmental targets** are met.
- *Evaluation* — the company monitors its operations to evaluate whether the targets are being met, and, if not, takes **corrective action**.
- *Review* — the EMS is modified to optimize its effectiveness. The review stage creates a loop of continuous improvement for the company (Figure 1-a).

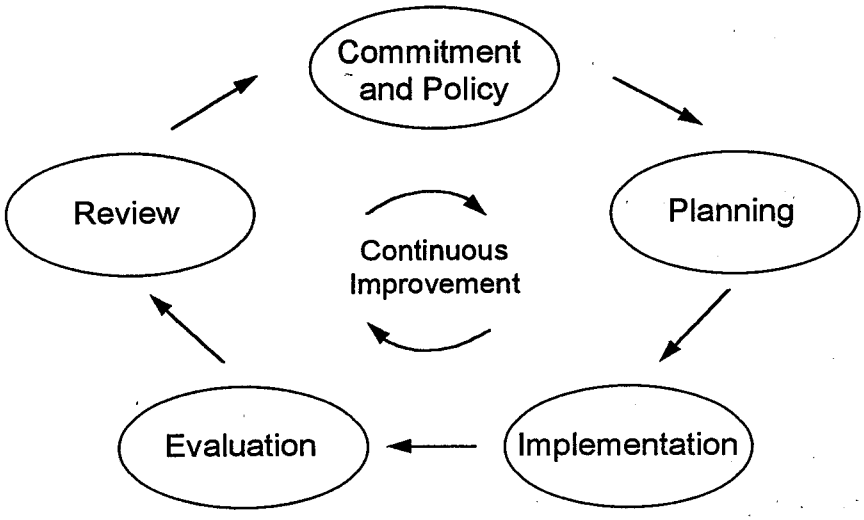
☞ **Tip**

For more information on ISO 14001 EMS, check Appendix G (References and Resources).

☞ **Tip**

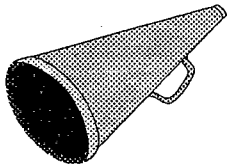
Continuously identifying and reducing risk leads to improved competitiveness and environmental performance.

Figure 1-a. The Continuous Improvement Cycle



The advantage of adopting the DfE Program approach is that it enables your company to consider and plan for managing the environmental risk of your company's products, processes and services. The method outlined in this Guide will help your company compare alternatives to identify the least cost, best performing and lowest environmental impact option. This approach will help your company do the following:

- practice pollution prevention,
- use resources efficiently,
- avoid shifting problems from one waste stream to another,
- understand the risks associated with using both regulated and unregulated chemicals,
- integrate management of worker safety and health requirements with management of environmental concerns,
- practice extended product and process responsibility, and
- manage system change in addressing environmental concerns.



Screenprinters from the SGIA/EPA IEMS Pilot Project have this to say about what they learned:

"That you can have a *system* to achieve environmental improvement. Never gave it much thought before."

"Changed from being reactive to environmental regulations to being more proactive."

"The benefits of having documented operational controls."

"General environmental awareness building across the board; and that you can be bottom-line oriented and environmentally conscious at the same time."
"That the ultimate benefit is improving the environment and improving the bottom line at the same time."

Thus, by using the approach provided in this Guide, you can develop a IEMS that helps you continuously identify and reduce risks to people and the environment. This Guide provides methods to help you consider risk reduction when answering the following questions.

- How does your company impact the environment?
- Which of these environmental impacts are significant?
- How can your company improve its environmental performance?

Building Support for Your IEMS

Both management and employees need to understand not only what a IEMS is, but also why they would want one. This step is designed to get people to think about and discuss the ways in which a IEMS would benefit your company. Even though you may already have management support, it is still important to get employee buy-in to this process.

Through years of working with companies, the DfE Program has learned the importance of building support from participants through open and frequent discussion about mutual concerns.

Set up times to discuss your company's need for a IEMS with key managers and employees. Recording the discussions provides important documentation, which can be used to communicate the benefits of your IEMS to others. One way to record the discussion is to assign someone the task of writing the group's comments on a flip chart, so that everyone can see them for discussion. The following set of general questions will lead you through the discussion.

Discussion Questions

1. Which environmental and worker safety laws and regulations is your company required to follow?
2. How does your company define environmental

performance?

3. Does lack of time or resources prevent your organization from taking charge of its environmental obligations? Are there individuals appointed to be responsible for this function?
4. What is your company's environmental policy?
5. Does your organization know how its environmental objectives relate to its business objectives?[1]

To build support, consider the benefits a IEMS might provide for your company. A more systematic approach to meeting your environmental and business goals might contribute to the following in your company:

- improved environmental performance
- improved worker health and safety
- improved competitiveness
- improved compliance and reduced liability
- fewer accidents
- lower insurance premiums
- improved public image
- enhanced customer trust
- better access to capital
- improved internal communication
- improved company morale
- reduced operating costs

It will be helpful at this point to create a worksheet comparing the expected costs and benefits of developing a IEMS.

☞ Tip

To help get facility-wide buy-in to the IEMS process, find the workers who are most enthusiastic with the process and recruit them to spread the word among their peers. Commitment from top management is essential, but you also need promoters at all levels of your company.

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1 Adapted from: *Environmental Management Systems: An Implementation Guide for Small and Medium-Sized Organizations.* Ann Arbor, MI: NSF International, November 1996, p.3.

Worksheet 1-1 provides some general categories of costs and benefits. When making your comparison, provide specific examples from the discussion.

Assigning Responsible Persons

Designate, as soon as possible, the Management Representative, the IEMS Coordinator, and a Committee who will be responsible for promoting and developing your IEMS. If you have a very small company, these may all be the same person! However, it is still important to designate who will be responsible for various activities. Worksheet 1-2 provides a means to document the responsible persons. This worksheet can be placed in your Company IEMS Manual (see the *Company Manual Template*).

Worksheet 1-1: Costs and Benefits of Developing and Implementing an IEMS[2]

Costs	Benefits
▸ Staff/employee time for: collecting information reading and understanding this Guide preparing worksheets facilitating IEMS sessions participating in IEMS development ▸ Possible consulting assistance ▸ Training of personnel in new procedures ▸ Technical resources to analyze environmental impacts and improvement options ▸ Resources required to make changes	▸ Improved environmental performance ▸ Expected increased efficiency/reduced cost of materials ▸ New customers/markets ▸ Enhanced employee morale ▸ Expected savings in compliance and overall compliance monitoring and assessment, and record-keeping requirements due to changes in materials used ▸ Reduced **waste** disposal/treatment costs ▸ Fewer regulatory requirements
Contact Person:	Date completed:

Worksheet 1-2: IEMS Responsibilities

IEMS Function	Person	Regular Position
Management Representative		
IEMS Coordinator		
IEMS Committee		
Contact Person:		Date Completed:

Corresponds to RESP-01 in the *Company Manual Template*.

[2]Ibid, p. 5.

In addition, Figure 1-b shows the job functions and skills that would make a strong contribution to your IEMS team. Small companies might not have a person for each function identified on the table. The list is provided to identify skills that would be useful, not to suggest that a company would need all of these on a team.

Figure 1-b. Functions to Include in Your IEMS Team

Company Function	Expertise Brought to Project Team
Production	Management of environmental aspects of production
Maintenance	Management of environmental aspects of equipment maintenance
Facilities Engineering	Management of environmental aspects of new construction and installation/ modification of equipment
Storage/Inventory	Management of environmental aspects of raw material and product storage and in-facility transportation
Shipping, Receiving, Transportation, Logistics	Management of environmental aspects of shipping, receiving, and transportation
Product Design	System for examining environmental aspects of new designs
Quality	Quality management system, including document control procedures
Human Resources	Training on environmental issues Inclusion of environmental incentives in performance measurement system
EH&S	System for complying with environmental regulations Management of environmental records
Purchasing	System for procurement (including screening of suppliers, material composition of components)
Sales/Marketing	Environment-related commitments to customers
Public Relations	System for communicating with public on environmental issues
Accounting/ Finance	System for tracking environmental costs of operations

Planning the Process

To effectively implement your IEMS, you will need to set up a plan for getting the work done. This plan will be unique to your company. You will identify the steps to take, in the appropriate order; the decisions that will need to be made; and the resources and schedules for accomplishing the tasks. Start out by considering the following points as you plan for your IEMS development:

- Determine what level of management involvement is required and what decisions will be needed from both middle and senior management.
- Set a deadline for developing your IEMS and establish a schedule. (See worksheet at the end of this module.)
- Estimate a budget.
- Determine how you will document your IEMS.

If you have never developed an IEMS before, estimating resources and time can be difficult. You will need to create a schedule and estimate resources for completing your IEMS. As you begin to work on each module, you may want to identify intermediate steps for which you will set target completion dates. At some points, you may need to alter the overall schedule. Worksheet 1-3 will assist you in developing and tracking this plan. As you go through each module, revisit this worksheet and list who is participating in each task and your estimated budget and schedule. Also, Worksheet 1-4 will help you identify and document the persons responsible for different parts of the IEMS and the resources needed to support their effort. You may not be able to completely fill out these budget and resource worksheets at the beginning of this process. In addition, the items in the worksheet blocks may change as you work your way through the IEMS process. These worksheets only present ideas to get you started.

Worksheet 1-3: IEMS Development Schedule and Resources Worksheet

Module	Participants	Budget	Target Completion
Laying the Groundwork: Identifying Environmental Aspects			
Intermediate steps: (As appropriate)			
Making the Commitment: Creating a Policy Statement and Determining the Scope			
Intermediate steps: (As appropriate)			
Determining Significant Environmental Aspects and Setting Objectives			
Intermediate steps: (As appropriate)			
Setting Targets and Measuring Success			
Intermediate steps: (As appropriate)			
Developing Operational Controls			
Intermediate steps: (As appropriate)			
Evaluating Alternatives			
Intermediate steps: (As appropriate)			
Implementing Your IEMS			
Intermediate steps: (As appropriate)			
Setting Up Environmental Management Projects			
Intermediate steps: (As appropriate)			
Establishing Continuing Improvement			
Intermediate steps: (As appropriate)			
Contact Person:	Date Completed:		

Worksheet 1-4: Persons Responsible for IEMS Development

Roles	Individual(s) Responsible	% of Time Designated	Budget
"Management representative" having responsibility for implementing the IEMS (in small businesses, this could be the owner).			
IEMS Coordinator			
IEMS Team Participants			
Identifying and determining significance of environmental aspects.			
Identifying and determining applicability of legal and other requirements.			
Competency-based training.			
Operational controls.			
Emergency preparedness and response.			
Monitoring and measurement of "key characteristics" of operations and activities that can have significant environmental impacts (i.e., the "significant environmental aspects.").			
Periodic evaluations of environmental compliance.			
Handling and investigating non-conformance with the EMS.			
Records management.			
Internal EMS audits.			
Contact Person:		Date Completed:	

Note: Most of these blocks will be filled in as development of the IEMS progresses. This worksheet will help track progress and serve to remind the team and management of necessary assignments.

Gathering Information and Identifying Environmental Aspects: Understanding Your Company's Possible Impacts

The work in this step mostly involves gathering and organizing information about your company's activities. Information gathering involves four activities:

- map your company's activities and processes,
- identify inputs and outputs for each activity and process step,
- identify the environmental aspects associated with each input and output, and
- identify regulatory and other requirements.

The process of identifying environmental aspects is best undertaken through group discussion with all levels of production employees, office staff, and managers. This helps to gain insight through different perspectives, and it engages everyone in the process of understanding the environmental component of your daily activities.

An **environmental aspect** is an element of your company's activities, products, or services that can affect the environment. Environmental **impacts** are the changes to the environment whether adverse or beneficial that result from your company's activities, products or services. Most elements of your business operations will have environmental aspects, intended or unintended.

For example, an unintended aspect of using a cleaning solvent may be that there are **volatile** (airborne) emissions produced during use. The "impact" of these emissions may be hazardous exposure to workers or the community or a contribution to smog formation. Another example is the business activity of making paper copies. The toner cartridges contain chemicals that could interact with the environment if they are not disposed of properly. The used toner cartridges with chemical waste would

Design for the Environment U.S. EPA

Each DfE project begins with a simple mapping exercise to identify possible environmental concerns. Informed participants then select a priority concern that becomes the focus of the DfE project.

☞ **Tip**

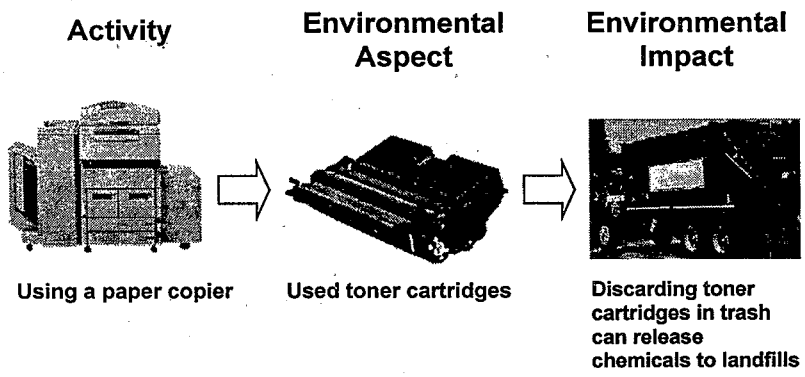
An environmental **aspect** is any element of your company's activities, products, and services that has the potential to affect the environment.

be an environmental aspect. The release of these chemicals into a land fill would be an environmental impact. Figure 1-c lists examples of environmental aspects and their potential impacts, and Figure 1-d graphically shows the relationship between activities, aspects, and impacts.

Figure 1-c. Examples of Environmental Aspects and Associated Impacts

Environmental Aspects	**Potential IMPACTS of Each Aspect**
Metals discharged to POTW	Contamination of aquatic habitat and drinking water supply
VOC emissions	Contribution to smog; worker or community exposure to volatile organic compounds (VOCs)
Scrap generation	Degradation of land, habitat, water supply
Solid waste generation	Habitat destruction, drinking water contamination from landfills, wasted land resources
Fresh water use	Depletion of natural resources
Electricity use	Contribution to global warming; degradation of air quality by electric generating plants
Exposure to chemicals during business activities	Harm to health of workers, neighbors, wildlife or plant life

Figure 1-d. How an Activity Becomes an Impact



Step 1: Develop a Process Map of Your Company's Activities and Processes

The first step in identifying environmental aspects of your business is to develop a map of your company's processes, products and services. First, categorize your business activities into areas or steps in the process, so that you can review them one by one. Some typical areas to consider might include:

- Receiving Raw Materials
- Storing Raw Materials
- Manufacturing Process, Step 1
- Manufacturing Process, Step 2
- Manufacturing Process, Step 3
- Packaging
- Process Clean-up
- Waste Disposal
- Office
- Building Maintenance
- Shipping Product
- Transportation (including employee, sales, and management staff, parking)
- Optional: map customer and supplier activities and processes that directly relate to your company's activities, products and processes

Use this list of areas to develop a process map describing the order in which activities take place in your company. Some areas may need their own map; others could be parts of a larger map. Figure 1-e shows a generic process map of a manufacturing company that might help you to set up your own map. Worksheets EA-01a and EA-01b in the *Company Manual Template* also provide a way to document your company's operations.

Internet Help

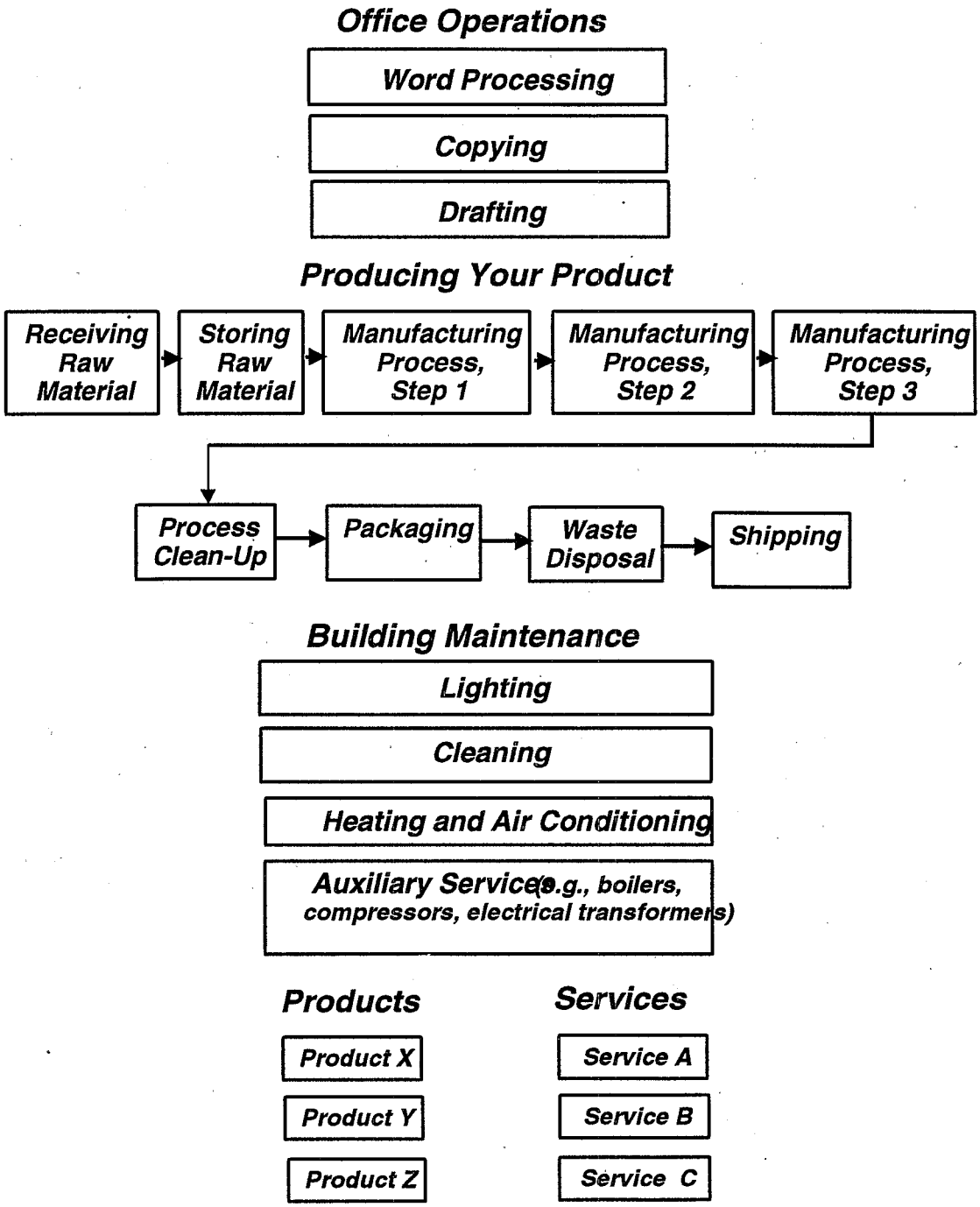
Visit the DfE website for more tools related to process mapping.

www.epa.gov/dfe

☞ Tip

These technical sections are best developed through group discussions. There is no "right" way to build these lists. The process, however, must make sense to you and be documented so that you can review it or change it later.

Figure 1-e. Generic Process Map for Business Activities

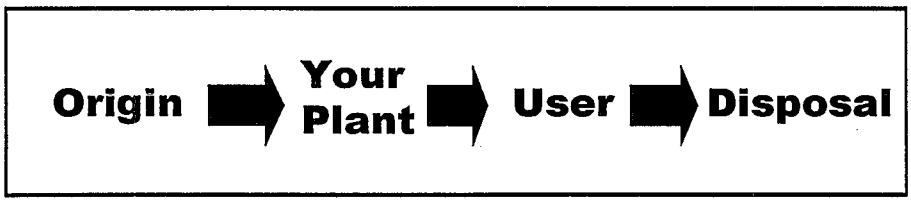


You will notice that two areas of activities, office operations and building maintenance, have boxes that are separate rather than being part of a sequence. This is because the activities identified under these areas are not related sequentially. Under the area "Producing Your Product," the activities are connected in steps required to produce a product or service. This order will be important to understand later if you decide to work on an aspect that is part of a sequence of steps.

☞ **Tip**
Appendix H contains full-page versions of the blank worksheets.

In addition to the process steps laid out in your map, you should consider the environmental aspects of your products and services. For example, does your product or its packaging have potential impacts on the environment? If so, there may be opportunities to form partnerships with customers to work on making changes that reduce the impact. As shown in Figure 1-f, many companies are extending their responsibility to consider the upstream impacts of their materials choices and the downstream impacts of consumer use and disposal of products.

Figure 1-f. Product X — Extended Responsibility



Step 2: Identify the Inputs and Outputs of Each Activity

The next step in identifying environmental aspects is to identify the inputs and outputs of each box in the process map you developed in Step 1. Among those inputs and outputs will be some that have environmental effects. Figure 1-g shows a generic step in a manufacturing process. Figure 1-h illustrates this concept with an example of a business activity (paper copying) that is an office activity rather than part of an operational sequence. The second example, shown in Figure 1-i,

shows the process step of press cleaning in printing operations at ABC company. Figure 1-j shows graphically the general inputs and outputs of a company's products and services.

Figure 1-g. Input-Output Diagram for a Step in a Manufacturing Operation

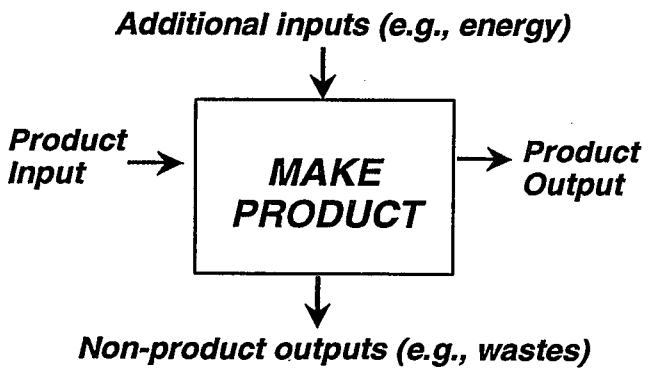


Figure 1-h. Input-Output Diagram for a Copier

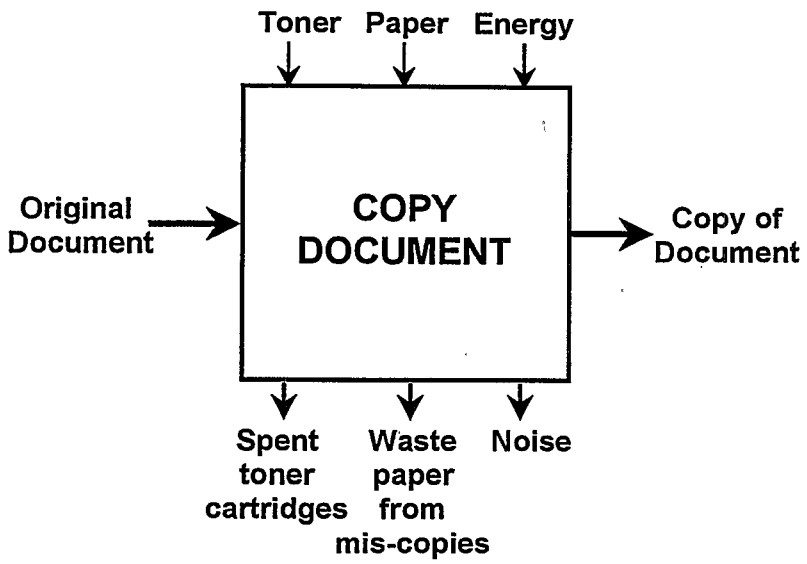


Figure 1-i. Input-Output Diagram for Cleaning a Printing Press

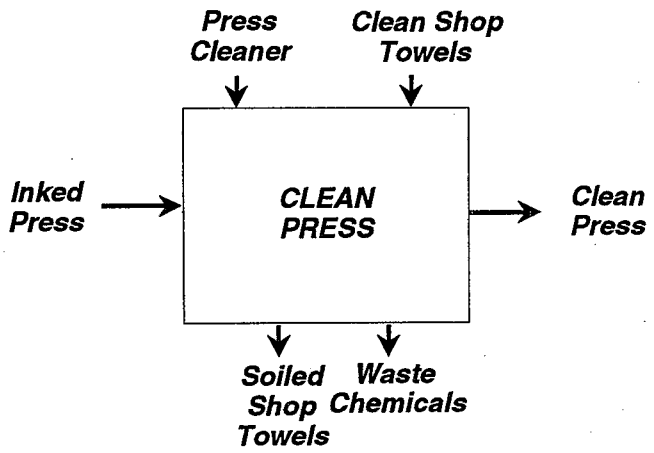
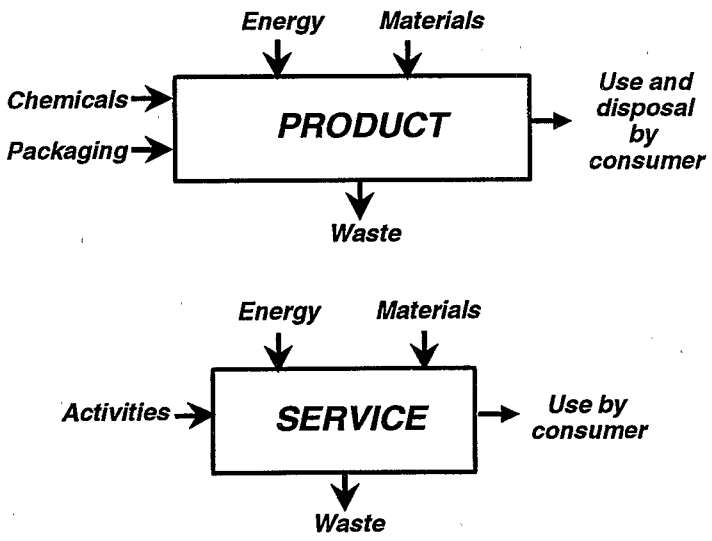


Figure 1-j. Inputs and Outputs of a Company's Products and Services



Step 3: Identify environmental aspects of each activity

Next you will identify environmental aspects associated with each input and output. Using your process map developed in Step 2, identify the environmental aspect of each input and output. Keep the following key points in mind when identifying the environmental aspect of a particular activity.

- Can it interact (beneficially or harmfully) with anything in the environment?
- Can it be toxic or hazardous to humans or anything in the environment?
- Does it use natural resources?
- How is it disposed of?
- If a product, how will it be used and disposed of by the consumer?

Use Worksheet 1-5 to help you list each process step and its associated environmental aspect. Appendix H contains a blank copy for your use.

Worksheet 1-5:* Identifying Environmental Aspects

Input/Output	Environmental Aspect (Quantify if available)	Environmental Impact
Office Activities		
Paper (In)	Use of paper	Use of natural resources
Energy & fuel (In)	Use of energy	Use of natural resources; air quality degradation
Toner (In)	Harmful chemicals	Health and environmental effects**
Documents (In)	Solid waste	Degradation of land, habitat, drinking water
Waste paper (Out)	Solid waste	Degradation of land, habitat, drinking water
Used Toner (Out)	Solid and chemical waste	Degradation of land, habitat, drinking water
Odors (Out)	Production of odors	Indoor air quality
Manufacturing Process		
Press cleaner (acetone, toluene, MEK, isopropyl alcohol blend) (In)	Chemicals that are toxic to humans or the environment	Health and environmental effects*
Wipers (In)	Materials that are toxic to humans or the environment	Health and environmental effects*
Energy & fuel (In)	Use of energy	Use of natural resources; air quality degradation
Soiled wipers (Out)	Production of hazardous waste, solid waste	Degradation of land, habitat, drinking water*
Waste chemicals (Out)	Production of hazardous waste, solid waste	Degradation of land, habitat, drinking water*
Air releases of press cleaner (Out)	Production of air pollutants	Degradation of air quality*
Products and Services		
Product X: Chemicals	Chemicals that are toxic to humans or the environment	Health and environmental effects*
Materials	Materials that are toxic to humans or the environment	Health and environmental effects*
Packaging	Production of hazardous waste, solid waste	Degradation of land, habitat, drinking water
Waste	Production of hazardous waste, solid waste	Degradation of land, habitat, drinking water
Energy use	Use of energy	Use of natural resources; air quality degradation
Service X: Chemicals used	Chemicals that are toxic to humans or the environment	Health and environmental effects*
Waste products	Production of hazardous waste, solid waste	Degradation of land, habitat, drinking water
Energy use	Use of energy	Use of natural resources; air quality degradation
Contact Person:		Date Completed:

*Use the blank form in Appendix H for your data, then use the information to fill in EA-02 in the *Company Manual Template*. ** See Module 3 for information on chemical effects.

Step 4: Identify your legal and other requirements

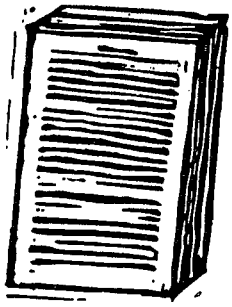
The last step in identifying environmental aspects is to identify environmental legislative and regulatory requirements that pertain to your business activities, products, and services. Regulated concerns that apply to your business should be included in your system of environmental programs because your IEMS will integrate all of your company's efforts to manage environmental concerns.

State and local legal requirements, in addition to federal, need to be considered. Often states administer federal environmental and occupational safety and health regulatory programs and may have stricter and/or different requirements than federal regulations.

You can obtain information on regulatory requirements from a variety of sources. State or city departments of environmental protection might be able to assist you in finding this kind of information. For example, state technical assistance programs are often excellent resources and often can provide one-on-one consultation. In addition, public information offices of both the Environmental Protection Agency (EPA) and the Occupational Health and Safety Administration (OSHA) of the Department of Labor (DOL) can help provide publications that explain regulations pertinent to your company's activities. Publications by the DfE Program at EPA and EPA's Office of Enforcement and Compliance Assurance (OECA) also identify federal regulations affecting certain industries. Appendix G gives full citations of the DfE publications, addresses for some resources, and describes how to obtain them. You can also visit the DfE Web site at www.epa.gov/dfe. Regulatory information is also available at the websites of many agencies.

☞ Tip

It is helpful to begin identifying regulatory requirements by making a list of those regulations that you know affect your company. Searching for additional information can take time. Any newfound regulatory requirements can be added into your IEMS at a later date.



☞ Tip

Even regulations that may not directly apply to your business may contain important information about the environmental impacts associated with your type of business.

Worksheet 1-6 will help you organize your search of regulations that affect your business. In many cases, very small businesses are exempt from some regulations. Still, the problems addressed by the regulations may affect your business and may be concerns you would want to address in your IEMS. Thus, it is worthwhile to familiarize yourself with regulations, just to identify concerns and determine whether any of them apply to your operations. Use Worksheet 1-6 to keep track of regulations that apply to your business.

Worksheet 1-6*: Regulations

Regulatory Agencies	Regulations That Apply to My Business Sector	Business Operations Potentially Affected	Does it Apply to My Business?
Contact Person:		Date Completed:	

*Corresponds to Table LR-01 in *Company Manual Template*.

In addition to regulations, industry codes of practice and other non regulatory guidelines can help point to environmental aspects of your business activities. Your trade association also may be able to help identify useful publications.

The following case study shows how "Company A" set up a process for creating an environmental management system and some of the benefits of doing so.

Case Study: Company A

EMS Development

Company A is a 20-person manufacturer of large custom metal machine parts for industrial customers. To initiate its EMS, the company formed a small EMS implementation team that includes the managers of quality, purchasing, and human resources and is led by the owner's son. This team developed the environmental policy for review and approval by the owner, and, equally important, set up a structure for involving all employees in the EMS process. Employees receive general environmental awareness training during some of the company-wide Friday meetings, and have been involved in identifying environmental problems and solutions in their areas of responsibility.

Company A's comprehensive approach to environmental management yielded immediate results. After identifying oil usage as a significant environmental aspect, a team of workers and managers identified faulty gaskets as the primary cause of oil leaking from the machines. By replacing these gaskets, the company cut its oil use by 50%. This change, as well as more general improvements in work environment and worker safety, caused the local environmental enforcement agency to reclassify Company A as a non-hazardous waste generator (it had been classified as a hazardous waste generator). The company also reports significant improvements in the environmental awareness of management and workers; though less tangible, this change in attitude may prove equally significant over the long run.

MODULE 2: CREATING AN ENVIRONMENTAL POLICY

This module will help you review your company's current methods for managing environmental concerns, develop an environmental policy for your company, and determine the scope of your IEMS. Sample environmental policy statements are presented at the end of the module.

Understand How Your Company Currently Manages Environmental Concerns

This step is designed to help you review how your company currently handles environmental and human health concerns and compares current practice with where you would like to be. In some references, this is called a "gaps analysis" because it is designed to uncover ways to improve your management of these concerns. This step is best developed through discussions with groups of employees representing different functions in your company, *especially line managers and line workers*. You'll need to involve people that have the day-to-day working knowledge of your company's operations. It is important for everyone to understand what the IEMS involves and why it is being implemented. In this way, they can then explore alternatives to your current practices, so as to improve both environmental management and cost savings for your company. It will be helpful to keep a list of answers for future reference.

Discussion Questions

1. Does your company have an Environmental, Health & Safety Policy?
   - Is this policy written down?
   - Where is it located?
   - How many employees know about this policy?

☞ **Tip**

Your discussion should be comprehensive and detailed enough to give you some idea of what will need to be done to develop an IEMS for your company.

Principles that can be a part of your environmental policy include a commitment to risk reduction, pollution prevention, and wise resource management.

☞ **Tip**

The **environmental policy** is the foundation of the company's IEMS. Through it, top management should communicate goals such as preventing pollution and minimizing risk to workers and the environment.

- How did they learn of it? Is it included in a training or orientation program?
- Do employees have the opportunity to make suggestions regarding environmental concerns?
- What points are included in this policy?

2. Does your company have specific environmental or health & safety goals?

- Are these documented?
- How are these communicated to employees?
- Is there a way of tracking whether goals are met?
- Are there penalties within the company for not achieving the objectives?
- Is there a way to change these goals when changes in processes, production, or activities occur? How are these changes communicated?

3. Does your company have a process to identify all environmental, health & safety regulatory requirements?

- Has your company conducted compliance audits?
- Has your company received any fines or penalties requiring corrective action?

☞ **Tip**

Remember to consider worker health and safety, as well as people outside your plant, when evaluating known health concerns.

☞ **Tip**

The EPA National Enforcement Investigations Center (NEIC) has recognized the way in which an EMS improves a company's compliance record by providing a guidance document for developing a "compliance-focused" EMS. (See Appendix G for more information.)

- Has your company experienced difficulties in complying with regulations?
- Are some regulations difficult/costly to meet?
- Does your company know whom to contact at local, state, and federal regulatory agencies in the event of environmental accidents or compliance concerns?
- Does your company have a mechanism for staying up to date on changing regulations?

4. How does your company evaluate risk to human health & safety and the environment caused by your business operations? How is this information incorporated into planning for business activities/production?

5. Is there a process within the company to review any changes in products or processes with an eye toward environmental concerns?

6. Are there policies and procedures regarding procurement and contracting that consider environmental concerns?

7. What training is offered at your company that would support environmental objectives?

- Do employees receive environmental, health & safety training? What percent of employees? Which ones?
- How is that training documented? Where are the records kept?
- Is there provision for regular training on environmental, health & safety requirements?

8. Does your company have a procedure for responding to suggestions regarding environmental concerns that it may

☞ **Tip**

Reviewing these questions in six months and, again, in one year provides a good way to track progress in developing your IEMS.

receive from customers, neighbors, or employees?

- Is there a process for soliciting and recording any "suggestions"? Where are these records kept?
- Is there a process for following up on any of these suggestions to be sure that appropriate action was taken?

9. How does your company keep track of its documents?

- Is there a filing system?
- How many people are familiar with the system?
- How many people have access to it?
- How could someone find information relating to environmental, health & safety concerns? Are there Material Safety Data Sheets (MSDS) available? Does your company have documented standard operating procedures for plant operations, emergencies, or document control?
- How are decisions made about when to dispose of documents?

10. How does your company identify potential accidents or emergency situations?

- Are emergency procedures documented?
- How do employees find out about them? Is there regular training?
- Are these procedures periodically tested, evaluated, and revised as needed?
- Have there been failures in response to accidents or emergency situations?
- Is there a communications plan in place in the event of emergencies?

11. Does your company have a way of measuring the

☞ **Tip**

As you discuss these questions, it will be beneficial to write down the answers for reference as you proceed with the following modules.

☞ **Tip**

You should review this policy statement as you complete the modules following this one to determine whether changes need to be made.

environmental effects of any of its operations?

- Are there records kept?
- How long?
- Are these records reviewed regularly with an eye to whether performance has improved or worsened?

12. How does your company track its environmental costs?

- Does your company track environmental costs such as on- and off-site waste handling and treatment?
- Does your company track regulatory compliance costs such as labor costs for labeling, manifesting waste and/or permitting, and record keeping?
- When purchasing materials and supplies, does your company consider things like handling costs, OSHA training, and shelf life?
- Are the above costs allocated to overhead accounts or traced to products or activities?

Internet Help

Visit the DfE website for more tools related to gaps analysis:

www/epa.gov/dfe

Environmental Policy Statements

An environmental policy is your declaration of commitment to the environment and worker health and safety. This policy serves as the foundation for your IEMS, and provides a unifying vision of environmental principles that will guide the actions of employees and management. This policy statement serves as the framework for setting environmental objectives and targets, and will be brought to life in your plans and business activities. Consider the scope of your environmental policy statement for that will also determine the scope of your IEMS.

