

US EPA ARCHIVE DOCUMENT

Green Zia Environmental Excellence Program



The Nothing to Waste Program: Incorporating Pollution Prevention

into Small Businesses

The Green Zia Environmental Excellence Program is a voluntary program of the New Mexico Environmental Alliance designed to assist all New Mexico businesses, from the largest facility to the smallest corner business, achieve environmental excellence by implementing pollution prevention and energy efficiency programs.

Acknowledgements

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Dr. Robert Pojasek for his assistance in developing the Green Zia Environmental Excellence Program.

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For more information on the Systems Approach tools used in the Green Zia Environmental Excellence Program, please call Dr. Pojasek at (781) 641-2422

Introduction: Incorporating Pollution Prevention

The “Nothing to Waste Initiative introduces pollution prevention as a core component of business management. The minimization of waste and the maximization of efficiency are important to micro-business viability and to protecting the environment.

The following six tutorials have been developed to demonstrate the key principles of pollution prevention. Entrepreneurs are encouraged to immediately and continuously apply these pollution prevention concepts toward their businesses,

The process of applying pollution prevention includes examining the business process, identifying material loss, identifying the cause of the loss, generating possible solutions, selecting an alternative and implementing an action plan to prevent material loss and reduce costs. The tutorials walk through the process, each building upon the strategy presented in the previous tutorial. After you complete all six tutorials, you will be asked to answer several summary questions to determine whether the tutorials develop the critical skills intended.

The six pollution prevention tutorials are briefly outlined below:

1. Process mapping: Process mapping determines the steps materials pass through as they are transformed into the final product. These maps allow for the identification of all inputs to and outputs from a process, making wastes, or losses, evident.
2. Activity-based costing: This method helps you identify key losses and total dollar value of these losses. The Pareto principle suggests that 80% of the problems in a business come from 20% of the machines, raw materials, or operators. (The same is true for any facet of business. For example, 80% of sales come from 20% of customers, etc.) We will

demonstrate this principle by assigning costs to each loss in the process, a technique known as activity-based costing.

3. Root cause analysis: The underlying reason for a loss is known as its “root cause”. A cause and effect diagram is one way of determining the root causes for losses. By producing a diagram participants can see why and where losses occur in the process. Once the diagram is complete, a group “Dear Abby” letter will be written as a definitive statement of the problem to ensure that all participants are in agreement and can identify the reason for the loss.
4. Brainwriting: Because there are many ways to address a problem, this exercise is designed to help participants generate as many alternatives as possible to minimize loss. Each participant writes two ideas on a sheet of paper, the papers are exchanged, and two more ideas are written. This process continues until all ideas are exhausted. The team then discusses the ideas and produces a viable list of alternatives.
5. Bubble-up/bubble-down: Bubble-up/bubble-down is just one of the many evaluation methods available for ranking alternatives to determine the optimal solution. The list of alternatives is ranked by comparing the first two items, arranging them by order of preference, and continuing the process for the second and third items, etc., until the entire list is ordered. Considering each option with such factors as cost, implementability, and effectiveness will help identify the best alternative.
6. Action Plan: Now that the pollution prevention opportunity/opportunities have been identified and alternatives have been discussed, it is time to develop an action plan. This plan details the steps that need to be taken to implement the alternative and reduce or remove the loss from the process.

Each of these tutorials will take approximately 60 to 90 minutes to complete. We hope you will find the tutorials enjoyable and useful in your future management practices.

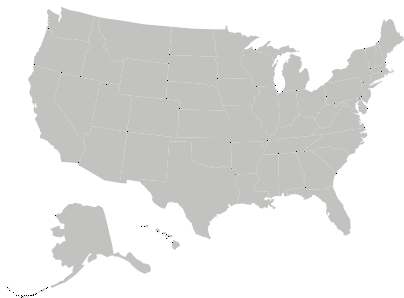
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Tutorial 1: Process Mapping

To begin incorporating pollution prevention into your business, you must first get a full understanding of where wastes are being generated. This tutorial will discuss the advantages of using process maps to logically evaluate each step of your process.

Warm-up Exercise



Maps have been used throughout the ages for many purposes from helping sailors navigate the seas to providing a safe route for climbers hiking to the tallest peaks. You have probably drawn maps to your home or office so that someone could visit. It is important that the information on this map is complete and accurate or, as you may have found, your guest will get lost!

Take a minute now and think of a coffee shop or restaurant nearby that everyone in the group knows. Draw a map from the building you are currently in to this establishment - include traffic lights, landmarks, and any other important features along the way. Now compare maps with the other members of your group. Are they the same? If a person not familiar with the area was to use your map, would they have found their way?

Introduction

Are you aware of the amount of waste that your business generates? Could this waste be turned into profit? By considering methods of reducing wastes, recycling used and unused raw materials, and reusing lost material you could not only help the environment but also reduce your raw material and waste disposal costs.

This tutorial discusses process mapping, a method of analyzing a process in order to catalogue all the materials used and lost in the process. With process mapping, you will systematically identify the series of steps materials pass through as they are transformed into the final product. Evaluating your process in this manner will allow you to recognize the opportunities to prevent losses and possibly streamline operations. Each loss identified during the process mapping is an opportunity to prevent that loss.

During this exercise you will:

Objectives

- Fully understand the functionality of each step of a process.
- Identify the inputs and outputs/losses within the process.
- Communicate findings in a clear and concise manner.

Basic Instructions

This tutorial should be completed by your Green Zia Group.
Please read aloud from here on.
Allow 60minutes to complete.

Process mapping and *Discount Signs*

Jim Davis, a Green Zia participant, arrived at his Green Zia Group meeting full of enthusiasm. He had attended a training session on pollution prevention the previous evening and was surprised to discover the many opportunities for pollution prevention in his business. He was excited to share his findings with the group and help them discover opportunities in their businesses.

“Last night I attended a session on pollution prevention and I would like to repeat an exercise we did on process mapping,” said Jim. “Process mapping,” he continued, “is a method of identifying and documenting every input and output in a process by logically evaluating each process step.”

