Companies that want to improve their operational processes can choose from several different approaches when designing their improvement programs. Basically, however, most improvement program models fall into two broad categories: the traditional approach and the Systems Approach.

This installment of the “Quality Toolbox” column compares the two approaches, highlighting their similarities and differences and discussing how they affect actual practices within companies.

Background: Two Different Paths to Process Improvement

Traditional Approach

The traditional approach to process improvement stresses a “top-down” methodology. It follows the typical project management models used by process engineers. The traditional approach begins by getting top management approval for the improvement program. Operations personnel are involved only at a later time—often by being told what they must do.

The traditional approach has been widely used in pollution prevention and cleaner production initiatives, as well as in the implementation of environmental management systems. While the approach varies from place to place, it basically follows the six steps listed in Exhibit 1.

Unfortunately, the traditional approach makes it very difficult to integrate environmental, health, and safety (EHS) programs into the larger corporate business structure. As a result, in companies that follow the traditional approach to process improvement, the EHS department often operates as a separate “silo” within the organization.

Systems Approach

The Systems Approach builds process improvement projects from the “bottom up.” It relies on a series of quality management tools that allow personnel involved in the operational process to identify and solve problems on their own.

The Systems Approach tools are discussed in detail in An Organizational Guide to Pollution Prevention (EPA/625/R-01/003), which was published in 2001 by the U.S. Environmental Protection Agency (US EPA). The tools have also been discussed in previous installments of this column. A brief description of some of these tools is included in Exhibit 2.

Many businesses already use these quality management tools (along with related methodologies such as lean production, Six Sigma, and operational excellence) throughout their operations. Because the Systems Approach relies on tools that companies already use in other contexts, practitioners of the approach find it easier to integrate pollution prevention and other EHS efforts with other corporate programs, such as quality improvement initiatives.

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This in turn allows the company to align its combined process improvement efforts with the overall operation of the business, in accordance with its vision, mission, and core values.

**Differences and Compatibilities**

In the sections that follow, I describe some specific differences between the traditional approach and the Systems Approach to process improvement. The organization of topics follows the six steps favored by the traditional approach.

It is important to note that the methods used by the two systems are not mutually exclusive. Various combinations of methods can be used as needed to adapt to the culture of the organization that is implementing the process improvement program.

**Organizing the Improvement Program**

**Traditional Approach**

Traditional approaches typically do the following at the beginning of a formal process improvement program:

- obtain senior management commitment;
- prepare and communicate a policy for process improvement;
- assign an accountable manager (i.e., a program champion);
- commit adequate resources; and
- train the process improvement implementation team.

In guidance published in 1992, US EPA specified that the goals for the process improvement program should be outlined at this stage. This timing is similar to that reflected in the requirements of the ISO 14001 standard.

These initial activities are typical of “top-down” process improvement programs. Management-by-objectives is used to set goals before the program is planned and implemented. There is little or no involvement by the company’s workers. In addition, the process improvement program often is devised and implemented without consideration of other types of improvement programs that may be under way at the company.

**Systems Approach**

With the Systems Approach, an informal team initiates the improvement program by preparing a preliminary process map and linked resource accounting sheets for the process that is under consideration. The team can enlist a facilitator trained in process mapping to help guide it in the preparation of this information, or use software to prepare the process maps.
Exhibit 2. Some Quality Management Tools Used in the Systems Approach

The Systems Approach relies on a number of decision-making tools that also are widely used in quality management programs. The tools are easy to use, although they may require some initial assistance from an outside facilitator.

The tools are designed to be used by teams rather than by individuals, which promotes teamwork and encourages employees to buy into the decisions being made.

Many of the tools also allow users to create charts, diagrams, or other graphics that can serve as effective visual aids when discussing proposed projects with management.

Several of the most important quality management tools are described in the list that follows.

• Process Mapping
  Process mapping creates schematic depictions of operational processes. The maps identify all the crucial elements of a process, allowing users to see the sequence of work steps and their relationship to one another. The work steps depicted on the maps also show how materials flow through the process.

  Process maps use boxes to depict the series of steps through which materials and other inputs pass as they are transformed into the ultimate product. Arrows between the boxes represent the movement of materials from one step to the next. Process maps can also be used to depict how materials are used and wasted.

  One key thing to remember about process mapping: It is “hierarchical.” A process map is actually a set of diagrams that depicts a process in more detail as you descend through its levels.