Refine Your List of Issues

Review the environmental aspects identified in Module 1. Make a list of general environmental concerns that could be addressed in your company's environmental policy statement.

Set Your Boundaries

Think also about the scope of your policy. Decide whether it will include activities beyond internal operations, such as supplier environmental performance or customer product use. Remember to consider the company's property beyond plant walls up to the "fenceline." Consider how to include contractors working at your site, and consider companies you use for outsourcing. You will want to drop issues from your list that do not fall within the boundaries set for your policy statement. As you begin your IEMS, you may want to define your boundaries within the company. As you gain experience, you may choose to expand the scope of your IEMS to include environmental issues important to your customers and suppliers.

Draft Your Environmental Policy Statement In General Terms

Address your list of specific issues in general terms in your policy statement. For example, if chemicals in your water or air are a concern because they potentially impact the community, you could express a commitment to review and, where feasible, make changes in the chemicals used by your company, or make sure you are managing them appropriately. Or, if solid waste in landfills is a concern in your area or to your company, you could express a commitment to reduce the solid waste your company produces.

Next, think about *how* to put commitments into action. For example, your commitment to reduce solid waste may be achieved through a pollution prevention program and/or a program to design products or services that result in minimal waste generated by the consumer. Also, these programs may be implemented one at a time over a several-year period, as part of your commitment to continuing improvement.

Sample Policy Commitments

It is important to think through which commitments your company will be capable of addressing. Do not include commitments in your policy that the company will not be able to carry out. The following is a checklist of commitments or principles that you may wish to consider including in your policy statement:

- Comply with applicable environmental or worker safety laws/regulations.
- Work to achieve pollution prevention.
- Prevent accidents.
- Identify opportunities for risk reduction associated with the processes and chemicals used in your plant, the supplies procured, the products produced, and the disposal of waste products.
- Consider the life cycle (from raw materials extraction and processing to use and eventual disposal) of products produced, including packaging, so as to affect how suppliers and end users impact the environment through your products.
- Continue improvement in your use of cleaner technologies and processes, and in the safer use of chemicals.
- Practice wise resource management, including conservation of limited resources and reuse and recycling of materials.
- Consider which goals of industry or your trade association could be adopted for your environmental policy statement.

Make sure top management commits to the environmental policy statement. If possible, the company president should sign and date it. The final environmental policy statement should be posted or distributed to employees and other interested parties.

Resource

Review the *Company Manual Template* for examples of how to document your policy.

Examples

The following are sample environmental policy statements that in some way incorporate most of the principles listed above.

YOUR COMPANY (ABC)
HEALTH, SAFETY AND ENVIRONMENTAL POLICY

This is a sample policy. Adapt for your company.

ABC Company is committed to managing health, safety and environmental (HS&E) matters as an integral part of our business. In particular, it is our policy to assure the HS&E integrity of our processes and facilities at all times and at all places. We will do so by adhering to the following principles:

COMPLIANCE

We will comply with applicable laws and regulations and will implement programs and procedures to assure compliance. Compliance with HS&E standards will be a key ingredient in the training, performance reviews, and incentives of all employees.

RISK REDUCTION, PREVENTION, RESOURCE MANAGEMENT

We will seek opportunities, beyond regulatory compliance requirements, for reducing risk to human health and the environment, and we will establish and meet our own HS&E quality standards where appropriate.

We will employ management systems and procedures specifically designed to prevent activities and / or conditions that pose a threat to human health, safety, or the environment. We will look for ways to minimize risk and protect our employees and the communities in which we operate by employing clean technology, including safe technologies and operating procedures, as well as being prepared for emergencies.

We will strive to minimize releases to the air, land, or water through use of cleaner technologies and the safer use of chemicals. We will minimize the amount and toxicity of waste generated and will ensure the safe treatment and disposal of waste.

We will manage scarce resources, such as water, energy, land, forests, in an environmentally sensitive manner.

COMMUNICATION

We will communicate our commitment to HS&E quality and to our company's environmental performance to our employees, vendors, and customers. We will solicit their input in meeting our HS&E goals and in turn will offer assistance to meet their goals.

CONTINUOUS IMPROVEMENT

We will measure our progress as best we can. We will review our progress at least on an annual basis. We will continuously seek opportunities to improve our adherence to these principles and to improving our environmental performance, and we will periodically report progress to our stakeholders.

{Signature} President Date

Adapted from: *Environmental Management Systems: An Implementation Guide for Small and Medium-Sized Organizations.* Ann Arbor, MI: NSF International, November 1996, p.3.

SAMPLE POLICY

This is the environmental policy of a small environmental services company specializing in wastewater treatment and laboratory analysis of effluent. The policy should be signed by the company's President.

We supply quality products and services. This requires the commitment of everyone working in this institution to pursue our activities safely, protecting our health and preserving the environment.

To realize this vision we will:

- Establish and review periodically our environmental goals within a program of **continual improvement**.
- Comply with legal requirements pertinent to our industry and with the requirements of other initiatives we enter into in accordance with our commitment to offer quality products and services.
- Conduct laboratory analyses and supply environmental services without risk to workers' health.
- Operate the laboratory with a minimum of waste, in current and future operations.
- Pursue our work with a minimum of disturbance to our neighbors and the community.
- Maintain our vehicles in optimal condition to minimize their consumption of fuel and their emissions to the atmosphere.
- Manage our chemical products safely, principally to prevent spills in their storage and transport.

This policy and any subsequent modifications should be familiar to all employees and available to the public. Implementation of this policy is a primary objective of the President and the responsibility of all employees.

{Signature} President Date

CASE STUDY: COPY PLUS SERVICES

Sam Worth, owner of a copy center business, was attending a conference on issues affecting small businesses. The conference was the first of this type that Sam had attended. His business, Copy Plus Services, has five centers located in the western suburbs of Chicago. Each center provides a full range of copy services including fax, binding, computer usage, video conferencing, and blueprint service. The centers are run 24 hours a day and seven days a week. Sam grew the business from a simple copy center located in Elgin, Illinois, five years ago and is planning to go national with the business.

During one of the small group sessions, Sam and five other attendees were discussing how their businesses affected the environment. One of the presentations had mentioned a new standard — ISO14001 Environmental Management Systems — which applies to service businesses as well as manufacturers. None of the people in Sam's small group was familiar with the standard. They decided to share with one another what they'd been doing in their businesses to protect the environment and then review the ISO 14001 standard.

Naturally Sam's five copy centers recycled waste paper. However, beyond that Sam had never thought of other environmentally conscious programs that they could implement. He was a bit embarrassed that he had not really given it much thought. He has had complaints of odors bothering the people in stores adjacent to his centers. In an attempt to appear as if he had given it some thought, Sam told the group that he had a good quality program which he thought addressed environmental issues, and that one of his centers had received an ISO 9001 quality award for doing quality work.

For the most part, the other members of the group had also not given environmental programs much thought. They didn't have any specific issues confronting them and were somewhat concerned about embarking on a program for which they could not see any beneficial return and that might be a big cost to the business. Since they had never dealt with the EPA, they were leery of the possibility that EPA might come into their business if they participated in the ISO 14001 program.

One of the group members said that, from what she had read on environmental programs in *Business Week*, there were benefits to be derived by undertaking such a program. Since these programs had to be integrated into the overall business plan, it seemed important that top management provide the leadership in incorporating environmental stewardship. She cited some examples of this from case studies she had read, as well as from her personal experience. One of the examples was an ice cream business in Chicago, which increased its overall productivity by focusing on energy efficiency. In addition, an international clothing distributor used the environment as a major selling point for its product.

After Sam returned home from the conference, he sat down and thought about what had been discussed in the small group session. He wanted to start an environmental program in his business but was not quite sure how to proceed. He decided to draft an environmental policy for his Copy Plus Service before going to bed, and present it to his staff at their weekly meeting the following Tuesday.

At the meeting Tuesday, Sam presented his environmental policy to his staff. Sam's staff was composed of the managers of the five centers, a finance manager, and himself.

The reaction from the group was split. Two of the managers felt that, other than recycling the paper, there wasn't anything of significance that they could do within their business. The other three seemed to think that this was something worth pursuing. The finance manger was on the fence. While she acknowledged that there might be some ideas for them to pursue, she was concerned that it would add cost to the business. The copy business was a low-margin business and competition was increasing.

Although Sam knew that everyone wasn't equally committed, they all agreed to pursue the idea further. The finance manager and the two managers who were enthusiastic would review Sam's environmental policy to determine whether it was appropriate for the business. If so, they would help figure out how it could be incorporated into the business. Sam suggested that they might want to talk with someone else in the copy business to see what they are doing about environmental programs. The finance manager said that she knew someone from The Body Shop, also in the mall, who had worked on a committee to develop their environmental program. They all agreed that the friend should be invited to join them for a meeting as an outside observer and advisor.

> ☞ **Tip**
>
> Sam may have had a better response if the managers had all participated in developing the policy together.

When the three managers met, Laura Witherspoon from The Body Shop, a neighboring store in one of the malls, was able to attend. She agreed to provide her perspective and ideas in establishing an environmental management system. The first order of business was for them to explain their operation to her.

> ☞ **Tip**
>
> So far Sam has only involved managers. He should now include employees from all levels of the company.

Copy Center Operations

Each copy center produces a million copies per year using premium grade paper. Of that output, 70% is single-sided copies. Each copy center also does a significant amount of blueprint business. There are fifteen employees per center. Each center's energy bill is $50,000 per month. The majority of the work is done during 9 AM to 6 PM business hours. They recycle approximately 100,000 pieces of paper per year in each center. Each center uses 400 toner cartridges and two gallons of ammonia per month. Supplies are stored on shelves in a back room and chemicals are stored either in metal cabinets or next to the machines (for easy access). Copy Plus Center customers come both through newspaper advertising and pamphlets, and through their Web site.

Equipment: The copy machines and computers are three to five years old. They are typically left on 24 hours a day. The managers are not sure if any of the chemical products used in the copy and blueprint equipment have an impact on the environment.

Location: The Copy Plus centers are in shopping malls and residential areas. Businesses in the area such as restaurants have expressed concern over the odors coming from the centers.

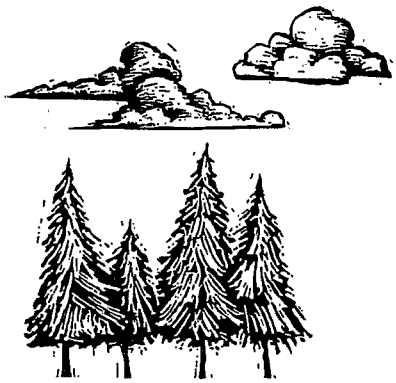
Delivery Service: Each center has vans providing customer pickup and delivery. In addition, the vehicles are used to pick up supplies for the centers.

Cleaning Service: Each center contracts with a cleaning service that cleans the facilities. A waste disposal company handles the waste, and recycling is subcontracted.

Training: Employee training focuses on running the equipment and administrative procedures, including paper recycling.

Considering this information, Laura suggested that they approach environmental management system implementation not just from the standpoint of the copy center operation but from a total systems approach. Laura presented a simple input/output model to begin the process of understanding the environmental aspects of the business. The three managers immediately recognized the possibility and benefits of this approach. They asked Laura if she would be willing to prepare a rough plan that described this approach in more detail, and outlined a typical copy center environmental management system. Laura agreed because she remembered how difficult it was to get the synergy in her own organization. She felt that she could assist them with this.

MODULE 3: DETERMINING SIGNIFICANT ENVIRONMENTAL ASPECTS AND SETTING OBJECTIVES



From your work in Module 1, you have probably identified a number of "environmental aspects" associated with your company's activities. This module will help you prioritize those aspects. It will also help you determine which one(s) you will want to work on first. Do not expect to work on all the environmental aspects identified. "Continuous improvement" implies that this is an on-going process where you address some concerns now and others in the future.

Your operations may have many environmental aspects, but they may not all be significant. First, by ranking each aspect against a set of environmental criteria (e.g., toxicity, wasted materials), you can determine which are most significant. Next, to select which significant environmental aspects (SEAs) you will work on, rank each aspect against practical criteria (e.g., technical and economic feasibility) and benefits criteria (e.g., improved health). For those aspects you select, you will set objectives in terms of the improvements you hope to make.

Determining which aspects are significant includes making subjective decisions. For this reason, you will improve results by having a team of people who represent different job categories. They can provide a cross-section of operational experience when you work on this module.

Design for the Environment U.S. EPA

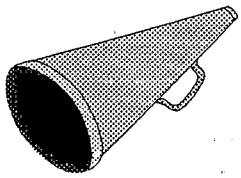
DfE projects emphasize integrating evaluation of both risk and resource conservation into performance and cost evaluations.

Create a Working List of Environmental Aspects

When you developed a list of environmental aspects using the process map of your company's activities, you may have identified a large number of environmental aspects. This is not surprising, since virtually all of your business activities could interact with the environment in some way. In order to identify which environmental aspects are significant, we will review environmental risk information. However, ranking your environmental aspects using environmental risk information can be a labor-intensive process. Therefore, you may want to create a smaller list of environmental aspects to rank using risk information.

First, create a list of selection criteria that suit your company. Below is a list of examples to help you get started:

- Which aspects might affect your company's ability to comply with regulations and other requirements?
- Are there pollution prevention opportunities?
- Are there potential cost savings or business opportunities (e.g., potential customers who require their suppliers to have EMSs)?
- Are there concerns that might be shared by customers or suppliers?
- Is there "low-hanging fruit" that might provide early successes which can serve both to educate employees and to build confidence in the IEMS?
- Are there opportunities to integrate environmental with worker health and safety requirements?
- Are there community concerns regarding your company's activities?



In describing the approach used to identify and prioritize SEAs, one screenprinter stated that his company:

"Brought in a cross-section of staff and conducted facilitated brainstorming. They then captured the information in a matrix to help prioritize aspects."

Another said his company used "common sense." He said,

"A quick walk around any print shop will produce at least enough SEAs to get an IEMS project under way."

- Are there unregulated hazardous chemicals that could be managed better or substituted?
- Are some of your "solutions" to environmental concerns or regulations shifting waste from one media (air, water, land) to another?
- Could resources be used more efficiently, e.g., energy, water, materials?

You may want to use all or some of these, and you may think of others specifically related to your company's circumstances. Create a list of criteria and use that to select a group of environmental aspects to rank.

There are several ways to make this selection. One way is for the IEMS team to review the list of environmental aspects and vote on their top concerns. Set a target number to rank, say ten, and let the top ten environmental aspects be your working list.

When you have a reduced list of environmental aspects (e.g., ten), you are ready to rank them using environmental risk information to determine which are significant environmental aspects.

☞ Tip

Remember: "aspect" refers to the potential for environmental impact. A significant aspect would have the potential for large impact, either because impact is likely to occur under current operating conditions, or because there is potential for serious impact. Even aspects that are well-controlled should be considered for their **potential** for impact should controls fail.

Using Environmental Risk Information to Rank Your Environmental Aspects

Although you will not attempt a formal risk assessment for your IEMS, this module will help you apply your working knowledge and judgment about the chemicals and materials your company uses, and the way in which they are used, to select environmental goals to help create healthier working conditions, communities, and environments. This section presents a brief introduction to the concept of risk and to ranking symbols. Then it presents methods to gather chemical and material **effects** information and

rank aspects according to effects; a method for making judgments about **exposure** to chemicals and materials and rank aspects according to exposure; a method for laying out risk as well as other environmental concerns and ranking aspects considering these factors. In addition, methods for ranking environmental aspects as projects in terms of cost and expected improvements are presented as a way to prioritize projects that your company will undertake to get started on your IEMS.

Risk

Risk assessment, in brief, is a process that integrates the work of several sciences to determine the kind and degree of environmental and human health impacts *potentially* produced by *exposure* to a chemical or material.

Risk is composed of two parts: toxicity (hazard or "effects") and exposure. *Toxicity* is the ability to cause harm to the health of humans, wildlife, or vegetation, as well as the type and seriousness of that effect. You will collect the information needed to form a judgment about effects in Worksheet 3-1. You will review the chemical effects information for each aspect and give a rank based on your judgment of the seriousness of the effects of this chemical or substance.

Exposure is the *amount* of material with which workers, the community, or the environment come into *contact*. The amount is determined by both *severity* and *time* of contact. Severity refers to the amount of material that one can come into contact with at any one time. The time of contact depends on the number of times that contact occurs in a given period (the *frequency* of contact) and the *duration* of the contact. You will collect the information needed to form a judgment about exposure in Worksheet 3-2.

☞ **Tip**

Visit the DfE website for more tools related to risk.

www.epa.gov/dfe

Contact with humans and animal or plant life is characterized as occurring along pathways. These pathways describe the routes along which the substance must travel, before it enters an animal or plant, and how the substance is taken up by the living organism. Several pathways for human exposure include:

- breathing the material (inhalation pathway),
- touching the material (skin or dermal pathway), and
- ingesting (eating or drinking) the material (oral pathway).

Using Ranking Symbols

One way to rank environmental aspects is to use symbols representing a range of high (H) to low (L). Whatever ranking you use (Figure 3-a shows an example), phrase the meaning consistently across all ranking categories; this is most straightforward if you think of "high" as meaning a project you would ultimately like to undertake and "low" as one having lesser priority. Thus, when considering environmental effects, a chemical receiving a "low" rank would be one with low impact or good environmental performance.

Figure 3-a: Ranking Symbols

Symbol	Meaning	IEMS Meaning
H	High	Most environmental impact
M-H	Moderately High	More environmental impact
M	Moderate	Medium environmental impact
M-L	Moderately Low	Lower environmental impact
L	Low	Lowest environmental impact

Identify and Rank Potential Human Health and Environmental Effects of Chemicals and Materials

To rank the environmental aspects associated with chemicals and

☞ **Tip**

See Appendix B for a list of sample questions to ask your suppliers.

materials used in your business operations, you will need to find information on the human health and environmental effects associated with those chemicals. Without this information, you cannot identify the potential impact of each chemical on the environment. Unfortunately, there is no single and comprehensive source of information for most chemicals. Information that will help you understand the effects associated with the chemicals you use may be located in several different sources.

By taking the time and effort to find information about the chemicals you use, you will be able to understand the potential effects of the chemicals on humans and on the environment. You will also know how to use them in a way to minimize or avoid harmful effects. You can decide whether you want to continue using your current chemicals, or find alternatives that would mitigate any potential harmful impact.

Sources of information about chemicals include:

- Manufacturer's Safety Data Sheets (MSDSs). These are supplied by the manufacturer according to OSHA regulation. You should receive a MSDS with any chemicals you purchase. They should be kept in a location that is available for review.
- Your suppliers. Ask them for hazard and exposure information on any products you purchase. Ask them to supply the environmental information that is not on the MSDS.
- Your trade association.
- EPA or state environmental agency.
- Online sources in various websites, e.g. various EPA programs. (EPA's DfE Program website contains a Risk Guide with additional information.)

☞ **Tip**

Remember, any chemical strong enough to take the place of human labor or to make human labor easier is strong enough to have some kind of environmental risk associated with it. The challenge is how to best manage that risk.

Organize the information you have into a format that will enable you to make comparisons between aspects. You may find that sometimes there exists very little information for a particular chemical. That discovery in itself is useful. By using this format and showing where information gaps occur, you will know that whatever decision you make now about using a specific chemical may change if information becomes available at a later date. Although you may want to use the chemical now, you may need to make adjustments later when more information becomes available. Worksheet 3-1 will help you organize your information on the chemicals you use in your business activities. The column headings list the categories and specific information needed. The final column asks for your judgment about the ranking of the environmental concerns associated with the chemical or material under consideration.

Figure 3-b lists the kinds of information OSHA requires on an MSDS. Most of the kinds of data listed below can be used to fill in the columns on Worksheet 3-1. Much of the environmental information will have to be found elsewhere.

In addition to carcinogenicity information and qualitative descriptors of health hazards (e.g., sensitizer, causes dizziness, etc.), MSDSs sometimes include *quantitative* toxicity values, which are important for assessing chemicals hazards. These include lethal dose (LD) and lethal concentration (LC) measures, which are typically from laboratory studies done on small mammals such as rats, mice, or rabbits. These measures are used to give guidance as to the dose required to kill a human. This is important information; however, interpreting its meaning is difficult. In general, if you are comparing several chemicals that have LD or LC measures, the lower measure is the most potent

(it means that it takes less to be lethal). Therefore, you would have to be more careful using the chemicals with the lower LD or LC measures, *as compared to* those having higher measures. Be sure to record any quantitative toxicity values found on an MSDS, as well as the more qualitative information.

Figure 3-b: Information on an MSDS

As defined by the Occupational Safety & Health Administration (OSHA) (29 CFR 1910.1200), an MSDS is written or printed material concerning a hazardous material which contains the following:

- The identity of the hazardous material (except as provided for materials that are trade secrets).
- The physical and chemical characteristics of the hazardous chemical (such as vapor pressure, flash point).
- The physical hazards of the hazardous chemical, including the potential for fire, explosion, and reactivity.
- The health hazards of the hazardous chemical, including signs and symptoms of exposure, and any medical conditions which are generally recognized as being aggravated by exposure to the chemical.
- The primary route(s) of entry.
- The OSHA PEL (Permissible Exposure Level), the ACGIH (American Conference of Governmental Industrial Hygienists) Threshold Limit Value, and any other exposure limit used or recommended by the chemical manufacturer, importer, or employer preparing the MSDS, where available.
- Whether the hazardous chemical is listed in the National Toxicology Program (NTP) Annual Report on Carcinogens (latest edition) or has been identified as a potential carcinogen in the International Agency for Research on Cancer (IARC) Monographs (latest editions) or by OSHA.
- Any generally applicable precautions for safe handling and use which are known to the chemical manufacturer, importer, or employer preparing the MSDS, including appropriate hygienic practices, protective measures during repair and maintenance of contaminated equipment, and procedures for clean-up of spills and leaks.
- Any generally applicable control measures which are known to the chemical manufacturer, importer or employer preparing the MSDS, such as appropriate engineering controls, work practices, or personal protective equipment.
- Emergency and first aid procedures.
- The date of preparation of the MSDS or the last change to it.
- The name, address, and telephone number of the chemical manufacturer, importer, employer or other responsible party preparing or distributing the MSDS, who can provide additional information on the hazardous chemical and appropriate emergency procedures, if necessary.

Worksheet 3-1:[a] Health, Safety and Environmental Potential Effects Information

Operation	Environmental Aspect	Information Sources	Regulatory Data: [b] Carcinogen? OSHA Permissible Exposure Limit (PEL)? Volatile Organic Compound (VOC)? Toxic Release Inventory (TRI)?	Human Health Effects by Pathways Acute and Chronic [c]			Effects on Wildlife and Other Environmental Effects [d]			Worker Safety	Rank	
				Inhalation	Dermal	Oral	Air	Water	Land		Human	Environ-ment
Manufacture Step 1	Chemical 1	MSDS, trade association	yes 10 ppm no no	Chronic: cancer Acute: dizziness	Chronic: sensitizer	acute: LC50 of 100 ppm	ozone depletion	Acute: kills fish	kills worms	flammable		
Contact Person:				Date Completed:								

a Corresponds to Table EA-03 in *Company Manual Template.*

b Most information for this column can be found on the MSDS.

c Partial information for these columns might come from the MSDS, but other resources may be needed. In particular, acute effects are usually reported on MSDS sheets. Chronic effects are sometimes on MSDS sheets, but often will have to be found elsewhere. LC refers to lethal concentration. Inhalation LC50 is the concentration of a chemical in air that causes death in 50 percent of the test organisms at the end of the specified exposure period. LD refers to lethal dose. LD50 is the dose of a chemical taken by mouth, absorbed by the skin, or injected that is estimated to cause death in 50 percent of the test animals. Lethal dose data are expressed in terms of amount of chemical divided by the body weight, e.g., mg/kg.

d MSDSs usually do not include environmental effects.

Note: This worksheet provides an example of the kinds of information found on an MSDS, but it is not a part of the press cleaning example. For more information on risk-related data, including methods for interpreting quantitative toxicity values, refer to the Risk Guide provided on the DfE Program website.

Rank Exposure to Chemicals and Materials

In determining exposure, the amount of material as well as the frequency and duration of contact must be considered. An important element in exposure is contact. If there is no possibility of contact occurring, then there may be no exposure and therefore no risk. In some cases, as when a toxic substance such as lead is embedded in a product such that no contact occurs during use of that product, the toxic substance may still leach out of that product if it is disposed of in a landfill. The possibility of contact throughout the use and disposal of a product should therefore be considered. If, however, a toxic substance is contained such that neither humans nor the environment would come into contact with it, then exposure would be low. In ranking such a chemical use the rank given to the "Workers, " "Community," and "Environment" would be "Low" (L). In ranking exposure, it is, therefore, necessary to consider how contact might occur and whether, in fact, it does.

Severity (Quantity)

Determining the quantity of chemical or material that humans or the environment are exposed to can be difficult, especially if the substance becomes diluted in air as vapor or dust or in water. Potential exposure is affected by both the amount of a chemical product used and the concentration of the subject chemical in the product. First, determine the quantity used per time period (shift, week, month, year). If the chemical of interest is part of a product, then apply the percentage that the chemical constitutes in the product to the total usage of the product to determine the quantity used of that chemical. For example, a product may be a single, pure chemical (such as a solvent), or it may be a dilute water-based mixture, with the active ingredients being only a small percentage of the total amount. The higher the concentration, the higher the potential exposure to that

ingredient. See the Exposure section of the Risk Guide on the DfE website for more information on evaluating the exposure amount and ingredient concentrations.

Exposure Time

In addition to quantity, the duration of contact determines the exposure to a chemical or material. How often is the chemical or material used and for how long? The time period used should be related to that used for quantity. For example, if you measure quantity per month, then the time periods should show how many times (frequency) and for how long (duration) it is used per month. Use whatever time frame works with your business operation, but be consistent.

Personal Protective Equipment

The use of personal protective equipment (e.g., gloves, eye protectors, breathing masks) can greatly alter exposure to a chemical or substance, for the personal protective equipment provides a barrier that prevents or reduces contact. Even though personal protective equipment is used, some exposure may occur because people are not perfect in their adherence to instructions and because equipment fails. Consider the possibility of failure when making judgments about exposure to chemicals and materials.

Pathways

Substances can come into contact with living organisms through air, water, land, and other solids. For example, chemicals and substances can be inhaled from the air in the form of dust, vapors, and mists. Humans can ingest chemicals and substances in liquids or food. Substances can get into liquids or food by falling into them from the air, or by food coming into contact with chemicals on surfaces or hands. Finally, touching the chemical or substance can occur when dust, mists, or vapors

☞ **Tip**

See the Exposure section of the Risk Guide on the DfE website for more information on evaluating the exposure amount and ingredient concentrations.

contact bare skin or when unprotected hands touch contaminated surfaces. Animal and plant life can take up chemicals and substances from the environment in much the same way. Figures 3-c and 3-d show some typical exposure pathways for chemicals used in business operations. When ranking aspects, determine how contact might occur; then decide how severe that contact actually is and how much time is involved (the frequency and duration of contact). (For consistency in comparisons between criteria, apply the same time period to every aspect in your ranking exercise.)

Worksheet 3-2 will help you think about the exposure for each chemical you consider. This chart can be filled in for each chemical or material and represents your best judgment about exposure. The rank for each can then be placed in the last column. The rank represents your judgment.

Worksheet 3-2: Exposure to Chemicals and Materials

Operation	Aspect	Quantity* Used per time period	Exposure Time		Personal Protective Equipment (PPE)	Pathway		Rank Exposed Groups		
			Duration**	Frequency		Human: Inhalation, Dermal, Oral	Environment: air, water, land	Workers	Community	Environ-ment
press cleaning	acetone, toluene, MEK, isopropyl alcohol blend air releases	24 oz. per day	10 min.	5 times per day	gloves	inhalation	air, water	H w/o PPE	L	M-L
Contact Person:				Date Completed:						

*If ingredient in chemical product, use quantity of chemical not product, i.e., apply the percentage that the ingredient makes up of the product.

**How many minutes or hours per day is the chemical or material used?

Note: For more information about evaluating exposure, refer to the exposure section of the Risk Guide on the DfE Program website.

Figure 3-c: Screen Printing Exposure Pathways

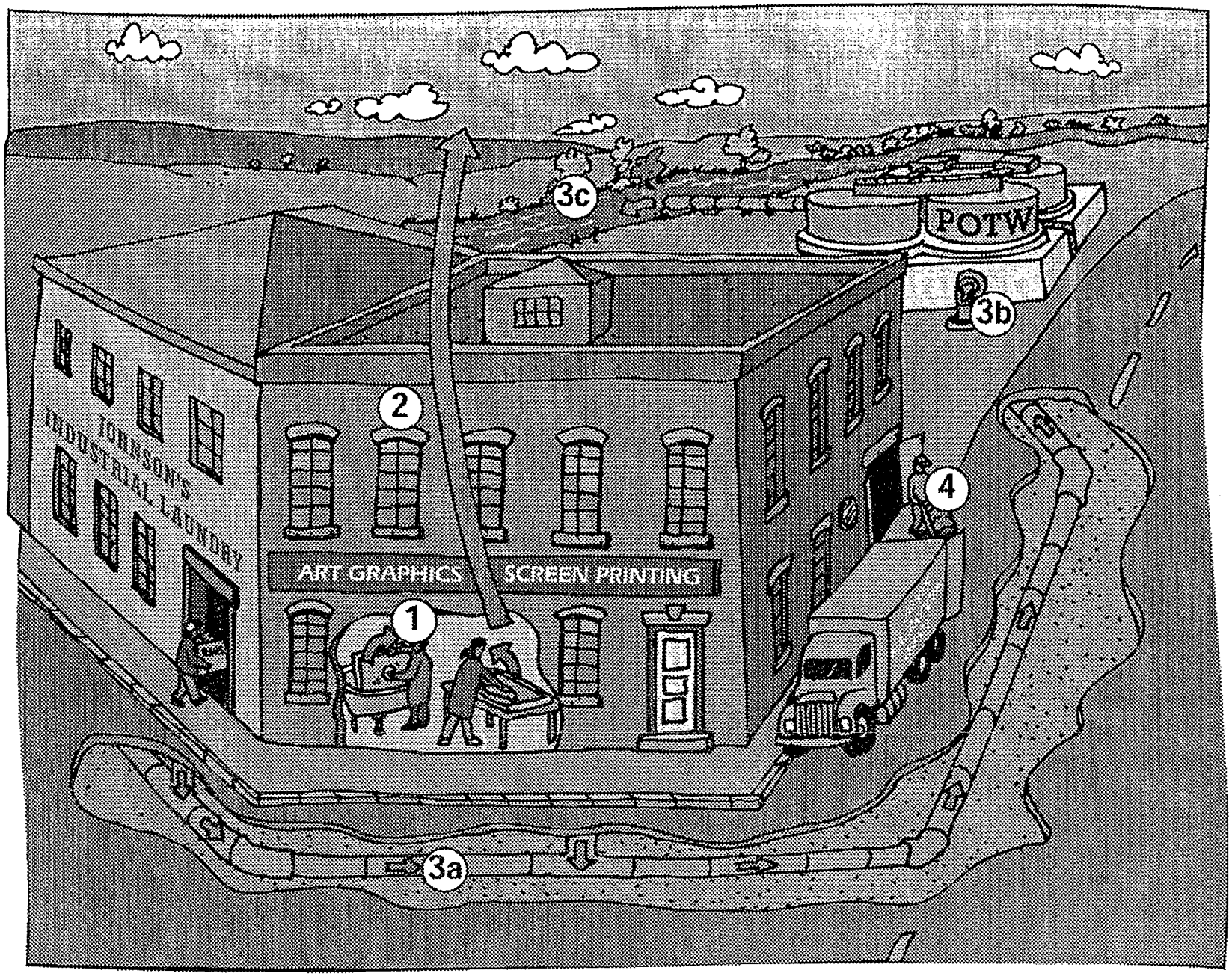
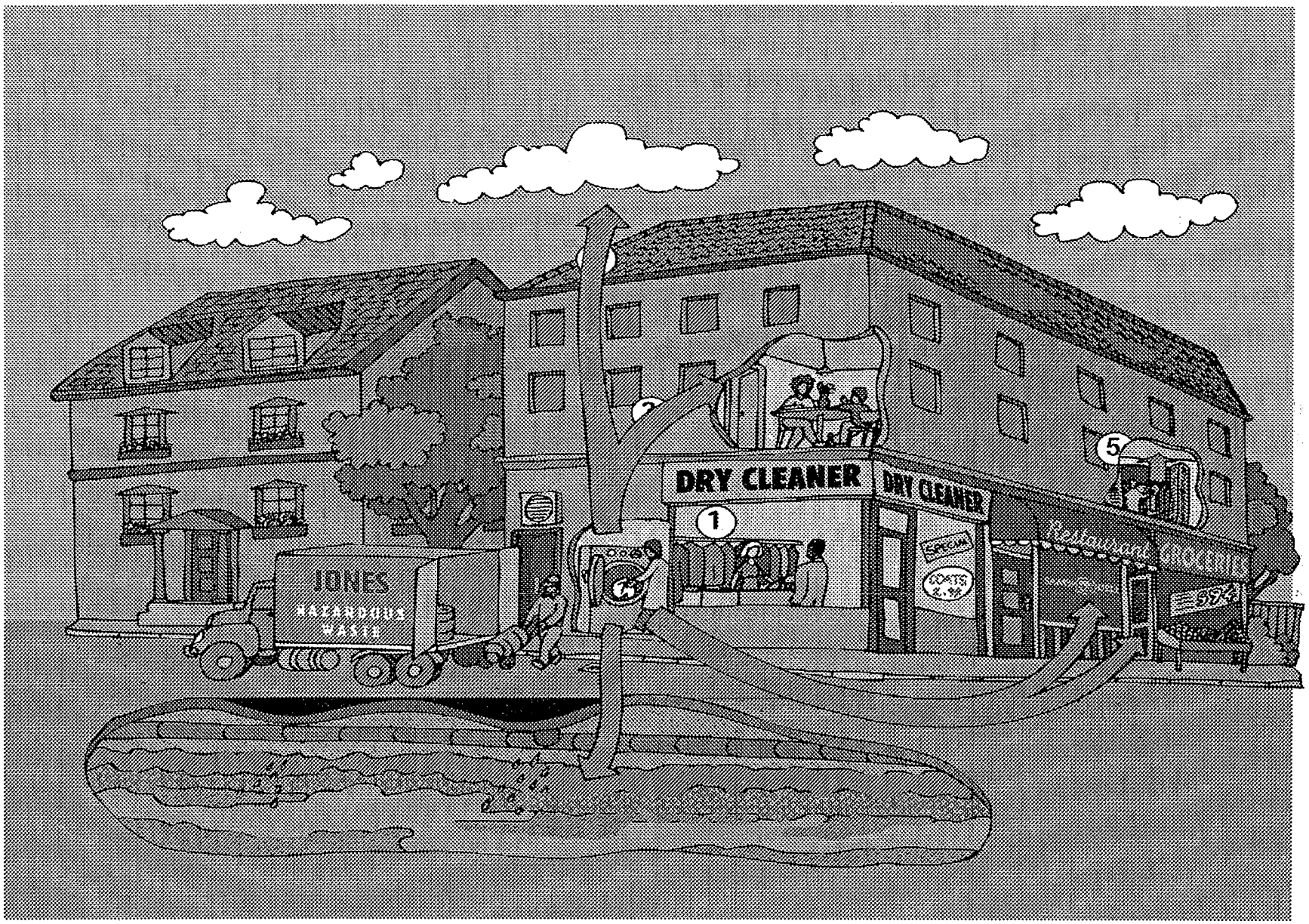


Figure 3-d: Dry Cleaning Exposure Pathways



Ranking Your Significant Environmental Aspects

Now you will put the Effects information together with the Exposure information and consider some additional information. The following paragraphs explain how to use Worksheet 3-3 to rank significant environmental aspects.

Regulatory Concerns

For each aspect, refer to the regulations associated with it that were identified in Module 1 and decide how important these are to your company. For example, an aspect might be regulated, but your company might be small enough that it was exempt from the regulation. The regulatory concern for your company might therefore be considered low (i.e., not important enough for a project). On the other hand, your company might have an environmental aspect to which a regulation applies. If you can stay in compliance easily, you might also rank the regulatory concern low. Or, if the cost of compliance is large or you have experienced difficulties in meeting compliance, you may rank this high (meaning that it may be a good candidate for a project). You do not need at this point to define your aspect in terms of an environmental concern. That will show up as you rank the remaining columns for this aspect.

Chemical and Material Risk

Place both the ranking for effects and the ranking for exposure from Tables 3-1 and 3-2 in the columns. The effects rank for humans would be placed in both the worker and community columns.

Worker Safety

Look at the information in Worksheet 3-1 under worker safety and apply a judgment of ranking. Enter this rank in the worker safety column.

Other Community Issues

There are a variety of community concerns that might affect your designation of a particular activity as a significant aspect. These are issues other than pollution. Some examples are the noise level or odor produced by your plant; increased traffic caused by your business; and increased light needed for your operations. You may come up with others specific to your operation and your community. Worksheet 3-3 provides a place to document and rank these issues. Place the rank from this worksheet in Worksheet 3-5.