“Let's start by looking at my sign business,” said Jim. Jim has been operating *Discount signs* for five years and has recently been able to expand. His customers range from other small businesses in the area to consumers looking for unique gifts. The metal signs he produces come in a variety of standard colors and sizes. Jim stressed the importance of asking many questions during the exercise to be sure not to miss any losses.

“When I receive an order, I first cut a piece of metal to fit the specifications,” Jim began.

“Do you have a lot of scrap metal?” asked Cecilia.

“Well,” said Jim, “that's a good question. Sometimes I do have a lot of scrap metal. It depends on the size of the sign I'm making. Normally I just throw the scrap metal away.”

“Next I clean the metal to remove any dirt and oil,” he continued.

“What exactly do you use to clean the metal?” asked John.

“Just soap and water,” he answered.

“Next I brush on a primer to get the part ready for painting and, once that dries, I rinse it in the sink. The paint doesn't stick if I leave out these steps.”

“Finally, I paint the signs to meet the customer s specifications. Sometimes I have bottles of half-used dried-up paint that I throw away: this is one of my losses that I would like to reduce.”

“Do you package the signs for your customers,” asked another group member.

“I used to package all the signs in bubble wrap and then place them in a box, but I stopped doing that. Finding the right size boxes was difficult and expensive, and half the boxes would end up in the garbage in front of my store. Now I use my delivery company to package the few signs that I have to mail out to customers. I guess you could say I already identified that opportunity!”

“What about defects? Do you have a lot of defects? And do you reuse the metal if you can?”

“Do you have many spills? With the paint and paint thinner laying around I would think you have spills from time to time.” asked members of the group.

“I never thought about those things,” replied Jim. “You’re right I do have an occasional defect that makes its way into the trash. Normally the defects are due to cutting the metal too small or making a mistake with the lettering. If it's just a lettering mistake I remove the paint with some thinner and salvage the part, but if I cut the metal to the wrong specifications, I throw it out. I should really think of that some more. As for the spills, I try to keep a clean shop to keep spills at a minimum but I do have an occasional spill.”

Now that the group talked about the process in detail and discussed all the inputs and outputs, the next step was to create the process map.

“Let's present all this information pictorially by creating a process map,” said Jim. “Make a box and define the first step with a one or two word identifier such as *Cut Metal*. Put an arrow into the top of the box for each input and put an arrow coming from the bottom of the box for each loss. Then draw an arrow from the right side of this box into the next box, defined

by the second step. Continue this procedure until the entire process is defined.”

The group began mapping the process. (*See Figure 1*)

“As you can see,” said Jim, “my inputs are metal, soap, rags, water, paint, and paint thinner, and my losses are scrap metal, soapy water, used rags, paint, and paint thinner. Each of these losses is actually costing me money so reducing them will translate into additional profits. Plus if I can reduce these losses I will be helping the environment. Definitely a win-win situation.”

“I can see how you can benefit from pollution prevention,” said Benito, “but I own a small restaurant. I don't see how pollution prevention can help me make sandwiches.”

Jim replied, “Don't you have any losses? Stale bread, napkins, or maybe cleaning products?”

“Yes,” responded Benito.

“Well, where there is a loss, there is an opportunity to prevent that loss. Let's look at your operation next time.”

Discussion Questions/Activities

1. What did Jim discover by creating a process map?
2. How was Jim preventing pollution in his business? How was he benefiting from it?
3. What did Jim discover by discussing his process with his Green Zia Group?
4. Use the attached form to create a process map of your operation. You may need to modify this map by adding or removing more boxes, arrows, etc. Explain your operation to the group by walking them through your process map.

5. Bring your process map to your business. Go through your process step-by-step ensuring that you have not left out any steps or materials. Update your process map, if necessary, and bring it to the next meeting: you will need to refer to it.
6. Did you find this tutorial useful? Why or Why not?
7. Were the tutorial exercises clear? If not, please specify which ones were unclear and why.

At the next meeting, Activity Based Costing will be presented to examine the value of material losses.