• Resource Accounting Sheets
  Resource accounting sheets offer a detailed look at the resources used and lost in each work step. They can also include all the supporting processes that are necessary for a work step to be performed. A spreadsheet typically is linked to the resource accounting sheet.

• Pareto Charting
  Process mapping generally reveals many different points where improvement can be made to processes. The team then needs to decide which of these many opportunities it will choose as the focus of its process improvement efforts.

  The team will probably notice that a handful of problems account for a disproportionate share of the organization’s EH&S issues. This observation is consistent with the “Pareto Principle,” which predicts that approximately 20 percent of an organization’s activities will cause 80 percent of its problems.

  Identifying the biggest EH&S problems will allow the team to create a Pareto chart that graphically illustrates which activities are generating the most costs. The Pareto chart tends to make a dramatic impact since it usually includes a few tall bars that clearly stand out from all the others—a sure way to capture management attention.

• Root Cause Analysis
  An organization’s EH&S problems often involve numerous contributing causes, some of which may not be immediately apparent. To identify these factors, the team needs to analyze root causes by creating a cause-and-effect diagram.

  Working through a cause-and-effect diagram requires the team to consider several different categories of potential causes—including materials, methods, equipment, and personnel—that may be contributing to the problem. The major causational categories are entered in boxes on the diagram, and the factors that relate to each category are then drawn in as branching lines.

• Generating Alternative Solutions
  Once the team has identified the likely causes of EH&S problems, they will need to generate some potential solutions. It is important not to simply seize the first solution that comes to mind, or assume there is one “best” solution. Instead, the team should try to consider a range of possibilities.

  A good method for generating alternative ideas is brainwriting (a written variant on brainstorming), in which participants write down alternatives in a process that allows them to comment and build on other team members’ ideas.

• Prioritizing Solutions
  Once the team has come up with a number of alternative solutions, they will need a way to choose the one most likely to work effectively. A good tool for doing this is “bubble up/bubble down,” a technique that allows team members to quickly sort through alternatives by comparing them two at a time and choosing the better of the two.

• Creating Action Plans
  At this point, the team will have identified the EHS issues they want to address and will have identified a workable solution for each one. They now need to commit that solution to writing in an “action plan.”

  This is a simple form that identifies each action the team plans to take. It specifies the person responsible for each action, along with the performance standard to be achieved, techniques for monitoring implementation, a target completion date, and the resources needed to implement the action.

Process maps are hierarchical, meaning that each successive level of the map describes the process in more detail. Process maps also are very visual, which makes them valuable tools for communicating with management and with operational and maintenance personnel.

Such communication is important in building consensus for process improvement. Effective communication also makes it easier to integrate the process improvement effort with other improvement initiatives going on elsewhere in the company.

Once the process maps are prepared, the team seeks comment on them from people involved with the process. In addition, the team briefs managers on its preliminary efforts. If the company does not have prior experience with the Systems Approach, the team can ask management to sponsor a pilot project to demonstrate how the Systems Approach works.

Conducting Pre-Assessment

Traditional Approach

The traditional process improvement team uses available process information (such as flow diagrams, block diagrams, process flow diagrams, piping and instrument diagrams, or value stream maps) to understand the process and select opportunities for improvement, while also identifying several other considerations, including:

- relevant legal and other requirements;
- related company policies and targets;
- concerns of internal and external stakeholders; and
- total costs of losses in materials flows.

The team typically identifies and quantifies inputs and outputs for each step. Several methodologies actually demand a detailed mass and energy balance of the process.

This is an expensive way to start a process improvement project. In addition, mass and energy balances need to be repeated every time the project is modified as part of a continuous improvement effort.

Systems Approach

In the Systems Approach, the preliminary hierarchical process map and the linked accounting sheets are refined with available process information. The process improvement team does not quantify inputs and outputs at this stage.

The process maps maintain a unique perspective on the process and link supporting processes to work steps in the main process. Because of their hierarchical nature, process maps typically offer more detailed information than do the process diagrams used in the traditional approach.

The process maps are shared with operators and maintenance staff, as well as with engineering and design personnel. In addition, people involved in other process improvement efforts are shown the hierarchical process maps and the resource accounting information.

Sharing information in this way helps the team verify that the information is correct, and involves everyone in the process improvement program pilot project. The process maps can be computerized to help organize all available process information by work step. Key information includes:

- inputs and outputs;
- supporting process links;
- equipment and systems used;
- environmental, health, and safety activities;
- environmental aspects (for ISO 14001); and
- workplace hazards (for OHSAS 18001).
The information relevant to management systems and standards (such as ISO 14001 and OHSAS 18001) needs to be updated every two years with a documented process. Using hierarchical process maps to collect and maintain the information will clearly meet these management system requirements.