Worksheet 3-3: Community Issues

Operation	Aspect	Community Issues (List)	Rank

Contact Person: Date:

Natural Resources

This criterion should be used to identify the use of water, energy, and other environmental resources, such as forests or land. The rank that you give to a particular aspect under this criterion is highly subject to the specific circumstances and values of your company and community. For example, a high rate of water use would be of higher concern in a desert region than in a region where water is more plentiful. This column allows you to consider what resource issues you might associate with a particular aspect. The rank you give is based on your judgment related to your own specific circumstances. Other natural resource issues include generation of solid waste and its contribution to landfills in your area. Worksheet 3-4 provides a place to document and rank these natural resource concerns. Place the rank from this worksheet in Worksheet 3-5.

☞ Tip

Remember: The ranks have no intrinsic meaning. They are merely a shorthand for expressing your judgment about priorities.

Worksheet 3-4: Natural Resources Use

Operation	Aspect	Natural Resources Used	Rank
Contact Person:		Date:	

Overall Ranking and Significance

Review the columns for each aspect and make a judgment as to whether each aspect should be determined H, H-M, M, M-L, L in rank. After all the aspects have been given an overall rank, determine which of them you believe are significant for your

company. Place a yes (Y) or no (N) in the final column.

Ranking Environmental Aspects: Examples

The following example shows you how to rank the aspects identified in Module 1 using the criteria in Worksheets 3-5a and 3-5b. Examples of both small and large projects are included. It is important that you think through even solutions that seem obvious, because sometimes you might find a better solution. Refer to Figure 1-h and Worksheet 1-5 to refresh your memory on this example.

☞ **Tip**

If you are pursuing ISO 14000 **certification**, you will have to address each significant aspect. You may want to consider reducing the number of significant aspects to two or three in the beginning and add more as your company grows in experience with the IEMS process.

Example 1: Toner Cartridges

In this example, a copy machine is used to make paper copies as part of day-to-day business activities. The inputs are toner, paper, and electricity (energy) to run the copies. Outputs include spent toner cartridges, waste paper from poor quality copies, noise, and usable copies. There are no restrictions on use of the copier. Spent toner cartridges are simply discarded with the office trash.

Let's consider the use of toner in copying. Unused toner is considered as an input, while used toner is considered as an output. The same product generates different concerns at different stages of its use. Let's look at the criteria for each in Worksheet 3-5a. The worksheet shows the aspects identified in Figure 1-h. Only the two toner input and output aspects are scored for this example, for illustration. However, in a real exercise, all the aspects would be scored.

Worksheet 3-5a:[a] Criteria to Determine Significant Aspects—Toner Cartridge Example[b]

Operation	Aspect[b]	Regulatory Concerns	Chemical and Material Risk			Worker Safety	Other Community Issues:[d]	Natural Resources:[e]	Overall Ranking	Significant ? Y/N
			Worker Eff/Exp[c]	Community Eff/Exp[c]	Environment Eff/Exp[c]					
Copying	Paper Use									
	Toner (Input)	M	L/L	L/L	L/L	L		L	M-L	N
	Documents									
	Waste Paper									
	Used toner (Out)	M-H	L/L	L/L	H/H	L		M-H	M-H	Y
	Odors									
Contact Person:					Date Completed:					

[a] Corresponds to SEA-01 in *Company Manual Template.*

[b] Include each input and output of a process step.

[c] Effects/Exposure

[d] Noise, Traffic, Light, Odor.

[e] Include such items as Resource Use, Solid Waste, Energy Use

Ranking Notes for this Example:

Regulatory concerns may be present due to the chemicals used inside the cartridge or due to solid or hazardous waste regulations.

Effects of Chemicals and Materials inside the toner cartridge are probably of concern. You would have identified these in Module 1. However, since the cartridges are not opened either during input or output use, there would be no exposure. Frequency of impact, therefore, would be low.

Workers: Worker health and safety would be of low or no concern if the toner is used only in the cartridges.

Community: The community's health and safety would be of low or no concern if the toner is used only in the

Environment might be high if you do not currently recycle your cartridges. Chemicals can spill out of the cartridges if they are placed in a landfill.

Natural Resource Use would be low for water, but might be a concern for land if you do not recycle the used cartridge.

How to Obtain Overall Rank: this can be done in two ways.

1. Look across the columns and assign a total that in your judgement best reflects the individual ranks in each column.
2. Assign a number from 1-5 to each rank such that H = 5 and L = 1. Sum these across the columns and then divide by the number of columns used to get an average rank for that row. For toner input the total would be 11 (counting each risk column as 2 because they have two scores and disregarding other community issues because it was not applicable). Divide by 9 (the number of columns used). The average rank would be 1.2, which corresponds with M-L. Place M-L in the Total column.

Meaning of Environmental Aspects Rank: The total rank for toner used as an input is M-L and for used toner as an output is M-H. These ranks tell you that toner cartridges as waste outputs of your copying generate more concern than they do as new inputs. Your main concern would be to reduce any potential impact of the used toner cartridges. You could reduce potential impact in at least three ways:

- ensure that the cartridges are not opened either before or after use, to avoid exposure to the chemicals;
- ensure that the cartridges are recycled according to the distributor's instructions, so that there is neither concern for ecological exposure to the chemicals in landfills, nor a contribution to the solid waste going into landfills; and
- reduce the number of waste toner cartridges by cutting down on unnecessary copying.

Example 2: Chemical Use and Waste

A second example will provide more points to consider in developing objectives. Consider the chemical inputs and the chemical waste outputs of a "Press Cleaning" example.

In this example, a printer uses a chemical press cleaner (solvent mixture) to manually clean the press after each print run. An uncovered bucket of cleaner is kept at press-side along with a bin of clean, cloth wipers and an uncovered container of soiled wipers. To clean the press, the printer scrapes excess ink from the press for reuse, dips one or more wipers in the press cleaner and wipes the press; wipes the press with one or more clean, dry wipers; and places soiled wipers in an open bin. Soiled wipers are transferred to a closed storage container at the end of the shift. Most of the resulting ink/solvent mixture is contained on the wipers, but excess is captured in drums and disposed of as a hazardous waste. Soiled wipers are sent to the laundry weekly.

Thus, the inputs are the press cleaner and clean wipers. Outputs are reusable ink, soiled wipers, and waste ink/solvent mixture. The environmental aspects include the waste ink/solvent mixture and air and water emissions of press cleaner. Air emissions of press cleaner occur both in the print shop (from the uncovered bucket of cleaner, the cleaning operation itself, and the storage container of soiled wipers), and at the laundry (from the soiled wipers). We will score the two aspects of chemicals used in press cleaning and waste from those chemicals.

☞ **Tip**
Refer to Figure 1-i and Worksheet 1-5 to refresh your memory on this example.

Worksheet 3-5b:[a] Criteria to Determine Significant Aspects—Chemical Use and Waste Example[b]

Operation	Aspect[b]	Regulatory Concerns	Chemical and Material Risk			Worker Safety	Other Community Issues:[d]	Natural Resources[e]	Overall Ranking	Significant? Y/N
			Worker Eff/Exp[c]	Community Eff/Exp[c]	Environment Eff/Exp[c]					
Press Cleaning	Step 1									
(in)	Toxic chemical constituents	M-H	M/ M-H	M/ M-L	M/ M-L	M-L	n/a	M-H	M	
	Wipers									
	Energy									
	Water									
(out)	Waste chemicals	M-H	M/ M-H	M/ H	M/ H	M-L	n/a	M-H	M-H	
	Soiled Wipers									
	Waste Water									
	Air Releases #1									
	Product for next step									
Contact Person:					Date Completed:					

[a] Corresponds to SEA-01 in *Company Manual Template.*
[b] Include each input and output of a process step.
[c] effects/exposure
[d] Include noise, traffic, light, odor.
[e] Include such items as resource use, solid waste, energy use.

Ranking Notes:

Regulatory Concerns: check the lists of regulations and standards to see if they apply to any of the chemicals you have identified as inputs. For outputs from your manufacturing process, find out whether the regulations for solid and hazardous waste make mention of these chemicals. Consider whether new chemical products are formed and become wastes during the process of step 1. If so, don't forget to check for these chemicals as well as the input chemicals. *Chemical and Material Risk:* Assign the ranks from your Effects and Exposure Worksheets. *Safety* might include reference to a flammable chemical. Hence the rank of M-L. *Natural Resource Use* may be important for both input and output chemicals. Also, consider the quantity of water used as an input or to take care of waste.

Meaning of Rank

The total for input chemicals is M and M-H for output (waste). If you compare all the ranks, it would seem that the waste chemicals in this example, using assumed criteria, constitutes a more significant concern than do the other activities.

Grouping Environmental Aspects

In reviewing your company's list of environmental aspects you may discover that some aspects occur in more than one process step. Energy use is a good example. It might be effective in some circumstances to combine all the process steps having energy aspects, and develop a facility-wide strategy and program for achieving improvement. Understand, however, that the energy aspect should be ranked in each process step to determine its relative importance in that step. For example, energy use in office work might be a different priority than energy use in a manufacturing step. In addition, standards and procedures developed to reduce energy use would be different for each process step. Consequently, although you might achieve certain efficiencies through a facility-wide effort , your actual environmental improvement will be attained through objectives set for each process step.

☞ Tip

You do not have to evaluate alternatives for all significant environmental aspects. Therefore, it is important to consider the "do-ability" of each project and to determine what improvements might be achieved by each project before deciding which ones to undertake.

Consider "Practical" Criteria Also

In order to determine which significant environmental aspects will become projects, it is important to consider the economic and technical feasibility and the time frame for your company. It is also important to consider what improvements could be expected from each project. Selecting high-priority projects is desirable from an environmental perspective, but there is value in undertaking some short term, "easier to implement" projects which may not be ranked high in environmental risk. The easier projects provide a useful learning experience, boost confidence as people see results, and

☞ Tip

Remember: If your company is considering ISO certification, you will have to demonstrate action on every SEA.

focus attention on environmental goals.

In the examples above, deciding to reduce the volume of copying and to recycle toner cartridges used in your office copier is a relatively short-term, low-cost environmental project to set in place as shown in Worksheet 3-6. Determining how to deal with chemical waste products could be a longer process: the obvious solution may not be the best, and a project that appears difficult and long-term may turn out to have a simple solution. The many alternative approaches to dealing with waste products can range from chemical substitutions to changing the nature of the wastes, changing work practices to reduce the volume of the waste, and changing disposal methods. Your final environmental program might include changes in each of these phases. In the example, although ink wastes may have the highest environmental risk rank, addressing those problems could be longer-term and more costly. On the other hand, doing so might yield greater cost savings than the quicker, cheaper toner cartridge example.

You need not rank your practical criteria; you can consider them by simply describing the practical considerations for each potential project. Worksheet 3-6 helps you lay out the considerations for each significant environmental aspect. At this point the worksheet provides you with a "first cut" qualitative judgment, to help choose aspects for further work. Aspects not selected at this time may be suitable for future projects.

Worksheet 3-6: Criteria to Select Environmental Projects

Project to Address Aspect	Time Frame	Cost	Technical Feasibility	Total Feasibility
Toner (In)	N/A	N/A	N/A	N/A
Used Toner (Out)	Short (1 month)	Negligible; time to write procedure	Easy	Excellent
Press cleaner (In)	Longer evaluation	Employee time	Needs help from suppliers, etc.	More difficult
Waste Ink (Out) Soiled Wipers (Out)	Longer evaluation	Employee time, process change	Needs help from suppliers, etc.	More difficult
Contact Person:			Date Completed:	

Finally, compare in general the expected improvements to be gained by working on each aspect. Like any undertaking in a business operation, you should be able to describe what you expect to get before you undertake the project! First, develop a list of benefits criteria. These might include such things as:

- Reduced human health impacts
- Reduced environmental impacts
- Cost savings
- Improved community relations
- Improved employee morale
- Customer benefit

Again, these particular criteria might not fit your company. Make a list of criteria identifying kinds of improvements that could be derived from undertaking environmental projects. These expected improvements need not be ranked; simply describe the potential for each criterion to be achieved. Worksheet 3-7 illustrates the two examples.

☞ Tip

Considering the benefits does not mean undertaking an analysis of potential outcomes. It means identifying the kinds of improvements that might be achieved by implementing a particular project and then deciding what value (priority) that improvement has for your company.

Worksheet 3-7: Potential Improvements

Aspect	Human Health[1]	Environment	Cost Savings	Community Relations	Morale	Expected Improvements
Toner (In)	Little effect	Little	Low	N/A	N/A	N/A
Used Toner (Out)	Some effect through waste	Some effect in waste	Some	Good; shows effort	Good learning tool	Some
Press Cleaner (In)	Improve worker health	Some improve, air	Some through efficiency	Good	Good; workers happy	Good
Waste Ink (Out) Press Cleaner (In) Soiled Wipers (Out)	Improve community; reduce presence of hazardous materials	Improve effect on landfill, groundwater, habitat	Some through efficiency and reduced waste fees	Excellent PR	Good; workers happy	Excellent
Contact Person:					Date Completed:	

[1] Workers, Community, Global

Overall Summary of Ranking

Worksheet 3-8 illustrates how to put together the results from ranking the significant environmental aspects with the results from the economic, technical and improvements worksheets so that you can determine which will make the best projects for your company at this time. Projects not chosen now can be developed later. The example illustrates that while chemical waste may present one of the most involved projects in terms of feasibility, it may also provide the greatest improvements. The final decision rests with your company and should reflect both your values and your needs. You may want to undertake both a short-term and a long-term project.

☞ **Tip**

It is important to recognize that the tables are merely a tool to help you summarize your judgment and organize your thoughts. The ranks placed in the tables do not have any intrinsic value but are used for purposes of comparing the results to each other.

Worksheet 3-8: Overall Ranking Summary

Process Step Aspect	Aspect Total	Feasibility Total	Benefits Total	Significant Y/N
Toner (In)	M-L	N/A	N/A	
Used Toner	M-H	H	M	N
Chemicals	M	M-L	M-H	
Chemical Waste	H	M-L	H	Y
Contact Person:			Date Completed:	

Setting Objectives

The point of the priority setting exercises, of course, is to reduce your company's impact on the environment. The process outlined in this Guide describes two approaches: making your current activities and processes the best they can be and making significant changes in the products your company uses or produces, and in the processes or activities of your company. If you intend to seek ISO 14000 certification, you will need to take

action on each SEA identified. If you are not seeking certification, you can be more flexible in undertaking projects. Module 4 describes the process of evaluating alternatives for those SEAs you believe will require changes. Module 6 describes the process of developing operational controls for the SEAs that will not involve significant changes at this time. (You may decide to evaluate alternatives and make changes in these later.)

At this point, general objectives can be developed for each SEA identified. These objectives should be consistent with your company's environmental policy and also with your company's compliance requirements. Using the examples ranked on the worksheets above, a company could specify its objectives as follows:

- Reduce the waste from used toner cartridges.
- Reduce the environmental impact of press cleaning.

These objectives state the desired outcome in terms of the desired improvement in environmental impact, not in terms of the specifics of how it might be accomplished. For example, the objective of reducing waste from toner cartridges is open as to how that might be accomplished. One could reduce the use of toner cartridges, ensure that the recycling program is adhered to, or stop using copiers and printers that have toner cartridges in favor of another technology. Likewise, reducing impact from the press cleaning process can be accomplished in different ways.

In looking at these two objectives, one might note that the toner cartridge objective might be met by writing and posting a **procedure** that ensures recycling of the cartridges and by making sure that people who change the toner cartridges have

sufficient *training* in this procedure. On the other hand determining how to reduce the impact of chemical wastes may involve some greater changes that would be provided by operational controls and training *alone*. In this case, an **alternatives evaluation** would be necessary. After an alternative is identified, of course, operational controls and training would be needed for the new product, process or activity.

It is important to take on what you can finish. In the beginning, tackle the SEAs that you can handle, what is environmentally important, and whatever is urgent. Your company can start on any remaining SEAs when you have completed the first ones.

MODULE 4: EVALUATING ALTERNATIVES

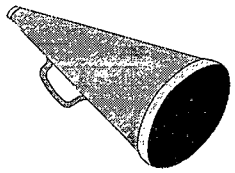
In this module we explore ways to evaluate alternatives for environmental aspects that you want to change. In Module 6 we will review how to write and implement operational controls for significant aspects where you are not evaluating alternatives. As examples of alternatives evaluations, we will show one project having a quick, low-cost solution and one requiring greater analysis and longer-term implementation: the examples of toner cartridges and press cleaning chemicals. The objectives from the end of Module 3 were as follows:

- Reduce the waste from used toner cartridges.
- Reduce the environmental impact of chemical wastes from press cleaning. The environmental aspect is vapors released to air during the press cleaning process and at the industrial laundry where used press wipers are sent. Identification of this significant aspect occurred when the laundry called the company and said they had received complaints from the local regulatory agency regarding solvent traced to the printer's press cleaning wipers. The information for this example comes from the DfE Program Lithography Case Study 1. (See DfE Program website for Case Study.)

This module will help you determine how to work toward the objectives you selected in Module 3. In some cases, this might

The DfE Program emphasizes the importance of evaluating an array of alternatives before determining appropriate action. The best solution may not be the most obvious and risk reduction, like pollution prevention, may save you money.

not be a difficult process. In others, however, the solution might not be obvious. For example, you may have identified the waste from the use of a chemical as a significant aspect and determined that alternative practices exist. You may have then set an objective of reducing the environmental impact from that chemical as it is used in your business processes. One alternative way to achieve that objective would be to target that chemical for replacement, but that may not be the best solution for your company. It is important, therefore, to consider other options for managing the environmental impact of that chemical as it is used by your company, as well as the option of replacement. This module will walk you through a process of evaluating options for substitution. It will also help you develop achievable targets having both environmental and economic advantages.



Screenprinters in the SGIA IEMS Pilot Project had this to say about the DfE method:

"The DfE method forces one to evaluate all aspects–health, safety, regulatory, environmental. The method helps you to make informed decisions.

"The process standardizes methods used to assess risk and resource efficiency. It makes it easier to compare "apples to apples." While some matters are still judgement calls, having a frame of reference to work within ensures that the standards used to make those calls are constant and logical."

Step 1: Define the Baseline

The baseline is your current chemical, activity or technology that is the source of the environmental aspect. The process map you developed in Module 1 is a convenient tool for defining boundaries of the baseline.

Usually it is fairly straightforward to determine at what point in the overall process the baseline begins and ends. The definition can make a big difference, however, in the scope of an alternatives evaluation and in the variety of alternatives examined. In our press cleaning example above, the baseline could be defined in different ways, depending on exactly how the environmental aspect is specified. If one identifies the

environmental aspect as vapors contaminating the work area, then the baseline would be use of the product producing the vapors and whatever ventilation hoods or personal protective equipment are used. If, however, the environmental aspect is identified as the regulated chemical discharges from the laundry when washing the press wipers, then the baseline becomes the chemical product used to clean presses and the work practices that leave large quantities of the solvent in the press wipers when they are sent to the laundry. In the first case, alternatives might include different chemical cleaning products and also different kinds of ventilation equipment and personal protective equipment. In the second case, alternatives would include products, work practices and methods of reducing solvent left in used wipers. Be sure to capture all you need when you define your baseline.

Step 2: Identify the Function

Next, define the function of the activity with which the significant environmental aspect is associated. Defining the function helps to broaden your perspective in developing alternatives because it allows you to step back from that specific part of the process and think holistically about how things might be done differently. Looking at earlier parts of the process will inform you about potential alternative practices. Defining the function often opens up opportunities that may be missed by focusing only on the process step. Here are two examples:

Internet Help

Visit the DfE website for more tools related to evaluating alternatives.

www.epa.gov/dfe

Example 1

Aspect identified: Waste from toner cartridges used in copier.

Baseline: Day-to-day copying activities in an office environment with no restrictions on use of the copier. Spent toner cartridges are discarded with office trash.

Function of toner cartridges: to deliver the chemicals to make clear copies.

Example 2

Aspect identified: air and water emissions from solvent used for press cleaning.

Baseline: Manual cleaning of press using a chemical press cleaner (a blend of acetone, toluene, methyl ethyl ketone, and isopropyl alcohol) and cloth wipers to wipe down the press, with no restrictions on the amount of cleaner or number of wipers used. Chemicals and soiled wipers are kept in uncovered containers during the work day and closed containers after work hours. Waste ink/solvent mixture is collected in drums and disposed of as hazardous waste. Wipers are collected and sent to laundry.

Function of press wash: to ensure good quality printing by thoroughly cleaning the press during and after the printing process.

Step 3: Develop a List of Alternatives

The important question to ask is how this function could be accomplished in other ways that might prove to be environmentally preferable, while still meeting cost and performance concerns. Different levels and kinds of alternatives should be considered. For example:

- Substitute products
- Reduce product use, through technology changes and improved work practices
- Improve treatment technologies
- Improve disposal technologies

Example 1: List the alternatives for reducing the waste from used toner cartridges

- First, are there substitute products that could be used in place of toner cartridges? Probably not, given current technology and the fact that the toner cartridge specifications are required by the make and model of the printer.
- Is there a way to reduce the use of the toner cartridges, thereby reducing the waste product? By defining copier needs, the quantity of copying could possibly be reduced by encouraging the use of electronic transfer of information within the company, in place of distributing paper copies.
- Improved treatment technologies — does not apply for this example.
- Improved disposal technologies. The disposal alternatives include throwing in the trash or recycling.

Example 2: List the alternatives to the current press wash process

- Substitution: First ask the question, is there any way to achieve the required product quality with the use of less or no press cleaning solution? You may consider

substitutions in another part of the process, such as the type of ink, so that less or different press cleaning solution could be used. Or, you could also consider substituting the press wash solution for a less volatile cleaner.[3] Such substitution may require other process changes to work. You could also consider using disposable cleaning wipers, which would eliminate the releases and exposures at the laundry. In doing so, however, you may create a problem of hazardous waste at the landfill, thereby merely transferring the problem from one location to another rather than solving it.

- Reducing use of the product: reduction in use of the press wash solution might be brought about by scheduling jobs to require less cleaning (e.g., heavy coverage jobs *after* light coverage; dark colors *after* light colors), or by implementing inventory control procedures that discourage operators from using more wash than necessary (e.g., by limiting the amount of wash kept at press-side). In addition, a study could be made to determine what methods are used by press operators who use the least solvent. Their methods could be used to train others.
- Responsible recycling/reuse: Possibly the waste press wash solution could be reused one or more times; if not on the press, then in other clean-up applications.
- Improved treatment technologies: Soiled wipers can be run through a centrifuge to capture excess solvent prior to being sent to the laundry, but fire regulations should be

☞ **Tip**

Think broadly when developing alternatives. Sometimes an alternative that is upstream or downstream from your process will produce better results than will a change of chemicals or another in-process change.

[3] "Volatile" means that the substance evaporates easily.

consulted to ensure this doesn't impose a fire hazard.

- Improved disposal technologies: What are alternatives for disposal? Sending the wipers to the laundry; extracting waste solvent from the wipers and reusing the solvent for other cleaning jobs, then sending it to be burned as a fuel; using disposable wipers and throwing them in the trash.

Worksheet 4-1 will help you organize the functions and alternatives for your evaluation. Create your own worksheet from the significant environmental objectives you selected in Module 3. Some of these boxes can be filled out by brainstorming within the team working on the IEMS, but some will require further work before they can be completed. Some additional sources of information include chemical product suppliers, machinery manufacturers and suppliers, workers on the line, trade associations, technical magazines associated with your business, or other businesses like yours. You may be surprised at how much information you will uncover. One way to proceed might be to assign each member of the team one area of information to collect, and then have them use it to fill in the chart at the next team meeting. It's important to collect as many ideas as possible and then narrow down your list of alternatives to evaluate. By keeping your mind open in your initial brainstorming you may uncover worthwhile alternatives that are not obvious.

Worksheet 4-1:* Potential Alternatives

Significant Environmental Aspect: Waste toner cartridges
Baseline: Spent toner cartridges are discarded in trash.
Function: Provide ink for duplicating

	Current Practices	Potential Alternatives
Products	Toner Cartridges	N/A
Technologies	Paper	More electronic media use would reduce need for toner cartridges
Work Practices	Unlimited copier use	More careful about use of printing could reduce quantity of toner needed
Recycling/ Reuse	Discard in trash	Follow manufacturer's directions to recycle
Treatment	N/A	N/A
Disposal	See Recycling/Reuse Above	See Recycling/Reuse Above
Contact Person:		Date Completed:

* Document these results in Section AE of the *Company Manual Template.*

Worksheet 4-1:* Potential Alternatives

Significant Environmental Aspect: Press washing

Baseline: Manual cleaning of press using a chemical press cleaner (a blend of acetone, toluene, methyl ethyl ketone, and isopropyl alcohol) and cloth wipers to wipe down the press, with no restrictions on the amount of cleaner or number of wipers used. Chemicals and soiled wipers are kept in uncovered containers during the work day and closed containers during after hours. Waste ink/solvent mixture is collected in drums and disposed of as hazardous waste. Wipers are collected and sent to laundry.

Function: Provide crisp print quality by effectively cleaning press.

	Current Practices	Potential Alternatives
Products	Prod. A (current)	Prod. B Prod. C (Special formulation)
Technologies	Current blankets, Cloth wipers, Current ink	Different blankets; Disposable wipers; Different ink
Work Practices	Work Practice A	Work Practice B Work Practice C
Recycling/Reuse	Leave solvent in wipers	Reuse of solvent for other clean up.
Treatment	Leave solvent in wipers	Extraction of solvent from wipers
Disposal	Laundry	Trash Drain Hazardous Waste
Contact Person:		Date Completed:

* Document these results in Section AE of the *Company Manual Template.*

Step 4: Set the Scope of the Evaluation

You have now reached a critical decision point in your evaluation of alternatives. You must decide how detailed an evaluation is feasible. Keep in mind the cost of performance testing as you choose alternatives to evaluate.

When you have selected alternatives to evaluate, place these alternatives in the appropriate parts of your process map developed in Module 1. If necessary, create new segments of the process map so that you can show how the alternative fits into your process.

The following worksheets show the kinds of information that should be collected for each set of alternatives to yield a decision about which option would be the most feasible, both technically and economically, for your company to reduce its environmental impact. These tables will also give you the information needed to frame specific measurable targets for your environmental programs.

Each alternative requires developing several kinds of information:

- health,
- safety,
- environmental effects,
- performance capabilities,
- cost,
- effects on resource use, and

- regulatory concerns.

This information will help you integrate human health and environmental concerns into your usual decision-making criteria of performance and cost. The following worksheets are designed to help you organize this information in a way that makes comparisons easier. The following sections take you step by step through the evaluation process.

Example 1

To develop alternatives on copier toner cartridges, your company would conduct brainstorming sessions about the options for more use of electronic media within your office and otherwise reducing the need to use the copier in your office activities. Developing ways to cut down on copying can extend the life of toner cartridges and reduce the volume requiring disposal. Steps that seem appropriate and desirable can be recorded and incorporated into your targets. You could establish a dual goal of reducing the volume of copying and 100% recycling of toner cartridges. Module 6 explains how to develop operational controls to ensure reduced environmental impact. Module 7 explains how you can make your goals into an "environmental project."

Most of the alternatives for Example 1 do not require substantial changes and would be implemented by designing guidelines for use and maintenance of the copier, i.e., operational controls. While these alternatives could be evaluated using the steps below, we will not include this example in the sample worksheets. Example 2 provides a more thorough example of

the evaluation process, and we will focus on that.

Example 2

To develop alternatives to reduce air and water emissions caused by press washing, a full evaluation would require research for each of the alternatives identified. (You may view such an extensive analysis on the DfE Website. See Appendix G.) You may not have the resources to do a full evaluation at this time, but you can research any of the alternatives you choose. The point of identifying a range of alternatives is to let you choose the options to evaluate with full knowledge of the range available to you, rather than in response to preconceptions. For example, you could choose to evaluate one set of alternatives now and another set at a later date as part of a continuing effort.

Step 5: Evaluate Potential Human Health and Environmental Effects of Alternatives [4]

Worksheet 4-2 through 4-6 shows the kind of information needed to evaluate the environmental effects of alternative products. Refer to Module 3 for explanation of the elements. Worksheets 4-2 through 4-6 correspond to worksheets 3-1 through 3-5 in Module 3.

☞ **Tip**

The worksheets presented in this section are designed to be "one-size-fits-all." Unfortunately, not all evaluations will be the "same size." Adapt these worksheets to suit the needs of your evaluation.

[4] All information in worksheets is created for purposes of illustration and does not represent real data.

Worksheet 4-2:[a] Alternatives Evaluation: Health, Safety and Environmental Potential Effects Information

Baseline: Manual cleaning of press using a chemical press cleaner (a blend of acetone, toluene, methyl ethyl ketone, and isopropyl alcohol) and cloth wipers to wipe down the press, with no restrictions on the amount of cleaner or number of wipers used. Chemicals and soiled wipers are kept in uncovered containers during the work day and closed containers during after hours. Waste ink/solvent mixture is collected in drums and disposed of as hazardous waste. Wipers are collected and sent to laundry.

Significant Environmental Aspect: Press cleaning

Alternative	Information Sources	Regulatory Data:[b] Carcinogen? OSHA Exposure limit? Volatile Organic Compound (VOC)? Toxics Release Inventory (TRI)?	Human Health Effects by Pathways Acute and Chronic[c]			Com-ments	Effects on Wildlife and Other Environmental Effects[d]			Worker Safety[e]	Rank	
			Inhalation	Dermal	Oral		Air	Water	Land		Human[f]	Env
Products Baseline: Blend A	MSDS	Greater than 50% VOC — all chemicals in blend										
acetone 25%		OSHA PEL, 8H TWA: 1000 ppm, burn in chemical incinerator, EPA FIFRA pesticide, Calif Prop 65 Repro Haz	irritant, liver, kidney,	irritant, eye damage			may contribute to smog	?	?	highly flammable, vapor may flash back, explosive, combustive, may produce carbon monoxide or carbon dioxide	H	?

toluene 25%		Burn in incinerator, OSHA PEL 8H TWA 200 ppm, SARA 313 reporting, Calif Prop 65 developmental toxicity	toxic, liver, kidney, destructive to tissues, lung irritation, chest pain, edema, possibly fatal, abortion, changes in bone marrow	toxic, extremely irritating	toxic	Effects may be increased by alcohol consumption	may contribute to smog	?	?	Highly flammable, combustive, protect from moisture	H	?
MEK 25%		burn in chemical incinerator, EPA FIFRA pesticide, OSHA PEL 8H TWA 200 ppm, TSCA 8a rule, SARA 313 reporting	irritant respiratory system, central nervous system depression, nausea, dizziness, headache, gastro-intestinal, narcotic effect	irritant eyes, skin, dermatitis			may contribute to smog	?	?	Highly flammable, combustive, protect from moisture	M-H	?
isopropyl alcohol 25%		may be disposal regulations	irritant nose & throat, central nervous system depression, vomiting, headache, coma, death	irritant eye, corneal burns, dermatitis	large amounts: headache, nausea, vomiting, unconsciousness, death		may contribute to smog	?	?	Flammable, reactive, may produce carbon monoxide and carbon dioxide	H	?
Special blend B: vegetable ester	DfE Litho-graphy Project	Less than 30% vocs No regulations	Low	Low	Low		?	no aquatic toxicity	?	No concerns	L	L
Technologies												

Work Practices												
Recycling/ Reuse												
Treatment Centrifuge used to extract solvent from wipers, using Blend A	DfE Lithography Project, Case Study 1	Possible regulation about using centrifuge, all other regulations applying to Blend A above	Same as Blend A	Same as Blend A	Same as Blend A	Same as Blend A	Same as Blend A	Same as Blend A	Same as Blend A	Same as Blend A, also will need an explosion proof centrifuge	H	H
Disposal												
Contact Person:			Date Completed:									

a See Section AE of the *Company Manual Template.*

b Most Information for this column can be found on the MSDS.

c Partial information for these columns might come from the MSDS, but other resources may be needed. In particular, acute effects are usually reported on MSDS sheets. Chronic effects are sometimes on MSDS sheets, but often will have to be found elsewhere.

d MSDSs usually do not include environmental effects.

e There may be information on the MSDS that would be useful for preparing your emergency preparedness plan.

f This rank is based on the potential effects of the chemical and not on the dose required to obtain those effects. For example, a person can drink a certain amount of Scotch. Drinking a large quantity of Scotch, however, can be lethal. Therefore dose does make a difference ultimately in making a judgment. However, one can still make a qualitative ranking about whether Scotch, cola, water, milk or juice have beneficial or negative impacts. For more discussion of the role of "dose" see the Hazard Guide on the DfE web site. Note: For more information on risk related data, including methods for interpreting quantitative toxicity values, refer to the risk Guide provided on the DfE Program website. The data on this table were constructed for purposes of illustration and do not represent real data.

Worksheet 4-3: Alternatives Evaluation: Exposure to Chemicals and Materials

Baseline: Manual cleaning of press using a chemical press cleaner (a blend of acetone, toluene, methyl ethyl ketone, and isopropyl alcohol) and cloth wipers to wipe down the press, with no restrictions on the amount of cleaner or number of wipers used. Chemicals and soiled wipers are kept in uncovered containers during the work day and closed containers during after hours. Waste ink/solvent mixture is collected in drums and disposed of as hazardous waste. Wipers are collected and sent to laundry.

Significant Environmental Aspect: Press cleaning

Alternative Products	Quantity* Used per time period	Exposure Time		Personal Protective Equipment (PPE)	Pathway		Rank Exposed Groups		
		Duration**	Frequency		Human: Inhalation, Dermal, Oral	Environment: air, water, land	Workers	Community	Envir-onment
Baseline: blend A	24 oz. Per day for cleaning press	10 min. for cleaning all day for wipers in open bins	5 times per day for cleaning				H w/o PPE	H (laundry releases)	M
acetone				face shield, chemical safety goggles, chemical gloves, mechanical exhaust, NIOSH-OSHA respirator	All for workers, inhalation for community				
toluene	Same	same	same	above, plus chemical fume hood	All for workers, inhalation for community	air, water			
MEK	same	same	same	same as acetone	All for workers, inhalation for community	air, water			

isopropyl alcohol	same	same	same	half mask respirator, gloves, local exhaust, safety goggles, rubber apron, boots, impervious clothing	All for workers, inhalation for community	air, water			
Blend B: vegetable ester	12 oz per day for cleaning press	10 min. for cleaning, all day for wipers in open bins	5 times per day for cleaning	none	all	water	M w/o PPE (less due to less volume used and less volatile mix)	M	L
Technologies									
Work Practices									
Recycling/Reuse									
Treatment: Centrifuge (assuming Blend A)	8 oz recovered per day - reduce environmental releases by 1/3	10 min while putting wipers in centrifuge	1 time per day	gloves	inhalation, dermal	n/a	M w/o PPE	M (possibly some fumes from venting centrifuge)	L
Disposal									
Contact Person:					Date:				

*If ingredient in chemical product, use quantity of chemical not product, i.e., apply the percentage that the ingredient makes up of the product.

**How many minutes or hours per day is the chemical or material used?

Note: All data are for purposes of illustration and do not represent real data.

Worksheet: 4-4: Alternatives Evaluation: Community Issues

Significant Environmental Aspect: Press Cleaning

Alternative	Community Issues (List)	Rank
Products	no additional issues	
Technologies		
Work Practices		
Recycling/Reuse		
Treatment		
Disposal		
Contact Person:		Date:

Worksheet: 4-5: Alternatives Evaluation: Natural Resource Use

Significant Environmental Aspect: Press Cleaning

Alternative	Natural Resources Used (List)	Rank
Products	no additional issues	
Technologies		
Work Practices		
Recycling/Reuse		
Treatment		
Disposal		
Contact Person:		Date:

Worksheet 4-6:[a] Alternatives Evaluation: Criteria to Determine Environmental Impact

Baseline: Manual cleaning of press using a chemical press cleaner (a blend of acetone, toluene, methyl ethyl ketone, and isopropyl alcohol) and cloth wipers to wipe down the press, with no restrictions on the amount of cleaner or number of wipers used. Chemicals and soiled wipers are kept in uncovered containers during the work day and closed containers during after hours. Waste ink/solvent mixture is collected in drums and disposed of as hazardous waste. Wipers are collected and sent to laundry.

Significant Environmental Aspect: Press Cleaning

Alternative	Regulatory Concerns	Chemical and Material Risk			Worker Safety	Other Community Issues:[c]	Natural Resources[d]	Overall Ranking	Preferred Alternative? Y/N
		Worker Eff/Exp[b]	Community Eff/Expb	Environment Eff/Exp[b]					
Products:									
Blend A (Baseline)	H	H/H	H/H	?/M	H	n/a	n/a	H	
Blend B	L	L/M	L/M	L/L	L	n/a	n/a	L	yes
Technologies									
Work Practices									
Recycling/Reuse									
Treatment: Centrifuge	M	H/M	H/M	?/L	H	n/a	n/a	M-L	yes
Disposal									
Contact Person:				Date Completed:					

[a] Corresponds to SEA-01 in *Company Manual Template*.
[b] Effects/exposure
[c] Noise, traffic, light, odor.
[d] Include such items as resource use, solid waste, energy use.

Step 6: Evaluate the Performance of Alternatives

Evaluating the performance of your alternative chemical products requires several steps, as described below. Performance evaluations can be expensive to perform. Consider the cost of the evaluation when deciding how many and what kind of alternatives to test.

Describe the baseline. The baseline is the standard chemical, activity, or technology that is currently used. The baseline also includes the boundaries of the baseline, its process steps and how they are performed. This ensures that (1) a similar process is used to evaluate the performance of the baseline and alternatives where possible, or (2) when a different process is used due to the nature of the alternative (e.g. technology), differences will be noted and understood. The alternatives will then be compared to this baseline.