Process Map

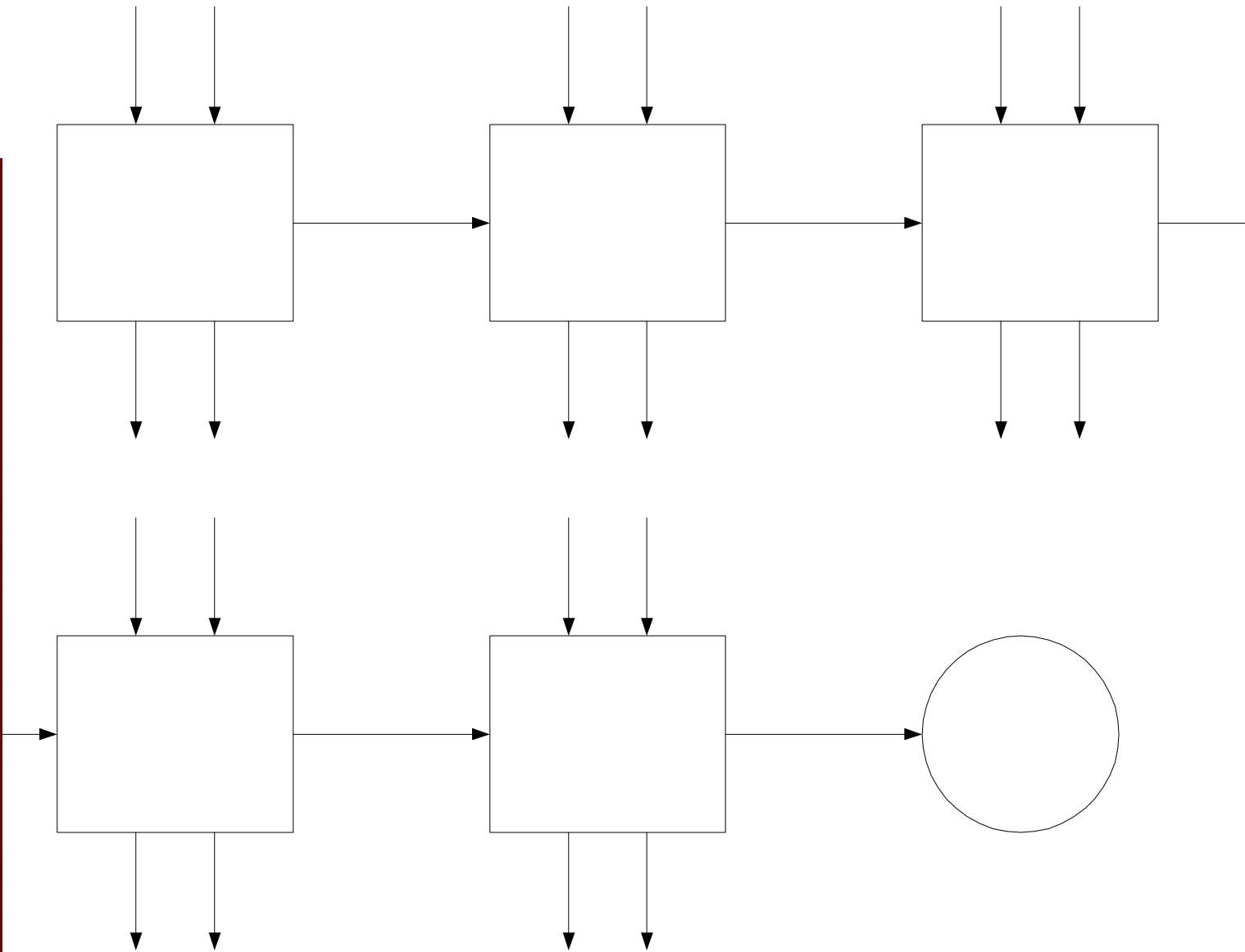
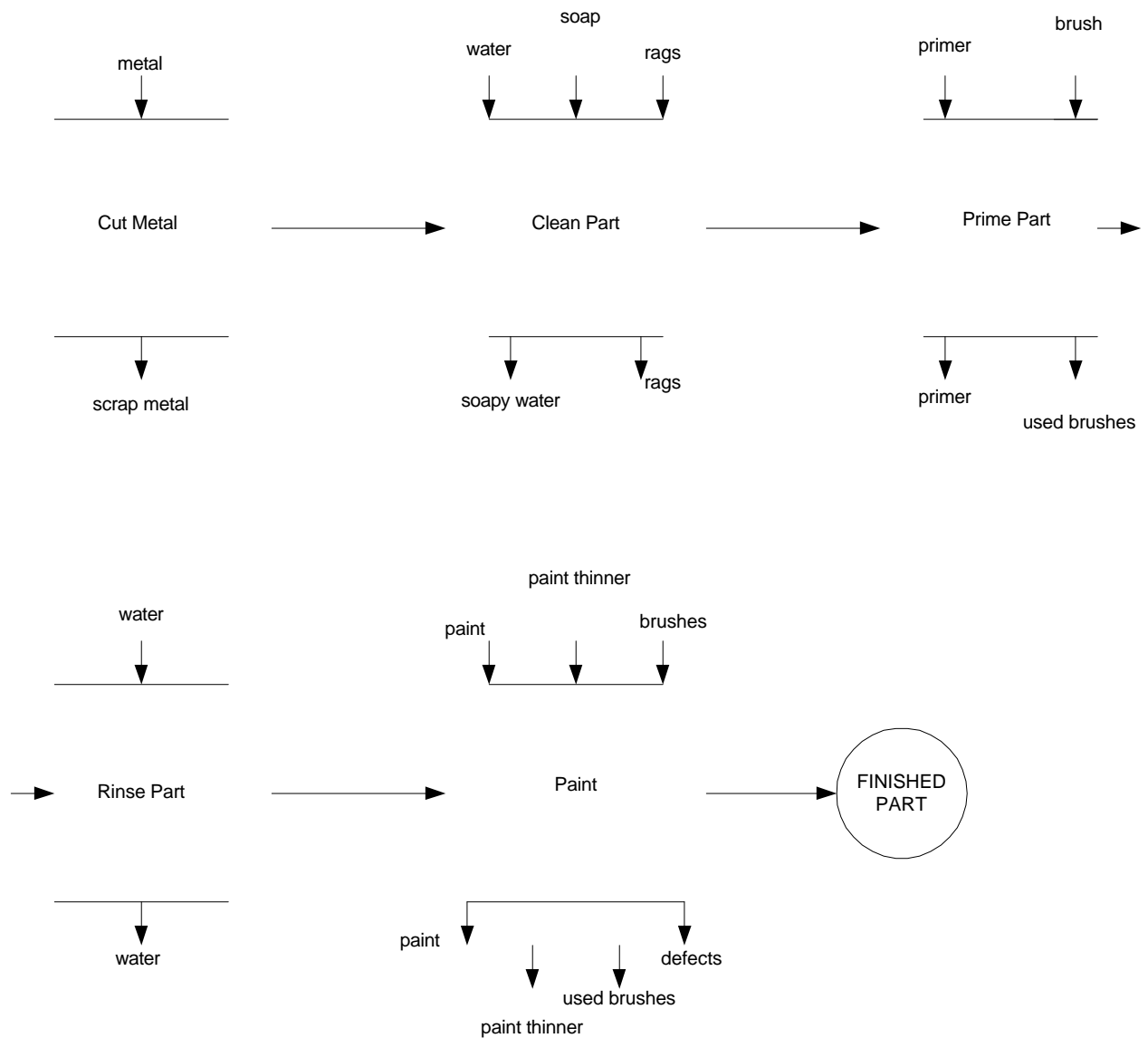


Figure 1: Discount Signs Process Map



Tutorial 2: Activity Based Costing

Every waste or environmental loss costs you money. By determining the activities that cause waste, you can focus your pollution prevention efforts to minimize the cost to your business and protect the environment. This tutorial will introduce you to a method of evaluating your waste.

Warm-up Exercises



Your daughter approaches you one evening and says that she is planning to buy a car. With the \$400 she has left over each month, after paying all of her bills, she is sure she will be able to afford the \$220 monthly car payment.

