Tactic 1
THE SYSTEMS APPROACH:
EHS Integration and Process Improvement Tools

1. Select a Process

◆ The first step in the preparation of an EHS process improvement program is to Select a Process (see Attachment 1) in the facility that will be the focus of your improvement effort.

— The initial process improvement efforts should focus on a process that involves the manufacture of a part or a product or offers a service that uses and loses resources.

— Try to find information on the “inputs and outputs” of the process. If the company has a materials resources planning (MRP) system, it might have this information. Purchasing is another source for this information. If applicable, review the information that the facility used to search for “aspects” in its ISO 14001 program or “risks” in its OHSAS 18001 program.

— The process selected should include EHS issues that you wish to address. Remember, by changing the process, you might be able to prevent the very need to be in compliance in the first place!

◆ You should not focus only on the unit process that is responsible for the EHS issue of concern, but you should also consider all “supporting processes” associated with that process.

— For example, if the use of water is a concern because of local water use restrictions, you should not focus, for example, just on the parts washers. You should also evaluate the process of producing a part as it goes through the various steps including the parts washer. The answer to using less water may lie in a work step “up-stream” of the parts washer, e.g., how the part got dirty to require this cleaning.

◆ Another way to select a process is to look at the volume of waste that it creates when compared to other processes at the facility or the amount of health and safety risk that it poses. Maybe it is a process that has already been selected for improvements in the company’s process improvement programs (e.g., Lean or Six Sigma).

Tip: There is no single way to select the first or best process to focus on. However, you will need to select a process to have a starting point for applying the Systems Approach to process improvement. Refer to the checklist under the Select a Process in the attachments.

2. Prepare the Preliminary Hierarchical Process Map

◆ An EHS process improvement oversight committee should be formed to provide the resources and provide the management oversight for this important effort. See the Oversight Committee (see Attachment 2) information in the attachments. While it is not necessary to have an oversight committee, it is very helpful to ensure that you have management approval and involvement in the program. There may be other ways for you to secure the management approval without forming this committee. The oversight committee should authorize someone to initiate the EHS process improvement program.
activity. This person should meet with the operations staff and obtain a process flow diagram or process flow chart for the selected process.

— Typically, a facility process flow chart is several pages long.
— Value stream maps may be available from the Lean program.

◆ Using the basic rules of hierarchical process mapping (see Attachment 3), develop a preliminary process map (see Attachment 4) from this information.

— Have the people who maintain the facility process flow charts or value stream maps review the information with you to make sure it is correct.
— Next, you should identify each process work step at the lowest level using the process mapping instructions.

◆ Prepare a resource accounting sheet (see Attachment 5) and resource accounting sheet template (see Attachment 6) for each of these work steps. Complete each accounting sheet at the lowest level in the hierarchical process map (i.e., highest level of detail). Make sure you capture all the resources that are used in the work step and all of the resources that are lost in that work step.

— List all of the supporting processes (see Attachment 7) that are required in order to make that work step operate.
— Be very careful with the nomenclature of work steps, supporting processes, and resources. Use the same terms that the workers use or as listed on the flow charts.
— Create a glossary (see Attachment 8) to make sure that you are always using the correct term and that you are not using different terms in different places.

◆ Preparing these hierarchical process maps should be a repetitive process using the rules of process mapping. The initial process maps should be reviewed with the production staff.

◆ Once the process maps have been completed, move on to complete the preliminary resources accounting sheets.
— Also, link all of the work steps to the supporting processes that support the work found in the work steps.

Tips: • It is important for the oversight committee to make sure that the hierarchical process mapping effort is consistent with the process your company uses to select and manage EHS aspects and risks.

• It is also important for you to realize that you will have to develop some skill to become proficient at preparing hierarchical process maps. The best way to learn is to practice what is described here.