Input and output information, and resource accounting information from supporting processes, is quantified only for the work steps that are involved in process improvement projects.

Process maps and resource accounting sheets make resource flows clear. Resource accounting sheets that show many inputs, outputs, and supporting process links are often good candidates for process improvement projects.

The interviews that have been conducted to verify the process maps and the resource accounting sheets. It is not uncommon for employees to suggest more than 30 projects for process improvement.

In many cases, there is no way to assemble these suggestions for improvement in an organized and effective manner. Sometimes management has a list of process improvement activities that it is considering as part of other programs it has instituted to improve the business. It is important to note that, at this point in the Systems Approach methodology, there are no “options” or solutions associated with these opportunities for improvement.

Once a list of opportunities for improvement has been compiled, the team can use Pareto analysis to prioritize them. Such analysis allows the team to identify the 20 percent of opportunities that typically account for 80 percent of the problems faced by the organization.

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The program evaluates these options by comparing them against company priorities, strategies, and operational barriers. Preliminary screening is required to identify the specific projects and options that will be submitted for feasibility analysis.

Some traditional process improvement programs set process improvement goals at this step. It should be noted that, up to this point, only the process improvement team will have been involved in the project.

**Planning the Process Improvement Program**

**Traditional Approach**

The top-down approach typically identifies opportunities for process improvement and then selects a small number of “options” for potential solutions to the problems that are found. In most cases, the team searches the available literature for “best practices” used by other businesses or “success stories” from companies operating in the same or similar industrial sectors.

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**Systems Approach**

In the Systems Approach, the team compiles a list of process improvement opportunities from the interviews that have been conducted to verify the process maps and the resource accounting sheets. It is not uncommon for employees to suggest more than 30 projects for process improvement.

In many cases, there is no way to assemble these suggestions for improvement in an organized and effective manner. Sometimes management has a list of process improvement activities that it is considering as part of other programs it has instituted to improve the business. It is important to note that, at this point in the Systems Approach methodology, there are no “options” or solutions associated with these opportunities for improvement.

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The team selects eight to 11 opportunities for improvement (experience having shown that this is the optimum number of problems that a program should try to tackle at once). These opportunities become the focus of the next step. A criteria matrix similar to the one used in ISO 14001 and OHSAS 18001 significance determination can be used to make the selection.

Management needs to be involved in the selection of these opportunities for the pilot program. Employee teams should be assigned to each improvement opportunity that is selected. The ideal team size is five people, and should include an operator who works with the process work step involved.

In addition, it often is useful to involve someone who is unfamiliar with the work step (such as a purchasing agent, accountant, salesperson, or...
other front office person) to help the team expand its thinking beyond day-to-day problem-solving approaches.

**Conducting Project Feasibility Analysis**

**Traditional Approach**

With the traditional approach, this is the point at which the team conducts the feasibility analysis. Internal or external engineering assistance may be required for this effort. The feasibility study will consider a limited number of options for addressing each selected project and rank the options based on their environmental benefits, technical feasibility, and cost.

Often the team prepares a detailed economic analysis with colorful charts and graphs to help management decide which projects to implement. Usually there is no operator input in this effort, and no root cause analysis is conducted on the opportunities for improvement. Only a limited number of options are considered to solve the problem identified.

**Systems Approach**

This step is at the heart of the Systems Approach. It does not rely on independent engineers, although it may use some engineering support. Instead, employee teams meet with a trained facilitator to perform the following activities:

- use the hierarchical process maps and accounting sheets to review the information that has been gathered and help prepare a definitive statement of the problem;
- conduct root cause analysis on the opportunity for improvement (i.e., the problem to be solved);
- generate a large number of alternative solutions using a brainwriting tool;
- select alternative solutions that the team wishes to implement using a bubble up/bubble down sorting tool; and
- prepare a detailed draft action plan for the work to be completed.

Once these activities are completed, the team submits its draft action plans to a management oversight committee for approval and allocation of resources to the project.

The quality management tools help the team members create important documentation that management can use in their review of the process improvement projects that are selected. The information is kept brief and is presented in a visual format, making it much easier to use than a complicated engineering feasibility study.

This is the point at which goals are set in the Systems Approach. Each project clearly states its performance goals in action plans after the necessary information has been evaluated and the route to a solution has become clear.