What are the other costs of operating and maintaining a car that she is forgetting?

Consider not only the annual costs, such as insurance, but also the intermittent (once in a while) costs. Can she really afford this car?

Introduction

Once you have determined the losses in your process, you can begin to discover how these losses are affecting your "bottom line". How much does it cost you to discard 10% of your raw materials, or 2% of your finished products? Which activities have losses that most hurt the profitability of your company? In this exercise we will take a look at the cost of the losses in your business and see how much these losses are costing you. The results may surprise you!

Activity based costing, or ABC, is a method of accounting for a certain type of cost by assigning each cost to the activity that generates it. In the warm-up exercise you used ABC to account for all the costs associated with operating a car, now you will use ABC to account for all the costs associated with the losses in your business, also called your environmental costs. Environmental costs include the costs of raw materials that are discarded, fees paid for hazardous materials disposal, and regulatory fines associated with a loss to name a few. As you saw in the warm-up exercise, there are many hidden costs that should not be overlooked.

Which losses should you be most concerned about? The Pareto principle, or 80/20 Rule, suggests that 80% of the problems in a business come from 20% of machines, raw materials, or operators. (The same is true for any facet of a business, for example, 80% of sales comes from 20% of the customers, etc.) Once you have assigned costs to your activities, you can figure out which 20% of your activities are contributing 80% of your costs. A Pareto diagram visually depicts total costs for each activity, making the biggest cost-drivers very apparent. The most prominent pollution prevention opportunities can then be targeted for improvement.

During this exercise you will:

Objectives

- Identify all the environmental costs in a process (that is, the costs associated with your losses).
- Assign each cost to an activity.
- Create a Pareto diagram depicting the total cost for each activity.

Basic Instructions

- This tutorial should be completed by your Green Zia Group.
- Please read aloud from here on.
- Complete all exercises as they appear.
- Allow 90 minutes to complete.
- Please have the process map you created in the last exercise readily available. You will need to refer to it.

New Terms

Activity based costing (ABC) - An accounting method used to assign the cost of your losses to the activities that generate these losses. By assigning costs to activities, you will discover the activities should be targeted for prevention.

Environmental costs - The costs associated with the losses in your process.

Pareto principle - A principle that suggests that 80% of anything can be attributed to 20% of the factors involved. For example, 80% of your environmental costs can be attributed to 20% of your activities.

Intermittent operations - Operations that occur once in a while.

Activity Based Costing in a Restaurant

Benito runs a small restaurant in downtown Farmington. After attending the session on process mapping, he is still unsure of how pollution prevention can work in his business. Benito decided to create a process map of his most popular lunch item, a chicken sandwich, to see if he could identify the losses. (see *Figure 1*)

“I mapped out the process of making a chicken sandwich,” said Benito at his Green Zia Group meeting, “and I found several losses. Most of my losses have to do with food being spilled, such as bread and chicken. But I also have several losses associated with cleaning the restaurant. I’m not sure how this ties into my process. But these losses are very important to me because they cost me a lot of money.”

“That activity,” said Jim, “is called an “intermittent operation”, or an operation that occurs once in a while. Intermittent operations can be mapped separately.”

“I see. The preparation area is visible to all the customers. Having food and ketchup all over this preparation area, as well as on the floors where the customers wait, and below the tables where people eat, is very unappetizing. Preventing spills will go a long way towards keeping these areas clean. Keeping the floors clean is very difficult, especially when we are at our busiest between 11:30 am and 1:30 pm. The other reason I like to maintain a clean restaurant is because I never know when the Farmington Health Department will be coming in to do its annual inspection. The inspection always goes better if the restaurant is tidy.”

“What do I do next?” asked Benito.

“The next step,” said Jim, “is to determine the losses (and thus the activities where these losses occur) that drive your costs. You will assign dollar values to each loss by the activity that generates it. Then we can evaluate the activities that are costing you the most. First you need to summarize all your activities and all your losses. List all your activities as they appear on your

process map and any intermittent activities that may be important. Then you can summarize your losses.”

Benito listed his activities:

List of Benito's activities:

Clean working surface

Take order

Cut bread

Make sandwich

Wrap sandwich

Clean restaurant

Exercise

Make a list of all the activities in your operation. Be sure to include the activities from your process map as well as any intermittent operations (such as cleaning or maintaining equipment.)

Benito then began to look at his losses. Again he referred to his process map. Benito's losses include soapy water, paper, bread wrappers, improperly cut bread, crumbs, odd pieces, etc., food wrappers, chicken, cheese, etc., mistakes, containers, condiment spills, and sandwich wrappers. Other losses not on Benito's process map include cleaning agents, dirty rags, etc.

Exercise

List all of the losses in your operation. Look on your process map and add any others that you think of.

“Great,” said Jim. “Now start to think about all the types of costs that are associated with these losses. When you think about the mistakes you have when you make a sandwich, don't just include the cost of the raw material that gets thrown away. There are other costs too. For example, the cost of the time spent making the sandwich and the cost of the unhappy customer that waits too long.”

Benito summarized his cost categories. “Well, there are many costs associated with the wasted raw materials; bread, chicken, cheese, vegetables, condiments etc. I have to store these products this also costs me money. The

other costs that are associated with the mistakes are the cost of my time spent making a sandwich that then gets thrown away, as you just mentioned. The further down the line a mistake is made, the more valuable the sandwich is, since additional foods are being added and additional time is being spent on its preparation. This concept is known as the “value added” to a product. I also have the cost of a potential lost customer: they may go away dissatisfied if I make them wait too long or give them the wrong order. Finally, there are the costs of the paper that I use to take orders and pieces of wrap that get thrown away.”

“What about the cleaning you do?” asked Cecilia. “You said earlier that this is a big concern of yours.”

“Yes, you are right. There are costs associated with the cleaning. The more cleaning I need to do, the more cleaning agents I must use. Excessive cleaning also leads to an excessive laundry bill from all the aprons and towels that must be cleaned. This takes up a lot of my time. By preventing spills, I could reduce these costs.”