3. Verify the Preliminary Hierarchical Process Map

◆ Once this preliminary information has been completed, it must be verified by visiting the process area with the process maps in hand. Refer to the verification checklist (see Attachment 9).

◆ Two questions should be asked at each work step in the process:

— What improvements have been made to this work step in the past 2 years that have led to waste minimization results?
If there were no rules and money was not an object, what EHS improvements would you initiate on the process to improve or increase its efficiency and effectiveness?

◆ It is also important that all of the supporting processes that are linked to the work step be identified.
   — The supporting processes also need standard and consistent names.
   — Allocate the resources used and lost by the supporting processes to the work step in the main process in proportion to its use or loss.
◆ Upon verification of the process map, a revised set of hierarchical process maps and their resource accounting sheets should be completed, verified by the workers, and agreed to by the supervisors of those work areas.

Tips: • In some cases, this will be the workers’ first exposure to the Systems Approach. Therefore, it is important that they be provided with an opportunity to help modify the process maps and add to the uses and losses of resources on the resource accounting sheets.
   • All the uses and losses of resources should have standard names.
   • Typically, the process verification activities can be conducted by using a facilitator trained in the Systems Approach in a period of approximately 3 days to 1 week.

4. Select Opportunities for EHS Process Improvement

◆ The questions posed to the workers along with ideas they may raise once becoming involved in the hierarchical process map verification activity will lead to the generation of numerous opportunities for EHS improvements. Remember that some of the projects for the EHS improvement program will be projects that are already planned. They will be conducted using the Systems Approach and included within this program.
◆ The targets and objectives of the ISO 14001 program or the risks in the OHSAS 18001 program (if applicable) are another source of potential EHS improvement projects. There may also be other process improvement programs that are in place and worth considering. Your company may have another form of systems that is used to measure EHS performance. Make sure that you look at the goals established within that program.
◆ A Systems Approach and related tools will make the opportunities selection process (see Attachment 10) more structured and this should lead to better results.
◆ A complete list of opportunities for EHS process improvements should be prepared as part of the verification activity.
◆ The oversight committee should review the opportunities identified and select at least two opportunities from the EHS improvement program to be implemented.
◆ The EHS process improvement projects should then be identified for each of the selected opportunities. This will be the list of EHS process improvement projects (see Attachment 11.)
Dedicated employee teams will need to be assigned to each of these EHS process improvement projects. Refer to the team organization checklist (see Attachment 12) for important team considerations.

During the first meeting of the EHS process improvement project team, the members should take a look at the hierarchical process map and the resource accounting sheet for the work step that is associated with their project.

Next, the team should visit the location of the given work step and ask the operator questions about the problem.

It is important that there be a good statement of the problem (see Attachment 13) that is understandable and acceptable to all of the team members.

The oversight committee should ensure people (i.e., EHS, engineers, Lean or Six Sigma experts, purchasing, and accounting) are available to attend team meetings or to answer questions that may arise during the statement of the problem.

**Tips:**

- **Given typical workloads and other logistical problems, the teams often require at least 2 weeks to prepare their statement of the problem.**
- **The effort of selecting the opportunities for EHS process improvement and forming the teams typically takes at least a month to complete at an average facility.**
- **It is very important that the facility management make it clear to the workers and their supervisors that work on the EHS process improvement program is a priority. The oversight committee should also see to it that this management support is provided. This is only a suggestion to make the program work better. Experience has shown that the use of the Systems Approach helps get management’s attention because of their familiarity with the quality management tools or just the visual presentation of the information.**

**5. Prepare a Draft Action Plan**

- Once the opportunities have been selected, each team will meet with a facilitator trained in the use of the Systems Approach tools. These meetings will typically take about 2 hours. You may be the facilitator once you are familiar with the tools and some of the basic techniques of facilitation. (A good reference for developing facilitator skills is a paperback book by Michael Doyle, “How to Make Meetings Work.”)