Example: The baseline for press washing is manual cleaning of press using a chemical press cleaner (a blend of acetone, toluene, methyl ethyl ketone, and isopropyl alcohol) and cloth wipers to wipe down the press, with no restrictions on the amount of cleaner or number of wipers used. Chemicals and soiled wipers are kept in uncovered containers during the work day and closed containers during after hours. Waste ink/solvent mixture is collected in drums and disposed of as hazardous waste. Wipers are collected and sent to laundry.

Identify the most important performance traits for the selected process area. Some sample performance traits include the following: how well does it work, how long does it take, how easy is it to use, and how easy is it to install?

Example: The most important performance traits for press wash are that it work quickly to cut ink, require minimal wiping to remove any oily residue, dry quickly, and not adversely affect print quality.

☞ **Tip**

Cost data for your cost evaluation should be collected during the performance evaluation There may be more uncertainty in the cost data if you wait to develop it until after the performance evaluation. See Step 8 for information on what kind of data will be needed for your cost evaluation.

☞ **Tip**

See Appendix C for sample performance evaluation worksheets from the DfE Printing Project.

Determine how the alternatives will be compared with the baseline. One example of a quantitative comparison is measuring the time it takes to complete a task. One example of a qualitative comparison is using a scale, such as ++ representing "much more favorable than the baseline."

Example: We will use a comparison scale from -2 to +2, where -2 represented "much less favorable than the baseline," +2 represented "much more favorable," and a 0 represented "no difference with the baseline."

Select the operating conditions for testing the baseline and alternatives and conduct the evaluation. The operating conditions should be realistic and consistent for the baseline and alternatives. If you cannot test an alternative at your facility (e.g., new equipment), have the supplier provide off-site service or performance test data. Conditions should be as similar as possible for each test, or the results will not be comparable. Examine work practices as well to ensure similar application from test to test. Other elements that may affect testing include room temperature and humidity. Make a list of what things might affect your test results and try to make sure that they are similar for each test.

Example: Evaluate the baseline and alternatives using the same size printing run, the most commonly used ink formulation, the same application procedures, and the same printed image.

An evaluation example is shown in Worksheet 4-7.

Worksheet 4-7:* Performance Comparison of Alternatives

Significant Environmental Aspect: press cleaning
Baseline: Manual cleaning of press using a chemical press cleaner (a blend of acetone, toluene, methyl ethyl ketone, and isopropyl alcohol) and cloth wipers to wipe down the press, with no restrictions on the amount of cleaner or number of wipers used. Chemicals and soiled wipers are kept in uncovered containers during the work day and closed containers during after hours. Waste ink/solvent mixture is collected in drums and disposed of as hazardous waste. Wipers are collected and sent to laundry.
Function: ensure crisp print quality by effectively cleaning press

	How well it works	Time	Ease of use	Overall Performance Evaluation
Blend A (baseline)	0	0	0	0
Product B	0 (Did not show much difference from baseline)	0	0	0
Technologies				
Work Practices				
Recycle/ Reuse				
Treatment: Centrifuge to recover Blend A	+ (demonstrates that worked well, but is not comparable to products above)	"+"	"+"	"+" works well to recover solvent
Disposal				
Contact person:			Date Completed:	

*Document these results in Section AE of the *Company Manual Template*.

Step 7: Evaluate what regulations may be triggered by using each alternative

For each alternative being considered, make sure you understand the applicable regulations. This may influence your choice of alternatives. Identify what management controls might be required by these regulations. Also consider what additional cost might be attributed to the regulation. Some of the costs associated with using a product or process may be attributable to a regulation triggered by using that product or process. These would be the regulatory cost and should be included on Worksheets 4-8 and 4-9.

Worksheet 4-8:* Regulatory Comparison of Alternatives

Alternative	Applicable Regulations	Required Controls	Regulatory Cost Items [1]	Overall Regulatory Concerns Evaluation
Product Blend A	same as Worksheet 4-2	same as Worksheet 4-3	SARA reporting, PPE, Chemical fume hoods, fire controls	H
Blend B	none	none	none	L
Technologies				
Work Practices				
Recycle/ Reuse				
Treatment Centrifuge	possible local fire regulations	May not be allowed		H
Disposal				
Contact Person:			Date Completed:	

*Document results in Section AE of the *Company Manual Template.*

[1] Include: paperwork triggered, reporting requirements, cost of controls, personal protective equipment and any other costs that may be attributed to regulations associated with using that product or process. It is not necessary to quantify on this table. See Step 8 and Appendix F for more ideas.

Step 8: Evaluate the cost of the baseline and alternatives

Determine the cost of each alternative, including: raw materials, labor, disposal costs, (all from Step 6) and regulatory costs (from Step 7). Include all the cost categories in the baseline and the alternatives. It's important to document all costs, even those that are the same for the baseline and for the alternatives. Documenting all costs gives you a reference later to answer questions and to support further evaluations. Figure 4-a shows possible costs associated with regulations that may be hidden in overhead in your company's accounting system. Be sure to include these hidden costs when completing the worksheets.

See Appendix F for more discussion of environmental cost accounting.

Figure 4-a. Examples of Environmental Costs Incurred by Firms*

Potentially Hidden Costs

Regulatory

- Notification
- Reporting
- Monitoring/testing
- Studies/modeling
- Remediation
- Recordkeeping
- Plans
- Training
- Inspections
- Manifesting
- Labeling
- Preparedness
- Protective equipment
- Medical surveillance
- Environmental insurance
- Financial assurance
- Pollution control
- Spill response
- Stormwater management
- Waste management
- Taxes/fees

Upfront

- Site studies
- Site preparation
- Permitting
- R&D
- Engineering and procurement
- Installation

Conventional Costs

Capital equipment
Materials
Labor
Supplies
Utilities
Structures
Salvage value

Back-End

- Closure/ decommissioning
- Disposal of inventory
- Post-closure care
- Site survey

Voluntary (Beyond Compliance)

- Community relations/ outreach
- Monitoring/testing
- Training
- Audits
- Qualifying suppliers
- Reports (e.g., annual environmental reports)
- Insurance
- Planning
- Feasibility studies
- Remediation
- Recycling
- Environmental studies
- R & D
- Habitat and wetland protection
- Landscaping
- Other environmental projects
- Financial support to environmental groups and/or researchers

Contingent Costs

- Future compliance costs
- Penalties/fines
- Response to future releases
- Remediation
- Property damage
- Personal injury damage
- Legal expenses
- Natural resource damages
- Economic loss damages

Image and Relationship Costs

- Corporate image
- Relationship with customers
- Relationships with investors
- Relationship with insurers
- Relationship with professional staff
- Relationship with workers
- Relationship with suppliers
- Relationship with lenders
- Relationship with host communities
- Relationship with regulators

*Taken from "An Introduction to Environmental Accounting as a Business Management Tool: Key Concepts and Terms," EPA 742-R-95-001.

Evaluating the cost of the baseline and alternatives requires several steps, as described below.

Annual operating costs

Collect annual operating costs for your baseline and alternative. Use Worksheet 4-9a to help you collect cost information. Review Worksheets 4-2 and 4-8 to assist you in evaluating environmental costs. Be as thorough as possible when considering costs, but don't worry about how you classify costs. For example, you may wish to consider personal protective equipment as a regulatory compliance cost, especially if its use is required by regulations. Alternatively, you may wish to classify all protective equipment as "materials." Use Worksheet 4-9a to record operating costs.

Worksheet 4-9a: Annual Operating Costs

Significant Environmental Aspect: Press Cleaning

Baseline: Manual cleaning of press using a chemical press cleaner (a blend of acetone, toluene, methyl ethyl ketone, and isopropyl alcohol) and cloth wipers to wipe down the press, with no restrictions on the amount of cleaner or number of wipers used. Chemicals and soiled wipers are kept in uncovered containers during the work day and closed containers during after hours. Waste ink/solvent mixture is collected in drums and disposed of as hazardous waste. Wipers are collected and sent to laundry.

Alternative	Materials	Direct Labor	Utilities	Waste Management	Regulatory Compliance	Insurance	Future Liability	Total Operating Costs
Products Blend A: Baseline	$24,320	$2,075	n/a	$7,000	$2,100	$0	possible medical suits	$35,495
Blend B	$6,320	$2,500		$0	$0	$0		$8,820
Technologies								
Work Practices								
Recycle/ Reuse								
Treatment: Centrifuge	n/a	$420	$200	$6,200	$2,100	$200	$0	$9,120
Disposal								
Contact person:					Date:			

Potential Annual Revenue Effects

Environmental projects may save you money not only by reducing your costs, but also by generating revenues. For example, an alternative may increase your product throughput because the activity takes less time to complete, or product quality may be improved enabling you to sell more of your product. The alternative may also let you recover materials previously disposed of, and generate revenues through sales of the reclaimed material (such as recovering metal scrap which can be sold to scrap dealers). These annual revenue effects should be considered using Worksheet 4-9b. If these potential revenues are difficult to quantify, you can consider them qualitatively in your evaluation by making a note in the last column of Worksheet 4-9d. In general, a reduction in materials needed would show up on Worksheet 4-9a: Annual Operating Costs. In this example, the reduction in press cleaning solvent needed due to switching to a less volatile blend (much less lost through evaporation during use) does show up in the first column of Worksheet 9-a. The revenue effects shown in Worksheet 4-9b are caused by reusing the solvent recaptured by the centrifuge for other cleaning operations (not press cleaning). In other words, the centrifuge saves on the purchase of other kinds of cleaning solvents than the ones being considered for press cleaning.

Worksheet 4-9b: Potential Annual Revenue Effects

Significant Environmental Aspect: Press Cleaning

Baseline: Manual cleaning of press using a chemical press cleaner (a blend of acetone, toluene, methyl ethyl ketone, and isopropyl alcohol) and cloth wipers to wipe down the press, with no restrictions on the amount of cleaner or number of wipers used. Chemicals and soiled wipers are kept in uncovered containers during the work day and closed containers during after hours. Waste ink/solvent mixture is collected in drums and disposed of as hazardous waste. Wipers are collected and sent to laundry.

Alternative	**Product Throughput**	**Product Quality**	**Reuse of or Sales of Recovered Materials**	**Total Revenue Effects**
Products: Blend A or B	none	none	none	0
Technologies				
Work Practices				
Recycle/Reuse				
Treatment: Centrifuge	0	0	$34,000	$34,000
Disposal				
Contact Person:		Date:		

Initial Investment Costs

Collect initial investment costs for each alternative. If any of your alternatives will require an investment in new equipment, you will need to consider these costs. These not only include capital costs, but also other one-time costs accompanying your investment, such as installation costs or new equipment training. Use Worksheet 4-9c to help you collect these costs.

Worksheet 4-9c: Initial Investment Costs*

Significant Environmental Aspect: Press Cleaning

Baseline: Manual cleaning of press using a chemical press cleaner (a blend of acetone, toluene, methyl ethyl ketone, and isopropyl alcohol) and cloth wipers to wipe down the press, with no restrictions on the amount of cleaner or number of wipers used. Chemicals and soiled wipers are kept in uncovered containers during the work day and closed containers during after hours. Waste ink/solvent mixture is collected in drums and disposed of as hazardous waste. Wipers are collected and sent to laundry.

Alternative	Purchased Equipment	Utility Systems/ Connection	Planning/ Engineering	Site Preparation	Construction/ Installation	Start-up/ Training	Permitting	Other**	Total Inv. Costs
Products Blend A or B	none	none	none	none	none	none	none	none	none
Technologies									
Work Practices									
Recycle/Reuse									
Treatment: Centrifuge	$15,000	0	$2,000	$500	0	$200	Depends on local regulations	0	$17,700
Disposal									
Contact Person:					Date:				

*Typically there are no investment costs for your "business as usual" baseline.

**"Other" costs potentially include land or building purchases, contingency to cover unforeseen expenses, and investment in initial inventory (also known as working capital). For further description of these costs, see Appendix F.

If a change in your processes or activities will affect your costs and savings over many years, the analysis should look at long term costs and savings. A critical component of assessing a project where costs and savings may occur over several years is incorporating the notion that the value of money changes over time – commonly called the "time value of money." Most businesses prefer to have money sooner rather than later. If you have money today, you have the opportunity to use it now to grow your business. See Appendix F for more information on how to obtain the net present value of your initial investments, if you wish to make that calculation.

☞ **Tip**
Remember that your accountant can assist you in making these calculations.

Cost Comparison

Use Worksheet 4-9d to list and rank the results of each cost table.

Worksheet 4-9d: Cost Comparison of Alternatives

Significant Environmental Aspect: Press Cleaning
Baseline: Manual cleaning of press using a chemical press cleaner (a blend of acetone, toluene, methyl ethyl ketone, and isopropyl alcohol) and cloth wipers to wipe down the press, with no restrictions on the amount of cleaner or number of wipers used. Chemicals and soiled wipers are kept in uncovered containers during the work day and closed containers during after hours. Waste ink/solvent mixture is collected in drums and disposed of as hazardous waste. Wipers are collected and sent to laundry.

Alternative	Total Operating Costs	Total Investment Costs	Annual Revenue Effects	Rank
Products Blend A Blend B	 $35,495 $8,820	 $0	 $0	 H L
Technologies				
Work Practices				
Recycle/Reuse				
Treatment: Centrifuge	$9,120	$17,700	$34,000	L
Disposal				
Contact Person:			Date:	

Document results in Section AE of the *Company Manual Template.*

Step 9: Evaluate Results

Use Worksheet 4-10 to compare performance, regulatory considerations, cost, and environmental effects for alternatives.

Worksheet 4-10:* Evaluation of Alternatives

Significant Environmental Aspect: Press Cleaning

Baseline: Manual cleaning of press using a chemical press cleaner (a blend of acetone, toluene, methyl ethyl ketone, and isopropyl alcohol) and cloth wipers to wipe down the press, with no restrictions on the amount of cleaner or number of wipers used. Chemicals and soiled wipers are kept in uncovered containers during the work day and closed containers during after hours. Waste ink/solvent mixture is collected in drums and disposed of as hazardous waste. Wipers are collected and sent to laundry.

Alternative	Performance Rank [1]	Regulatory Considerations Rank [2]	Cost Rank [3]	Environmental Effects [4]	Overall Evaluation[5]
Chemical Product A (current baseline)	0	H	H	H	Poor due to effects
Product B	0	L	L	L	Good due to effects & cost
Technologies					
Work Practices					
Recycle/Reuse					
Treatment: Centrifuge	"+"	H	L	M-L	Good due to effects & savings
Disposal					
Contact Person:			Date Completed:		

*Document results in Section AE of the *Company Manual Template*.

[1] Take from Worksheet 4-7 Performance Comparison of Alternatives.

[2] Take from Worksheet 4-8 Regulatory Comparison of Alternatives.

[3] Take from Worksheet 4-9d Cost Comparison of Alternatives.

[4] Take from Worksheet 4-4: Criteria to Determine Environmental Impact.

[5] Rank the desirability of each alternative. This is a judgment call.

Note: For more information on the methodology for comparing alternatives, refer to both the DfE Website and the *Cleaner Technologies Substitutes Assessment, A Methodology Resource Guide*, DfE, U.S. EPA 744-R 95-002, Dec. 1996.

Interpretation of Results

Performance

The rank of "0" for product A reflects that it is the baseline. The rank of "0" for product B indicates that it's performance is very similar to the baseline. The + shown for the centrifuge shows that it performs well, but is not directly comparable to the products above.

Regulatory Considerations

Ranks show that product A has many regulations associated with the chemicals it contains, but product B chemicals have little or not regulations. The centrifuge is rated high because some states have regulations that may prohibit the use of centrifuges for recovering solvent from wipers. Also, the explosive nature of Product A ingredients would affect the type of centrifuge used. If product B were used with the centrifuge, the regulatory concern might not apply.

Cost

The rankings show the high cost associated with using product A compared to the low cost of using product B. In addition, the low cost rank for the centrifuge reflects the cost savings affected by re-using reclaimed solvent.

Environmental Effects

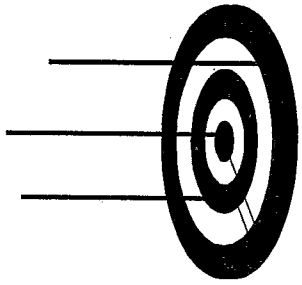
The high rank for product A reflects the serious impact of the chemicals contained in it, while the low score for product B reflects the low impact of that product's chemicals. The M-L rank for the centrifuge reflects the reduction in use of solvent with some continuing exposure to the solvent for workers who transfer the wipers from bins to the centrifuge. There would also be some community exposure from venting the centrifuge out doors. In addition, it reflects the concern with the possibility of explosion of the centrifuge while extracting these solvents.

Conclusion

From both a cost and environmental perspective, switching to product B and using the centrifuge would make sense.

Remember, like all other aspects of your IEMS, evaluating SEAs and alternatives is an ongoing process. What you cannot accomplish this year, you can plan on doing next year. Take it step by step to avoid being overwhelmed.

MODULE 5: SETTING TARGETS AND MEASURING SUCCESS



For each objective you set for your significant environmental aspects in Module 3, you will set a corresponding target. A target is a detailed performance requirement. Using the Module 4 press cleaning example, assume that the alternatives evaluation showed that the Company could reduce air and water releases both in the plant and at the laundry by substituting Product B, and that this shows an acceptable level of performance and cost. The environmental target then could be stated as follows:

> Reduce air releases of regulated chemicals in press cleaner by 80% in the plant, and reduce the volume of regulated chemicals on used wipers by 40% by the end of a 12-month period through product B substitution and improvements in work practices.

☞ Tip

State your target in terms of the environmental improvement to be achieved, rather than the means of achieving it. For example, "reduce air releases of X" rather than "substitute X." The desired improvement may continue for a long time, but the means may change with circumstances.

The evaluation showed you what is possible in terms of reducing air and water releases, and also showed you the best means to accomplish that objective. When you frame your target consider how you will measure the results. You will need to establish ways of measuring your progress in meeting the targets, in order to both evaluate your process and document success. Time frame is also important. How long will it take you to implement the program, which includes training people, acquiring new product, phasing out old product, acquiring equipment, defining new work procedures for several steps of the production process, and establishing operational controls for changed processes?

☞ Tip

Be sure to consider what operational controls may be needed for any new processes. Refer to Module 6 for help.

Measuring Results

Some say that "an EMS without an effective monitoring and measurement program is like driving at night without the headlights on – you know that you are moving but you can't tell

where you are going!"[5]

For each target, identify a measurement for success, e.g. volume of waste or energy used or percent of cartridges recycled (see Worksheet 5-1). These measurements, also called performance indicators, should be:

- simple and understandable,
- objective,
- verifiable,
- linked to production, and
- relevant to your objectives.

Below are some sample performance indicators:

- tons of SO_2 released per unit of electricity produced,
- pounds of hazardous substance "X" emitted per unit of product, or per dollars of sales, and
- percentage reduction in the discharge of a material in a given year versus that in a base year.

Measure changes in the aspect (e.g., reduced waste) with respect to production or sales rather than by itself in order to evaluate environmental improvement. Changes in the aspect can be caused by changes in the sales volume with no real environmental improvement. Each measure should be an indicator of where problems may be occurring in the process. Worksheet 5-1 is designed to assist you in tracking your measurement indicators.

☞ **Tip**

Measuring and evaluating environmental performance is an ongoing process.

[5]Environmental Management System: *An Implementation Guide for Small and Medium-Sized Organizations*, NSF International, Ann Arbor, Michigan, November 1996, p. 49.

Worksheet 5-1: Environmental Performance Measurement Indicators

Aspect	Objective	Indicator	Date Checked	Who Checked	Result	Corrective Action
Waste Toner Cartridge	Recycle cartridges	Number bought / number recycled	monthly	Office manager	1 missing	Discuss problem with copier maintenance person
Contact Person:				Date Completed:		

In the toner cartridge example, the performance indicators might be the number of toner cartridges used and the number sent for recycling. In the case of the air emissions from the press cleaning, measurements could include:

- amount of press cleaner used per 1,000 images printed,
- amount of press cleaner saved over a selected time period,
- amount of press cleaner used at each press per 1,000 images printed,
- amount of fluid collected from wipes before sending them to the laundry, and
- levels of solvent in water reported by POTW associated with laundering this company's press wipes.

You may be able to think of more. It is important to recognize that each "indicator" measures something different. The first one measures "input" with respect to "output." This ratio is important because changes in use of press cleaner can be caused by fewer print runs, as well as more efficient use of the cleaner during the production process. To be sure that you are measuring success rather than simply reduced production, be sure to include output in your measurement criteria. You may also need to include more than one kind of measurement to understand the results and be able to evaluate the process.

Experience has shown the importance of setting up measurement criteria to assess how things are going.

The second measurement allows you to compare a current time period with previous time periods with respect to press cleaner use, which could help to indicate efficiencies in use, such as better work practices. Again, this comparison should not be made without reference to output over the same time period. Number three also provides a comparison among different work practice methods. Number four shows how much press cleaner is being reused and the reduction in burden on the laundry, and number five shows the success in reducing water releases at the laundry. In a sense, number five is the "acid test" of whether your goal is being met. Without success here, the achievement of the targets within your plant would be meaningless because

the original problem was the water releases from the laundry caused by the wipes. Each of the other measurements shows success in the achievement of targets that are steps toward your final goal. Also, some of these measures can be used to determine cost savings related to particular steps and to the overall goal. Most important, each measure is an important indicator of where problems may be occurring in the process.

If you use special equipment to measure environmental performance, it is important that you maintain and calibrate the equipment on a regular schedule. Again, designate a person to be responsible for this task, provide appropriate training on maintaining the equipment, and document the calibrations schedule. Worksheet 5-2 provides a sample log for calibration.

Worksheet 5-2: Calibration Log

Indicator	Measurement Method	Equipment Used	Equipment calibrated: date/method
Contact Person:		Date Completed:	

Determining Causes of Problems

You will need to establish a method to determine the causes of failing to meet a target. In some cases, the cause might not be difficult to understand. Other times, however, the cause might not be obvious.

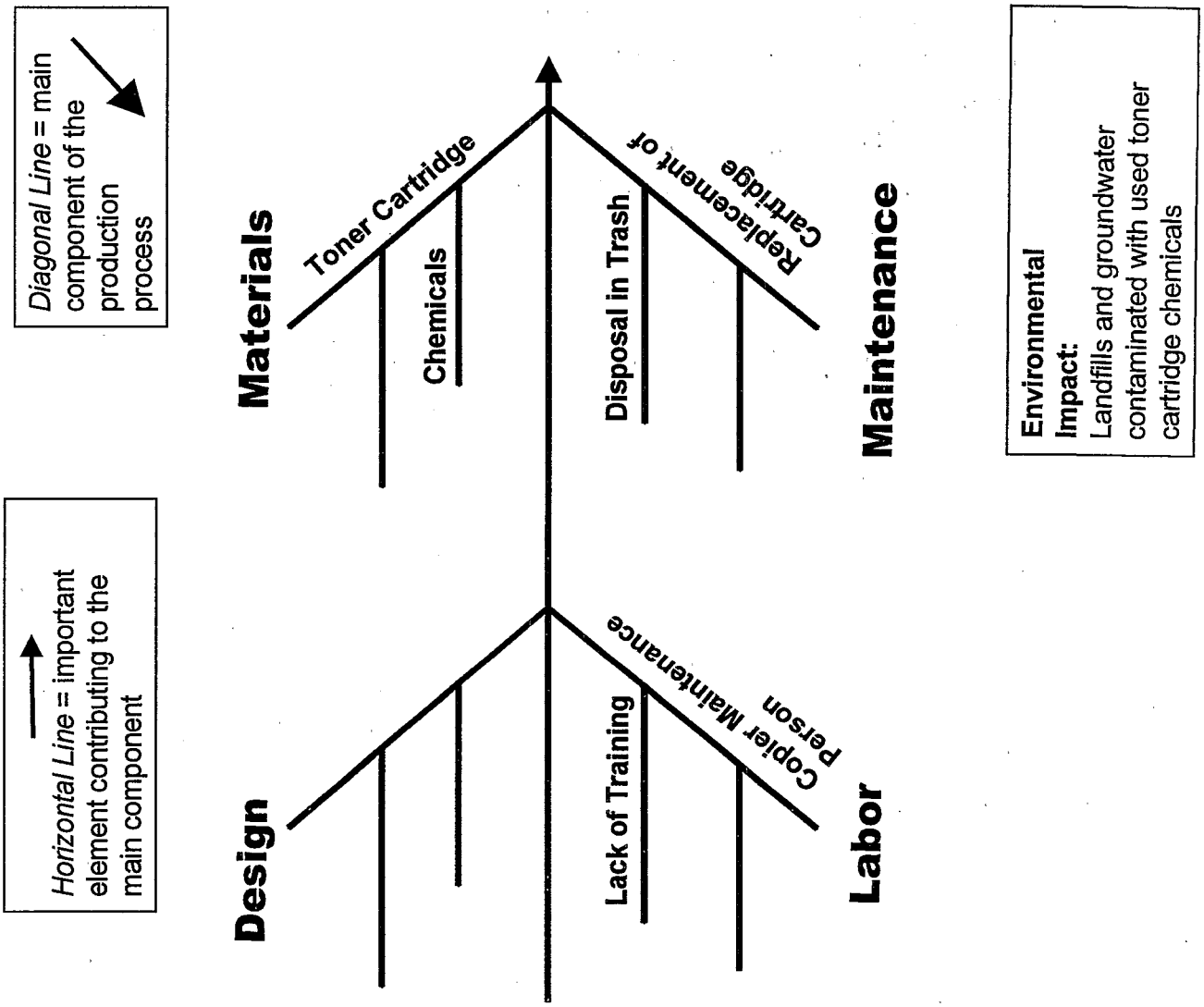
One method is called "root cause analysis." This method can be applied here to identify causes for not meeting targets. You can also use it to determine the possible causes of a potential impact. You should determine the root cause of each of your significant aspects.

The root cause diagram, shown in Figure 5-a, will help you organize your thinking when you analyze your company's potential for environmental impact. This analysis can be done by one person or by a group, with one person writing down the ideas produced. Each diagonal line represents a main component of the production process. Your company may have different or additional components (for example, "disposal") beyond those represented here. Each horizontal line stemming from the diagonal represents an important element contributing to each of the main components. For example, elements of work practices might contribute to the labor component. This diagram is simply a device to help organize the analysis of the cause of potential environmental impacts. Use it if it helps, but don't get hung up on trying to make it work.

☞ **Tip**

For more information on constructing a "Cause and Effect Diagram," go to www.sytsma.com/tqmtools.cause.html

Figure 5-a. Root Cause Diagram



The following are typical, but not necessarily obvious, causes of problems:

- poor communication,
- faulty or missing procedures,
- equipment malfunction (or lack of maintenance),
- lack of training,
- lack of understanding (of requirements), or
- failure to enforce rules.

Be sure that you have considered these possibilities in your environmental impact analysis.

Taking corrective action

Once you document a problem with respect to meeting targets, the company must be committed to resolving it. Take action as quickly as possible. First, make sure assigned responsibilities for actions and schedules are clear.

Employees in the shop may recognize the need for corrective action and provide good ideas for solving problems. Find ways to get them involved in the improvement process. It's important to determine whether a lapse is temporary or due to some flaw in the procedures or controls. For this reason, communicate any findings to employees, and provide any follow-up training for changes in the procedures that may result. The following is a checklist to help complete corrective action. Have you:

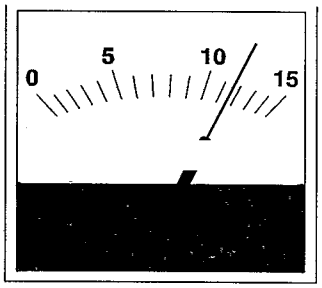
- Identified the problem(s)?
- Identified the cause(s)?
- Come up with a solution for each?
- Implemented the solution(s)?
- Documented the solution(s)?
- Communicated the solution(s)?
- Documented the action(s)?

Worksheet 5-3 is a sample Corrective Action Notice that will assist in documenting the resolution process.

Worksheet 5-3:* Corrective Action Notice	
Issue Date:	Solution Due Date:
Requested by: Issued to:	
Problem Statement:	
Most Likely Causes:	
Suggested Solutions:	
Action Taken:	
Measured Results:	
Corrective Action Closed by:	Date:
Contact for Notice:	Date completed:

*Report results on TCA-01 in the *Company Manual Template.*

MODULE 6: DEVELOPING OPERATIONAL CONTROLS



As mentioned at the end of Module 3, for every environmental aspect your company determines to be significant (SEA), it is desirable that one of two actions be taken. Action may include either:

- Evaluating alternatives to make changes in processes in order to reduce the potential for impact, or
- Writing operational control procedures for activities or steps in a production process where the potential impact may be well controlled.

In writing operational controls for an SEA, determine the environmental objectives desired, set targets for performance and write operational controls (procedures) to ensure that the objective will be met. Your company may already have procedures in place. These should be reviewed to be sure they are consistent with EMS objectives. This module describes the process for setting objectives, developing operational controls, and creating the organizational support for ensuring that those objectives are met.

If you determine that process changes should take place in order to address an SEA, the IEMS emphasizes the need to evaluate alternatives before setting targets. Module 4 describes the process for evaluating alternatives.

The following are some examples of the kind of activities that might be improved with operational controls[6]:

- management/disposal of wastes,

☞ Tip

ISO 14000 requires action to be taken on each SEA. If you are not pursuing ISO certification at this time, you could focus on selected SEAs.

☞ Tip

Objective: Overall environmental goal, based on the environmental policy, which is quantified where practicable.
Target: Detailed performance requirement based on an environmental objective.

[6]Adapted from *Environmental Management Systems: An Implementation Guide for Small and Medium-Sized Organizations.* See References (Appendix G) for more information.

- approvals for using new chemicals,
- storage & handling of raw materials and chemicals,
- wastewater treatment,
- building and vehicle maintenance,
- transport,
- operation and maintenance of equipment,
- management of contractors,
- marketing and advertising, and
- acquisition or construction of property and facilities.

The process of setting targets and ensuring their success has several steps which are discussed in more detail below. These include:

- determining the possible causes of potential impact,
- setting measurements for the desired environmental performance,
- drafting operational controls,
- designating persons responsible for maintaining operational controls and for reviewing the success of the controls,
- developing training for persons assigned responsibility,
- taking corrective action when objectives are not met, and
- establishing a DfE environmental review for new processes and products.

1. Determine the possible causes of potential impact

For all of your significant environmental aspects, you should determine the cause of the impact. In some cases, the cause might seem obvious. However, sometimes the root cause of the problem is not the most obvious cause. Use the "root cause" analysis described in Module 5 to help your EMS team get to the cause of the impact prior to developing your operational controls.

Experience has demonstrated the importance of written procedures and thorough employee preparation and involvement.

2. Set targets and measurements for environmental performance

As discussed in Module 5, you need to set a target for each objective and establish measurements for environmental performance indicators. The targets should reflect correction of the root cause identified above. Measurement indicators should document changes in the causes identified above. Using the indicators, you can determine if your operational controls are helping you meet your objectives.

3. Draft operational controls

Next, for each significant aspect which you have decided to address with procedures, draft operational controls. (For some aspects, you may choose to make process changes instead, as explained in Module 4.) Review each of the causes identified in your root cause analysis that would contribute to the environmental impact of a significant aspect. Address the causes by drafting operational controls.

Operational controls may already exist for some of the activities associated with a significant aspect. Identify which aspects have written procedures that describe operational controls, and which aspects will need to have procedures developed. In some cases the procedures that you have in place to comply with environmental and health and safety regulations may be useful to meet your IEMS objectives. Worksheet 6-1 below will help you track which aspects will require procedures to be developed.

☞ **Tip**

DfE Partner Jeff Adrian of the John Roberts Company has provided operational control examples. See the Case Study at the end of this module.

Worksheet 6-1:* Operational Control Procedures

Significant Environ-mental Aspect	Indicator(s)	Associated Job Functions	Existing Operational Control Procedures	Operational Control Procedure Development/ Modification Needed	Responsible for Developing	Responsible for Checking	Location Posted
Waste Toner Cartridges	Number of Toner Cartridges recycled compared to number purchased	Copy machine maintenance	none	yes / new	Office manager	Office manager	Over copy machine
Contact Person:					Date Completed:		

*Corresponds to OC-01 in the *Company Manual Template.*

It is important to involve the people who will implement the procedures in drafting them. You can accomplish this in several ways:

- Meet with workers and have them describe current procedures. Discuss the environmental objective desired, and how to write operational controls (procedures) to ensure that the objectives will be met.
- Or, have someone (possibly an intern) interview the workers to establish current (undocumented) procedures; then draft (or revise) operational controls. Have the workers and a manager review the draft.
- Keep the written operational controls simple and concise. They should include the appropriate actions, precautions, and notifications required. Focus on activities that may lead to significant impacts and avoid getting overwhelmed by trying to control every activity and process.

4. Designate responsibility for maintaining and reviewing controls

Designate those people responsible both for maintaining the controls and for reviewing them to ensure that procedures are followed and deviations corrected. Generally, the workers responsible for the significant aspect under consideration will be responsible for implementing the operational controls. The immediate line manager would most likely be responsible for regular review of the controls. It is helpful to list those people responsible for each set of procedures. Worksheet 6-2 will help with documenting responsibilities.

Worksheet 6-2: Operational Control Responsibilities		
Significant Aspect	**Procedures (list)**	**Responsible for maintaining controls**
Waste toner cartridges	-save package from new toner cartridge -place waste cartridge in package -follow supplier instructions for return of used toner cartridges	Copier maintenance person
Contact Person:		Date Completed:

5. Develop training

Achieving success in meeting environmental objectives for each significant aspect depends upon making sure that each person responsible for maintaining or reviewing controls has received adequate training. After operational controls are drafted, develop a training program that ensures everyone understands both the controls and their own role in ensuring that they are followed. Training can include on-the-job training. Worksheet 6-3 identifies some of the decisions to be made when setting up a training plan. This worksheet helps you identify, plan for, and track the training needs of your employees. Include this training with any general environmental training to create an integrated training plan for your IEMS. See the John Roberts case study at the end of this module for an example of training materials one printing facility prepared to support an operational control.

☞ **Tip**

The training described here relates to operational controls. More information on training for environmental awareness and regulatory training can be found in Module 8.

Worksheet 6-3: Training Plan for Operational Controls

Aspect	Procedures	Person Responsible for Carrying Out	Training Needs	How to Train	When/ Length	Budget	Completion Date	Person Responsible for training
Waste Toner Cartridges	For Recycling	Copier Maintenance Person	Recycle Procedure	Office Manager Explain	When assigned copier maintenance duties/ 20 min	N/A	Within one week of taking job responsibility	Office Manager
Contact Person:						Date Completed:		

6. Take corrective action when objectives are not met

Take action to correct failures in operational controls as quickly as possible to meet environmental objectives. Use the process in Module 5, to take appropriate corrective action when your operational controls are not helping you meet your objectives.

☞ **Tip**

If the problem cannot be resolved, review Module 4 to determine a need for evaluating alternatives.

CASE STUDY FROM THE JOHN ROBERTS COMPANY

Example of an Operational Control For Cleaning Press Blankets

Steps

1. On the first turn of the cylinder, use a solvent saturated shop towel pad (as is the current practice) to loosen and remove most of the ink from the blanket's surface.
2. With a second shop towel pad that has been first dipped into water and then wrung out, remove the balance of the ink from the blanket's surface on the second turn of the cylinder.
3. Start the press as before.

Critical points

By *not* using water on the first turn of the cylinder, the full strength of the Press Wash is available to move the ink. So, do not blend down Press Wash with water.

It is *not* necessary that the blanket be *absolutely* dry after the second turn of the cylinder. Rather, a slight film of water (think of how the sidewall of your car's tires look after just washing the car) will not be problem on startup of the press. The first few sheets will very easily carry this moisture off.

By using a second pass with a water wipe, clays, starch and paper dust are better removed. A water wipe should be easier to slide across the blanket than a drywipe.

Care does need to be taken in just one respect, and that is in the area of the blanket cylinder's grippers. Excess Press Wash or moisture there has the potential of being spun off the cylinder onto the stock if not removed.

Towel usage

When the solvent shop towel pad is dirty, discard it in the safety cans as before.

The water wipe shop towel pad now becomes the solvent shop towel pad and a new pad (from clean shop towels) is made up for the water wipe step.

CASE STUDY FROM THE JOHN ROBERTS COMPANY

Example of Training for Operational Controls

As part of training, the Director of Environment and Safety distributed additional materials to all employees involved with press blanket cleaning. Because this operational procedure documents a new and standardized method, there were many questions from employees. The director prepared additional written information, including: 1) a background sheet telling employees why this procedure was important, and 2) a Q&A list addressing issues that had come up in training.

These materials and the associated training were done to ensure that employees knew why the procedure was needed and what part they were to play in consistently implementing it.

Training for Press/Blanket Washing

New Procedures Background

Background

As some of you may already know, the elimination of Blanket Wash 2215 is necessitated by the tightening of environmental regulation.

Blanket Wash 2215 is a blend of solvents that includes the chemical 1,1,1 Trichlorethane (TCA), a chemical that has been banned internationally by the Montreal Protocol..

The reason for this is that TCA is an upper level ozone depleter, destroying the ozone layer that shields us from the harmful effects of the sun's ultraviolet radiation.

While still being manufactured today, TCA is being taxed at ever higher rates until it will no longer be manufactured in 1995.