There is a saying, “Employees never resist their own ideas.” This observation is key to the Systems Approach. Involving employees in the process of choosing projects and developing solutions helps capture important information while increasing worker “buy in.”

With the Systems Approach, employees are directly involved in the process improvement effort rather than simply being told what to do—something that is often common in the traditional top-down approaches to process improvement.

**Implementing the Process Improvement Program**

**Traditional Approach**

At this point in the process, the top-down approach transfers some of the work to an imple-
mentation team. Working with the feasibility study that has been completed previously, those involved identify employee training needs and arrange to provide the training. The team will also typically do the following as implementation progresses:

- create supporting mechanisms such as incentives, internal and external communications systems, and reporting mechanisms;
- secure approval for project implementation and funding;
- collect baseline data for projects being undertaken;
- document results, costs, and benefits (with results being expressed in financial terms as well as in weight and volume indicators);
- create a means for taking corrective actions as needed during the process improvement program; and
- report to management about project progress on a regular basis.

**Systems Approach**

At this point in the Systems Approach, employee teams have an approved action plan that they are prepared to implement—one they wrote themselves.

Accounting should pre-approve all the cost categories that will be used to track the financial basis for each project. Financial analysis is institutionalized in each project by creating a task within the action plan that focuses on analyzing financial issues at the beginning and end of the project, as well as before every meeting of the management oversight committee. Physical measurements can also be tracked to monitor performance on the project.

The management oversight committee meets on a regular basis (usually quarterly) to review progress on the process improvement action plans. Each project tracks its financial costs and benefits. If necessary, action plans can be modified at management oversight meetings.

Management also typically searches for process improvements that can be made without formal projects. These improvements are called “look out” projects since supervisors should always be looking for such opportunities and identifying the people who will be responsible for all process improvements. Look out projects often include leveraging successes achieved in one area to other areas that have similar problems.

**Managing the Process Improvement Program**

**Traditional Approach**

In top-down programs, management authorizes audits to make certain that progress is being made within the process improvement program. Emphasis is often placed on physical measurements, with financial benefits generally calculated as lagging indicators.

In order to sustain a process improvement program, the company must be convinced of its business value and financial rewards.

In order to sustain a process improvement program, the company must be convinced of its business value and financial rewards. The traditional approach to process improvement typically focuses on the net present value of capital projects when computing financial returns. Practitioners of this approach often do not adequately track the costs and benefits of other factors such as modifying materials, changing methods, and training personnel. Financial calculations frequently are derived from estimates made during the feasibility analysis, or else are prepared after the project has been completed.

Project teams typically use traditional financial measures for calculating the savings associated with changes to materials and technology.
These measures do not use activity-based management assessments or real options for the calculation of the intangible benefits associated with the project. As a result, savings are usually understated. In most cases, companies that use the traditional approach do not calculate the costs associated with obtaining the benefits of process improvement.

During the process improvement program, the management oversight committee monitors the recognition and other incentives that have been adopted to promote the program.

**Systems Approach**

With the Systems Approach, management provides for regular oversight of the action plans that are prepared by each employee project team. Teams commonly use project management software to track all their costs, and review benefits and costs on a “planned versus actual” basis.

All cost items (e.g., people time, equipment purchased, and benefit cost savings) are pre-approved by the accounting staff before the project begins. The project teams have costs and benefits reviewed at the oversight committee briefing, in addition to discussing successes and opportunities for improving their work.

The management oversight committee spends time documenting the lessons learned from each of the project teams and from the program as a whole. Each team is able to take corrective action to improve the project. However, this corrective action must be approved by the management oversight committee at one of the regularly scheduled review meetings.

While the formal process improvement program is restricted to eight to 11 projects, other process improvement activities are usually happening as a part of the company’s continuous improvement efforts. These projects can be included in reports to the management oversight committee at their regular meetings in the form of “look out” reports. Most often these look out projects are sponsored by a member of the oversight committee and reflect improvements made in their department or under their control.

Process documentation on each look out project, along with a description of the project, is collected and submitted for review. At the end of the year, all projects are reviewed to determine which ones might be included in the next year’s process improvement program.

Typically, there is also a review of look out projects to determine whether any of them should become formal projects in the following year. In addition, some completed formal projects will become look out projects for the succeeding year so that their benefits can be further calculated, and to make certain that there is no “backsliding” in the progress that was made during project implementation.