“Then there are costs associated with inspections and other health issues. If the regulators come in and the restaurant is not clean, the inspection will not go well. I will need to spend a great deal of time with the regulators and I could end up with a few fines and a lot of paper work. In fact, this just happened a couple of weeks ago. An inspector came in at 1:30 right when the place looks the worst. I spent the entire afternoon with him and ended up with a fine because I didn't have the storage room in order. I know if the place looked better, he wouldn't have issued the fine because I didn't have any major violations.”

“If a customer gets food poisoning, such as salmonella, because the food is not properly stored or handled I could potentially be shut down. I'm careful not to allow this to happen. My other big concern is if mice get into the building they could get into the bread I keep in storage. The Health Department always checks for signs of mice, and the lost bread costs me a lot,” Benito continued.

“Make a summary list of all of your cost categories that are associated with the losses in your operation,” said Jim. “Next to each cost category, write the activity that the cost can be attributed to. Think about the steps, or activities,

in your process when you waste your time because of the losses that occur during this activity.”

Benito listed all his costs categories.

List of the cost categories and. activities associated with these costs:

Raw materials (Take order, cut bread, make sandwich, wrap sandwich)

Lost customers (Clean working area, make sandwich)

Time (Cut bread, make sandwich)

Regulatory Fines (Clean working area, clean restaurant)

Exercise

Create a list of the cost categories associated with the losses in your operation. Next to each cost, write the activities that the cost can be attributed to.

“Now that you've listed your activities, your losses, and your cost categories, with the activities that cause these costs, you should set up a table with this information we'll fill it in later,” said Jim. List all the different costs in the first column, such as the cost of raw materials etc., and across the top of the table list all the different activities, such as taking orders,” he continued. (*see Table 1*)

Exercise

Use the attached table for your costs and activities. Put all your cost categories in the first column, and all of your activities in the first row.

“Your activities and your costs are summarized,” said Jim. “Now your need to assign a dollar value to each cost by the activity. For example, in the second row, second column, you will enter the cost of the raw materials lost when you take an order.” (*see Table 1*)

“At this point, though, because you don't have all the information for all of your costs, divide \$100 among all of your cost categories based on their relative weight. Think about all your costs (due to the losses in your operation) from last month,” said Jim.

“So I should take \$100 and divide it up based on how much I think raw materials, lost customers, time, and regulatory fines cost me last month,” said Benito.

“That's right,” said Jim. “And these values should be based on the costs of your losses. That is, you wouldn't include the costs of all of the time spent by you and your employees, just the cost of the time required to cleanup or the time wasted when a mistake is made. This will give you a pretty good estimate.”

“Well, I would have to say when considering these costs from last month, the regulatory fine I received is my biggest expense. Probably close to half. I'll call it \$47.50,” Benito began. Benito continued to estimate his costs. “I also noticed that some of my regular customers haven't been around as much lately. This is my next biggest costs. I'll call it \$25.” Benito finished assigning his total costs.

“Place these values in the row marked TOTAL COST,” instructed Jim. “And then continue to assign costs by dividing up the TOTAL COST value for each cost into costs per activity. For example, if the total cost of raw materials lost is \$15, how much of this cost is due to lost bread during the “Cut Bread” activity? Fill all these values into the table. Add up all the costs by activity (i.e. each column) and calculate the percent.” (*see Table 2*)

Benito considered each cost. He broke down the \$47.50 for the regulatory fines into the two activities that had to do with cleaning the restaurant. After all, if the restaurant was clean, he would not have received this fine. Next he divided up the \$25 for the cost of lost customers. A small part of this cost, he figured, may have been due to mistakes. Thus, he assigned \$2.50 to the make sandwich activity. The rest of this amount (\$22.50) he divided among the two cleaning activities. Benito continued until all the costs were divided.

Exercise

Fill in the column marked TOTAL COST in your table. Take \$100 and estimate the relative amounts of this total that should be attributed to each cost category. Once you have finished entering TOTAL COST values, divide up the totals to the individual activities in each cost category. Fill these values in as well. Total each column.

Note: If you wish, see how well you estimated these costs by updating this table based on your actual expenses.

“Reading a graph is always easier than trying to interpret a table, so we are going to use the information from the table and create a Pareto diagram. It is

easy to do. Along the horizontal line, list all your activities. The vertical line will represent the relative cost represented by each activity.” (see *Figure 2*

Exercise

Using the attached graph to create a Pareto diagram. Write all your activities, as they appear in your table, in the boxes marked activity 1, etc. Now, for each activity, draw a bar up to the total cost for that activity (again as they appear in your table.)

“As you can see from the graph a majority of the costs associated with the losses from Benito's restaurant are from the cleaning operations, or just two of the activities. The Pareto principle suggests that 80% of the problems in a business come from 20% of machines, raw materials, or operators. This example demonstrates this principle. From this information, Benito now knows that he should focus on his cleaning operations. If he does this, he can increase his profitability by reducing his environmental costs.”

Discussions Questions/Activities

1. What is the Pareto Principle? Think of an example of how this principle holds true in your life (business or personal).
2. What advantages are there to graphing the results of your analysis?
3. What activity drives the environmental costs in your operation? Share this information with the group using your Pareto diagram.
4. As an optional exercise, spend some time between now and the next meeting and determine your actual costs. Some of these costs may be hidden or hard to determine. For example, how do you put a dollar value on your time? To put a value on your time, or the time of your employees, you need to consider what is called the “fully burdened rate”. When you calculate the fully burdened rate, consider not only the hourly rate you pay, but also the cost of all benefits. For example, if you pay someone \$7 an hour to work the counter and you also provide some health benefits and sick time, they are probably costing you as much as \$10 an hour. Now consider the cost of your time. If you pay yourself \$20 an hour, with all your benefits this number is probably more like \$30 an

hour. This brings up a couple of points. First, if someone is needed to perform tasks like cleaning the floor, you should assign the least specialized person on your staff - the person you are paying the least. Second, consider these fully burdened costs when you determine the total cost of a person's time since this is what the person's time is actually costing you.