Additionally, because Blanket Wash 2215 evaporates readily to the atmosphere, the other chemicals in the blend contribute volatile organic compounds (VOC's), which when combined with nitrogen oxides (from the burning of fossil fuels) and sunlight, leads to the formation of smog in the lower levels of our atmosphere.

The replacement for Blanket Wash 2215 will be the use of the much less volatile, and thus less harmful, Press Wash.

Because Press Wash solvent works at a different rate that the discontinued Blanket Wash 2215, a new cleaning procedure will have to be followed.

This new procedure, though somewhat different than today's method, will work nicely to clean press blankets.

CASE STUDY FROM THE JOHN ROBERTS COMPANY

Training for Press/Blanket Washing Questions You May Have

If we can still buy solvent blends that contain some 1,1,1 Trichlorethane (TCA), why do we need to make the change now?

Well, there are several reasons. First, there are some health concerns with TCA, so we want to eliminate any exposure as much as we possibly can. Second, in an effort to discourage the use of TCA now, the government is increasing taxes on this chemical (and other targeted chemicals), making the product unduly costly. Third, this is a reportable usage chemical, which requires that we complete Form R (a complicated procedure) that is also public information. It is better that we have no reportable chemical usage because if we do, then we are also brought into the regulatory loop on many other time consuming and costly programs. Fourth, John Roberts has made a commitment to *reduce* its total emissions as part of the Minnesota Toxic Pollution Prevention Plan and we will be accountable for reaching these goals. Fifth, as a responsible member of the community (in which many of us live as well as work), it is the right thing to do for the betterment of our environment.

Will this new procedure slow down my work and reduce my productivity? Will I be penalized because of this?

Unquestionably, this new procedure will slow things down slightly, but not by much. Even with the older Blanket Wash, pressmen would often use two turns of the cylinder to complete the cleanup of the blanket. Understanding that the blanket does *not* need to be *completely dry* will save otherwise wasted time. So the only remaining time element is the need to switch to a water wipe shop towel pad and the time to take care to wipe the blanket ends, especially the cylinder gap. Management's commitment to environmental responsibility supports your efforts.

What if I find I need more shop towels? Won't this new procedure use a lot more shop towels?

If it turns out that you need more shop towels, they are available (we ordered extra last week and have them in stock). Testing that we have already done has shown that towel rotation (where the water wipe pad becomes the new solvent wipe pad and clean towels are then used for the new water wipe pad) works very well.

Can I use a sponge instead of a shop towel pad for the second (water) wipe?

Yes, it's possible to use a sponge instead of a padded shop towel for the water wipe. But if you do choose to use a sponge, you will have to use less wiping pressure or you will squeeze the water out of the sponge onto the blanket leaving the blanket too wet. Try it and see if you like it. You may find a shop towel water wipe easier to control.

Can I mix water with the Press Wash and do it all at one time? Why might this not be a good procedure?

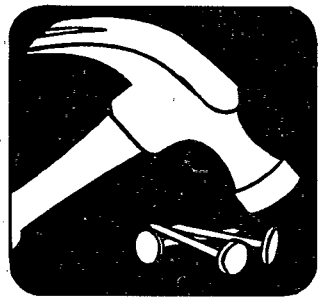
Yes, again it's possible to do this, but it's not recommended. Here's why. When you add water to Press Wash, you dilute the Press wash's ability to cut the ink in the first place. This may mean more work and slower cleaning. Also, Press Wash contains surfactants that make it able to mix with water, and it is these surfactants that tend to *remain* on the "clean" blanket that cause problems with both the ink roller train *and* the water fountain systems. It's good to

remove surfactants as completely as possible, and this is best done with a separate water wipe.

Can I just use a dry shop towel pad to wipe the blanket completely dry instead of a second water wipe? Would I be better off?

Well, for the reasons listed above, it's not recommended to use a dry shop towel second wipe. Aside from the fact that some feel a dry shop towel is harder to move across the blanket (it tends to drag), how would you clean the blanket of water solubles such as starches, clays and paper dust? The only reason I can think of to completely dry the blanket would be to ease your fear of "throwing"solvent drops on the work after startup. This is addressed by taking a little care on the second (water) wipe, especially at the ends of the blanket in the cylinder gap.

MODULE 7: IMPLEMENTING YOUR IEMS



You will ensure the success of your IEMS by developing the capabilities and support mechanisms to achieve your environmental policy, objectives, and targets. This module will cover planning for and setting up environmental management projects for each objective. In addition, this module covers tools that will help you keep your IEMS on track: a new product review process, a regulatory compliance tracking system, a pollution prevention tracking log, and an Emergency Preparedness and response plan development process.

Setting Up Environmental Management Projects

This section will help you set up environmental management projects developed to achieve each objective and target selected in previous modules.

The three main elements in developing an environmental management project are:

- identifying the person responsible for achieving the environmental objectives and targets in each relevant function and level;
- establishing the means or action plan for achieving targets and objectives; and
- implementing timetables.

An outline for such a program might include:

- objective,
- target,
- person(s) responsible,
- budget,
- date of expected completion,
- date of actual completion, and
- performance indicators for measurement.

Let's continue working with the two examples from Module 3:

- Recycle used toner cartridges.
- Reduce the environmental impact of chemical wastes from cleaning a printing press. Remember, the environmental aspect is the air releases during the press cleaning process and the water releases at the commercial laundry where the used press wipes were sent.

Figures 7-a and 7-b show example projects for the above two sample objectives and targets.

Figure 7-a. Sample Environmental Management Project Plan

Environmental Management Project Plan

SEA: Waste from Copy Toners

Date_____

Environmental Objective: Reduce the waste from used copy toner cartridges

Performance Indicator Measurement: Number of cartridges purchased vs number mailed and number remaining in stock in one-year period.

Target: 100% recycling of used toner cartridges in conformance with manufacturer instructions.

Action Plan: Train persons in charge of replacing toner cartridges. Create a check list for dates cartridges mailed for recycling.

Responsibility: Office Manager

Budget: One hour training

Schedule: One month

Review: Monthly by company manager.

Corresponds to OTP-02 of the *Company Manual Template.*

Figure 7-b. Sample Environmental Management Project Plan

Environmental Management Project Plan
SEA: Chemical Wastes from Press Cleaning

Date_____

Environmental Objective: Reduce the Environmental Impact of Chemical Wastes from Press Cleaning

Performance Indicator Measurement: Amount of fluid reused; reduction in vapors measured at laundry provided by laundry.

Target 1: Reduce air releases of cleaning fluid by 80% in plant by end of 12-month period

Action Plan 1: Substitute Product B cleaning fluid, train printers in new product use

Responsibility: Printing Press Manager

Budget: Cost of new fluid

Schedule: Six months

Review: Monthly by company manager.

Action Plan 2: Substitute best work practice, train printers in best work practice

Responsibility: Printing Press Manager

Budget: Time for training and evaluation of results

Schedule: One year

Review: Monthly by company manager.

Performance Measurement: Amount of Product B substituted for current product in one-year period and reduction in total product used over one-year period.

Target 2: Reduce releases to the water at laundry by 40% after 12-month period.

Action Plan: Remove excess fluid from wipes prior to sending to laundry; reuse recovered fluid

Responsibility: Shop manager

Budget: Cost of centrifuge, time to process wipes

Schedule: 12 months

Review: Monthly by company manager.

Corresponds to OTP-02 of the *Company Manual Template*.

As you can see from Figure 7-b, more than one target can be used to accomplish an objective, and more than one action plan to accomplish a target. You need to outline the steps necessary to achieve each target and make sure that the responsibility for completion is assigned, the time frame specified, and a budget given to ensure completion. Appendix H contains a blank worksheet to assist you in planning your environmental projects.

Resource

The results of your environmental projects plan can be documented on OTP-02 in the *Company Manual Template.*

Review New Products, Processes, and Activities

Change is an important part of business survival for most companies. Products, technologies, ways of doing things are updated regularly. To avoid creating new "significant environmental aspects" that must be addressed later, it is helpful to integrate new processes, products, and activities into the environmental management program that you are developing for the rest of your company. You can do so by setting up a procedure for reviewing new processes, products, or activities while they are in the planning stage. One way to accomplish this is to create a sign-off form to be circulated among the people responsible for or affected by the new process or product, including those responsible for the area of the company where the new process or activity will be implemented. Worksheet 7-1 is an example of such a sign-off form. The worksheet is a model that should be modified to reflect your company's activities and environmental policy.

☞ Tip

Conduct an Environmental Review when buying a new product, making a new product, changing an existing process, developing a new process, or undertaking new or changed activities.

Worksheet 7-1: Environmental Review of New Processes, Products and Activities

Area of Company	New Process, Product, or Activity	Environmental Review by	Environmental Effects	Pollution Prevention Opportunities
	Manager/Date	Manager/Date		

Contact for form: Date Completed:

Compliance Tracking

If your company does not already have a method in place for tracking regulatory compliance activities, this IEMS Program provides the opportunity for developing one. A tracking system will help you integrate this aspect of environmental control into your IEMS Program, future planning, and your annual management review. Worksheet 7-2 provides an illustration.

☞ Tip

Investigate the legal requirements that may be associated with documenting your company's compliance before you design the worksheet that you will use. Worksheet 7-2 is an example of components that are useful, but regulations differ by locality. One source to review would be EPA's Small Business Compliance Policy.

Worksheet 7-2:* Compliance Tracking Log

Person Responsible	Regulation	Compliance Check Date	Results and Root Cause	Corrective Action/Date	Compliance Verified/ Date

Contact Person: Date Completed:

*Document results on CA-01 in the *Company Manual Template.*

Root cause analysis and the corrective action notices described above are useful in examining failures in compliance and ensuring that corrective action occurs.

Pollution Prevention: Ideas and Tracking

Pollution prevention is another environmental management tool that is important to integrate with your company's business activities. Pollution prevention means reducing or eliminating waste at the source. The focus is more on waste than on environmental risk. There is a hierarchy of solutions for pollution prevention:

1. source reduction,
2. reuse/recycle, and
3. treatment.

Before deciding on major changes, an evaluation of alternatives, as described in Module 4, should be completed. There are, however, many different ways in which your company could successfully implement pollution prevention activities, especially if employees are encouraged to think about how to implement pollution prevention in their work practices. Some examples would include reuse and recycle of office paper, turning off lights/equipment when not in use, and keeping the lid on solvent containers.

You may develop specific programs that incorporate pollution prevention, such as the toner cartridges example above, and you

may also want to encourage pollution prevention practices across the company. Measuring pollution prevention achievements is different from, and often more difficult than, measuring environmental achievements in general. Simply measuring the reduction in a waste stream might mean only that the waste has been transferred to another medium, not reduced. It is therefore important to measure the reduction at the source of waste generation. It may also be important to measure the activities that your company directs towards pollution prevention. The following are existing sources of information that your company may have that would help you track pollution prevention:

- Permit applications
- TRI reports
- Purchasing records
- Utility bills
- Hazardous waste manifests
- Material Safety Data Sheets

In addition, administrative procedures can be set in place that support pollution prevention activities. Below is a checklist to help you consider opportunities for your company:

- Establish procedures in each company area for identifying pollution prevention opportunities.
- Have a chemical or raw material inventory system in place.

- Assess how many objectives have been met through pollution prevention.

Worksheet 7-3 provides a tracking log for pollution prevention in your company.

Worksheet 7-3: Pollution Prevention Tracking Log					
Area of Company	**Pollution Prevention Activity**	**Date Started**	**Results**	**Measurement Method**	**Person Responsible**
Contact:				Date Completed:	

Emergency Preparedness and Response

It is important to include environmental concerns in your emergency preparedness and response plans and training. The following steps will help you integrate plans for reducing the potential environmental impact of accidents, spills or other emergency situations.

- Appoint a person responsible for integrating environmental concerns. This can be the person already responsible for Emergency Preparedness and Response or someone from the IEMS team who will work with that person.
- Identify the potential environmental impacts of potential emergency scenarios.
- Develop response procedures to minimize these impacts and integrate them into the emergency preparedness and response plans.
- Conduct training for employees affected by these new procedures.

Worksheet 7-4 will help you identify your needs so that you can develop a plan.

Worksheet 7-4: Environmental Emergency Preparedness and Response

Potential Emergency Scenario	Potential Environmental Impact	Action Required	Procedures Needed	Training Needed

MODULE 8: BUILDING ORGANIZATIONAL SUPPORT

Effective organizational support is important to achieving long term success for your IEMS. This module will cover training, documentation, stakeholders and communication.

Training to Get the Job Done

It's very important that people receive the training needed to get work done in a way that is consistent with your objectives. Training is needed both in technical work and for general awareness on the part of all employees. The following are some examples of areas where training is needed:

- legal requirements,
- ability to recognize new problems,
- technical work needed to solve problems,
- procedures to implement operational controls,
- any new procedures or needs related to significant environmental aspects, and
- awareness of the company's environmental policy and the IEMS and its objectives

In addition to environmental or worker health and safety training that your company may currently carry out, you will have specific training requirements associated with significant environmental aspect operational controls, as your IEMS develops. Module 6 addressed the training for that phase of your

☞ Tip

Don't overlook the need for on-going training when experiencing employee turn-over. Be sure that new employees are trained soon after they arrive.

IEMS. Training plans developed during completion of that module should be integrated with the training identified in this module.

Go through the Action Steps listed below and use Worksheet 8-1 to help you identify, plan for and track the training needed to assist in developing and putting your IEMS in place. You will probably be able to identify some general training needs now, but will need to return to this module to add specific technical training needs that may be identified as you proceed with the IEMS.

Action Steps

1. Identify all job functions that affect the environment. Small companies may wish to identify individuals. Identify who is responsible for employee health and safety.

2. Identify the training and type of training these people currently receive that relates to environmental, including health and safety, concerns.

3. Determine if IEMS education could be included in this training or whether there should be special IEMS training, at least in the beginning.

4. Identify training materials or programs available outside your company. Some places to check include:

- Trade Associations
- Small Business Association
- EPA materials
- State Department of Environmental Protection
- Suppliers
- Certified Contractors

Worksheet 8-1: Training Plan

Jobs Affecting Environment	Training Needs	How to Train	When/ Length	Budget	Completion Date	Who is Responsible
Sample: Staff EH&S Person	Environmental Policy	Staff Training Session	Once/ Two hrs.	?	?	?
Production Employees	Emergency Preparedness & Response					
Contact Person:			Date Completed:			

Documenting Your Work

When undertaking a new activity like IEMS development, documenting discussions, plans, targets, and programs is crucial. Documentation ensures that no information is lost, and lets you track your performance. Much of this documentation will become the content for your company's IEMS Manual. The companion document to this guide, the *Company Manual Template*, provides a template for your own documentation development. Documentation is important to the success of your IEMS for several reasons:

- Word-of-mouth information is rarely communicated consistently, whereas written information is more likely to be constant from person to person and over time.
- Creating documentation helps you assess the progress of your IEMS. Some inconsistencies show up only as you commit your ideas to paper, and having a record allows you to check on progress and evaluate results.
- Documentation is vital to maintaining consistency in an IEMS over time and from department to department. In most companies, change is a fact of life: new products are developed, the company grows, employees change positions or leave the company. Accurate documentation will make it much easier to maintain an effective and flexible IEMS during these changes.

Resource

Review the *Company Manual Template* for sample documentation to help you develop your own IEMS Manual.

Experience has proven the value of documenting meetings, decisions, and study results, and of making that documentation accessible to those who need it.

What is Documentation?

The term "documentation" has many different interpretations. The term can refer to any or all of the following:

- instructions for doing something;
- records of what was done;
- policies developed;
- printed matter that is given or sent to clients, regulatory agencies, customers, and the public; and
- any electronic copy of the items above.

How a company interprets "documentation" will depend on its particular experience. For example, documentation could include environmental impact statements, process manuals, or even the local newspaper that reports your company's activities. Other examples might include environmental training records and OSHA manuals. All of the work completed to develop your IEMS also provides documentation.

How to Develop Your Documentation

The basic steps in preparing IEMS documentation include:

Step 1: Determine how EMS documentation can be integrated into existing documents.

Before you dive into your documentation, learn how deep the water is. Find out what documentation already exists,

☞ Tip

Documentation is usually the single most overlooked administrative procedure in most companies, but it can play a vital role in EMS development. Determining what you need from your documents, both for future reference and to teach procedures to others, will help you understand the overall needs that you want your IEMS process to meet.

☞ Tip

Remember that you will not finish most of the modules in this Guide the first time through. You will probably overlook items that will be useful for your IEMS documentation during your first search. Simply add items as you think of them later in the process. Whoever is in charge of documentation will therefore need to plan for later additions.

what its purpose is, and whether it works. The goal of this search is to locate materials you can use to begin your EMS implementation and documentation. Many companies use the same format for all their documents. An example of existing documentation might be a quality plan or tracking reports.

Step 2: Tailor the documentation to your organization's individual needs.

You will probably have to compromise in producing documentation that meets your needs while also meeting your budget. Here are some questions to help you determine what fits your needs:

- How can you extend those documents that already exist rather than creating new ones?
- Does your business operate in a single location or many? This will affect who creates some of the documents and where they are located. It may also affect how many versions of a document might be necessary to cover different circumstances.
- What is your current computer capability? Many companies use an electronic system to maintain documents.
- What security precautions do you need? As a computer system becomes larger and can be accessed by more people, electronic information can more likely be edited

and destroyed. Security, or at least restrictions on who can change data, can be a critical issue for many companies.

Step 3: Determine a format for all documents.

Before developing your IEMS documents, plan the format (document and page appearance) for the documents to be created. If a company standard exists, use it. If not, the need for IEMS documentation provides an opportunity to create a standard company format. Consider whether pages are single- or double-sided and why; choose margins, header, footer, typefaces, text, headings, etc. Include plans for bulleted and numbered lists, tables, and even paragraph spacing. Once you have a consistent format for documents, anyone who writes one will use the established electronic format and fill in the necessary text. All documents will look like part of an organized, integrated system. Most important, documents will be it easier to read and understand!

Step 4: Prototype each document.

Prototyping means visualizing what you will need in the document and creating an outline for it before you actually have information to fill in. This practice is useful not only for document preparation, but for the IEMS process as a whole. As you visualize what you will need in the document, you will gain understanding about what you will need from the process of developing your IEMS. It's a way

of "outlining" your IEMS process as well as designing documents.

Who should do the prototyping? The best people to do this are the people who will use the document. Involving them in the process gives document users the power to develop documents they will actually use – effective documents.

The following questions will help your "prototypers" design documents. Consider these questions for each document you identify as necessary for your company.

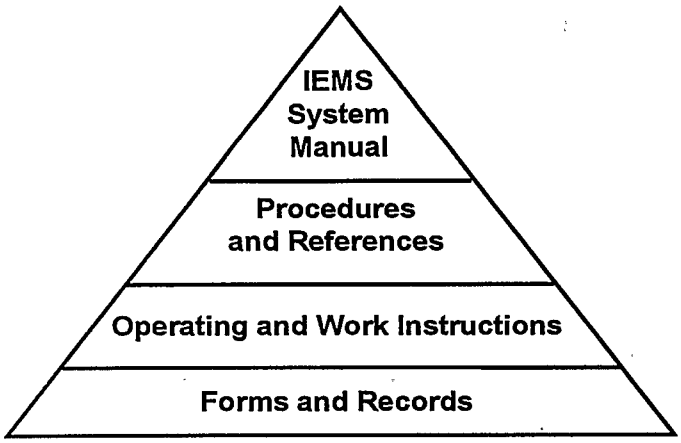
- What is the document's purpose?
- Who will use it, and how will they use it?
- How long should the document be?
- What must be included in the document? Which information is most critical?
- Is it process-focused? Process focus rather than regulation- or program-focus helps people who use the documents to better understand how their jobs fit into the rest of the company functions.
- How is the information best arranged? Will the user read sequentially or randomly?

Example: A Tiered Documentation System

The tiered documentation system consists of four "levels" of documents. The system can be shown as a pyramid with the environmental management system manual at the top and

records at the bottom (see Figure 8-a).

Figure 8-a. Documentation Levels



The pyramid shape illustrates a hierarchy in which the amount of detail, degree of specificity, and number of pages all increase as you progress from the top to the bottom of the figure.

Creating an Outline for the Process

It will be helpful at this point to develop some idea of what your IEMS documentation will look like, and thereby determine the work needed to fill it in. Doing so will help to plan the development of your IEMS. Create an outline for the process of developing your IEMS and your Company Manual or other form of documentation that suits your company. What and how much documentation you include depends upon your company's needs. The following outlines a sample Company Manual:

1. Environmental Policy
2. Environmental Action Responsibilities Assignments
3. Environmental Documents and Their Location
4. Identification of Environmental Aspects
5. Identification of Legal Requirements
6. Identification of Significant Environmental Aspects
7. Development of Objectives, Targets, and Action Plans
8. Conducting an Alternatives Evaluation
9. Development of Operational Controls
10. Environmental Training (Awareness and Task-Specific)
11. Emergency Preparedness
12. Review of New Products and Processes
13. Documentation and Document Control
14. Communication with External Stakeholders
15. Conducting a Compliance Assessment
16. Conducting an Internal Assessment
17. Taking Corrective Action
18. Management Review

The actual content of your outline will be filled in as you proceed to develop your IEMS.

Document Control

Documents must be easy to find and kept up to date. Consider the following points regarding your document control. Two worksheets follow this section. Worksheet 8-

Resource

Take a look at the accompanying *Company Manual Template* for sample procedures and formats to help you document important components of your IEMS.

2 will help you develop documents and Worksheet 8-3 will help you manage your documents once they have been created.

Sound document management ensures that:

- they can be located;
- they are periodically reviewed, revised as necessary, and approved for adequacy by authorized personnel;
- the current versions of relevant documents are available at all locations where operations essential to the effective functioning of the system are performed;
- obsolete documents are promptly removed from all points of issue and points of use, or are otherwise assured against unintended use; and
- any obsolete documents retained for legal and/or knowledge preservation purposes are suitably identified.

Worksheet 8-2: Documentation

List Existing Documents	Determine Format: Who/ Date Completed	Develop Prototype (Content): Who/ Date Completed	Assign Writing: Who/ Date	Review Writing/ Compare to Prototype Who/ Date	Added to Document List/ Date	Who Has Access	Where Located
	/	/	/	/	/		
	/	/	/	/	/		
	/	/	/	/	/		
	/	/	/	/	/		
List Documents to be Created							
	/	/	/	/	/		
	/	/	/	/	/		
	/	/	/	/	/		
	/	/	/	/	/		

Contact Person: Date Completed:

Corresponds to CS–2 of the *Company Manual Template.*

Worksheet 8-3: Document Control

Document	Who Will Use It	Permanent Location	Periodic Review Schedule/ Who	When Can Be Destroyed
			/	
			/	
			/	
			/	
			/	

Contact Person: Date Completed:

Working with Stakeholders

Stakeholders are anyone who has a stake in your company's environmental performance. Stakeholders can play an important role in helping your company develop an IEMS. Employees have strong stakeholder interest in your company and can provide strong support for IEMS development. Customers, suppliers, and neighbors can provide useful input. In addition, establishing partnerships with trade associations, suppliers, professional associations, and community colleges can be very helpful in developing parts of your IEMS. This section addresses the kind of stakeholders you may wish to include in the process and the potential benefits of including stakeholders. While involvement of employees is critical to the success of your IEMS, how far you proceed with including additional stakeholders is your decision.

The DfE Program has found that including a variety of stakeholders in a project provides proven benefits. DfE stakeholders include: industry, government, labor, environmental groups, and others. Their inclusion ensures both a mix of viewpoints and a wealth of different experience and training that contribute to a project. This level and breadth of stakeholders may not be available to a small company, but opening your IEMS planning process to a variety of stakeholders will improve results.

Stakeholder Roles

Consider why you would want to include internal and external stakeholders and what roles they can play. Before engaging stakeholders, be clear on what you expect their role to be. What do you want from them? What do you intend to tell them? Consider the following:

- Internal stakeholder (e.g., employee) participation can facilitate implementation of environmental projects as employees "take ownership" of the IEMS process and the process changes it may bring;

- Different stakeholders bring useful perspectives to identifying environmental issues, often identifying issues that might otherwise have been overlooked;
- Participation by all types of stakeholders can add credibility, transparency and value to your IEMS;
- Involving external stakeholders can help them understand your business operating constraints;
- Sometimes being an environmental leader can gain customer recognition and loyalty, and involving customers in your IEMS helps them recognize your leadership.
- Forming partnerships with customers and suppliers can help to identify shared concerns and ways to cooperate to resolve them. There may be ways that your company can help your customers meet their environmental management needs. Forming partnerships with suppliers can help your company obtain important information and may help you meet your IEMS goals.

☞ **Tip**

Working together with your customers to identify common needs in managing environmental concerns can help to build long term relationships.

Identifying Stakeholders

Almost every organization will have a wide array of internal and external groups that may be interested in and helpful partners to that organization. These groups will not be homogenous. Each will have its own priorities and perspectives, and each will have something different to contribute in support of your IEMS.

The following list provides types of stakeholders:

Internal Stakeholders

- Employees
- Shareholders
- Customers
- Suppliers
- Investors & Insurers
- Trading Partners

External Stakeholders

- Neighbors
- Community
- Organizations
- Environmental Groups
- Larger Companies
- The Media
- The Public
- Local Government

You may want to start with those stakeholders who have expressed interest in your operations. If you wish additional input, you can contact the following sources in your effort to locate suitable stakeholders:

- ask your organization's own employees, including plant/site managers and public relations personnel;
- contact local officials for suggestions;
- contact a local planning agency for suggestions;
- contact local schools, community colleges, or

☞ **Tip**

Remember, your stakeholders' concerns may be very different from what you expect, and even less difficult to resolve than you may think. The only way to find out is to talk with them.

universities; or

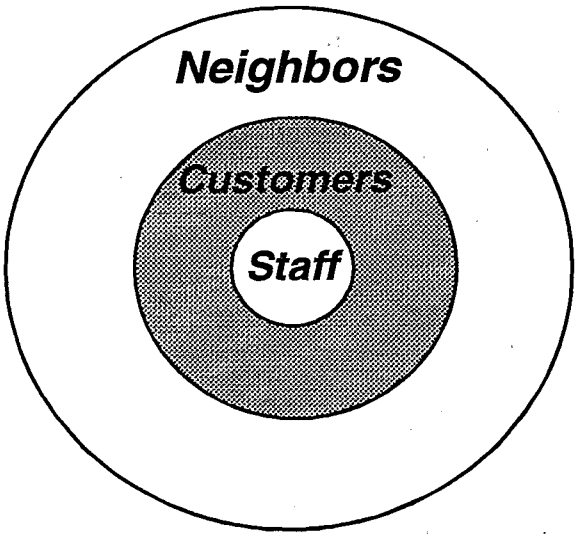
- contact a national advocacy group to elicit suggestions as to which local or national groups may be interested/suitable.

How to Work With Your Stakeholders

The next stage of the process is to establish dialogue with stakeholders. You may view this as an opportunity to further refine your understanding of the various interests of the groups.

Develop stakeholder participation in stages and learn as you go. You might think about the different kinds of stakeholders as forming ever broader circles around your business (see Figure 8-b). Begin with the innermost circle and work outward.

Figure 8-b. Levels of stakeholder interest



Communications

When working with either internal or external stakeholders, including your IEMS team, effective communication will facilitate a smooth implementation of your IEMS. You will want to follow these effective rules of communication:

Begin early in the process.

Let people know what you are doing. In most cases, you will need the cooperation of several people within your company to gather information and develop an IEMS that will work. In small and large organizations alike, early communication will pay off in greater acceptance of the resulting system.

Set your communication objectives.

Decide what you want to achieve in your communication. Setting this goal will help you get the right message across without overwhelming people with too much information, spending too much time, or missing the mark. It is helpful to create an IEMS communication policy for your company. The policy should outline what kinds of information will be communicated to external stakeholders, and how the company will document and respond to communications from external stakeholders. In addition, the policy should discuss how the company will report environmental health and safety (EH&S) incidents, such as spills, accidents and "near misses". The policy should include who reports what, to whom, and when.

☞ Tip

It's important to revisit the communication plan at various stages of your IEMS development to add any additional communication needs for each piece of your IEMS.

☞ Tip

Create and maintain a list of everyone you can think of who would be interested in your company's environmental activities. Include how you could reach them. You can then make a decision about where to begin. You could start with staff and later add other audiences if that suits your capabilities and needs. It is helpful to make your communication list as complete as possible to start with but pare it down to start out. Begin small, and then you can use the list to expand when ready.

Communicate regularly and integrate IEMS communication.

To build support for the IEMS, try to communicate on a regular basis. Some simple means of regular communication can usually be accomplished without straining resources – for example, a bulletin board posting, email messages, or articles in the organization newsletter. Don't forget to consider direct word-of-mouth communication, particularly in smaller organizations. Talking directly with key individuals at intervals may be the best mechanism for ensuring good communication. Use existing channels of communication to get the message out on your IEMS activities.

Consider various methods of communication when informing stakeholders about your company and what you are doing, or plan to do, to protect the environment. Methods may include:

- discussion in company meetings;
- company website;
- scheduling tours of your facility;
- producing a fact sheet about your company's activities, the EMS program, and why and how your company would like to include stakeholders;
- establishing a phone line to answer questions, record concerns, etc.;
- going to local schools, community colleges, universities,

or civic organizations, such as the Rotary, that may provide a focal point of interest about your company; and

- holding public meetings when you feel it is appropriate.

Ensure that stakeholder dialogue is a two-way process. The stakeholders will want to know that their comments and concerns are being listened to and taken into account. You need to convey that your organization is genuinely and actively including them.

Worksheet 8-4 will help you develop criteria.

Worksheet 8-4:* Working with Stakeholders

Your Stakeholders	Potential Environmental Interest	What you want to tell them:	What you want them to tell you:	How to communicate with/tell them:	When	Person Responsible
(Example) Employees		Environmental policy	How to get it done	Memo, bulletin board, meetings, suggestion box, intranet		
(Example) Neighbors		Environmental policy and IEMS plans	Their environmental concerns	Meetings, open house, flyers, suggestion box, web site		
Customers		Environmental policy and IEMS plans	Their environmental concerns	Above, plus inserts in direct mail advertising, or billing, web site		
Contact Person:			Date Completed:			

*Report results on CS-01 in *Company Manual Template.*

To complete this worksheet, think about ways to use your current means of communication to begin your dialogue. Consider which methods will work to convey your message to each group, and which will work to obtain the information you want to get from each group. The means that you choose may be different for each stakeholder group.

In addition to communicating with your stakeholders, it is important to track their communication to your company and the response made to that communication. A procedure for documenting and responding to stakeholder communication should be established and a person appointed to be responsible for carrying it out. Worksheet 8-5 will assist you in setting up and documenting each communication.

The following Case Study shows how "Company B" set up a process to train and then use its internal stakeholders to identify environmental concerns and some of the benefits achieved.

☞ **Tip**

Make use of current technology. A company website can be used to communicate your company's environmental policy and other important elements of your IEMS. It can also be used to solicit comments and suggestions from stakeholders.

Worksheet 8-5: Stakeholder Communication Record	
Date Communication Received:	
Type of Communication:	
Received From:	
Address/Telephone Number/E-Mail:	
Content of Communication (attach copy if possible):	
Will ABC Company Respond?	Y N
Date of Response:	
Person Responding:	
Nature of Response (attach copy if possible):	
Are Internal Actions Necessary? (If Yes, fill out a Corrective Action Form.)	Y N
Contact Person:	Date Completed:

Corresponds to CS-02 of the *Company Manual Template*.

Case Study: Company B — Working With Stakeholders

Company B is a 30-person company that manufactures sangria and chile salsa. With strong senior management backing and support from a local consultant, Company B focused initially on building environmental consciousness among its employees. To all of its workers and managers the company offered general environmental awareness training as well as more specific training on how to identify specific environmental issues. Employees then split into 10 teams, each charged with identifying the environmental issues associated with a specific area of operation, from the acquisition of raw materials through to product delivery. Based on the work of these teams, Company B developed a list of its most important environmental issues and concrete objectives and plans for improvement.

The key to Company B's success lay in using participatory teams to define new environmental problems and develop solutions. For example, the company identified waste of raw materials as an environmental issue, and teams from several areas found ways of reducing waste. Company B now requires its suppliers to use stronger containers to avoid materials spoilage. More significantly, the team from the mixing area realized that by using a spray nozzle to clean out left-over orange juice concentrate (a key ingredient in sangria) from large supply containers, it can recover an additional 3,000 pounds of concentrate (6% of its total consumption, valued at $4,200) per year. Company B gained an even greater economic benefit by revising its process for cleaning and sanitizing its stainless steel tanks, reducing use of an iodine-based cleaning fluid by 11,000 liters per year, or 90%, at an estimated yearly savings of $7,000.

Other benefits the company has realized include improved compliance, a safer work environment, and reduced emissions from its transport vehicles thanks to improved maintenance. The environmental awareness of all employees has increased significantly, with some workers extending their new-found environmental consciousness to their homes. The company has also publicized its participation in the EMS project to the local community in an effort to improve its community relations and to help improve the environmental awareness of the community.

MODULE 9: ESTABLISHING CONTINUING IMPROVEMENT

Now it's time to step back and look at the total picture. Your IEMS constitutes an overarching "Environmental Management Program" made up all of the elements we have covered above and a few additional elements that we will cover in this module. The framework of your IEMS Program at this point includes:

- Company Environmental Policy
- Environmental Aspects Review Process
- Objectives, Targets and Environmental Management Programs
- Measuring Environment Performance and Taking Corrective Action
- Operational Controls
- Documentation Plan
- Stakeholder Strategy
- Communication Plan

The final steps in developing your EMS include:

- determining program measurement criteria,
- setting up an internal assessment process, and
- establishing a management review process.

Design for the Environment U.S. EPA

Principles emphasize the importance of continuing improvement. Environmental improvement requires work in steps. It will not be achieved overnight, but must be viewed as a long-term, evolving process.

Resource

Review the *Company Manual Template* for sample procedures and formats to help you document important components of your IEMS.

Step 1: Determine program measurement criteria

Determining measurement criteria, also called environmental performance indicators, will help you evaluate the success of your overall IEMS program. The purpose of these indicators is different from the specific measurement criteria you developed for evaluating progress toward individual objectives. These performance indicators focus on how well the overall system for improving environmental management is functioning. Select performance indicators that will help you and your employees decide whether success has been achieved or whether improvement in procedures needs to be made. It is easier for management and staff to understand how things are going if they have benchmarks as guidelines.

You will need performance indicators that describe how well your environmental policy is being implemented. In addition, you will need performance indicators for all of the various components of your IEMS. The measurement criteria selected for each component of your IEMS will probably be different. For example, how will you measure the success of communication, documentation, stakeholder outreach, or training programs?

One approach is to measure the *activities*, for example, number of meetings held with stakeholders, number of documents created, number of employees trained, or number of hours of training. Activity, however, does not always mean results.

Consider the objective of each IEMS component and define a way to measure *results* so that you would feel satisfied that the objectives are achieved. To measure results effectively, your methods should be:

- simple
- flexible
- consistent
- ongoing
- usable (i.e., results communicated)
- accurate (i.e., reliable data produced)

Worksheet 9-1 will help you organize your thoughts.

Worksheet 9-1: IEMS Program Measurement Criteria

Company Name_____

Measurement Elements / IEMS Components	Objectives of Component	Activity Measures	Results Indicators	Review Period
Environmental Policy				
Communication Plan				
Stakeholders Input				
Environmental or IEMS Training				
Review of Aspects				
Operational Controls				
Environmental Review of New Processes and Activities				
Setting Objectives & Targets				
Environmental Management Project 1				
Environmental Management Project 2				
Documentation				
Regulatory Compliance				
Pollution Prevention				
Other				
Contact person for form:			Date Completed:	

Here are some examples of IEMS results measurements for various program components that can be tracked over time:

- number of significant environmental aspects included in environmental projects plan
- number of environmental objectives and targets met
- pounds of hazardous waste generated per unit of production
- employee sick leave absences related to work environment
- percentage of employees completing environmental training
- average time for resolving corrective action
- energy or water use per unit of production
- percentage of solid waste recycled/reused
- number of complaints from community; number of responses to complaints
- number of pollution prevention ideas generated from employees
- resources used per unit of product or service
- pollution (by type) generated per unit of product or service
- per cent of products for which life cycle assessment has been conducted
- number of products which have a recycling program
- number of instances of non-compliance

It is the results shown by these environmental performance indicators that will become the basis for your plans for next year and for establishing continuous improvement.

Step 2: Set up an internal assessment process

To make sure that your IEMS is achieving the general goals outlined in your Environmental Policy, you will need to establish procedures for an assessment process and assign people to be responsible for accomplishing the assessments on a regular basis. In general, assessments are conducted through interviews, examination of documents, observation of activities, and review of results of measurements. Assessments should be conducted regularly, for example, on every quarter. The purpose of the assessment is to develop information for management review and to take corrective action where needed. The assessment procedures should describe:

- the activities and areas to be considered in assessments,
- the frequency of assessment,
- the responsibilities associated with managing and conducting assessments,
- the communication of assessment findings,
- assessor competence, and
- how assessments will be conducted.

Assessments may be performed by personnel from within the organization or by external persons selected by the organization. In either case, the persons conducting the assessment should be in a position to do so impartially and objectively. Use Worksheet 9-1 along with Worksheet 9-2 and 9-3 to help you set up your assessment process. The Worksheet 9-2 specifies

some of the factors that will be examined during the assessment and Worksheet 9-3 will help you track correction of non-conformities.