- Each team will complete the four steps in the order listed with the tools as noted below;
  - **1st** - each team will use Root Cause Analysis (see Attachment 14) with a Cause and Effect Diagram (see Attachment 15) to understand the potential causes of each problem (opportunity) that has been selected.
  - **2nd** - the team will search for alternative solutions to the problem using a technique known as Brainwriting (see Attachment 16). This is a written brainstorming technique that can typically generate over 20 alternative solutions to improve EHS conditions at a selected process work step.
  - **3rd** - the team will select alternative solutions for implementation by prioritizing the brainwriting results. The systems tool used for selecting alternatives is called Bubble Sorting or “Bubble-up/Bubble-down” (see Attachment 17).
— 4th & finally - each team will prepare a preliminary Draft Action Plan (see Attachment 18). Refer to Draft Action Plan Template (see Attachment 19).

◆ After completing the above sequence of steps, each team must make sure that they have requested the proper resources to complete the work and that these resources (especially someone’s time) are available to them. Once the action plan is accepted by the oversight committee, the team members will be held accountable for implementing the action plan.

◆ These action plans can be attached to the environmental management program sheet in the ISO 14001 program or the risk management plan in OHSAS 18001 (if applicable).

**Tips:**

• Workers do not need to be separately trained in the use of the above tools. A facilitator can guide them through the process so the workers will learn about the tools as they use them. This facilitator needs to be trained in the use of the tools and have the skills necessary to use them on actual projects.

• Typically, it is possible to have all of the draft action plans completed in their preliminary form within 1 week.

6. Implementing the EHS Process Improvement Program

◆ The oversight committee will meet with each team and approve the action plans. By doing so, they are committing to make the resources available that the team has requested.

◆ Quarterly meetings (see Attachment 20) dedicated to the waste minimization program review should be scheduled.

— During the first meeting, the oversight committee should approve the EHS Process Improvement Program Plan.

— The steering committee should then meet with each of the employee teams to review and approve their action plans. Typically, this meeting will take place approximately 3 to 5 months after the original selection of the processes as noted in the action plan.
ATTACHMENTS

1. Select a Process Checklist

❑ Make a list of all the manufacturing and supporting processes responsible for each of the EHS compliance issues. This listing may already exist as part of your facility’s EHS management program if one exists.

❑ Make a list of all of the pollution control processes (e.g., air pollution control, dust control, oil/water separators, wastewater treatment/pretreatment, hazardous waste storage).

❑ Make a list of all of the safety controls (e.g., process guards, safety showers, first-aid stations). These will all be supporting processes in the process characterization.

❑ Make a list of departments that are responsible for the preparation of parts for products assembled at the facility. Processes are usually sorted by department at the facility level.

Next, using this list of processes, consider each of the following items:

❑ Does quality or operations use value stream maps, work flow diagrams, or work descriptions to describe work processes?

❑ Has facility management targeted any processes for improvement in the next year?

❑ Is facility management expecting to add new processes or expand existing processes in the coming year?

❑ Is facility management expecting to curtail or reduce the use of any existing processes during the coming year?

❑ Which processes, if any, are presently being examined by company process improvement efforts?

❑ Which processes use the most expensive and largest quantities of material and other supplies?

❑ Which processes generate the most solid and hazardous waste or are more highly regulated from an environmental perspective?

❑ Which processes have the greatest number of rejects?

❑ Which processes have the greatest health and safety issues?

Now, select a process to work with that has EHS issues and a product, family of products, or service associated with it.

2. Oversight Committee

It is important to have top management support and direct the EHS process improvement effort. The EHS coordinator (sometimes the responsibility is split between an environmental coordinator and a health and safety coordinator) should meet with the top management of the facility and explain what is involved in this EHS process improvement program. It is best to select a management committee that already exists. Often the facility manager has an operations committee that meets on a regular basis. This committee would have many of the senior managers on it including people from accounting, purchasing, quality, maintenance management, operations, and human resources. This committee would be asked to dedicate only four of their meetings per year to the management oversight of the EHS process improvement effort. This minimal commitment of their time is often the single point that brings agreement when this topic is raised. Do not forget to mention this!
The major requirement of the committee is to review the resources that are requested by the employee teams and find some way to provide the level of support they deem adequate to complete the work. The committee will also review the cost and benefit of each improvement project during the year.