The next tutorial will present Root Cause Analysis - a method to identify the factors which are causing material loss.

Figure 1: Chicken sandwich - Process Map

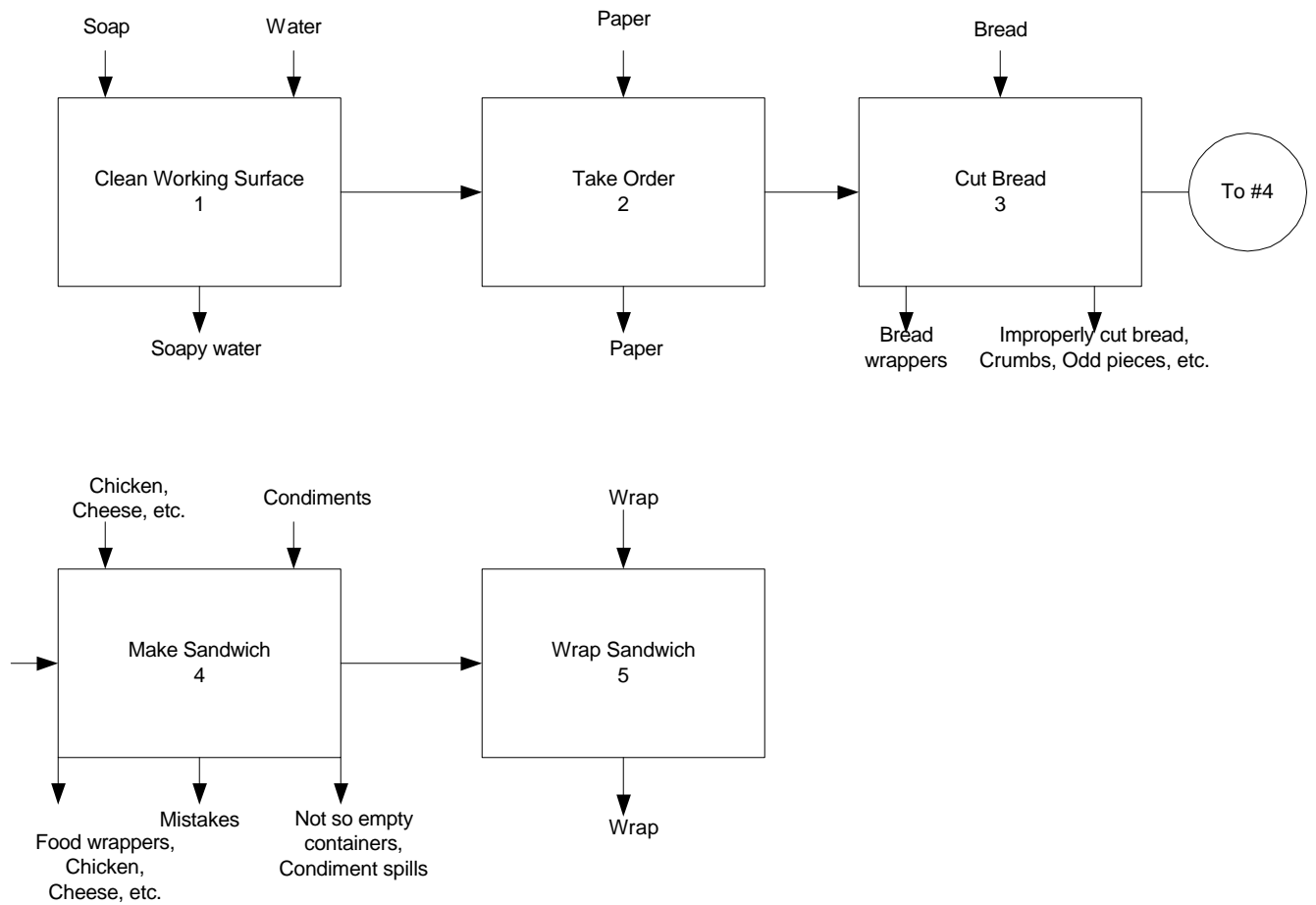


Table 1

Cost	TOTAL COST	Take Order	Clean Working Area	Cut Bread	Make Sandwich	Wrap sandwich	Clean Restaurant
Raw Materials							
Lost Customers							
Time							
Regulatory							
TOTAL By Activity							
Percent							