These forms alone will not be enough to conduct assessments. First, the categories should match what is appropriate for your company. Second, each category will probably require subheadings to fully describe what you need to check about each category to be assessed. These worksheets are more of a summary log with suggestions about what you might want to include. Although every part of your IEMS program should be assessed regularly, all parts need not be assessed at the same time, nor on the same schedule. Make this IEMS work to help you ensure that your IEMS program is doing what you want it to do.

Worksheet 9-2: Internal Assessment Checklist

Internal Assessment Team:

Date of Internal Assessment: _____ Signed: _____

IEMS Procedures:

Check each item assessed, including auditing of records, where applicable (codes in parentheses refer to the Worksheet number ("WS") in this Guide, followed by the document number in the *Company Manual Template*):

- __ Environmental policy (Module 2)
- __ Environmental objectives (progress; implementation of action plans)
- __ IEMS responsibilities (WS 7-2, RESP-01)
- __ Identification of Environmental Aspects (WS 1-5, P-EA)
- __ Identification of Legal Requirements (WS 1-6, P-LR)
- __ Identification of Significant Environmental Aspects (WS 3-3, WS 3-6, P-SEA)
- __ Development of Objectives, Targets, and Action Plans (WS 5-1, P-OTP)
- __ Conducting an Alternatives Evaluation (WS 4-1 to 4-6, P-AE)
- __ Development of Operational Controls (WS 6-1 to 6-3, P-OC)
- __ Environmental Training (Awareness and Task-Specific) (WS 8-1, P-ET)
- __ Emergency Preparedness (WS 7-5, P-EP)
- __ Review of New Products and Processes (WS 7-3, P-NPP)
- __ Documentation (WS 8-2, WS 8-3, P-D)
- __ Conducting a Compliance Assessment (WS 5-4, P-CA)
- __ Conducting an Internal Assessment (WS 9-2, WS 9-3, P-IA)
- __ Taking Corrective Action (WS 5-3, P-TCA)
- __ Management Review (WS 9-4, P-MR)

IEMS Performance

- __ Achieved objective #1
- __ Achieved objective #2
- __ Achieved objective #3

Contact Person: Date Completed:

Corresponds to LA-01 of the *Company Manual Template*.

Worksheet 9-3: Internal Assessment Record

Internal Assessment Team:

Date of Internal Assessment: _____ Signed: _____

Major Non-Conformities Observed

1.

2.

Minor Non-Conformities Observed

1.

2.

3.

Is ABC Company making progress in meeting its IEMS objectives?

Is ABC Company adhering to the commitments in its environmental policy?

Suggestions for Improving IEMS:

Contact Person: Date Completed:

Corresponds to IA-02 of the *Company Manual Template*.

Review your company's environmental aspects and objectives

As part of your internal assessment, it is critical that you regularly review your company's environmental aspects and objectives. Over time, you will probably add to the list of environmental aspects and you may need to re-rank the aspects as your activities change and as new information becomes available. Here are some things to check:

- New process review — have any changes introduced new environmental aspects?
- Worksheets from the most recent environmental aspect identification and ranking exercises — is there new information on chemical effects? If so, update your worksheets.
- Communication received from stakeholders — do any comments suggest a need for re-ranking your aspects?
- Environmental objectives and targets — what new ones will your company set for this time period?
- Pollution prevention program — has information become available from this effort that would add aspects or objectives?
- Assessment program — have your assessments turned up information on where your IEMS and environmental programs could be improved? Would this information be useful in your aspect identification process or in redesigning your objectives?

☞ Tip

Regularly revisiting your environmental aspects and objectives is an essential step in developing an EMS that achieves the goal of continuous environmental improvements.

The regular review of aspects can be used to change the priorities you set last time, or it can be used to examine a part of your company's activities that you set aside last time. The regular review can be part of a planned "phasing in" process, wherein different parts of your company's operations are reviewed until all your company's activities are included in your IEMS. The regular review of aspects is the foundation for your company's continuing improvement.

Step 3: Establish a senior management review process

To maintain continual improvement, suitability, and effectiveness of your environmental management system, and thereby its performance, your organization's senior management should review and evaluate the environmental management system at defined intervals, such as quarterly. The scope of the review should be comprehensive, though not all elements of an environmental management system need to be reviewed at once, and the review process may take place over a period of time. The worksheets in Steps 1 and 2 provide information for the management review. Review of the policy, objectives, and procedures should be carried out by the level of management that defined them. Following is a checklist of some of the things that should be included in the management review:

- results from assessment,
- the extent to which objectives and targets have been met,

- the continuing suitability of the environmental management system in relation to changing conditions and information, and
- concerns amongst relevant interested parties.

Questions for management to consider include:

- Is our environmental policy still relevant to what we do?
- Are roles and responsibilities clear and do they make sense?
- Are we applying resources appropriately?
- Are we meeting our regulatory obligations?
- Are the procedures clear and adequate? Do we need others? Should we eliminate some?
- What effects have changes in materials, products, or services had on our IEMS and its effectiveness?
- How effective are our measurement and assessment systems?
- Can we set new measurable performance objectives?
- What effects have changes in materials, products, or services had on our IEMS and its effectiveness?
- Do changes in laws or regulations require us to change some of our approaches?
- What stakeholder concerns have been raised since our last review?
- Is there a better way? What else can we do to improve?

Create a continual improvement plan and check progress. Document observations, conclusions, and recommendations for

necessary action. Assign action items for follow-up, and schedule the next regular review. Worksheet 9-4 will provide a place to record management review information.

Worksheet 9-4: Management Review Record
Date of review meeting:
Persons present at meeting:
Conclusions:
Actions to be taken/Person(s) responsible:
Signed:_____ _____ Management Representative Plant Manager

Worksheet 9-4 corresponds to MR-01 in the *Company Manual Template.*

Congratulations!

This completes your IEMS. Hopefully, the management system accompanied by the annual process of review and renewed objectives will bring its own rewards in greater productivity, reduced costs and healthier environments!

APPENDIX A: GLOSSARY

alternatives evaluation - A systematic evaluation of alternative ways to accomplish a task that reviews the cost, performance, and environmental impact of each alternative under consideration. Ideally, the range of evaluation would include alternative chemicals, products, processes, technology, work procedures, and disposal methods.

ancillary material - Material input that is used by the unit process producing the product, but is not used directly in the formation of the product.

aspect, environmental - Element of an organization's activities, products, and services that can interact with the environment.

assessment - An estimate or determination of the significance, importance, or value of something.

certification - Procedure by which a third party gives written assurance that a product, process, or service conforms to specified requirements.

compliance - An affirmative indication or judgment that the supplier of a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements.

continual improvement - Process of enhancing the environmental management system to achieve improvements in overall environmental performance , in line with the organization's environmental policy. Note - The process need not take place in all areas of activity simultaneously.

corrective action - An action taken to eliminate the causes of an existing nonconformity, defect, or other undesirable situation in order to prevent recurrence.

effects - Refers to changes, actual or potential, caused by a chemical, activity, or process as it comes into contact with humans or the environment.

environment - Surroundings in which an organization operates, including air, water, land, natural resources, flora, fauna, humans, and their interrelation.

environmental assessment - A systematic, documented, periodic and objective review by company management of facility operations and practices related to meeting environmental requirements. The assessment is a systematic, documented verification process of objectively obtaining and evaluating evidence to determine whether specified environmental activities, events, conditions, management systems, or information about these matters conform with selected criteria, and communicating the results of this process to management.

environmental management system (EMS) - Organizational structure, responsibilities, practices, procedures, processes, and resources for developing, implementing, achieving, reviewing, and maintaining the environmental policy.

environmental objective - Overall environmental goal, arising from the environmental policy, that an organization sets itself to achieve, and that is quantified where practicable.

environmental performance - The measurable results of the environmental management system, related to an organization's control of its environmental aspects, based on its environmental policy, objectives, and targets.

environmental performance evaluation - Process to measure, analyze, assess, report, and communicate an organization's environmental performance against criteria set by management.

environmental performance indicator - A specific datum selected, such as volume of a chemical used, which will provide measurable information regarding progress toward meeting a specific environmental goal.

environmental policy - Statement by the organization of its intentions and principles in relation to its overall environmental performance, which provides a framework for action and for the setting of its environmental objectives and targets.

environmental target - Detailed performance requirement, quantified wherever practicable, applicable to the organization or parts thereof, that arises from the environmental objectives and that needs to be set and met in order to achieve those objectives.

function - Performance characteristic.

hazard - The ability to cause damage.

impact, environmental - Any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organization's activities, products, or services.

inputs and outputs - Material or energy that crosses a unit process boundary. Example — Materials may include raw materials, products, emissions, and waste.

interested party - Individual or group concerned with or affected by the environmental performance of an organization.

life cycle - Consecutive and inter-linked stages of a product system, from raw material acquisition or generation of natural resources to the final disposal.

life-cycle assessment (LCA) - Compilation and evaluation, according to a systematic set of procedures, of the inputs and outputs of materials and energy and the potential environmental impacts of a product system throughout its life cycle.

life-cycle characterization - Element of the life-cycle impact assessment phase in which the potential impacts associated with the inventory data in each of the selected categories are analyzed.

media - The means or substance through which something is transmitted, e.g., air, water, or soil.

objective, environmental - Overall environmental goal, arising from the environmental policy, that an organization sets itself to achieve, and that is quantified where practicable.

pollution prevention - Pollution prevention means reducing pollution or waste at the beginning of a process. The underlying theory to this approach is that if you don't generate waste in the first place, there is nothing to treat or dispose of.

prevention of pollution - Use of processes, practices, materials, or products that avoid, reduce, or control pollution, which may include recycling, treatment, process changes, control mechanisms, efficient use of resources, and materials substitutions.

procedure - A specified way to perform an activity.

process - A set of interrelated resources and activities that transform inputs into outputs.

product - Any good or service.

risk - This is the probability that something undesirable will happen from exposure to a hazard.

risk assessment - Risk assessment is the process of gathering data and making assumptions to estimate short- and long-term harmful effects on human health or the environment from exposure to hazards associated with the use of a particular product or technology.

root cause - A fundamental deficiency that results in a nonconformance and must be corrected to prevent recurrence of the same or similar nonconformance.

stakeholders - Those groups and organizations having an interest or stake in a company's EMS program (e.g., regulators, shareholders, customers, suppliers, special interest groups, residents, competitors, investors, bankers, media, lawyers, insurance companies, trade groups, unions, ecosystems, cultural heritage, and geology).

substitutes - A chemical, product, process, or technology, which may be substituted for another to perform the same function or achieve the same end result.

target, environmental - Detailed performance requirement, quantified wherever practicable, applicable to the organization or parts thereof, that arises from the environmental objectives and that needs to be set and met in order to achieve those objectives.

volatile - Ability to evaporate easily.

waste - Any output from the product system that is disposed of.

APPENDIX B: SAMPLE QUESTIONS TO ASK YOUR SUPPLIER

(From *Solutions for Lithographic Printers*, Question 8.)

This appendix contains questions focused on getting information on chemical hazards of products used in press wash. Modify the questions to suit the chemical products that your company uses. The entire document can be found on the DfE website under industry projects.

What questions should I ask my blanket wash supplier?

Your supplier can be a valuable source of information for evaluating both the wash you use now and any substitute wash. Ask your supplier the questions listed below to gain important health and environmental information about the blanket wash you are currently using or a substitute blanket wash you may consider testing.

1. **What chemicals are in the blanket wash?**
   - Send me a copy of the MSDS.
   - What chemicals are in this wash that are not listed on the MSDS?

2. **Which regulations might be triggered when using this product?**
   - Are there any HAPs (Hazardous Air Pollutants under the Clean Air Act) in this wash?
   - How do you suggest I comply with the applicable regulations?

3. **What is the volatile organic compound (VOC) content and vapor pressure of the wash?**

> ☞ **Tip**
>
> The lower the VOC content, the better. The lower the vapor pressure, the better.

4. **What health risks are associated with the use of the blanket wash?**
   - What types of short-term symptoms, such as dizziness, headache or nausea, might I experience by using these products on a daily basis?
   - Does this product contain any chemicals with adverse long-term health effects?
   - When using this product on a daily basis, what type of ventilation do I need?

5. **Do I need to be concerned if workers get this wash on their hands or skin?**

6. **What are the best ways to use the wash to minimize both the health risk and waste generated?**

7. **Do I need to change the way I currently use blanket wash to make this product work best?**

8. **What is the proper method for disposing of the used blanket wash and wipers?**
   - Will my used wipers or used blanket wash be considered hazardous waste under RCRA?
   - Once the wash is mixed with other chemicals, such as inks or fountain solutions, what is the proper disposal method?

9. **Do I need to take any special precautions when laundering used wipers?**

10. **Do any of the chemicals in this product present a risk to aquatic species?**

APPENDIX C: EXAMPLE PERFORMANCE EVALUATION WORKSHEETS

This appendix contains two worksheets designed for evaluating the performance of ink remover and emulsion and haze remover for screenprinting. These worksheets can be adapted for other performance evaluations. These worksheets also can be found on the DfE website, as Appendices I and J in the *Cleaner Technology Substitutes Assessment* for the DfE Screenprinting Project.

INK REMOVER EVALUATION SHEET *Evaluation #*_____

Facility name and location:

_____

Date: _____ Time: _____ Ink Remover employee's name: _____

	Fill in the blank or circle the appropriate characteristic. Make any notes or comments in the space to the right.
Screen Condition	
Screen identification and history	• *Enter the identification marking (tracking) code for the screen:* • *Estimate how much ink was left on the screen?*
Screen size	_____ inches x _____ inches
Screen condition and threads per inch	• *Note screen condition including any rips, holes, corrosion:* • *Record the screen mesh size:* _____ threads/inch
Mesh *(Record mesh material type and type of mesh treatment, (e.g., abraded, calendared, etc.) if any)*	• *Mesh type:* • *Mesh treatment:*
Number of impressions of the screen's last run	
Ink type	• *Circle one:* Solvent-based, UV, Water-based • *Specify manufacturer and series #:*
Ink color	• *Circle one:* Blue, Black, Other (specify):

INK REMOVER EVALUATION SHEET

Evaluation #

Emulsion type	• *Circle one:* Capillary film, Direct photo, Dual cure, Other (specify): • *Specify manufacturer and series #:*
% Ink Coverage	• *Check one:* 0 - 25%...☐ 25 - 50%...☐ 50 - 75%...☐ 75 - 100%...☐
Drying Time	Time between end of press run and start of ink removal with product _____ *(hours or mins.; specify units)*
Performance	
Ink Remover Dilution	_____ *(enter ratio)* or *"none"*
Quantity of Ink Remover Used	_____ oz.
Time *(enter time from application of ink remover until screen is ready for the next step)*	Note: Do not include screen positioning or clean up time. _____ mins.
Physical effort required *(circle rating and comment)*	Low, Moderate, High
How many wipes did you use?	
Was a pressure washer used?	*(check one)* Yes _____ No_____
Examine screen after ink removal.	*Did the ink remover effectively and easily remove the ink? (Also note any side effects of the product on the screen)*
Comments or suggestions - Record any comments and note anything unusual about the reclamation on a separate sheet of paper. (e.g., did you have to reapply the product? why was the screen hard to clean?)	

INK REMOVER EVALUATION SHEET

Evaluation #___

Facility name and location: _____

Date: _____ Time: _____ Screen Reclamation employee's name: _____

	Fill in the blank or circle the appropriate characteristic. Make any notes or comments in the space to the right.
Screen Tracking	
Screen identification	• *Enter the identification marking (tracking) code for the screen:*
Performance	
Drying Time *(Specify units; hours or mins.)*	• Time from ink removal completed to start of emulsion removal: _____ • Time from emulsion removal completed to start of haze removal: _____
Dilution	• Emulsion Remover _____ *(ratio)* or *none* • Haze Remover _____ *(ratio)* or *none*
Quantity of Product Used	*Enter # of ounces used:* • Emulsion Remover _____ ounces *Enter # of ounces used:* • Haze Remover _____ ounces
Product Use Time *(enter time from application of product until screen is ready for the next step)*	• Emulsion Remover _____ mins. • Haze Remover _____ mins.

Was a pressure washer used?	• For emulsion removal? *(check one)* Yes _____ No_____ • For haze removal? *(check one)* Yes _____ No_____
Physical effort required *(circle one for each step and describe the level of effort)*	• **Emulsion Remover:** *circle one:* Low, Med., High; *Describe if the stencil dissolved easily or slowly, and if a great deal or very little scrubbing took place:*
	• **Haze Remover:** *circle one:* Low, Med., High; *Describe the effort required for haze removal:*
Examine screen after emulsion removal.	• Is there any ink haze or stencil stain on the mesh? If so, describe: • If any emulsion is still present, describe the residue left on the screen in detail:
Examine screen after reclamation is complete.	• Can the screen be reused for all jobs? *check one:* Yes _____ No_____ If "No", describe why the screen cannot be reused: *(e.g., Is there is a ghost image? Can the screen be used for reverse printing? Can it be used for close tolerance work? Can transparent inks be used with it?)*
Examine the substrate image after the screen is reused. Comment on the print image quality.	
Comments - Record any comments and note anything unusual about the reclamation on a separate sheet. (e.g., did you have to reapply the product? why was this screen more difficult to clean?)	

APPENDIX D: EXAMPLE ALTERNATIVES EVALUATION WORKSHEET

This study presents a worksheet that can be adapted to evaluate sets of alternatives.

From "A Worksheet to Help You Choose a Better Wash," Case Study #4 from the DfE Lithographic Printing Project.

A Cooperative Project between the U.S. Environmental Protection Agency and the Printing Trade Associations Nationwide

October 1996

EPA 744-F-96-015

design FOR THE ENVIRONMENT

LITHOGRAPHY PROJECT BULLETIN 4

BULLETIN HIGHLIGHTS

This Bulletin highlights How to Find a Better Blanket Wash for Your Company

- The Blanket Wash Comparison Worksheet
- A Description of Nine Different Cost Categories

ALSO IN THIS BULLETIN

- Hidden Costs of Your Blanket Wash
- Questions to Ask When You Call Your Blanket Wash Supplier
- What You Can Do to Compare Blanket Washes: A Checklist
- Use the Worksheet to Choose Other Chemicals for Your Shop

A Worksheet to Help You Choose a Better Wash

There are many factors to consider when choosing a blanket wash or other press chemical that is best for your shop. Perhaps the most obvious are purchase price and performance. But there are other, less obvious factors that are just as important. How flammable is the wash? Is it a regulated material? How hazardous is it to worker health or to the environment? Even if it is cheaper to buy, a wash that is more hazardous, or one that is regulated, may have large hidden costs that make it more expensive in the end.

The worksheet contained in this bulletin identifies many of these costs, both obvious and not so obvious. Use it to compare your blanket wash options - it may help you find a blanket wash that is better for your shop.

The Worksheet: How Does it Work?

The worksheet can help you compare test blanket washes to your normal wash. Complete the worksheet after you (or your press operators) know how well the test wash works (this may take a week or two of use). When you answer the questions and add up the scores, the worksheet will tell you if the test wash may be a better choice for your shop.

All information needed for the worksheet is available from:

- **the press operators in your shop who have been using the test wash**
- **the Material Safety Data Sheet (MSDS) that comes with the blanket wash**
- **your blanket wash supplier**

If the Final Worksheet Score Is...	Then...
Greater than zero	⇒ The test wash may be a better choice than your normal blanket wash
Less than zero	⇒ The test wash may not be a better choice for your facility than your normal blanket wash
Equal to zero*	⇒ The test wash is approximately the same as your normal wash

* If the test wash appears to be approximately the same as your normal wash overall, look at each individual category. Which is most important to you? Different scores in that category may still help you decide which blanket wash is best for your shop.

The Worksheet

Could a substitute blanket wash be a better choice for your facility?

Use the scorecard below to figure out whether a substitute blanket wash may be a better choice for your facility. Add the scores to see if the substitute wash is better, worse, or the same as your current wash.

Test Wash: _____

Supplier Name and Phone: _____

Compare the test wash to the blanket wash you normally use for the following questions and enter the score of your answer in the column on the right:

Compared to your normal blanket wash,	Scores -2	-1	0	1	2	Enter Score Below
1 Is the price per gallon of the test blanket wash:	Much more	More	Same	Less	Much less	
2 Is the amount of test wash used to clean each blanket:	Much more	More	Same	Less	Much less	
3 Is the time required to clean a blanket with the test wash:	Much more	More	Same	Less	Much less	
4 What does the press operator think of the test blanket wash? Is it	Much worse	Worse	Same	Better	Much better	

Consult MSDS forms and contact the blanket wash supplier to answer questions 5-9:

5 Does the test wash contain hazardous chemicals as defined by Federal/State environmental regulations or OSHA? Yes = -2 No = 2						

Compared to your normal blanket wash,	Scores -2	-1	0	1	2	
6 Is the vapor pressure of the test wash:	Much higher	Higher	Same	Lower	Much Lower	
7 Is the percentage VOCs of the test wash:	Much higher	Higher	Same	Lower	Much lower	
8 Is the flash point of the test wash:	Much lower	Lower	Same	Higher	Much higher	
9 How does the test wash compare on any other factors:	Much worse	Worse	Same	Better	Much better	

Add all nine scores on this worksheet to get the total score for this test blanket wash. Remember, when adding negative numbers -2 + 2 = 0.

Total [ ]

What does the score mean?

A score greater than zero means the test wash may be a better choice than your facility's regular wash, a score of zero indicates that the test wash is approximately the same, and a score of less than zero indicates that the test wash may not be a better choice for your facility.

Design for the Environment

Worksheet Questions

What Do They Mean?

1 **Purchase price: Compared to your normal blanket wash, Is the price per gallon of the test blanket wash much more, more, the same, less, or much less?**

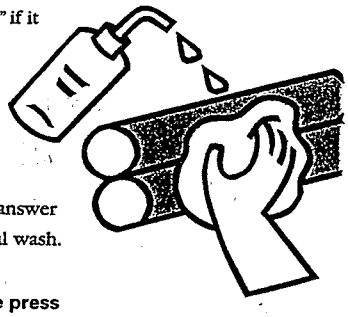
The most obvious difference between two blanket washes is the cost to buy them. Compare the cost per gallon of your normal wash to the test wash. Answer "much more" if the test wash costs twice as much as your normal wash or "much less" if it is half the price or less. Factor in dilution ratios for those washes that are shipped as concentrates.

2 **Amount used per cleaning: Compared to your normal blanket wash, Is the amount of test wash used to clean each blanket much more, more, the same, less, or much less?**

The more wash you use each time you clean a blanket, the more it costs you. Ask press operators how much of the test wash is needed to clean the blanket compared to the amount of normal wash. Answer "much more" if it takes twice as much test wash or "much less" if it takes less than half as much to clean the blanket.

3 **Time to clean a blanket: Compared to your normal blanket wash, Is the time required to clean a blanket with the test wash much more, more, the same, less, or much less?**

Press downtime costs money. If the test wash takes twice as long to clean the blanket, answer "much more". Answer "much less" if the test wash takes only half as long as your normal wash.



Use the Worksheet to Choose a Better Roller Wash Too!

4 **Press operator opinion: Compared to your normal blanket wash, What does the press operator think of the test wash? Is it much worse, worse, the same, better, or much better?**

Ask press operators to compare the test wash to the normal wash on odor, blanket swell, the time required for the press to come back to color, the effort required to use the washes, and any other factors they think are important. Combine these into an overall score for this question.

5 **Hazardous chemicals: Does the test wash contain hazardous chemicals as defined by environmental laws or the Occupational Safety and Health Act (OSHA)?**

Contact the supplier or manufacturer for this information. A variety of environmental regulations apply to hazardous materials because of their potential dangers to people and the environment. Violations may result in large fines. At the very least, using a regulated hazardous chemical may increase compliance costs. Ask your blanket wash supplier if the blanket wash, or its waste, is considered hazardous under any environmental law (such as RCRA, CAA, CERCLA, or EPCRA - Section 2, etc.) or under OSHA. Never mix hazardous and non-hazardous wastes. The hazardous chemicals in a blanket wash, as defined by OSHA, are usually listed in Section 2 of the MSDS form. If this section says "none", your test wash probably does not contain OSHA hazardous chemicals. But beware. The MSDS lists OSHA hazardous chemicals only. The blanket wash may still contain chemicals defined as hazardous by other environmental regulations. If this section is blank, ask your supplier. See **Questions to Ask When You Call Your Blanket Wash Supplier** for more information.

6 **Evaporation: Compared to your normal blanket wash, Is the vapor pressure of the test wash much higher, higher, the same, lower, or much lower?**

If the test wash vapor pressure (in mmHg) is	Score
More than ten times higher	Much higher
Between ten times and 1.5 times higher	Higher
Between 1.5 times higher and 1.5 times lower	Same
Between 1.5 times and ten times lower	Lower
More than ten times lower	Much lower

See MSDS Section 3 - Physical and Chemical Characteristics - for vapor pressure information. Vapor pressure is a measurement of how quickly a chemical evaporates. The higher the vapor pressure of a blanket wash, the quicker it evaporates. If a blanket wash has hazardous ingredients, they can evaporate into the air in your shop, enter the lungs of your workers, and pollute the surrounding environment. If the vapor pressure of your test wash is less than the wash you are currently using, it may evaporate less in your shop. Vapor pressure is usually expressed in mmHg. Call your supplier if the vapor pressures of the washes are expressed in different units. 10 mmHg is usually a regulatory cut-off, but the lower the vapor pressure the better.

7 **Environmental Regulations and Worker Health: Compared to your normal blanket wash, Is the percentage VOCs of the test wash much higher, higher, the same, lower, or much lower?**

Contact supplier or manufacturer for this information. The amount of Volatile Organic Compounds (VOCs) in your blanket wash can affect your costs of complying with environmental regulations, especially Clean Air Act regulations on emissions from your shop. VOCs contribute to lower level smog and may have health concerns. If the test blanket wash has low or no VOC content, your environmental compliance responsibilities (and costs) may be lowered and the health and safety of your employees may be improved. You might need to contact your blanket wash manufacturer for this item (see Questions to Ask When You Call Your Blanket Wash Supplier for more information). Score "much higher" if the percentage VOC content of the test wash is two times or more that of the normal wash or "much lower" if the percentage VOC content of the test wash is two times or more lower. Score "same" if within 10%.

8 **Flammability: Compared to your normal blanket wash, Is the flash point of the test wash much higher, higher, the same, lower, or much lower?**

See MSDS Section 4 - Fire and Explosion Data - for flash point information. The flash point is one measurement of the temperature at which a chemical will ignite. In general, as flash point increases, so does safety. Even though the minimum flash point for flammability is 100° F and for hazardous wastes is 140°F, the higher the flash point the better. A less flammable chemical may save you money on your property insurance as well as exempt you from costly storage and record keeping requirements of environmental and safety regulations such as RCRA and OSHA. Contact your insurance underwriter for a reappraisal to determine the cost savings from using a less flammable blanket wash at your shop. If the flash point of the test wash is two times lower than the normal wash, mark "much lower" on the worksheet. If the flash point of the test wash is more than two times higher, mark "much higher" on the worksheet. Score "same" if within 15°F .

9 **Other: Compared to your normal blanket wash, How does the test wash compare on any other factors? Much worse, worse, same, better, or much better?**

Compare the performance of the test wash to your normal wash on any other factors important to your shop. Some examples include acceptability of wash to commercial laundry, corrison of press parts, wash availability, dilution, and availability of recycled containers.

Why a Worksheet?

The worksheet provided with this bulletin gives you a place to keep information about the washes you try out at your shop. Make extra copies of the blank worksheet and record information about each blanket wash you test. After trying a variety of washes, you can use the completed worksheets to compare them and find the one that is best for your shop.

The worksheet is not a scientific evaluation and may not cover every potential cost. If a test wash scores significantly better than your normal wash, this means the test wash might be a better choice, but does not guarantee it.

The Hidden Costs of Your Blanket Wash

The environmental, health, and safety costs of blanket washes are often hidden. If your test wash is less harmful to your workers or the environment, or is less flammable than your current blanket wash, you may save money by using it even if it costs more per gallon. Potential savings include:

- ⇒ Decreased regulatory costs (such as disposal costs, pollution control equipment, permitting, permitting fees, training, fines)
- ⇒ Improved worker health and safety
- ⇒ Decreased insurance costs (such as workers compensation, fire, and liability)
- ⇒ Other decreased costs (such as energy)

Choosing a Better Wash — An Example

By testing a variety of washes you may be able to find one that is cheaper to use and better for the environment. During the DfE Lithography Project (see page 6 for more information), a vegetable ester wash was found that worked well and cost less than a petroleum-based wash. Cost per wash was calculated based on price per gallon, time required to wash a blanket, number of towels, and amount used. Results showed the vegetable ester wash was cheaper to use per blanket than the petroleum-based wash at one facility, but was more expensive at another facility. While savings may be even greater when factors such as those on the worksheet are also considered, these mixed results show how important it is to evaluate products in your own facility.

Use the Worksheet to Choose Other Chemicals for Your Shop

The nine worksheet questions can be easily adapted to compare other chemicals, such as roller washes, you test in your shop. These nine questions are important to consider when making any chemical decisions for your facility.

What You Can Do To Compare Blanket Washes

Follow the checklist below when testing different blanket washes:

Test Blanket Wash for a Set Amount of Time:

- ☐ Discuss blanket wash tests with press operators
- ☐ Set a trial period of one or two weeks with press operators
- ☐ Record major observations during test period

Collect Information from:

- ☐ Press Operators
- ☐ Material Safety Data Sheets
  - ⇒ Vapor pressure information from MSDS Section 3
  - ⇒ Flash point information from MSDS Section 4
- ☐ Blanket Wash Supplier
  - ⇒ Percentage VOC content
  - ⇒ Is blanket wash considered hazardous under environmental regulations or OSHA?

Complete Worksheet:

- ☐ Enter each score in worksheet column
- ☐ Add scores for final result

Complete Evaluation:

- ☐ Does the final result indicate potential improvement?
- ☐ Are there other benefits or costs of the test wash that are not on the worksheet?

Don't Give Up

Keep in mind that the process of choosing a better blanket wash will require some experimentation and an open mind. Not every blanket wash will work well at your shop right away, but some may work better as press operators become more comfortable with them. For this reason, allow a set period of time for trying a blanket wash, and stick to it. For more ideas on cost saving ways to reduce pollution and waste at your facility, see other Design for the Environment (DfE) Bulletins for the Lithographic Industry.

Questions to Ask When You Call Your Blanket Wash Supplier

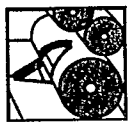
To complete the worksheet you will need to ask your supplier some important questions: **(Some blanket wash manufacturers may supply this information on the MSDS, but they are not required to do so.)**

1. **Does the blanket wash contain chemicals deemed hazardous under any environmental statute or OSHA?**
2. **What is the percent Volatile Organic Compound (VOC) content of the blanket wash?**
3. **What is the Vapor Pressure of the wash in mmHg?**

About the Design for the Environment Lithography Project

The goal of the Design for the Environment (DfE) Lithography Project is to provide lithographers with information that can help them design an operation which is more environmentally sound, safer for workers, and more cost effective.

Concentrating on the process of blanket washes, the partners of the DfE Lithography Project, in a voluntary cooperative effort, evaluated 37 different blanket wash products. Information was gathered on the performance, cost, and health and environmental risk trade-offs of the different types of substitute blanket wash. For more details on the evaluations, please refer to the booklet, *Evaluating Blanket Washes: A Guide For Printers*.



In addition to the Lithography Project, similar DfE projects are currently underway with both the screen printing and flexography industries.

To obtain additional copies of this or other bulletins and case studies, or for more information about EPA's Design for the Environment Program contact:

EPA's Pollution Prevention Information Clearinghouse (PPIC)
U.S. EPA
401 M Street, SW (3404)
Washington, DC 20460

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APPENDIX E: ALTERNATIVES EVALUATION SAMPLE WORKSHEETS

This appendix presents an alternatives evaluation conducted by a small company. The Significant Environmental Aspect (SEA) they identified was chemical hazard to workers from a solvent.

SCREEN ROOM COST IMPROVEMENT PLAN

Summary: A significant cost savings opportunity exists in our Screen Room operations by changing the method we use chemicals and also the vendor. Estimated yearly savings are $40,000. This is attain by replacing the Brand A "Cleaner" and Brand B Cleaner" with Brand C Cleaner and replacing the Brand B "Stencil Remover" with Brand C "Stencil Remover". The biggest $ impact is the difference in price and yield of Brand C "Stencil Remover". The price is $45/gal. compared to $85/gal. and the yield is estimated to be twice as much. The increase in yield is a direct result of not using the Brand A "Cleaner".

Brand C Cleaner is non-hazardous. It contains no cyclohexanone, xylene or glycol ether. The flash point is 122F. Brand A Cleaner is considered a hazardous chemical. It contains cyslohexanone and ethylbenzene, which the state of California has determined to cause cancer. The flash point is 50F.

It has been an ongoing goal to eliminate the need of Brand A "Cleaner" because of safety concerns. This proposal accomplishes this and attains a significant cost saving.

COST SAVINGS DETAILS – Sheet Fed Operation

There are several steps performed in the Screen Room that use the above chemicals as well as others. The following will be a comparison of present methods to the proposed methods highlighting usage, time required in the process, and noting potential savings in chemical and labor costs.

All Savings are based on 50 screens/day cycling through the Screen Room:

Initial Screen Cleaning after removing from printing press:

Present Method

I. Spray 2 oz. Of Brand B Cleaner onto the ink side of screen
II. Squeegee off ink into small bucket below screen
III. Repeat steps 1 and 2
IV. Wipe with cloth rag saturated with 3 oz. of Brand A "Cleaner". Repeats this operation an average of 3 times
V. Wipes with dry rag
VI. Total time: an average 5.5 minutes (This depends on UV or Solvent ink used or whether black ink was used)

Proposed Method

I. Spray 1 oz. of Brand C Cleaner onto the ink side of screen
II. Squeegee off ink into small bucket below screen
III. Repeat steps 1 and 2
IV. Spray 1 oz. of Brand C Cleaner on cloth rag and wipe clean
V. Total time: an average of 4 minutes

Cost Comparison

I. Cost Elements:
   1. Brand B Cleaner - $800/55gals. or .114/oz.
   2. Brand A Cleaner - $590/55gals. or .084/oz.
   3. Brand C Cleaner - $735/55gals. or .104/oz.

II. Present Method:
   1. 4 oz. of Brand B Cleaner - $ .456
   2. 9 oz. of Brand A Cleaner - .756

   Total Chemical Cost -$1.21

III. Proposed Method:
   1. 3 oz. of Brand C Cleaner - $ .315

   Total Chemical Cost - $ .315

IV. Yearly Chemical Savings:
   50 screens/day X 250 workdays/year X $.895 savings/screen = **$11,188**

V. Yearly Labor Savings:
   50 screens/day X 250 work days/year X 1.5 minute savings/screen / 60min./hour X $10/hour = **$3,125**

Reclaiming Process for Screens. Of the 50 screens that cycle through the Screen Room, only 30 (est.) screens go through this additional step to remove the emulsion.