If the company is very small, the manager/owner may take the place of the committee. In companies where there is not enough interest in providing management oversight to these process improvement efforts, you should simply keep them informed of the results of the program. They will often become interested and decide to provide the level of oversight described above. Do not give up on your attempts to have such oversight.

3. Hierarchical Process Mapping

Once a candidate process has been selected, a small team should be assembled to prepare a hierarchical process map (see examples in the Case Studies in Chapter 4). The process mapping activity should be facilitated by someone who has training in the use of the hierarchical process mapping technique and experience using this tool. Ideally, the team should consist of the following people:

◆ An operator or supervisor involved in the process
◆ An employee involved in EHS activities
◆ A maintenance person familiar with the process
◆ An employee from operations management or quality
◆ An employee who is not familiar with the process

A copy of the value stream maps, process flow charts, and/or work instructions for the process are obtained and reviewed by the team. It is important that the processes be defined as the work steps (i.e., the work performed by the operator as described in the work instructions) for the production process or service using and losing resources. Processes should not be limited to unit operations (e.g., five-stage washer) used in the processes as described here.

The team should take the “perspective” of the actual product being manufactured or the service being provided. They should follow the product or service through its journey from start to finish. Using the available information, the team should next create a complete set of work steps necessary to describe the full process. Only work steps directly experienced by the product or service should be included.

For example, a product never “sees” the air compressor, wastewater treatment system, and other supporting processes. We will be accounting for these “supporting processes” later.

This listing of work steps in the MAIN PROCESS needs to be expressed in three to six work steps. If there are only two work steps, the team needs to consider whether it has defined the process correctly (Is it really a unit operation in a process or is it a “supporting process?”). Often time-dependent activities take place within a unit process (e.g., a five-stage washer) that add additional work steps (i.e., not simply “wash the part” in the case of the five-stage washer).

◆ If there are more than six work steps, the team needs to determine how to express this process in three to six work steps. These steps will constitute what is called the “top level” (i.e., least detailed) of the hierarchical process map.
◆ If there were more than six steps in the first step, the extra steps will provide more detail at the second level of the hierarchical process map. Make sure that each work step is expressed as a “verb phrase.” This phrase needs to be familiar to the operators of the process. Each work step will be placed in a box and will have a single numeric number
under the verb phrase (e.g., 1, 2, 3, 4). (A reference describing the preparation of a process map and an example are provided to illustrate this information and provide additional detail.)

As the process mapping team looks at the top level map, it should ask the question, “Can we describe what is happening in this work step in three to six sub-work (more detailed) steps?”

◆ If the answer is yes, these work steps are mapped as the second level and numbered with two numbers, as in an outline (e.g., 1.1, 1.2, 1.3).
◆ If there are only two work steps at the second level, the team can either express the two steps as one step at the top level or see if there is something they have missed that would provide a third sub-work step and the opportunity to detail the second level.
◆ Once again, if there are more than six sub-work steps at the second level, the team will have to express the work in three to six work steps and provide additional detail at the third level of the process map.

This procedure is repeated at the second level to see if there are any third-level sub-work steps. The mapping teams should be careful never to go below the fourth level. In most cases, going below the third level is more detail than is necessary to explain the work.

Upper managers are typically concerned with the top level of the diagram. Supervisors are most concerned with the second level. In many cases, the workers need to know what is happening at the second or third level of the hierarchical process map.