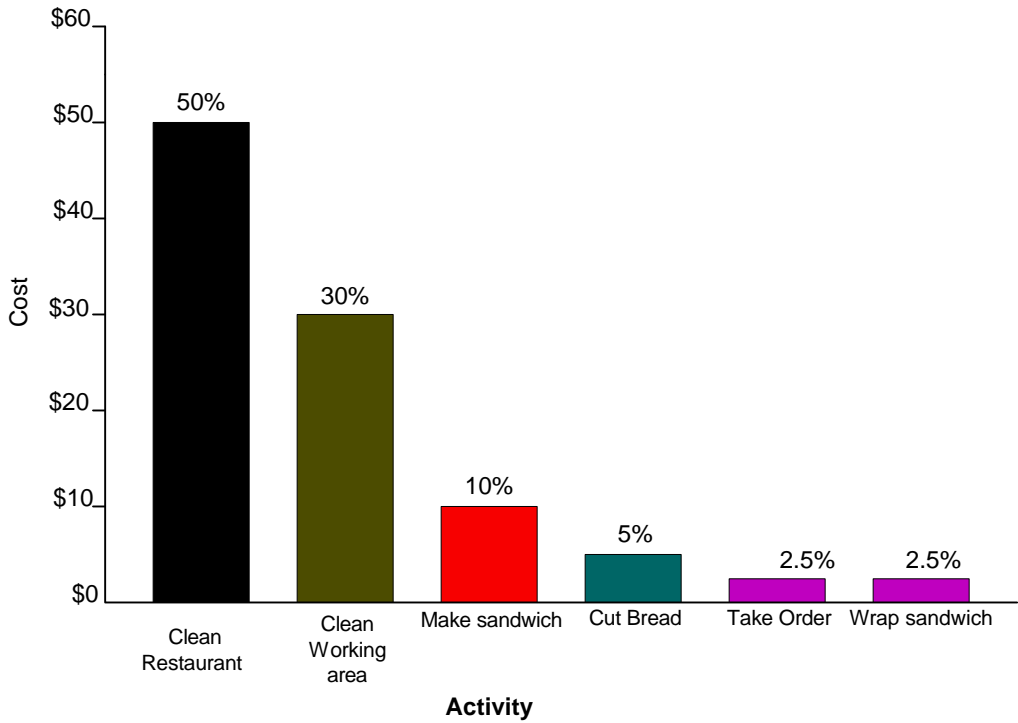
Table 2

Cost	TOTAL COST	Take order	Clean Working area	Cut bread	Make Sandwich	Wrap sandwich	Clean Restaurant
Raw Materials	15	2.50	0	2.50	5	2.50	2.50
Lost Customers	25	0	10	0	2.50	0	12.50
Time	12.50	0	0	2.50	2.50	0	7.50
Regulatory Fines	47.50	0	20	0	0	0	27.50
TOTAL By Activity	100	2.5	30	5	10	2.50	50
Percent		2.5%	30%	5%	10%	2.5%	50%

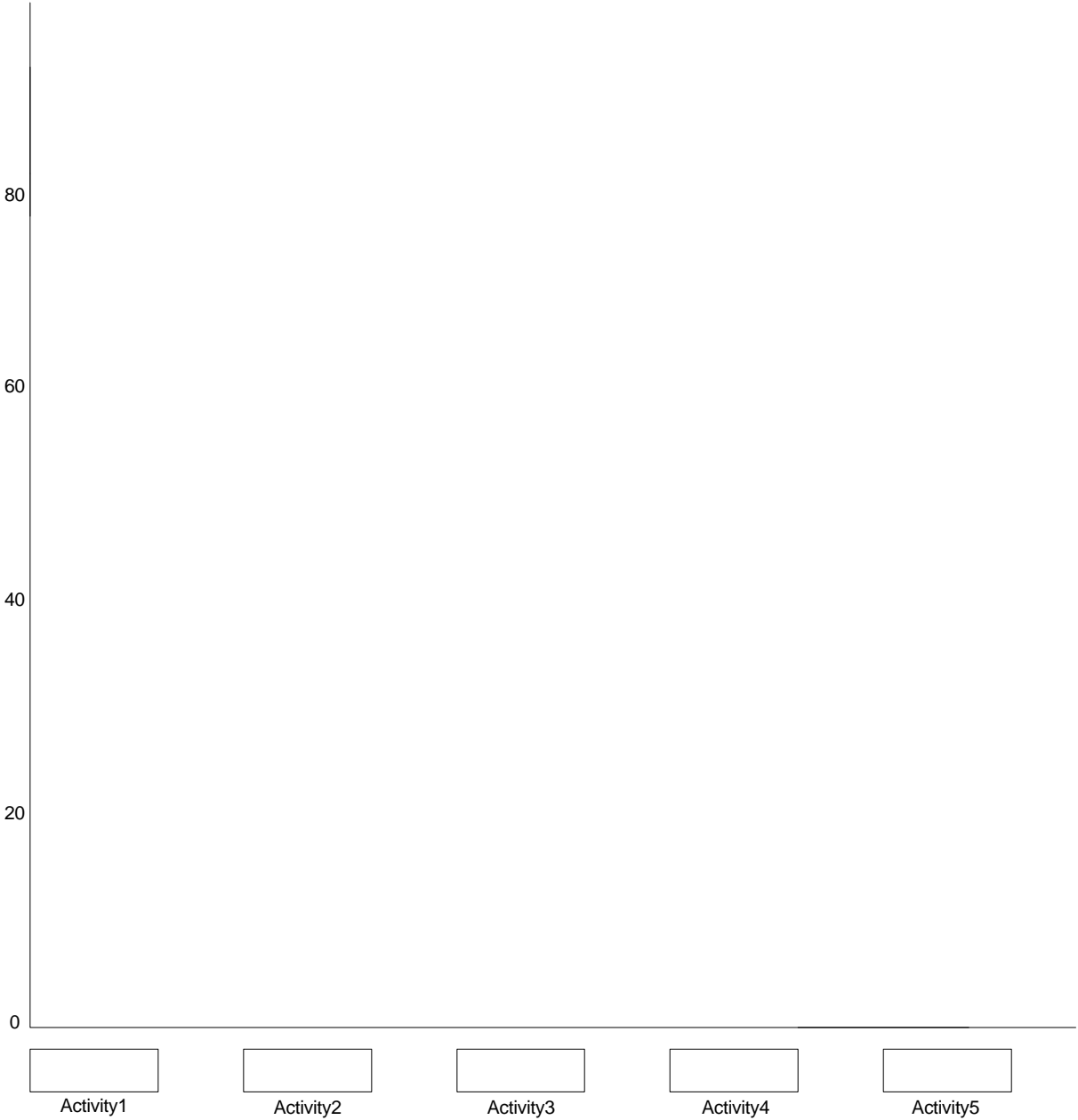
Activity Based Costing

Cost	TOTAL COST						
TOTAL By Activity							
Percent							

Figure 2: Chicken sandwich - Pareto diagram



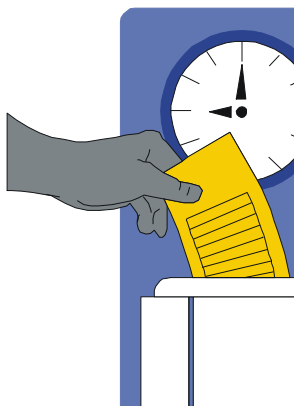
Activity Based Costing: Pareto Diagram



Tutorial 3: Root Cause Analysis

Now that you have recognized the activities in your process that are costly or expensive to your business, you can begin to focus your efforts on pollution prevention. This tutorial presents a method of detecting the underlying reason for an environmental loss so that the loss can be prevented.

Warm-up Exercise



Think of all of the times that you have been late for work and list the different reasons for your delay. Maybe your alarm clock did not go off, or perhaps your child was sick and you needed to arrange for a sitter. Did you spend too much time reading the newspaper or did you need to run to the store to pick up milk.