**Summary Comparison of the Traditional and Systems Approaches**

The most important differences between the traditional approach and Systems Approach relate to the following components:

- establishing program goals,
- employee involvement,
- use of quality management tools, and
- implementing and integrating solutions.

These differences are discussed in the sections that follow.

**Establishing Program Goals**

The traditional approach typically sets process improvement goals fairly early in the program.
The actual timing of goal setting can vary, taking place either in step one of the program (as suggested in US EPA’s 1992 guidance) or in step three (the planning stage).

By contrast, the Systems Approach waits until after action plans are written to prepare program goals (in step 4). These program goals are, in effect, the combined performance goals of the various action plans. Management then has the option of stretching these goals to meet other business aims.

Systems Approach timing allows the process improvement team to set more informed goals since there clearly will be much more information available about the problems to be solved during later stages of the process than there is in the first step of the program.

**Employee Involvement**

Typically, the traditional approach operates with a determined top-down style. Employees are rarely involved in the selection and planning of process improvement projects.

In the Systems Approach, employees are directly involved in verifying the validity of hierarchical process maps and in identifying opportunities for improving the process. Management then selects the particular opportunities that are consistent with current business conditions and assigns employee teams to each project.

The employee teams then use quality management tools to prepare draft action plans that management approves for implementation. Once management agrees to provide resources for a process improvement project, the employees will be held accountable for its success. If management does not provide the resources or fails to provide proper oversight, employees are not held accountable. This provides a proper balance of bottom-up and top-down management that should help the program to be more successful.

**Use of Quality Management Tools**

The quality management tools featured in the Systems Approach are widely utilized in the business world. In most cases, they will be virtually the same as tools that are already being used in other quality improvement efforts within the company. This consistency makes communication easier between workers and management.

These tools also generate useful documentation describing what each project is seeking to accomplish. This documentation can be used not only in communicating with management, but also for reporting to interested parties outside the company, including regulators, stockholders, and other important stakeholders.

The hierarchical process mapping tool enables teams to learn about connections among the various projects within the process improvement program. These process maps also help keep track of “environmental aspects” (for ISO 14001) and “hazards” (for OHSAS 18001).

Successes achieved by project teams can easily be leveraged to other parts of the system using these process maps and their associated accounting sheets. Process maps can also be used effectively in training operators, maintenance personnel, and new employees.

Suppliers can be integrated as “supporting processes” of the main process that is being mapped. Their process improvements thus are effectively transferred to the main process at the subject company—their customer.

**Implementing and Integrating Solutions**

Typically, the traditional approach to process improvement considers a particular option (a.k.a. “solution”) for each project based on the results.
of a feasibility study that considers only a few alternative solutions.

By contrast, the Systems Approach typically considers more than 20 alternative solutions that are generated by using the quality management tools. It is root cause analysis that makes this possible—and root cause analysis is rarely used in the traditional approach.

The Systems Approach uses “systems thinking” to link the process improvement projects that are selected, and to leverage their lessons learned to every other aspect of the system that can use this information.

This differs from the traditional approach, which tends to be project-focused: Once one project has been completed, the next project is started—typically with little attempt to apply the lessons learned from the previous project.

### Moving to the Systems Approach

As the foregoing discussion makes clear, the Systems Approach offers some key advantages over the traditional approach to process improvement. So why isn’t everyone using it?

Professionals who use the traditional approach often are reluctant to consider the Systems Approach because they think it takes too much time to develop the skills needed to use quality management tools effectively. They often resist investing the effort needed to learn the tools, especially if they feel that their own approach has worked well in the past.

In fact, however, a knowledgeable facilitator can guide the transition to the Systems Approach, and train company personnel to use the appropriate methods and tools, at a relatively low cost. A train-the-facilitator program can be effectively implemented using a pilot project. Increasing computerization of the quality management tools can also help facilitate implementation of the Systems Approach.

Once a Systems Approach–based process improvement program has gone through about two cycles of “lessons learned” and selection of new projects, the program will probably have established itself well enough to continue into the foreseeable future.

By contrast, the traditional approach has a greater tendency to be discontinued when there is a change in management or when the company imposes budget constraints that restrict use of the engineering services needed to prepare the feasibility studies. The cost of performing mass and energy balance updates also typically contributes to the demise of traditional programs after a couple of years.

### Until Next Time

Future installments of this column will provide additional information on using the Systems Approach and realizing the many benefits it offers.

### Notes

2. Facility Pollution Prevention Guide (EPA/600/R-92/088). This guide is still widely used in the pollution prevention community.

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