4. Preliminary Process Map Checklist

- Select a process using the checklist in Attachment 1.
- Obtain the value stream maps, work flow diagrams, and work instructions for that process.
- Assemble a process mapping team using the guidance provided in Attachment 3.
- Prepare a top-level process map for the MAIN PROCESS after selecting a “perspective” and making a complete list of all the work steps that occur using the perspective selected.

Note: Make sure that the steps are named with a verb phrase familiar to the workers and that each work step is numbered in order with a single number from 1 to 6.

- Prepare the second- and third-level process maps as directed in Attachment 3.
- Review these preliminary draft process maps with people familiar with the operations after double-checking them against the process documentation. Make corrections as necessary.
- The preliminary process map is now ready for verification.
- Collect a preliminary listing of processes that are required to support the MAIN PROCESS from the original list in Attachment 1.
- Create a glossary in alphabetical order of all the “verb phrases” used in the process map. Be certain that the phrases are not used multiple times for different work steps.

Examples of the hierarchical process maps and a flow chart are provided in the Case Studies in Chapter 4.
5. **Resource Accounting Sheets Checklist**

- Determine the work steps in the MAIN PROCESS that are at the “lowest levels” (i.e., more detailed).

- If there is a 1.1, 1.2, 1.3, etc., you eliminate 1 from consideration because the former are at a lower level. If there are 1.2.1, 1.2.2, 1.2.3, etc., you eliminate 1.2 from consideration since there is a lower level.

- Prepare a resource accounting (RA) sheet for each work step at the lowest level (see the template).

- The **top portion** of the RA sheet is used to describe the work being performed in that step. This description can come from the process documentation or the work instructions.

- The **center portion** of the RA sheet provides a 360-degree look at the work step. Be sure to use the same verb phrases in the featured work step (center box) and the work step that occurs before and after the featured work step.

- All the resources used in the work step are placed above the center box.

- All of the resources lost in the work step (i.e., wastes, discharges, emissions, noise, odors, spills/leaks, accidental losses) are placed below the center box.

- Each resource used and lost should have a unique name that is familiar to the workers. A glossary should be kept for each of these categories.

- The **bottom portion** of the RA sheet provides a listing of all the supporting processes that are necessary in order for the featured work step to be properly used. Each of the supporting processes should have a unique name and these names should be kept in a separate glossary.

- Allow people familiar with the work step to review the information and look for major omissions. Make any changes necessary in these work sheets.

*A template for the resource accounting sheet follows this checklist. An example resource accounting sheet is also provided.*
6. **Resource Accounting Sheet Template**

**RESOURCE ACCOUNTING SHEET**

**Description of the Work Step**

Describe the activity in the work step.

![Resource Accounting Sheet Diagram]

**Supporting Processes**

List all of the supporting processes.

**Other Information**

Relevant EHS information for this work step.

7. **Supporting Processes Checklist**

- Create an alphabetical listing of the supporting processes from the RA sheets and your initial listing of pollution and safety controls. Be sure that similar processes are arranged in a hierarchical manner (e.g., air pollution control – dust filter; air pollution control – fume hood; air pollution control – wet scrubber).

- Check to see that all supporting processes that were used to bring the resources to the work step are included. This would include receiving, storage, transportation within the facility, mixing, cleaning the used storage vessels, air compressors, providing steam, deionized water systems, etc.

- Check to see that all the supporting processes that were used to collect and manage the losses (wastes) are included. This would include pollution control equipment, cleaning, handling rejected parts, waste handling systems, recycling, contractor and vendor services, etc.

- All parts provided by suppliers should be considered to be supporting processes.

**Note:** There can also be processes that support the supporting processes.
— For example, cutting swath is collected at the machining operation. In another location, the swath is centrifuged or pressed to remove excess cutting fluids before the swath is sent to a metal recycling company. The collection of the cutting swath is a supporting process. The removal of the cutting fluids supports the collection process.