Present Method

I. Spray 5 oz. of Brand C Product 1 on both sides
II. Power Rinse w/water – 1 side
III. Spray both sides with Brand B Product 2 -90oz.
IV. Power rinse with water – 1 side
V. Brush with Brand C Product 3 – both sides-1.4oz.
VI. 10 minutes queue time so #V will work
VII. Power rinse with water – 1 side
VIII. Move to Rinse tank
IX. Total time: an average of 8 minutes

Proposed Method

I. Spray 5 oz. of Brand C Product 1 on both sides
II. Power rinse w/water – 1 side
III. Spray with Brand C Product 2 – 1 side-45oz.
IV. Power rinse w/water – 1 side
V. A) 25 % of screens: Brush with Brand C Product 3 . – both sides-1.4oz.
B) 75% of screens: Wipe with cloth rag saturated with Brand C Product 4 – 2 sides-2oz.: Go to step VIII**
VI. 25% of screens: 10 minute queue time so #VA will work
VII. 25% of screens: Power rinse w/ water – 1 side
VIII. Move to Rinse tank
IX. Total time: an average 6 minutes

****This is possible because of the elimination of Brand A A Cleaner" which locks the image into the mesh. Brand C Product 3 will only be needed on dark colors, part. black.****

Cost Comparison

I. Cost Elements:
1. Brand C Product 1 - $1,045/55gals. Or .148/oz.
2. Brand B Product 1 - $85/gal. (4 gals. Are mixed with 51 gals. Of water) or .012/oz. of blen
3. Brand C Product 2 - $45/gal. (2 gals. Are mixed with 53gals. Of water) or .006/oz. of blend
4. Brand C Product 3 - $175/5gals. Or.273/oz
5. Brand C Product 4 - $42/5gals. (1 quart is mixed with 5 gals. Of water) or .003/oz. of blend

II. Present Method:
1. 5 oz. of Brand C Product 1 - $ .740
2. 90 oz. of Brand B Product 1 - 1.126

3. 1.4 oz. of Brand C Product 3 - .388

Total Chemical Cost $2.25

II. Proposed Method:

1. 5 oz. of Brand C Product 1 - $ .740
2. 45 oz. of Brand C Product 2 .270
3. 25% of screens: 1.4 oz. of Brand C Product 3 .388

   75% of screens: 2 oz. of Brand C Product 4 .022

Total Chemical Cost $1.40 to $1.03

III. Yearly Chemical Savings:

12.5 screens/day(25% of total) X 250 workdays/year X $.85 savings/screen + 38.5 screens/day(75% of total) X 250 workdays/year X $1.22 savings/screen = **$14,398**

IV. Yearly Labor Savings:

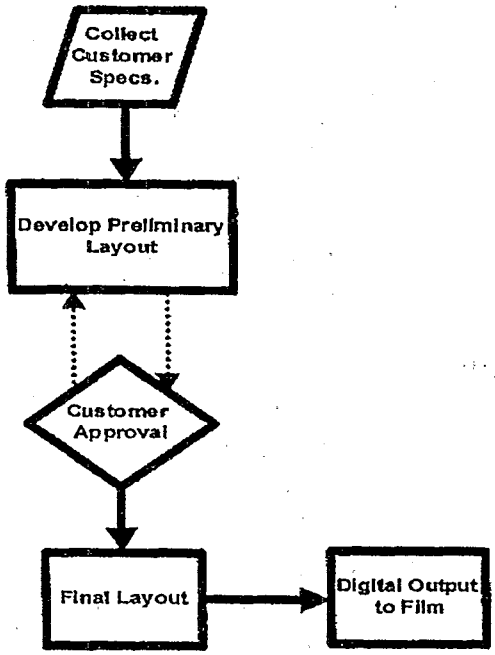
30 screens/day X 250 workdays/year X 2 minutes savings/screen / 60min./hour X $10/hour= **$2,500**

YEARLY SAVINGS IN SCREEN OPERATIONS:

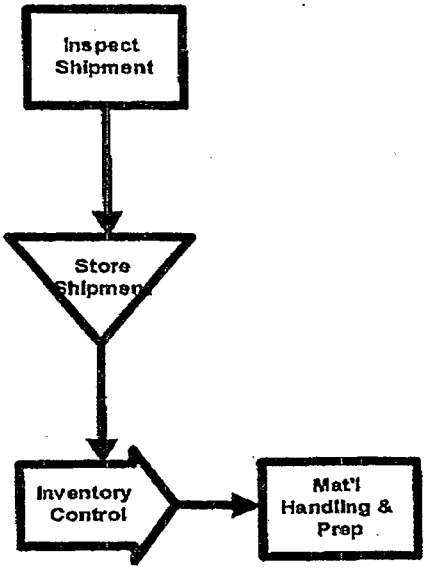
CHEMICAL SAVINGS	=	**$25,586**
LABOR SAVINGS	=	**5,625**
TOTAL		**$31,211**

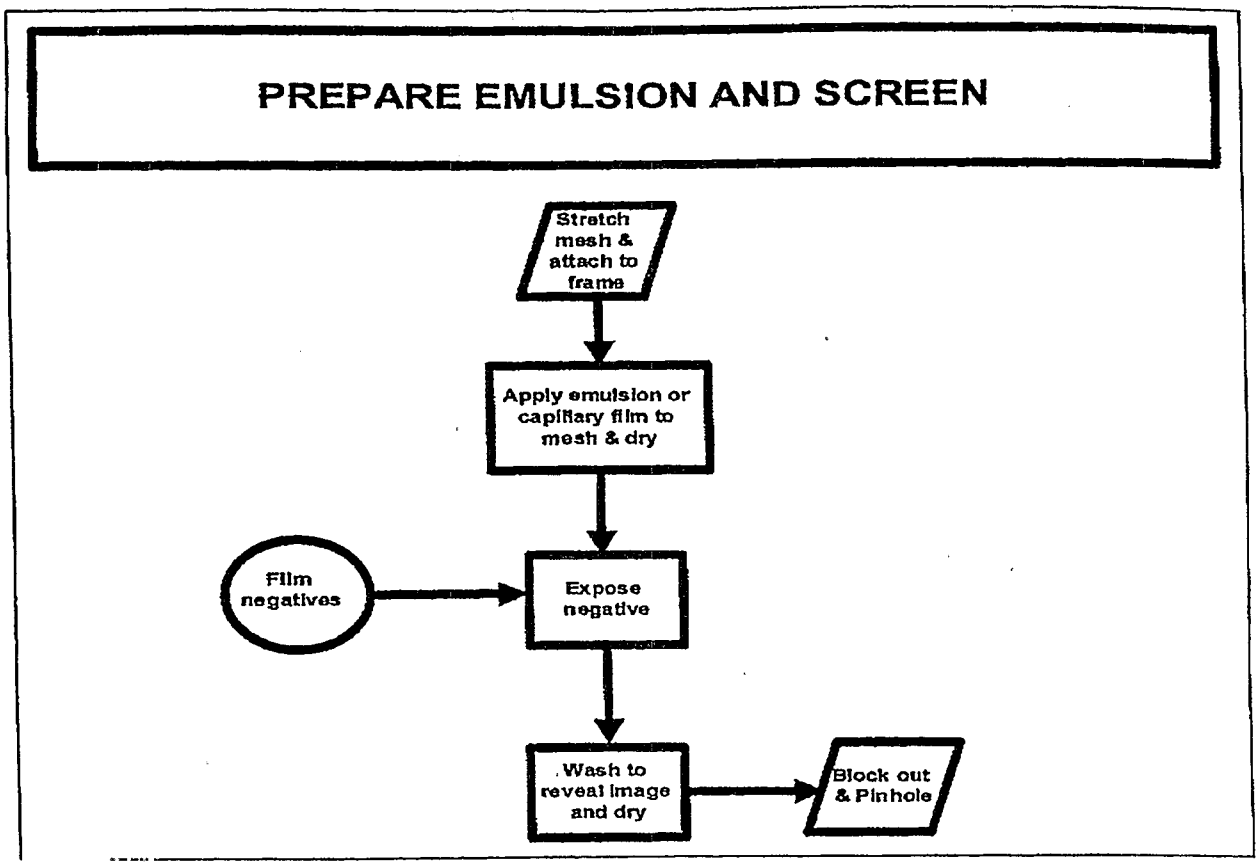
Richard O. Hilder

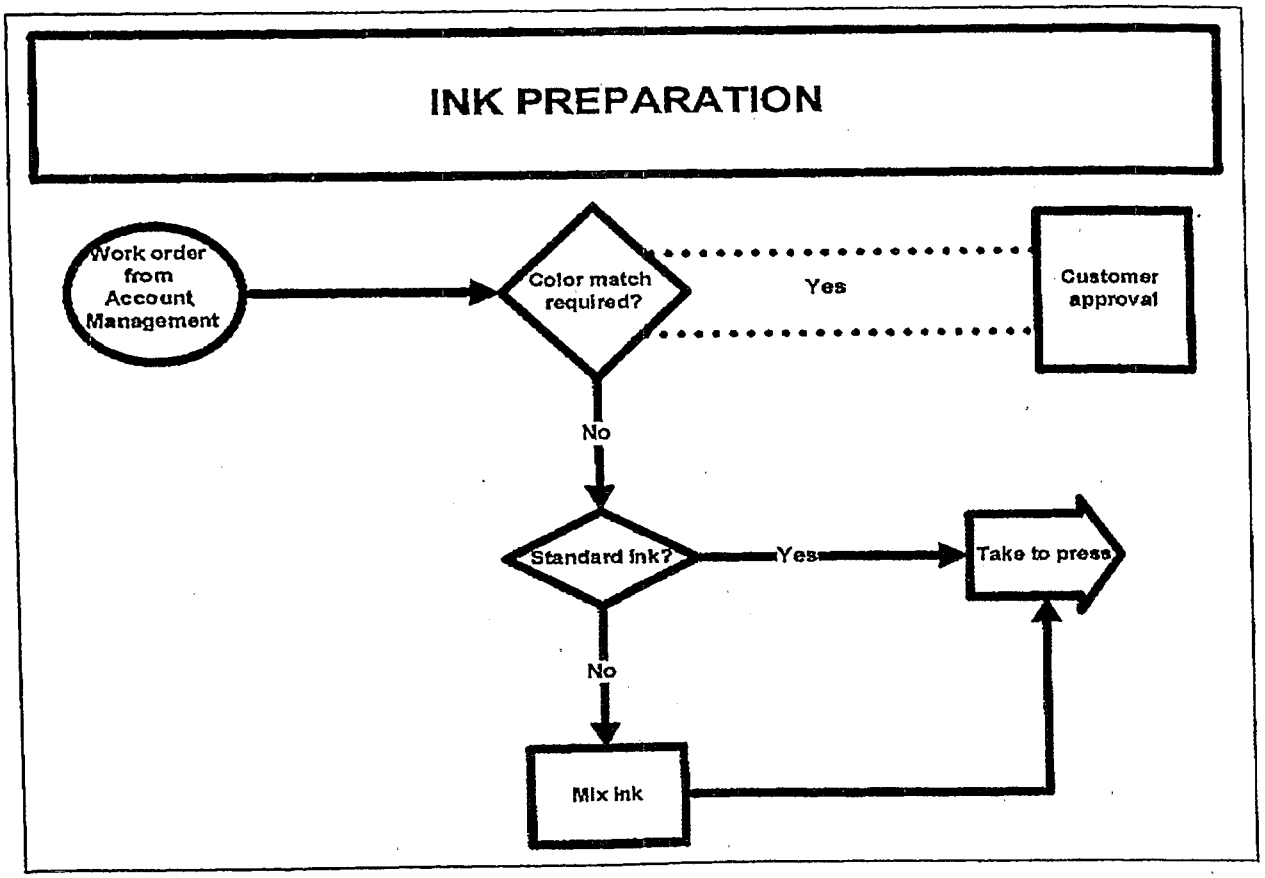
DESIGN ART

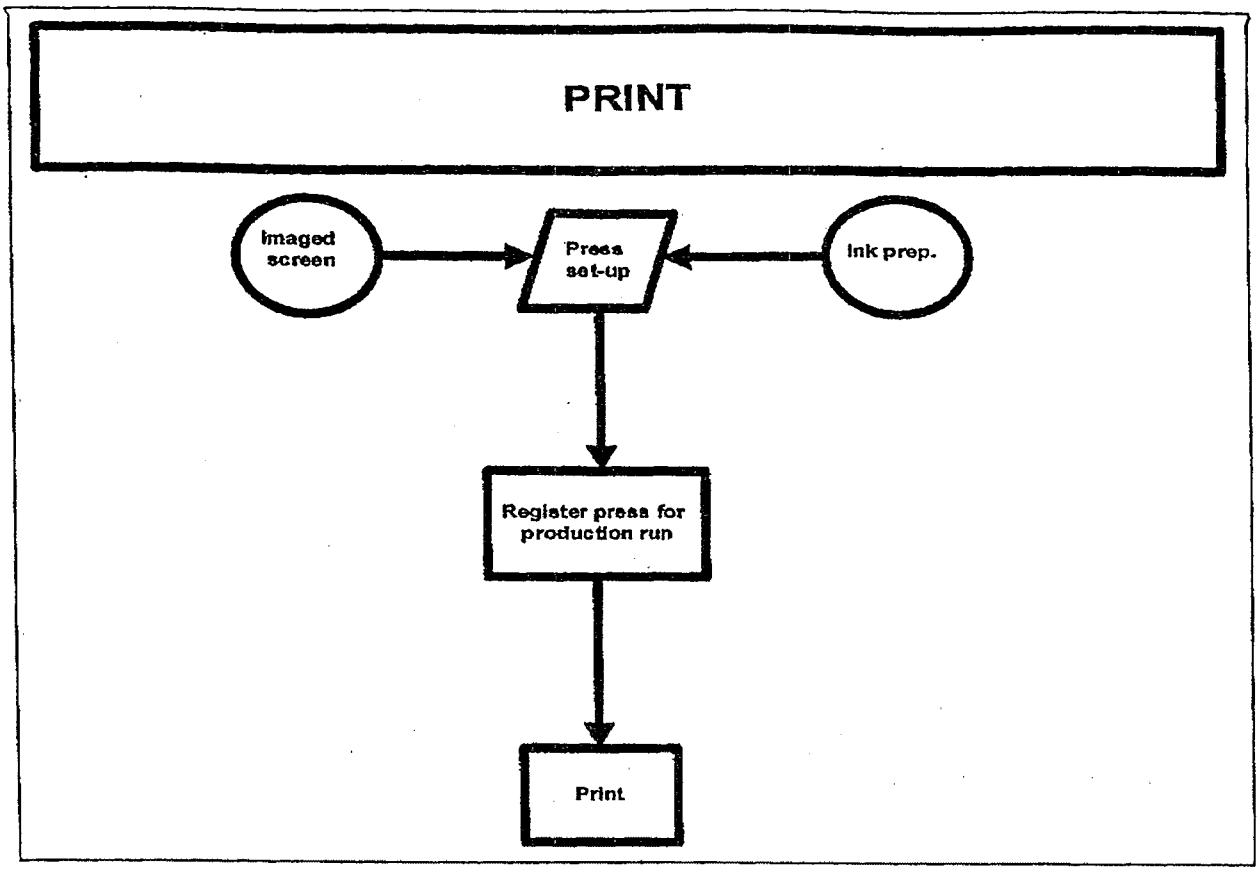


RECEIVE MATERIALS




PREPARE EMULSION AND SCREEN
Stretch mesh & attach to frame
Apply emulsion or capillary film to mesh & dry
Film negatives
Expose negative
Wash to reveal image and dry
Block out & Pinhole


INK PREPARATION
Work order from Account Management
Color match required?
Yes
Customer approval
No
Standard ink?
Yes
Take to press
No
Mix ink



INPUT/OUTPUT SUMMARY

NC Process Flow Maps

RECEIVE MATERIALS

I Store Shipment

Inputs

- Energy
- Building Space
- Safe Storage
- Recordkeeping

Outputs

- Leaking Containers
- Waste Products
- Spills (?)

II Inventory Control

Inputs

- Energy
- Recordkeeping

Outputs

- Expired Products
- Waste Products

III Material Handling & Preparation

Inputs

- Energy
- Recordkeeping

Outputs

- Empty containers

DESIGN ART

I Collect Customer Specifications

Inputs
- Energy
- Paperwork

Outputs
- Unusable Artwork
- Waste Packaging Materials

II Develop Preliminary Layout

Inputs
- Energy
- Paperwork
- Proofing Materials

Outputs
- Spent Printer Toner (cartridge)
- Paper
- Unusable Artwork
- Waste Packaging

III Customer Approval

Inputs
- Energy
- Paperwork

IV Final Layout

Inputs
- Energy
- Paperwork

V Digital Output to Film

Inputs
- Energy
- Paperwork
- Film Stock
- Imaging Device
- Imaging Material

Outputs
- Spent Imaging Materials
- Waste Film

PREPARE EMULSION AND SCREEN

I Stretch Mesh & Attach to Frame

Inputs
- Frame
- Mesh
- Adhesive
- Energy
- Paperwork

Outputs
- Minimal Air Emissions
- Waste Adhesive
- Waste Mesh
- Waste Frame (potential)
- Used Razorblades

II Apply Emulsion or Capillary Film to Mesh and Dry

Inputs
- Energy
- Paperwork
- Activator
- Film or Emulsion
- Water

Outputs
- Expired Emulsion
- Waste Emulsion
- Waste Activator

III Expose Negative

Inputs
- Energy
- Paperwork
- Film Positive (or negative)
- UV Bulbs

Outputs
- UV Bulbs
- Film

IV Wash to Reveal Image & Dry

Inputs
- Energy
- Water
- Light Bulbs

Outputs
- Waste Water
- Used Light Bulbs

V Blockout & Pinhole

Inputs
- Energy
- Paperwork
- Blockout
- Water
- Tape

Outputs
- Waste Water
- Waste Blockout
- Waste Blockout Applicator
- Expired Materials

INK PREPARATION

I. Color Match Approval

Inputs

- Energy
- Paperwork
- Ink
- Substrate
- Containers
- Solvents
- Additives
- Mesh
- UV Bulbs

Outputs

- Waste Ink
- Mixing Sticks
- Empty Containers
- Color Proofing
- Substrate
- Used Shop Rags
- Waste Mesh (potential)
- Waste Frame (potential)

II. Mix Ink

Inputs

- Energy
- Paperwork
- Containers
- Substrate
- Solvents
- Ink
- Ink Additives

Outputs

- Waste Ink
- Waste Ink Additives
- Empty Containers
- Substrate
- Mixing Sticks
- Used Shop Rags

PRINT

I Press Set-up

Inputs

- Energy
- Paperwork

Outputs

- Used Shop Rags

II Register Press For Production Run

Inputs

- Shop Rags
- Additives
- Solvents
- Paperwork
- Energy
- Substrate
- Ink

Outputs

- Used Shop Towels
- Tape
- Setup Paper
- Waste Substrate
- Waste Ink

III Print

Inputs

- Energy
- Shop Rags
- Paperwork
- Solvents
- Additives
- Substrate
- Ink
- Coatings
- Adhesives

Outputs

- Used Shop Rags
- Waste Inks
- Waste Solvent
- Spills (possible)
- Used Ink Containers
- Tape

SCREEN RECLAIMING

I Apply Ink Remover

Inputs
- Solvent
- Shop Rags
- Squeegee
- Ink Remover
- Storage Container

Outputs
- Used Shop Rags
- Waste Ink
- Spills (possible)

II Rinse

Inputs
- Energy
- Water

Outputs
- Waste Water

III Remove Emulsion or Capillary Film

Inputs
- Energy
- Shop Rags
- Water
- Stencil Remover
- Scrubbers

Outputs
- Waster Water
- Tape
- Used Shop Rags
- Spills (possible)

IV Rinse

Inputs
- Energy
- Water

Outputs
- Waste Water

V Remove Haze

Inputs
- Energy
- Water
- Haze Remover
- Scrubbers
- Shop Rags

Outputs
- Waster Water
- Used Shop Rags
- Spills (possible)

VI Rinse

Inputs
- Energy
- Water

Outputs
- Waste Water

VII Dry

Inputs
- Energy

FINISHING, PACKAGING, & SHIPPING

I Finishing Activities

Inputs

- Paperwork
- Energy
- Finishing Materials
- Finishing Tools
- Tape

Outputs

- Waste Material
- Trimmings
- Adhesive
- Spent Finishing Materials
- Spent Finishing Tools

II Packaging Activities

Inputs

- Energy
- Paperwork
- Pallets
- Boxes
- Packing Materials

Outputs

- Broken Containers
- Packaging Waste

III Shipping Activities

Inputs

- Transportation
- Energy
- Paperwork

Outputs

- Refused Product
- Transportation Emissions

SIGNIFICANT ENVIRONMENTAL ASPECTS (SEAs)

1) Reduce VOCs

2) Contain lead contamination (water table)

3) Employee health and safety

Worksheet 8-1: Functions and Alternatives

Aspect	Alternative Products	Alternative Technologies	Alternative Work Practices	Recycling/ Reuse	Treatment	Disposal
Baseline=	Screen cleaner/ ink remover					
Function=	screen reuse / ink remover					
	Brand C Cleaner					
	Brand D Cleaner	Auto screen washer				

Date Completed:_____ Contact Person: _____

Worksheet 8-2: Alternative Products Environmental Effects Comparison

Chemical Product	Known Effects[1]	Management of Effects[2]	Cost of Mgmt.[3]	Resource use	Effects Score
Baseline	Cancer Hi F.P. Odor	gloves		NA	
Brand C Cleaner	skin irritation	gloves exhaust fan	same	NA	
Brand D Cleaner		gloves exhaust fan	same	NA	

Notes:
[1] Return to the "Environmental Concerns Worksheet" in Module 5 for the "known effects."
[2] List protection required for each effect.
[3] Identify cost items.

Worksheet 8-3: Performance Comparison of Alternatives					
	how well does it work	how long does it take		how easy is it to use	total
		Qty*	Time		
Baseline Brand A cleaner	visual check	90z.	5½ min.		
Brand C cleaner	" work better	30z.	4 min.	easier/faster	
Brand D cleaner	" work better	30z.	4min.	easier / faster	

*Qty / screen

Worksheet 8-4: Regulatory Comparison of Alternatives				
	Regulations Required (list)	Controls Required (list)	Cost of Regulations	Total
Brand A cleaner	RCRA - Haz. CAA - Air, VOC			
Brand C cleaner	Same now; better in future (< VOC)		Better; less qty	
Brand D cleaner	Same now; better if future (<VOC)		Better; less Qty	

Worksheet 8-5: Cost Comparison of Alternatives

	raw material	labor	disposal	total cost	savings [1]	net cost
Brand A Cleaner	$590/ 55gal	5½ min	—			
Brand C cleaner	$735/ 55gal	4 min	less		25,500/yr - mtl 5,700/yr - labor	
Brand D cleaner	$920/ 55gal	4 min	less			

$25,500/yr savings

$5700/yr in labor

fewer shop towels

Worksheet 8-6: Alternative Products Evaluation Worksheet

Chemical Product	Performance	Regulations	Cost	Effects[1] Score	Overall Score[2]
Brand A	—	—	—	—	
Brand C	+	+	++	+	
Brand D	+	+	+	++	

Date Completed:_____ Contact Person: _____

[1] Take score from Environmental Effects Comparison Table above (last column).

[2] Score on a scale of low to high to reflect the desirability of each product. This is a judgment call.

APPENDIX F: HOW TO EVALUATE COSTS AND SAVINGS OF ALTERNATIVES

This appendix presents a rudimentary introduction to project financial analysis – whole textbooks have been written on this subject! While you may not quite need that level of detail for assessing your baseline and alternatives, a list of other resources is included in Appendix G (References and Resources). Your accountant can assist you in your analysis as well.

There are many factors to consider when evaluating alternatives. Will the alternatives perform as well? What are the environmental effects of alternatives? How much will each alternative cost? Module 4 describes ways to evaluate alternatives for environmental aspects that you want to change. This Appendix further describes one of those steps – Step 8: Evaluate the cost of the baseline and alternatives – and provides an example and guidance on where in your business to find cost data necessary for this evaluation step.

Many costs, especially environmental costs (waste hauling or disposal costs, for example) are often "hidden" in overhead accounts. These costs are usually unintentionally omitted from a financial analysis. If an alternative will reduce the amount of waste generated, for example, thereby reducing waste disposal costs, this savings may be omitted from a conventional analysis. Other costs and savings may not be included in a financial analysis because they are "less tangible," or difficult to quantify. Table #.1 gives examples of some of these costs. When evaluating alternatives, it is important to fully assess potential costs and benefits of the alternative, as well as your baseline costs, to provide a complete picture of the relative costs and savings.

Table #.1: Examples of Potentially Hidden and Less Tangible Costs

Potentially Hidden Costs	Less Tangible Costs
Up-front: site preparation, permitting, installation	Liability: Superfund, personal injury, property damage
Back-end: site closure, disposal of inventory, post-closure care	Future regulatory compliance costs
Regulatory: training, monitoring, recordkeeping	Employee safety and health compensation
	Organizational image

Evaluating the cost of the baseline and alternatives requires several steps as described below. A description of these steps is followed by an example.

Step 1: Map baseline and alternatives. Module 1 describes how to develop a map of your company's processes, products, and services. This map is important to understanding the activities occurring in your facility that cost you money. To also understand the potential costs and savings of alternatives, it is important to develop process maps for alternatives **if the alternative will vary your current processes.** For example, Figure #.1 shows a metal finisher's baseline cleaning process using a solvent, which is collected and shipped off-site for proper disposal. One alternative examined by the metal finisher was installing a distillation system that could recover 95% of the spent solvent. Figure #.2 shows the process map with the distillation system – spent solvent is collected, recycled on-site, and re-used in the cleaning process. The map helps you

Figure #.1 Current Cleaning Process

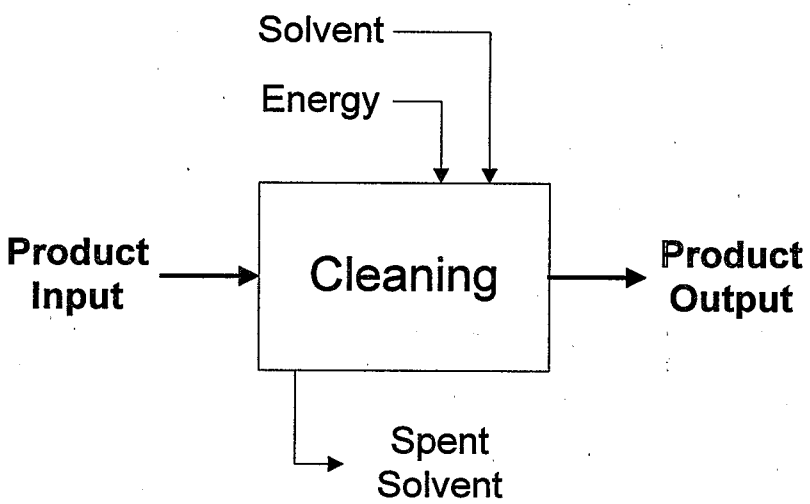
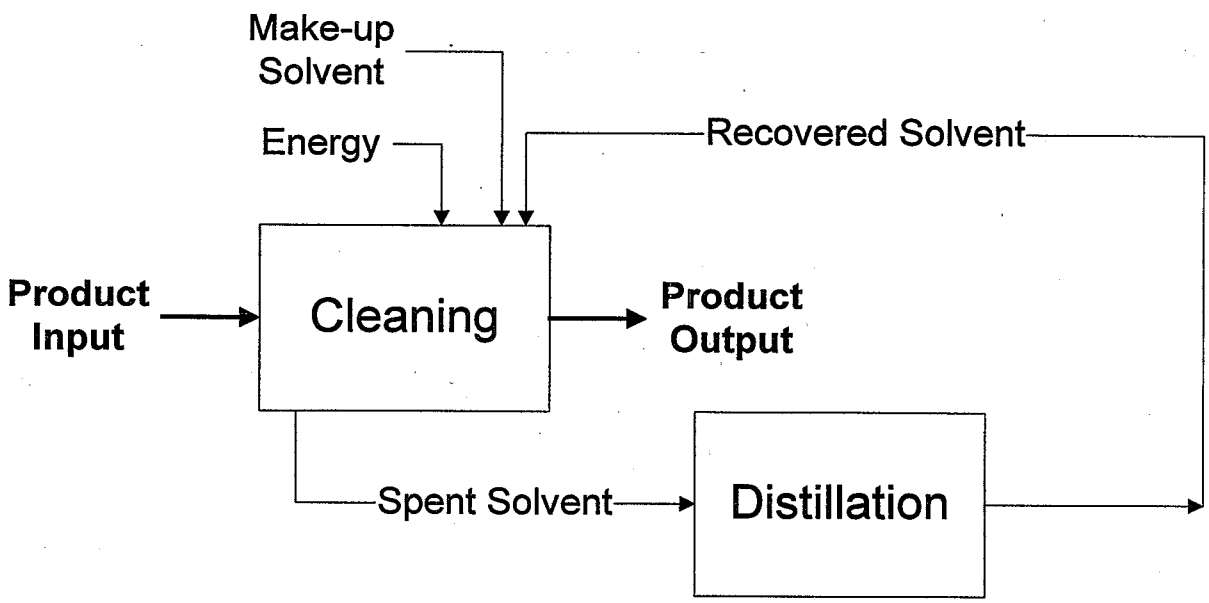


Figure #.2 Alternative Cleaning Process



visualize the differences between the baseline and alternative, and can help guide you in collecting cost data.

> **Note:** Remember to include potentially hidden and less tangible costs.

Step 2: Collect annual operating costs for baseline and alternatives. Using the process maps from Step 1 you can now begin collecting annual operating costs for both your baseline and alternatives. Use Worksheet 4-5a to help you collect cost information. Table #.2 lists examples of some of these costs that may be relevant to your baseline and alternatives. Costs that are the same for the baseline and the alternative can be omitted from the analysis. In the solvent cleaning example, labor time and energy required for cleaning remains the same for both the baseline process and the solvent recycling alternative. Therefore, these costs can be excluded from the analysis.

Be as thorough as possible when considering costs, but don't worry about how you classify costs. For example, you may wish to consider personal protective equipment as a regulatory compliance cost, especially if its use is required by regulations. Alternatively, you may wish to classify all protective equipment as "materials."

> **Note:** Remember that changes in one process may affect costs in other processes. You should include these costs as well.

Environmental projects may save you money not only by reducing your costs, but also by generating revenues. For example, an alternative may increase your product throughput because the activity takes less time to complete, or product quality may be improved enabling you to sell more of your product. The alternative may also let you recover materials previously disposed of, and generate revenues through sales of the reclaimed material (such as recovering metal scrap which can be sold to scrap dealers). These annual revenue effects should be considered using Worksheet 4-5b to assist you. Quantify these revenue effects if possible, and add them to the total operating costs in Worksheet 4-5d. If these potential revenues are difficult to quantify, you can consider them qualitatively in your evaluation by making a note in the last column of Worksheet 4-5d.

By convention, costs (or outflows) are usually denoted by a negative (-) sign while an inflow (or revenue) is denoted by a plus (+) sign. Make sure to keep these signs correct when adding revenues to costs. For example, if the annual operating cost of your alternative is -$20,000, but the alternative will generate an additional $10,000 in revenues, your total annual operating cost would be -$10,000.

Table #.2 Annual Operating Costs

Materials (Purchase, delivery, storage)	**Regulatory compliance (Labor, materials)**
Raw materials	Labeling
Solvents	Manifesting
Catalysts	Recordkeeping
Personal protective equipment	Permitting
Maintenance supplies	Reporting
Direct labor (Wages, benefits)	Protective equipment
Operating	**Insurance**
Supervision	Commercial general liability
Inspection	Workers' compensation
Utilities	Health insurance
Electricity	Pollution liability
Steam	**Future liability**
Water	Fines/penalties
Fuel	Legal costs
Waste management (Labor, materials)	Business shutdown
On-site handling	Personal injury
Treatment	Property/natural resource damage
Storage	Remediation
Hauling	
Disposal	

Step 3: Collect initial investment costs for each alternative. If any of your alternatives will require an investment in new equipment, you will need to consider these costs. These not only include capital costs, but also other one-time costs accompanying your investment, such as installation costs or new equipment training. Use Worksheet 4-5c to help you collect these costs. Table #.3 lists examples of these costs that may be relevant to your alternatives.

Step 4: Calculate net present value for the baseline and alternatives. The next step enables you to compare the baseline and alternatives to determine which options appear to be most financially attractive. Because a change in your processes or activities may affect your costs and savings over many years, the analysis should look at long term costs and savings. For example, if you are considering installing new equipment that will last for 10 years, your analysis should include the costs and savings that will accrue to you over the 10 year period. This is especially important for environmental projects which often times reap benefits over the long term.

Table #.3 Initial Investment Costs

Purchased equipment (Purchase, tax, delivery)	**Construction/installation**
Process equipment	Consultant/contractor fees
Storage and materials handling equipment	In-house
Safety/protective equipment	Equipment rental
Monitoring/control equipment	Vendor fees
Laboratory/analytical equipment	**Start-up/training (Labor, materials)**
Waste handling/treatment equipment	Consultant/contractor fees
Initial spare parts	In-house
Utility systems/connection	Safety/environmental training
Electricity	Trials/manufacturing variances
Water	Vendor fees
Steam	**Permitting**
Fuel	Consultant/contractor fees
HVAC	In-house
Plant air	Permit fees
Inert gas	Vendor fees
Sewerage	**Other**
Refrigeration	Buildings
Plumbing	Land
Planning/engineering (Labor, materials)	Contingency
Consultant/contractor fees	Working capital (cash, inventory)
In-house planning/engineering	
Procurement	
Vendor fees	
Site preparation (Labor, materials)	
Consultant/contractor fees	
In-house	
Demolition & clearing	
Equipment rental	
Equipment/rubbish disposal	
Disposal	
Grading/landscaping	
Vendor fees	

A critical component of assessing a project where costs and savings may occur over several years is incorporating the notion that the value of money changes over time – commonly called the "time value of money." Most businesses prefer to have money sooner rather than later. If you have money today, you have the opportunity to use it now to grow your business, for example. Put another way, there is a cost if you receive the money tomorrow instead of today. For example if you receive $1,000 today and put it in the bank receiving 10% interest, at the end of the first year you would have $1,100. This is clearly preferable to receiving $1,000 a year from now. Thus, because $1 today is not equal to $1 tomorrow, you need to adjust the value of future dollars to reflect their diminished value to you today.

The mechanism for making this adjustment is called a discount rate. A discount rate is a percentage that is applied to future costs or revenues to determine its present value. Typically, for business decisions, the discount rate chosen represents the business's cost of capital plus some level of desired return on an investment plus an additional margin to account for uncertainty. Your accountant will be able to assist you in selecting an appropriate discount rate for your analysis.

To calculate the present value (PV) of a cost or savings in the future, use the following equation:

$$PV = \frac{FV_t}{(1+r)^t}$$

where FV = the future value of a cash flow (i.e., a cost or cash outflow, or a revenue or cash inflow) received in year t, and

r = the discount rate.

For example, the present value of a $1,000 revenue you expect to receive over the next four years would be:

$$PV = \frac{\$1000}{(1+0.10)^1} + \frac{\$1000}{(1+0.10)^2} + \frac{\$1000}{(1+0.10)^3} + \frac{\$1000}{(1+0.10)^4} \quad \text{or:}$$

Year	Future Value	Present Value
1	$1000	$ 909
2	$1000	$ 826
3	$1000	$ 751
4	$1000	$ 683
Total		**$3169**

The net present value (NPV) can then be calculated as follows:

$$NPV = \sum PV - I$$

where ΣPV is the sum of the present values of the cash inflow or outflows and I = the initial investment cost.

In our above example, if the initial investment cost is $1000, then the NPV equals $2169 ($3169 - $1000). If your alternative won't require an initial investment – for example, you are substituting a toxic chemical with a less hazardous chemical, but there are no changes in your equipment, then NPV is equal to the sum of the present values ($3169 in the above example).

Note: In financial analyses, a cost (or outflow) is usually denoted by a negative (-) sign while an inflow (or revenue) is denoted by a plus (+) sign.

NPV can be calculated using a financial calculator, spreadsheet software like Excel, or using project profitability analysis software such as P2/FINANCE (see the resources list at the end of this Appendix).

Step 5: Assess the costs and savings. The last step is to evaluate your baseline and alternatives from a cost and savings perspective. The difference between the alternative and baseline is entered in Worksheet 4-6. A positive number indicates that the alternative saves money, while a negative number indicates that the alternative is more expensive than the baseline. The alternative with the greatest NPV is the most profitable one.

Note: Remember that your accountant can assist you in these calculations.

Example: Baseline vs. Alternative Cleaning Processes

As described above, as part of its EMS, a metal finisher examined methods for reducing solvent use in cleaning. Recovering solvent via a distillation system was one alternative identified. The cost and savings analysis of the baseline versus alternative follows.

Step 1: Map baseline and alternatives. These processes are mapped in Figures #.1 and #.2.

Step 2: Collect annual operating costs for baseline and alternatives. The current annual costs for the baseline are shown in Table #.4. These costs are readily available from purchase orders. Because labor and electricity costs for the cleaning operation remains the same for the baseline and alternative, these costs are omitted from our analysis.

Table #.4 Annual Operating Costs -- Baseline

Annual Operating Costs	$/year
MATERIALS	
Solvent	11,631
WASTE MANAGEMENT	
Solvent disposal	19,041

Annual operating costs for the alternative are shown in Table #.5. Material costs include make-up solvent (because 95% of the solvent is recovered from distillation, make-up solvent must be added) as well as oil and filters for the distillation system. Electricity costs are for operating the distillation system only (electricity use for cleaning is the same for both the baseline and alternative). These costs are available from the equipment vendor.

Table #.5 Annual Operating Costs – Cleaning with Solvent Recovery

Annual Operating Costs	$/year
MATERIALS	
Chemicals	6692
Oil	375
Filters	2284
WASTE MANAGEMENT	
Disposal	439
UTILITIES	
Electricity	241

These operating costs are entered into Worksheet 4-5a. Note that there are no potential annual revenue effects for the alternative project so Worksheet 4-5b is not included.

Step 3: Collect initial investment costs for each alternatives. The initial investment costs for the distillation system, provided by the equipment vendor, appear in Table #.6. These costs are then entered in Worksheet 4-5c.

Table #.6 Initial Investment Costs for the Distillation System

Investment Costs	Cost in $
PURCHASED EQUIPMENT	
Distillation system	26,200
START-UP/TRAINING	
Start-up & Training	750

Worksheet 4-5a – Annual Operating Costs

Alternative	Materials	Direct labor	Utilities	Waste management	Regulatory compliance	Insurance	Future liability	Total Operating Cost
A (Baseline)	11,631		0	19,041				30,672
B	9,351		241	439				10,031

Worksheet 4-5c – Initial Investment Costs

Alternative	Purchased equipment	Utility systems/ connection	Planning/ engineering	Site preparation	Construction/ Installation	Start-up/ training	Permitting	Other	Total Inv. Costs
A (Baseline)	--	--	--	--	--	--	--	--	--
B	26,200					750			26,950

Worksheet 4-5d – Cost Comparison of Alternatives

Alternative	Total Operating Costs (Present Value)	Total Investment Costs (Present Value)	NPV	Annual Revenue Effects (qualitative
A (Baseline)	-233,293	N/A	-233,293	
B	-76,296	-26,950	-49,346	

Worksheet 4-6 – Evaluation of Alternatives

Alternative	Environmental Effects	Performance	Regulatory Considerations	NPV (Alternative – Baseline)	Overall Evaluation
A (Baseline)				--	
B				$183,947	

Step 4: Calculate net present value for the baseline and alternatives. Next, the net present value for the baseline and alternative is calculated using the company's discount rate of 10%. Because the lifetime of the distillation system is 15 years, operating costs are assessed over 15 years. These costs are entered in Worksheet 4-5d. Remember that cash outflows (such as investments or operating costs) are entered using a negative (-) sign while inflows (revenues) are denoted by a plus (+) sign.

Step 5: Assess the costs and savings. Worksheet 4-5d shows that the NPV for the baseline is -$233,293 while the NPV of the alternative is -$49,346. The difference between the alternative and baseline (alternative minus baseline) is entered in Worksheet 4-6. A positive number indicates that the alternative saves money, while a negative number indicates that the alternative is more expensive than the baseline. Worksheet 4-6 shows that the distillation system will save the metal finisher $183,947 over 15 years.

Getting Started – Where to Find Cost Data

You now have the tools to evaluate the cost and savings of your alternatives. However, you may not be sure where to find the data necessary for conducting this analysis. To assist you, Table #.7 lists costs and sources for these data in your business. Note that when collecting similar cost data for your alternatives, suppliers and vendors are frequently a good information source.

Future assessments can benefit from improving your business' current cost tracking system. While at first glance this may seem intimidating, you can begin to incorporate these costs into your accounting framework one step at a time. Begin by tracking a few costs on a routine basis, selecting the most significant costs first. You may want to begin by examining the costs associated with environmental issues to gain a better awareness of how they affect your business' bottom line. Use this awareness to focus your efforts on specific cost areas that appear to have the most importance to your business. As your level of knowledge increases, you can expand your cost tracking system to include other cost data. Eventually you will have a system that meets your needs and provides you with extensive crucial business information.

Table #.7 Where to Find Costs

Cost Category	Data Elements	Where Found	Who to Ask
Process Chemicals	Usage Rates Unit Costs	Production Records Purchase Orders	Foreman Billing Dept.
Ancillary Chemicals	Usage Rates Unit Costs	Prod. Specifications Purchase Orders	Product Engineers Billing Dept.
Storage Space	Total Square Footage Cost/Sq. Ft.	Actual Measurement Rental Contract	Maintenance or Engineering Billing Dept.
Waste Treatment	Flow Rates Total Chemical Costs	WWT Log Sheets Purchase Orders	WWT Operator Purchasing Dept.
Testing	Number of Tests/Year Cost per Test	Environmental Files Invoices	Environmental Manager Accounts Payable
Disposal	Type and Quantity Disposed Unit Costs of Each	Manifests Invoices	Environmental Manager Accounts Payable
Training	Number of People Number of Trainings Length of Training Hourly Labor Rates	Training Records Wage Rate Sheet	Environmental Manager or Contractor Personnel Dept.
Personal Protective Equipment	Type and Quantity Used Cost per Item	Stock Room or Inventory	Environmental Manager Purchasing Dept.
Insurance	Type and Coverage Premium	Capital Budgets Invoices	CFO, Accountant Accounts Payable
Production	Machine Down Time Machine Rates Labor Rates	Prod. Records Operating Budget Personnel Records	Production Manager Finance Dept. Personnel Dept.
Taxes/Fees	Sewer Use Tax Chemical Use Tax Water Use Tax Volume of Weight of Each Taxed Item	Water Bills Environmental Records Water Bills Water, Chemical Usage Records	Accounts Payable Environmental Manager Local POTW Production Manager, Purchasing
Environmental Compliance	Hours of Labor for All Compliance Tasks	Estimates, Salaries, or Environmental Management Records	Environmental Manager
Maintenance Labor	Hours of Labor Tasks Performed	Maintenance Log	Maintenance Dept. Shop Foreman
Maintenance Materials	Amount of Materials Costs of Materials	Maintenance Log Purchase Orders	Maintenance Dept. Purchasing Dept.
Water Usage	Annual Usage Rate Cost/Gal. or Cu. Ft.	Flow Meters or Logs Town Water Bills	Production Manager Accounts Payable
Electricity Usage	Annual Usage Rate Cost/kWh	Equipment Specs. Utility Bills	Production Manager Accounts Payable
Steam Usage	Cost of Production Fraction of Total Used by Process	Fuel Bills, Boiler Maintenance Logs, Count of Processes Using Steam	Accounts Payable Maintenance Dept. Plant Walk-Through

Source: Appendix C of *Total Cost Assessment for Environmental Engineers and Managers* (John Wiley & Sons, 1998).

APPENDIX G: REFERENCES AND RESOURCES

General Resources

The ISO 14000 Handbook, edited by Joseph Cascio, Chairman, US Technical Advisory Group to ISO/TC 207, CEEM Information Services, Fairfax, Virginia, 1996.

Environmental Management Systems: An Implementation Guide for Small and Medium-Sized Organizations, NSF International, Ann Arbor, Michigan, November 1996.
Developed with funding through a cooperative agreement with the U. S. EPA, Office of Wastewater Management and Office of Enforcement and Compliance Assurance.

EPA Position Statement on Environmental Management. Federal Register: March 12, 1998 (Volume 63, Number 48), pp. 12094-12097.

Design for the Environment, Building Partnerships for Environmental Improvement, Design for the Environment, U. S. EPA, EPA/600/K-95/002, September 1995.

Federal Environmental Regulations Potentially Affecting the Commercial Printing Industry, Design for the Environment, U. S. EPA, EPA744B-94-001, March 1994.

"Compliance-Focused Environmental Management System — Enforcement Agreement Guidance," EPA-330/9-97-002R, U. S. EPA, Office of Criminal Enforcement, Forensics and Training, August 1997, Revised January 2000.

"Improving Environmental Performance and Compliance: Ten Elements of Effective Compliance Systems." Enforcement Cooperative Program of the Commission for Environmental Cooperation, June 2000. (www.cec.org)

Government Printing Office (GPO)
The GPO website provides links to the full text of the Code of Federal Regulations (CFR), Federal Register notices for the past several years, and other resources.
Website: www.access.gpo.gov/nara/

The Clean Air Technology Center (CATC)
A source of general information on air emissions-related technology.
Telephone: 919-541-0800
Website: www.epa.gov/tnn/catc

The RCRA, Superfund & EPCRA Hotline offers information and publications that are relevant to RCRA.
Telephone: 800-424-9346
Website: www.epa.gov/epaoswer/hotline

The Office of Water
The Office of Water, especially the Office of Wastewater Management, can be contacted for information on Clean Water Act provisions that relate to the printing industry.
Telephone: 202-260-5700
Website: www/epa/gov/OW

The Safe Drinking Water Hotline can provide information on issues related to the Safe Drinking Water Act.
Telephone: 800-426-4791
Website: www.epa.gov/OGWDW/

The Superfund Website provides general information on CERCLA.
Website: www/epa.gov/superfund

The Chemical Emergency Preparedness and Prevention Office website offers information on the emergency response aspects of EPCRA, which are administered under the Chemical Emergency Preparedness and Prevention Office.
Website: www/epa.gov/swercepp/

The Toxics Release Inventory website provides information on the Toxics Release Inventory reporting requirements, which are implemented by the Office of Pollution Prevention and Toxics.
Website: www.epa.gov/opptintr/tri/index.html

The Occupational Safety and Health Administration (OSHA) website provides information on the Occupational Safety and Health Act, OSHA regulations, standards, interpretations, and other information.
Website: www.osha.gov/

Technical Resources

Cleaner Technologies Substitutes Assessment, A Methodology & Resource Guide, Design for the Environment, U. S. EPA, EPA744-R 95-002, December 1996.

Cleaner Technologies Substitutes Assessment, Industry: Screen Printing; Use Cluster: Screen Reclamation, Design for the Environment, U. S. EPA, EPA744-R-94-005, September 1994.

Information on developing a Cause and Effect (Fishbone) Diagram is available at: www.sytsma.com/tqmtools/cause.html

Cost Resources

Journal Articles/Publications

Aldrich, James. R., 2000. "P2 and the Bottom Line – Choosing Variables: What Factors Should You Include when Analyzing the Value of a P2 Project?" *Pollution Prevention Review*. John Wiley & Sons, Inc. Summer.

Aldrich, James. R., 1999. "P2 and the Bottom Line – Net Present Value," *Pollution Prevention Review*. John Wiley & Sons, Inc. Summer.

Aldrich, James. R., 1999. "P2 and the Bottom Line – Internal Rate of Return," *Pollution Prevention Review*. John Wiley & Sons, Inc. Spring.

Aldrich, James. R., 1998. "P2 and the Bottom Line – Depicting Financial Impacts Over Time," *Pollution Prevention Review*. John Wiley & Sons, Inc. Autumn.

Aldrich, James. R., 1998. "P2 and the Bottom Line – The Time Value of Money," *Pollution Prevention Review*. John Wiley & Sons, Inc. Summer.

Kennedy, Mitchel, 1998. "Critical Issues of Total Cost Assessment: Gathering Environmental Cost Data for P2," *Pollution Prevention Review*. John Wiley & Sons, Inc. Spring.

Pojasek, Robert B., 1998. "Practical Pollution Prevention – Activity-Based Costing for EHS Improvement," *Pollution Prevention Review*. John Wiley & Sons, Inc. Winter.

Pojasek, Robert B., 1997. "Understanding a Process with Process Mapping," *Pollution Prevention Review*. John Wiley & Sons, Inc. Summer.

U.S. EPA, 1995. *An Introduction to Environmental Accounting as a Business Management Tool:*

Key Concepts and Terms (EPA 742-R-95-001).

White, Allen L., Becker, M., and Savage, D., 1993. "Environmentally Smart Accounting: Using Total Cost Assessment to Advance Pollution Prevention," *Pollution Prevention Review*. John Wiley & Sons, Inc. Summer.

Software Tools

P2/FINANCE (Pollution Prevention/Financial Analysis Cost Evaluation System) This software provides spreadsheets (Microsoft Excel) for evaluating the profitability of pollution prevention and other types of projects. It can be downloaded free of charge from EPA's web site: www.epa.gov/opptintr/acctg

E2/FINANCE (Energy and Environment /Financial Analysis Cost Evaluation System) This software is useful for evaluating the profitability of energy efficiency, pollution prevention and other types of projects. It can be downloaded free of charge from Tellus Institute's web site: www.tellus.org

Web Sites

The US EPA Environmental Accounting Project web site (www.epa.gov/opptintr/acctg) contains case studies and other documents.

Other Resources

Design for the Environment Printing Project, Lithography Case Study 1, Managing Solvents and Wipes. U. S. EPA, EPA 744-K-93/001, October 1995.

Designing Solutions for Screen Printers, An Evaluation of Screen Reclamation Systems, Design for the Environment, U. S. EPA, EPA744-F-96-010, September 1996.

Solutions for Lithographic Printers, An Evaluation of Substitute Blanket Washes, Design for the Environment, U. S. EPA, EPA744-F-96-009, September 1997.

EMS Gap Analysis, The Lexington Group, Environmental Management Consultants, Inc., ©1997.

For a full list of DfE Program publications, contact EPA's Pollution Prevention Information Center, 1200 Pennsylvania Ave., N.W. (7409), Washington, DC 20460.
Phone: 202/260-1023; Fax: 202/260-4659
E-mail: ppic@epa.gov
http://www.epa.gov/opptintr/library/ppicdist.html

DfE website: http://www.epa.gov/dfe

The John Roberts Company
9687 East River Road
Minneapolis, MN 55433
(612) 755-0394

Ecological Benefits Assessment Model (EBAM)

What does EBAM do?

- Estimates the ecological benefits of risk management alternatives in economic terms.
- Estimates the dollar value of the ecological benefits of risk management alternatives on recreational fishing.
- Estimates the dollar value of environmental damages.

Technical Contact:
Lynne Blake-Hedges
U.S. Environmental Protection Agency
401 M Street, S.W. (7406)
Washington, D.C. 20460
Phone: 202-260-7241
E-mail: blake-hedges.lynne@epa.gov

Chemical Screening Tool for Exposure and Environmental Release (ChemSTEER)

What does ChemSTEER do?

- Estimates occupational inhalation and dermal exposures during chemical manufacturing, processing, and use activities.
- Estimates chemical releases to air, water, and land that are associated with chemical manufacturing, processing, and use.

For more information about the tool, contact:
Scott Prothero
U.S. Environmental Protection Agency
401 M Street, S.W. (7406)
Washington, D.C. 20460
Phone: 202-260-1566
E-mail: prothero.scott@epa.gov

Use Cluster Scoring System

What does the UCSS do?

- The Use Cluster Scoring System (UCSS) is a computer-based, risk-screening system with information about nearly 3,200 chemicals in the 380 clusters — or families — into which these chemicals are grouped. For example, instead of considering a single chemical that happens to be a paint stripper, the cluster of chemicals that perform as paint strippers is considered.
- The UCSS accesses hazard and exposure data that are extracted from the Toxics Release Inventory (TRI), the Integrated risk Information System (IRIS), and other readily accessible risk assessment related databases.
- The UCSS then uses a simple system to score and rank chemicals and their respective clusters. The program was developed to identify clusters of chemicals of potential concern to EPA.

For additional information about the Use Cluster Scoring System, contact:
Franklyn Hall
U.S. Environmental Protection Agency
OPPT, Economics, Exposure & Technology Division
401 M Street, S.W. (7406)
Washington, D.C. 20460
Phone: 202-260-9596
E-mail: hall.franklyn@epa.gov

Graphical Exposure Modeling System (GEMS)

What does GEMS do?

- GEMS will connect outdoor air, surface water, soil, groundwater, and multimedia models with some of the environmental and population data needed to run the models.
- GEMS will estimate environmental concentrations in a variety of environmental media.
- GEMS will have graphics capabilities for displaying data and environmental modeling results.

For more information about the model, contact:
Lynn Delphire
U.S. Environmental Protection Agency
401 M Street, S.W.
Washington, D.C. 20460
Phone: 202-260-3928
E-mail: delphire.lynn@epamail.gov

Exposure, Fate Assessment Screening Tool (E-FAST)

What does E-FAST do?

- Provides screening-level estimates of the concentrations of chemicals released to air, surface water, landfills, and from consumer products.
- Estimates potential inhalation and ingestion dose rates resulting from these releases.
- Modeled results, estimates of concentrations and doses, are designed to be conservative.

For more information about the model, contact:

Tom Brennan
U.S. Environmental Protection Agency
401 M Street, S.W. (7406)
Washington, D.C. 20460
Phone: 202-260-3920
E-mail: brennan.thomas@epamail.gov

APPENDIX H: BLANK WORKSHEETS

This appendix contains blank copies of all the worksheets presented in the *Implementation Guide*, for your use. The worksheets are identified by the same numbers used in the *Guide*. For example, Worksheet 6-1 would be the first worksheet found in Module 6.

Worksheet 1-1: Costs and Benefits of Developing and Implementing an IEMS

Costs	Benefits
Contact Person:	Date completed:

Worksheet 1-2: IEMS Responsibilities		
IEMS Function	**Person**	**Regular Position**
Management Representative		
IEMS Coordinator		
IEMS Committee		
Contact Person:		Date Completed:

Corresponds to RESP-01 of the *Company Manual Template*.

Worksheet 1-3: IEMS Development Schedule and Resources Worksheet

Module	Participants	Budget	Target Completion
Making the Commitment: Creating a Policy Statement and Determining the Scope			
Intermediate steps: (As appropriate)			
Planning the Process: Decision Points, Leadership & Participants, Schedule & Plan			
Intermediate steps: (As appropriate)			
Determining Significant Aspects: Prioritizing Concerns and Setting Objectives			
Intermediate steps: (As appropriate)			
Developing Operational Controls			
Intermediate steps: (As appropriate)			

Making Improvements: Evaluating Alternatives and Setting Targets			
Intermediate steps: (As appropriate)			
Implementation: Building Organizational Support for Your IEMS			
Intermediate steps: (As appropriate)			
Setting Up Environmental Management Projects; Measuring and Achieving Success			
Intermediate steps: (As appropriate)			
Establishing Continuing Improvement			
Intermediate steps: (As appropriate)			
Contact Person:	Date Completed:		

Worksheet 1-4: Persons Responsible for IEMS Development

Roles	Individual(s) Responsible	% of Time Designated	Budget
"Management representative" having responsibility for implementing the EMS (in small businesses, this could be the owner).			
IEMS Coordinator			
IEMS Team Participants			
Identifying and determining significance of environmental aspects.			
Identifying and determining applicability of legal and other requirements.			
Competency-based training.			
Operational controls.			
Emergency preparedness and response.			
Monitoring and measurement of "key characteristics" of operations and activities that can have significant environmental impacts (i.e., the "significant environmental aspects.").			
Periodic evaluations of environmental compliance.			
Handling and investigating non-conformance with the EMS.			
Records management.			
Internal EMS audits.			
Contact Person:		Date Completed:	

Note: Most of these blocks will be filled in as development of the IEMS progresses. This worksheet will help track progress and serve to remind the team and management of necessary assignments.

Worksheet 1-5:* Identifying Environmental Aspects

Input/Output	Environmental Aspect (quantify if available)	Environmental Impact
Office Activities		
Manufacturing Process		
Building Maintenance		
Products and Services		
Contact Person:		Date Completed:

Use the information you have included here to fill in EA-02 in the the *Company Manual Template.*

Worksheet: 1-6* Regulations

Regulatory Agencies	Regulations That Apply to My Business Sector	Business Operations Potentially Affected	Does it Apply to My Business?
Contact Person:		Date Completed:	

*Corresponds to Table LR-01 in the *Company Manual Template.*

Worksheet 3-1:[a] Health, Safety and Environmental Potential Effects Information

Operation	Environmental Aspect	Information Sources	Regulatory Data: [b] Carcinogen? OSHA Permissible Exposure Limit (PEL)? Volatile Organic Compound (VOC)? Toxics Release Inventory (TRI)?	Human Health Effects by Pathways Acute and Chronic [c]			Effects on wildlife and Other environmental effects [d]			Worker Safety	Rank	
				Inhalation	Dermal	Oral	Air	Water	Land		Human	Env.
Contact Person:				Date Completed:								

a Corresponds to Table EA-03 in *Company Manual Template.*

b Most information for this column can be found on the MSDS.

c Partial information for these columns might come from the MSDS, but other resources may be needed. In particular, acute effects are usually reported on MSDS sheets. Chronic effects are sometimes on MSDS sheets, but often will have to be found elsewhere. LC refers to lethal concentration. Inhalation LC50 i the concentration of a chemical in air that causes death in 50 percent of the test organisms at the end of the specified exposure period. LD refers to lethal dose. LD50 is the dose of a chemical taken by mouth, absorbed by the skin, or injected that is estimated to cause death in 50 percent of the test animals. Lethal dose data are expressed in terms of amount of chemical divided by the body weight, e.g., mg/kg.

d MSDSs usually do not include environmental effects.

Note: For more information on risk-related data, including methods for interpreting quantitative toxicity values, refer to the Risk Guide provided on the DfE Program website.

Worksheet 3-2: Exposure to Chemicals and Materials

Operation	Aspect	Quantity* Used per time period	Exposure Time		Personal Protective Equipment (PPE)	Pathway		Rank Exposed Groups		
			Duration**	Frequency		Human: Inhalation, Dermal, Oral	Environment: air, water, land	Workers	Community	Environment

Contact Person: Date Completed:

*If ingredient in chemical product, use quantity of chemical not product, i.e., apply the percentage that the ingredient makes up of the product.

**How many hours per day is the chemical or material used?

Note: For more information about evaluating exposure, refer to the exposure section of the Risk Guide on the DfE Program website.

Worksheet 3-3: Community Issues

Operation	Aspect	Community Issues (List)	Rank

Contact Person: Date:

Worksheet 3-4: Natural Resources Use

Operation	Aspect	Natural Resources Used	Rank

Contact Person: Date:

Worksheet 3-5:[a] Criteria to Determine Significant Aspects[b]

Operation	Aspect[b]	Regulatory Concerns	Chemical and Material Risk			Worker Safety	Other Community Issues:[d]	Natural Resources:[e]	Overall Ranking	Significant? Y/N
			Worker Eff/Exp[c]	Community Eff/Exp[c]	Environment Eff/Exp[c]					
Contact Person:					Date Completed:					

[a] Corresponds to SEA-01 in the *Company Manual Template.*
[b] Include each input and output of a process step.
[c] Effects/Exposure
[d] Noise, traffic, light, odor.
[e] Include such items as Resource Use, Solid Waste, Energy Use

Worksheet 3-6: Criteria to Select Environmental Projects

Project to Address Aspect	Time Frame	Cost	Technical Feasibility	Total Feasibility
Contact Person:			Date Completed:	

Worksheet 3-7: Potential Improvements

Aspect	Human Health[1]	Environment	Cost Savings	Community Relations	Morale	Expected Improvements
Contact Person:					Date Completed:	

[1] Workers, Community, Global

Worksheet 3-8: Overall Ranking Summary

Process Step Aspect	Aspect Total	Feasibility Total	Benefits Total	Significant Y/N
Contact Person:			Date Completed:	

Worksheet 4-1:* Potential Alternatives

Significant Environmental Aspect:

Baseline:

	Baseline	Potential Alternatives
Products		
Technologies		
Work Practices		
Recycling/ Reuse		
Treatment		
Disposal		
Contact Person:		Date Completed:

* Document these results in Section AE of the *Company Manual Template.*

Worksheet 4-2:[a] Alternatives Evaluation: Health, Safety and Environmental Potential Effects Information

Baseline:

Significant Environmental Aspect:

Alterna-tive	Information Sources	Regulatory Data: [b] Carcinogen? OSHA Exposure limit? Volatile Organic Compound (VOC)? Toxics Release Inventory (TRI)?	Human Health Effects by Pathways Acute and Chronic [c]			Comments	Effects on Wildlife and Other Environmental Effects [d]			Worker Safety [e]	Rank	
			Inhalation	Dermal	Oral		Air	Water	Land		Human [f]	Env

Contact Person:			Date Completed:									

a See Section AE inin *Company Manual Template.*
b Most Information for this column can be found on the MSDS.
c Partial information for these columns might come from the MSDS, but other resources may be needed. In particular, acute effects are usually reported on MSDS sheets. Chronic effects are sometimes on MSDS sheets, but often will have to be found elsewhere.
d MSDSs usually do not include environmental effects.
e There may be information on the MSDS that would be useful for preparing your emergency preparedness plan.
f This rank is based on the potential effects of the chemical and not on the dose required to obtain those effects. For example, a person can drink a certain amount of Scotch. Drinking a large quantity of Scotch, however, can be lethal. Therefore dose does make a difference ultimately in making a judgment. However, one can still make a qualitative ranking about whether Scotch, cola, water, milk or juice have beneficial or negative impacts. For more discussion of the role of "dose" see the Hazard Guide on the DfE web site.
Note: For more information on risk related data, including methods for interpreting quantitative toxicity values, refer to the risk Guide provided on the DfE Program website. The data on this table were constructed for purposes of illustration and do not represent real data.

Worksheet 4-3: Alternatives Evaluation: Exposure to Chemicals and Materials

Significant Environmental Aspect:

Baseline:

Alternative Products	Quantity* Used per time period	Exposure Time		Personal Protective Equipment (PPE)	Pathway		Rank Exposed Groups		
		Duration**	Frequency		Human: Inhalation, Dermal, Oral	Environment: air, water, land	Workers	Community	Envir-onment
Contact Person:					Date:				

*If ingredient in chemical product, use quantity of chemical not product, i.e., apply the percentage that the ingredient makes up of the product.

**How many minutes or hours per day is the chemical or material used?

Worksheet: 4-4: Alternatives Evaluation: Community Issues

Significant Environmental Aspect:

Alternative	Community Issues (List)	Rank
Contact Person:		Date:

Worksheet: 4-5: Alternatives Evaluation: Natural Resource Use

Significant Environmental Aspect:

Alternative	Natural Resources Used (List)	Rank
Contact Person:		Date:

Worksheet 4-6:[a] Alternatives Evaluation: Criteria to Determine Environmental Impact

Baseline:

Significant Environmental Aspect:

Alternative	Regulatory Concerns	Chemical and Material Risk			Worker Safety	Other Community Issues:[c]	Natural Resources[d]	Overall Ranking	Preferred Alternative? Y/N
		Worker Eff/Exp[b]	Community Eff/Expb	Environment Eff/Exp[b]					
Contact Person:				Date Completed:					

[a] Corresponds to SEA-01 in *Company Manual Template*.
[b] Effects/exposure
[c] Noise, traffic, light, odor.
[d] Include such items as resource use, solid waste, energy use.

Worksheet 4-7:* Performance Comparison of Alternatives

Significant Environmental Aspect:

Baseline:

Function:

Alternative	How well it works	Time	Ease of use	Overall Performance Evaluation
Contact person:			Date Completed:	

*Document results in Section AE of the *Company Manual Template.*

Worksheet 4-8:* Regulatory Comparison of Alternatives

Alternative	Applicable Regulations	Required Controls	Regulatory Cost	Overall Regulatory Concerns Evaluation
Contact Person:			Date Completed:	

*See Section AE of the *Company Manual Template*.

Note: Under "Cost of Regulations" include: paperwork triggered, reporting requirements, cost of controls, personal protective equipment, and any other costs that may be attributed to regulations associated with using that product or process.

Worksheet 4-9a: Annual Operating Costs

Significant Environmental Aspect:

Baseline:

Alternative	Materials	Direct Labor	Utilities	Waste Management	Regulatory Compliance	Insurance	Future Liability	Total Operating Costs

Contact person: Date:

Worksheet 4-9b: Potential Annual Revenue Effects

Significant Environmental Aspect:

Baseline:

Alternative	Product Throughput	Product Quality	Reuse of or Sales of Recovered Materials	Total Revenue Effects
Contact Person:		Date:		

Worksheet 4-9c: Initial Investment Costs*

Significant Environmental Aspect:

Baseline:

Alternative	Purchased Equipment	Utility Systems/ Connection	Planning/ Engineering	Site Preparation	Construction/ Installation	Start-up/ Training	Permitting	Other**	Total Inv. Costs

Contact Person: Date:

Worksheet 4-9d: Cost Comparison of Alternatives

Significant Environmental Aspect:

Baseline:

Alternative	Total Operating Costs	Total Investment Costs	Annual Revenue Effects	Rank

Contact Person: Date:

Document results in Section AE of the *Company Manual Template.*

Worksheet 4-10:* Evaluation of Alternatives

Significant Environmental Aspect:

Baseline:

Alternative	Performance Rank[1]	Regulatory Rank[2]	Cost Rank[3]	Environ-mental Effects[4]	Overall Evaluation[5]
Products					
Technologies					
Work Practices					
Recycle/Reuse					
Treatment					
Disposal					
Contact Person:			Date Completed:		

*See Section AE of the *Company Manual Template.*

[1] Take from Worksheet 4-7, Performance Comparison.

[2] Take from Worksheet 4-8, Regulatory Cost Comparison.

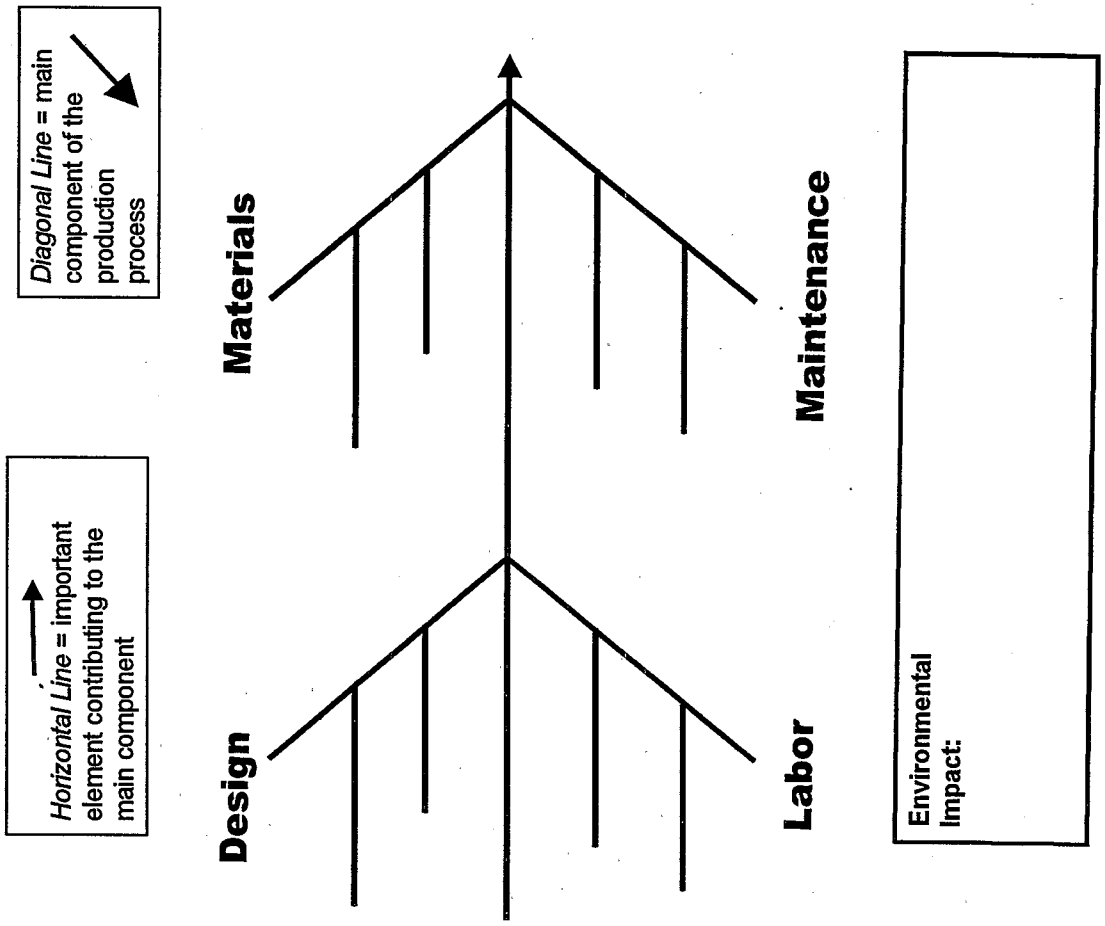
[3] Take from Worksheet 4-9d, Cost Comparison.

[4] Take from Worksheet 4-4, Criteria to Determine Environmental Impact.

[5] Rank on a scale of low to high to reflect the desirability of each product. This is a judgment call.

Note: For more information on the methodology for comparing alternatives, refer to both the DfE website and the *Cleaner Technologies Substitutes Assessment, A Methodology Resource Guide*, DfE, U.S. EPA 744-R 95-002, Dec. 1996.

Figure 5-a. Root Cause Diagram



Worksheet 5-1: Environmental Performance Measurement Indicators

Aspect	Objective	Indicator	Date Checked	Who Checked	Result	Corrective Action
Contact Person:				Date Completed:		

Worksheet 5-2: Calibration Log

Indicator	Measurement Method	Equipment Used	Equipment calibrated: date/method
Contact Person:		Date Completed:	

Worksheet 5-3:* Corrective Action Notice

Issue Date:	Solution Due Date:
Requested by: Issued to:	
Problem Statement:	
Most Likely Causes:	
Suggested Solutions:	
Action Taken:	
Measured Results:	
Corrective Action Closed by:	Date:
Contact for Notice:	Date completed:

*Report results on TCA-01 in the *Company Manual Template.*

Worksheet 6-1:* Operational Control Procedures

Significant Environ-mental Aspect	Indicator(s)	Associated Job Functions	Existing Operational Control Procedures	Operational Control Procedure Development/ Modification Needed	Responsible for developing	Responsible for checking	Location Posted

Contact Person: Date Completed:

*Corresponds to OC-01 in the *Company Manual Template.*

Worksheet 6-2: Operational Control Responsibilities

Significant Aspect	Procedures (list)	Responsible for maintaining controls
Contact Person:		Date Completed:

Worksheet 6-3: Training Plan for Operational Controls

Aspect	Procedures	Person Responsible for Carrying Out	Training Needs	How to Train	When/ Length	Budget	Completion Date	Person Responsible for training

Contact Person:

Date Completed:

Worksheet 7-1: Environmental Review of New Processes, Products and Activities

Area of Company	New Process, Product, or Activity	Environmental Review by	Environmental Effects	Pollution Prevention Opportunities
	Manager/Date	Manager/Date		

Contact for form: Date Completed:

Worksheet 7-2:* Compliance Tracking Log

Person Responsible	Regulation	Compliance Check Date	Results and Root Cause	Corrective Action/ Date	Compliance Verified/ Date

Contact Person: Date Completed:

*Document results on CA-01 in the *Company Manual Template.*

Worksheet 7-3: Pollution Prevention Tracking Log

Area of Company	Pollution Prevention Activity	Date Started	Results	Measurement Method	Person Responsible

Contact: Date Completed:

Worksheet 7-4: Environmental Emergency Preparedness and Response

Potential Emergency Scenario	Potential Environmental Impact	Action Required	Procedures Needed	Training Needed

Worksheet 8-1: Training Plan

Jobs Affecting Environment	Training Needs	How to Train	When/ Length	Budget	Completion Date	Who is Responsible
Contact Person:			Date Completed:			

Worksheet 8-2: Documentation

List Existing Documents	Determine Format: Who/ Date Completed	Develop Prototype (Content): Who/ Date Completed	Assign Writing: Who/ Date	Review Writing/ Compare to Prototype Who/ Date	Added to Document List/ Date	Who Has Access	Where Located
	/	/	/	/	/		
	/	/	/	/	/		
	/	/	/	/	/		
	/	/	/	/	/		
List Documents to be Created							
	/	/	/	/	/		
	/	/	/	/	/		
	/	/	/	/	/		
	/	/	/	/	/		
	/	/	/	/	/		

Contact Person: Date Completed:

Corresponds to CS–2 of the *Company Manual Template*.

Worksheet 8-3: Document Control

Document	Who Will Use It	Permanent Location	Periodic Review Schedule/ Who	When Can Be Destroyed
			/	
			/	
			/	
			/	
			/	
			/	
			/	
			/	
			/	

Contact Person: Date Completed:

Worksheet 8-4:* Working with Stakeholders

Your Stakeholders	Potential Environmental Interest	What You Want to Tell Them	What You Want Them to Tell You	How to Communicate With/ tell Them	When	Person Responsible

Contact Person: | Date Completed:

*Report results on CS-01 in The *Company Manual Template*.

Worksheet 8-5: Stakeholder Communication Record	
Date Communication Received:	
Type of Communication:	
Received From:	
Address/Telephone Number/E-Mail:	
Content of Communication (attach copy if possible):	
Will ABC Company Respond?	Y N
Date of Response:	
Person Responding:	
Nature of Response (attach copy if possible):	
Are Internal Actions Necessary? (If Yes, fill out a Corrective Action Form.)	Y N
Contact Person:	Date Completed:

Corresponds to CS-02 of the *Company Manual Template*.

Worksheet 9-1: IEMS Program Measurement Criteria

Company Name_____

Measurement Elements / IEMS Components	Objectives of Component	Activity Measures	Results Indicators	Review Period
Communication Plan				
Stakeholders Input				
Environmental or IEMS Training				
Review of Aspects				
Operational Controls				
Environmental Review of New Processes and Activities				
Setting Objectives & Targets				
Environmental Management Project 1				
Environmental Management Project 2				
Documentation				
Regulatory Compliance				
Pollution Prevention				
Other				

Contact person for form: Date Completed:

Worksheet 9-2: Internal Assessment Checklist

Internal Assessment Team:

Date of Internal Assessment: _____ Signed: _____

IEMS Procedures:

Check each item assessed, including auditing of records, where applicable (codes in parentheses refer to the Worksheet number ("WS") in this Guide, followed by the document number in the *Company Manual Template.*):

__ Environmental policy (Module 2)
__ Environmental objectives (progress; implementation of action plans)
__ IEMS responsibilities (WS 7-2, RESP-01)
__ Identification of Environmental Aspects (WS 1-5, P-EA)
__ Identification of Legal Requirements (WS 1-6, P-LR)
__ Identification of Significant Environmental Aspects (WS 3-3, WS 3-6, P-SEA)
__ Development of Objectives, Targets, and Action Plans (WS 5-1, P-OTP)
__ Conducting an Alternatives Evaluation (WS 4-1 to 4-6, P-AE)
__ Development of Operational Controls (WS 6-1 to 6-3, P-OC)
__ Environmental Training (Awareness and Task-Specific) (WS 8-1, P-ET)
__ Emergency Preparedness (WS 7-5, P-EP)
__ Review of New Products and Processes (WS 7-3, P-NPP)
__ Documentation (WS 8-2, WS 8-3, P-D)
__ Conducting a Compliance Assessment (WS 5-4, P-CA)
__ Conducting an Internal Assessment (WS 9-2, WS 9-3, P-IA)
__ Taking Corrective Action (WS 5-3, P-TCA)
__ Management Review (WS 9-4, P-MR)

IEMS Performance

__ Achieved objective #1
__ Achieved objective #2
__ Achieved objective #3

Contact Person: Date Completed:

Corresponds to LA-01 of the *Company Manual Template.*

Worksheet 9-3: Internal Assessment Record

Internal Assessment Team:

Date of Internal Assessment: _____ Signed: _____

Major Non-Conformities Observed

1.

2.

Minor Non-Conformities Observed

1.

2.

3.

Is ABC Company making progress in meeting its IEMS objectives?

Is ABC Company adhering to the commitments in its environmental policy?

Suggestions for Improving IEMS:

Contact Person: Date Completed:

Corresponds to IA-02 of the *Company Manual Template*.

Design for the Environment (DfE) Program
Envionmental Management Systems Project
United States Environmental Protection Agency
Office of Pollution Prevention and Toxics
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Washington, DC 20460

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