— The handling and disposition of the cutting fluids and the swath support the removal process. Once again, these can be arranged in hierarchical fashion. Supporting processes can be numbered with a letter: A1, A2, A3, etc. The second-level supporting processes could be AA1, AA2, AA3, etc. The third-level supporting processes could be AAA1, AAA2, AAA3, etc.

**Tip:** Typically, only 20% of the total number of supporting processes (at all levels) account for about 80% of the resources consumed by the supporting processes and the losses (wastes) generated by the supporting processes. This is referred to as “rank ordering.” If some of these noteworthy supporting processes are to be included in the selection of opportunities for EHS process improvement, hierarchical process maps should be prepared using the numbering sequence described above.

### 8. Glossary Checklist

- The use of a glossary helps the process mapping team ensure that consistent and familiar terms are used throughout the documentation of the processes. Multiple names for the same term are avoided when a glossary is prepared.

- Four glossaries are necessary to sort through the information collected in the process mapping and RA sheets:
  - Process work step names – verb phrases
  - Resources Used
  - Resources Lost (wastes)
  - Supporting Processes

- Once the hierarchical process map is computerized, there will be links that can be used to see what other work steps have the same resources used or lost. Whenever there has been a success involving the conservation of a resource use or the minimization of a waste, the resource can be tracked to every other work step with this resource to see if the success can be used at that point.

### 9. Verification Checklist

At this point, the process mapping team has completed and checked each of the following items:

- Hierarchical Process Map of the MAIN PROCESS
- RA sheets for each of the work steps at the lowest level in the process map
- An alphabetical listing of the supporting processes
- A draft glossary

- The process mapping team will then visit each work step of the process and make certain that the information that has been gathered is complete and understandable to the operator.
The team should ask the operator about improvements that have been made at their work step that have led to EHS improvements during the past 2 years. This information will be recorded and documented as an Appendix in the EHS Process Improvement Program Plan.

The team should ask the operator how they would change the work step if given the opportunity to further improve the EHS aspect of the work. This information will be recorded and documented as the list of opportunities for the Opportunity Selection Process described below in Attachment 10.

When the verification of the MAIN PROCESS has been completed, the process mapping team should visit each of the supporting processes listed on the RA sheets.

They should both confirm that their list is complete and try to get a sense of the percent of the total capacity of the supporting processes viewed that is dedicated to each of the work steps where it is listed on the RA sheet. In other words, they should try to find the 20% of the supporting processes that use 80% of the resources and lose 80% of the waste that the resources use supporting the MAIN PROCESS work steps. This is called rank ordering, or the 80/20 rule.

Tip: Given the fact that some supporting processes are more important to the MAIN PROCESS and contribute to the “significant aspects” or “risks” as defined in ISO 14001 and/or OHSAS 18001 (if applicable) of the MAIN PROCESS, the process mapping teams need to make a decision as to whether they should prepare hierarchical process maps and RA sheets for these important supporting processes. The reasoning behind this decision is to help them prepare a complete listing of the opportunities for waste minimization that will be used for the Opportunity Selection Process described below in Attachment 10.

Some facilities choose to attribute the resources used and lost by the supporting processes to the work step in the MAIN PROCESS that is demanding this support. In this manner, the MAIN PROCESS is required to be responsible for the EHS process improvement activities in the supporting process. The theory is that you use less compressed air, it will cost the facility less money to generate the compressed air. You cannot control this at the supporting process level.

10. EHS Opportunities Selection Process

From the interviews conducted in the verification of the process maps and RA sheets, a list of opportunities for EHS process improvement is prepared. It is important to remember that every use of a resource in the process (or supporting process) represents an opportunity to conserve the use of that resource. Every loss of a resource in the process (or supporting process) represents an opportunity to minimize that waste. By controlling the use of resources, the EHS coordinator can work to prevent EHS compliance issues associated with these resources and/or the work step that is using them. By eliminating wastes, EHS compliance issues may also be prevented. The focus on compliance is on the process. Even if no changes are possible at this time, the operator still becomes familiar with the EHS aspects of the work.

The list of opportunities is presented to the oversight committee so that they can select opportunities (typically, 8 to 11 opportunities) that will be included in the EHS Process Improvement Program. The committee can use many of the same criteria that were used to select the process in Attachment 1 in order to make their decision.
Special attention should be made to the means selected for determining significance in the ISO 14001 and/or OHSAS 18001 programs (if applicable). If you do not use these management standards, they do offer methods to consider for rank-ordering the opportunities that may be useful for your purposes.

11. List of EHS Process Improvement Projects

- The EHS process improvement projects selected using the Opportunities Selection Process will be documented and reviewed for inclusion in the program.
- The management oversight committee will have to assign employees to work on each of these project teams following the guidance in the Team Organization Checklist.

12. Team Organization Checklist

The management oversight committee should assign employees to each of the EHS process improvement projects that appear on the list in Attachment 11. Important members of the team should include:

- An operator at the process map work step that is involved in the EHS process improvement project.
- A supervisor of the section/department.
- An employee that represents an internal "supplier" or internal "customer" of the process work step.
- A person from maintenance that is familiar with the process work step.
- Someone from quality or another functional staff member (e.g., accounting, environment, health and safety).
- Someone unfamiliar with the process. This person would help the team explore alternative solutions that they have not considered because they may be too close to the problem.

The ideal team size is five people.

The environmental coordinator can act as a resource to the waste minimization project team. However, this person should be primarily involved in the management oversight committee.

13. Statement of the Problem

- During the first meeting of the EHS project improvement team, someone representing the process mapping team should review the process map and the RA sheet with them. They need to describe what has transpired and how this problem was selected for inclusion in the EHS Process Improvement Program.
- The relationship between the EHS Process Improvement Program and the process at your company used to measure EHS performance should also be explained to the project team.
- Next, the EHS project team members should discuss a good statement of the problem. They may need to visit the area and view the work step and/or the supporting process. Finally, they will need to develop and agree on a one or two sentence "statement of the problem." In this way, each member of the project team will have a similar view of the nature of the problem. This is very important when using the Systems Approach tools to prepare a draft action plan for the EHS process improvement project.
One way to derive a good statement of the problem is to have each team member write what they think is the problem. Then the team members should read their problem statement aloud, in turn, to the other team members. The team should then select the best “sound bytes” from the statements and agree on a common statement of the problem.

14. Root Cause Analysis

When each of the EHS process improvement teams (see Attachment 11) meets with the Systems Approach facilitator to prepare their draft action plan, the first step will be to examine the potential “causes” of the problem stated in their Statement of Problem (Attachment 13). Once you have become familiar with the use of this tactic, you should be able to serve as the facilitator of the group.

At the start of this meeting, the EHS project team should review the process maps, RA sheet, and the Statement of Problem. Once this material has been reviewed, they are ready to use the cause and effect diagram.

Using the root cause analysis (i.e., cause and effect diagram) template provided below, the team members will list all the components associated with their problem under the following categories:

- Materials (all of the resources used and lost)
- Machines (all of the technology, instruments, machines, etc.)
- Methods (all methods whether in writing or not)
- People (all of the positions that may have some responsibility for the problem)

The facilitator will help them answer the following question for each of the items displayed on the cause and effect diagram,

- “What is it about ______ that causes the “problem” described in the Statement of the Problem?

They will then write the answer to that question under the item and move to the next question until all the items have been addressed. It is important not to think of solutions to the problem at this point. The team should be looking for all of the logical causes of the problem in each of the four categories.
15. Root Cause Diagram

- MATERIALS
- MACHINES
- METHODS
- PEOPLE
16. Search for Alternative Solutions Using Brainwriting

❑ The EHS project team will look at the listing of potential causes of the problem and then work with the Systems Approach facilitator to use the brainwriting tool to generate a listing of potential solutions to the problem. The brainwriting tool is one of the tools in the Systems Approach. They will use brainwriting sheets as shown in the template on page 47.

❑ Each team member will select a brainwriting sheet and write down two different ways to solve the EHS problem (using boxes 1 and 2). They place that sheet back into the center of the table and withdraw another sheet. Two more alternative solutions are written and the sheet is once again exchanged.

❑ When the team member cannot think of any additional alternative solutions, they read what the other team members have written. Sometimes, this will help them think of something new or a modification of what they have read.

❑ A technique known as “provocation” is used to help spur some “out of the box” thinking. Any team member with a more or less “outrageous” idea uses it for one of the alternatives. Sometimes, these “blue sky” ideas spur thoughts of “something that just might work!”

Tip: Additional information on brainwriting can be found in an article titled “Identifying P2 Alternatives with Brainstorming and Brainwriting,” Pollution Prevention Review, 6(4), 93-97 (1996).
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<td>9</td>
<td>10</td>
</tr>
</tbody>
</table>
17. Prioritizing Alternative Solutions with Bubble-up/Bubble-down

- Next, the EHS project team will work with the Systems Approach facilitator to prioritize all of the potential alternatives previously identified using the brainwriting tool. For this prioritization activity, they will use a tool called “bubble sorting” or “bubble-up/bubble-down.”
- The little squares are cut from the brainwriting sheets and arranged in random order in a pile.
- Two of the alternative solutions are placed on the table and the team performs a forced pair comparison in which each alternative solution is compared with the alternative at the bottom on the list. The question is asked, “Which one is best?” The team members evaluate each alternative in the pair on the basis of cost (cheap is best), ability to implement (easy to do is best), and effectiveness (this is great as long as it does not cost too much or is not very difficult to accomplish). The better alternative bubbles up over the other alternative and is compared to the next alternative. If the team has five members, three members get to move an alternative or keep it where it is. Once the final order has been defined, the team can debate the final ordering.

18. Draft Action Plan

- Finally, the EHS project team will work with the Systems Approach facilitator to prepare a draft action plan. This is the final tool used in the Systems Approach. A template for the draft action plan is provided below.
- The top section of the action plan describes the “EHS project” and summarizes its purpose, describes the project itself, and states the benefits.
- The first task will be the baseline survey. It will be important for the EHS process improvement project team to determine what will be measured during the project. The team will also have to determine a financial measure of the project. In the next-to-the-last step, they will repeat these measurements to determine the physical and financial results of the project.
- The last step in the draft action plan is a statement of the “lessons learned” by the team in conducting this project.

Once the draft action plan has been reviewed and approved for implementation by the management oversight committee, it should be attached to the relevant environmental management program.
19. Draft Action Plan Template

ACTION PLAN
(PROJECT)

1.
Purpose:
Project:
Benefits:

<table>
<thead>
<tr>
<th>Work Tasks</th>
<th>Person/Team Responsible</th>
<th>Completion Date</th>
<th>Performance Goal</th>
<th>Resources Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
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<td>2.</td>
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<td>3.</td>
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<td>5.</td>
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<td>6.</td>
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</tbody>
</table>
20. Quarterly Meetings of the Oversight Committee

❑ The EHS Process Improvement Program Plan (described earlier) states that its management oversight committee should meet at least four times during the course of the year.

❑ At its first meeting, the EHS Process Improvement Program Oversight Committee will approve the Program Plan. They will also review each of the EHS process improvement project Draft Action Plans with the project teams.

❑ Once this oversight committee approves the EHS Process Improvement Program Plan and all of the project action plans, the EHS Process Improvement Program has commenced and this committee will meet on a quarterly basis as specified in the plan.

❑ All of the EHS Process Improvement Program information should be documented using the provisions for documentation as set forth in your facility’s EHS management program.