Arrange all these reasons in the categories listed below, or create an additional category. Some of the items on your list may be entered more than once.

Now consider the last time you were late for work. Why were you late? Circle the reason.

MACHINES

broken alarm clock

PEOPLE

sick child

METHODS

reading the newspaper

MATERIALS

out of milk

Introduction

In the last tutorial you determined the key losses responsible for the greatest amount of environmental costs. In order to try to prevent a loss, you must first understand why it is occurring. The underlying reason for a loss is also known as its "root cause". The root cause will answer the question: What *ultimately* caused the loss? Determining the root cause of an environmental loss is very similar to determining the root cause of being late for work

A cause and effect diagram is one method of determining the root cause for a loss. This tool provides a visual description of all possible causes for a specific loss. Once all the possible causes are depicted on the diagram, the most plausible cause or causes are identified. It is imperative that all persons involved in determining the root cause are in agreement. Having each team member construct a "Dear Abby" letter summarizing the cause or causes for a loss will ensure that all participants see the problem in the same way.

During this exercise you will:

Objectives

- Construct a cause and effect diagram with all potential causes for a loss.
- Discuss the most probable cause or causes.
- Write individual Dear Abby letters describing the reason for the loss.
- Write a group Dear Abby letter taking the best ideas from each letter.

Basic Instructions

- This tutorial should be completed by your Green Zia Group.
- Please read aloud from here on.
- Allow 60 minutes to complete.

Root cause analysis and *Belen Jewelry*

Cecilia Williams owns and operates a jewelry business, *Belen Jewelry*, specializing in beaded earrings and necklaces. With four to six part-time employees, she produces up to one-hundred items each day that she then sells to department stores.

After participating in process mapping and activity based costing exercises, Cecilia determined that her largest loss, the high-quality beads she purchases, accounts for approximately 80% of all her environmental costs. Cecilia was anxious to discuss this loss with her group and hoped that by talking through her problem she could discover the root cause of this loss.

“I knew I was throwing away some of the raw materials that I purchase,” Cecilia began, “but I could not believe how much this one waste is costing me. The result of my process mapping and activity based costing exercises indicated that the majority of my costs associated with wastes come from beads that are lost during all stages of the process. I really would like to spend some time getting to the bottom of this problem.” (*see Figure 1*)

Cecilia had done some research on methods of determining a root cause, including the use of cause and effect diagrams. She went on to explain the use of cause and effect diagrams.

“Let's spend some time discussing root cause analysis. To determine the root cause of a loss, you must ask “Why is the loss occurring?” I read about one way of gathering information concerning the generation of a loss called a cause and effect diagram, or fish bone diagram, since it resembles a fish bone. Major categories of possible causes for the loss are first defined and entered on the diagram as an off-shoot from a main horizontal line. Next, all possible causes of the waste are assigned to a category and entered on the diagram. Once all the causes are defined, an agreement is made as to the most plausible reason for the loss.”

“I have divided the causes into four major categories - Methods, Machines, Materials, and People - and what we need to do is write down all the

possible reasons why I could lose beads in my process and assign them to a category,” she continued. “I started the diagram and wrote down some of the things that immediately came to mind.”

“The first thing I thought of is my supplier. Normally the shipments are very good, but occasionally I get a shipment of beads that aren't very consistent. Some of the beads are different sizes and sometimes the shapes and the hues are slightly different and I can't use them. I also can lose beads when the chains break, but this doesn't happen very often. The other things I wrote down are that beads can get damaged when they are in storage either because the heat causes them to get deformed or because they are not stored properly: we don't really have any storage policies in place. Also the shop is a little small and sometimes it gets cluttered, so beads are easily spilled. Finally, I have a pretty high rate of turnover in my employees especially due to the cyclical nature of the business and I don't think I have been able to convey how important it is to prevent losses.”

“Those are the main issues I thought of, can anyone think of anything else?” asked Cecilia.

“Yes,” Jim replied, “You didn't mention anything about training. I know in my business when I put a formal training program in place, I saw a large improvement in the way raw materials were being used.”

“That's a good point. Currently I don't do any training,” said Cecilia.

Other ideas were also mentioned. One person brought up the importance of inventory control, after all, you would not have losses associated with parts being damaged in storage if there were no parts to be stored! Someone talked about the surroundings such as the importance of proper lighting in the workplace. Still another issue raised was process control, or the movement of material throughout the process. All these ideas were entered onto the diagram. (*see Figure 2*)

“Now that all the possible causes of beads being lost during the process of making beaded jewelry were categorized, it is time to determine the most probable cause. Let's go back to the diagram and circle the most probable causes. One of these should be the root cause. After much discussion, the team reached their conclusion. The lack of employee knowledge and training has lead to the excessive losses of beads. Cecilia suggested that each

member of the group write a short “Dear Abby” letter describing their interpretation of the problem to ensure that each person sees the problem the same way. After each letter was read to the group, a joint letter was written with the best ideas from each. Once the letter is in place, the group becomes Abby and seeks to solve the problem. (*see Figure 3*)

Discussion Questions/Activities

1. What is meant by the “root cause” of an environmental loss and why is it important to identify it?
2. Why is it important that all members of a group see a problem the same way?
3. Recall the activity that you identified as driving the environmental costs in your business. Write down all the possible reasons for this loss on the attached fish bone diagram.
4. Discuss your diagram with the group. Add any additional causes based on this discussion.
5. Circle the most probable cause and write a Dear Abby letter describing the problem. Read your Dear Abby letter aloud.
6. If other people work with you ask them to write down how losses occur in your business. Examine whether there are additional factors causing the loss that you did not think of.
7. Please give feedback on this exercise:
 - Was it useful?
 - Was the group response to Dear Abby productive?
 - Will you repeat this exercise to examine business losses in the future?
8. Were the tutorial exercises clear? If not, please specify which ones were unclear and why.

The next tutorial will present brainwriting - a method to generate ideas.

Figure 1: Beaded jewelry - Process Map

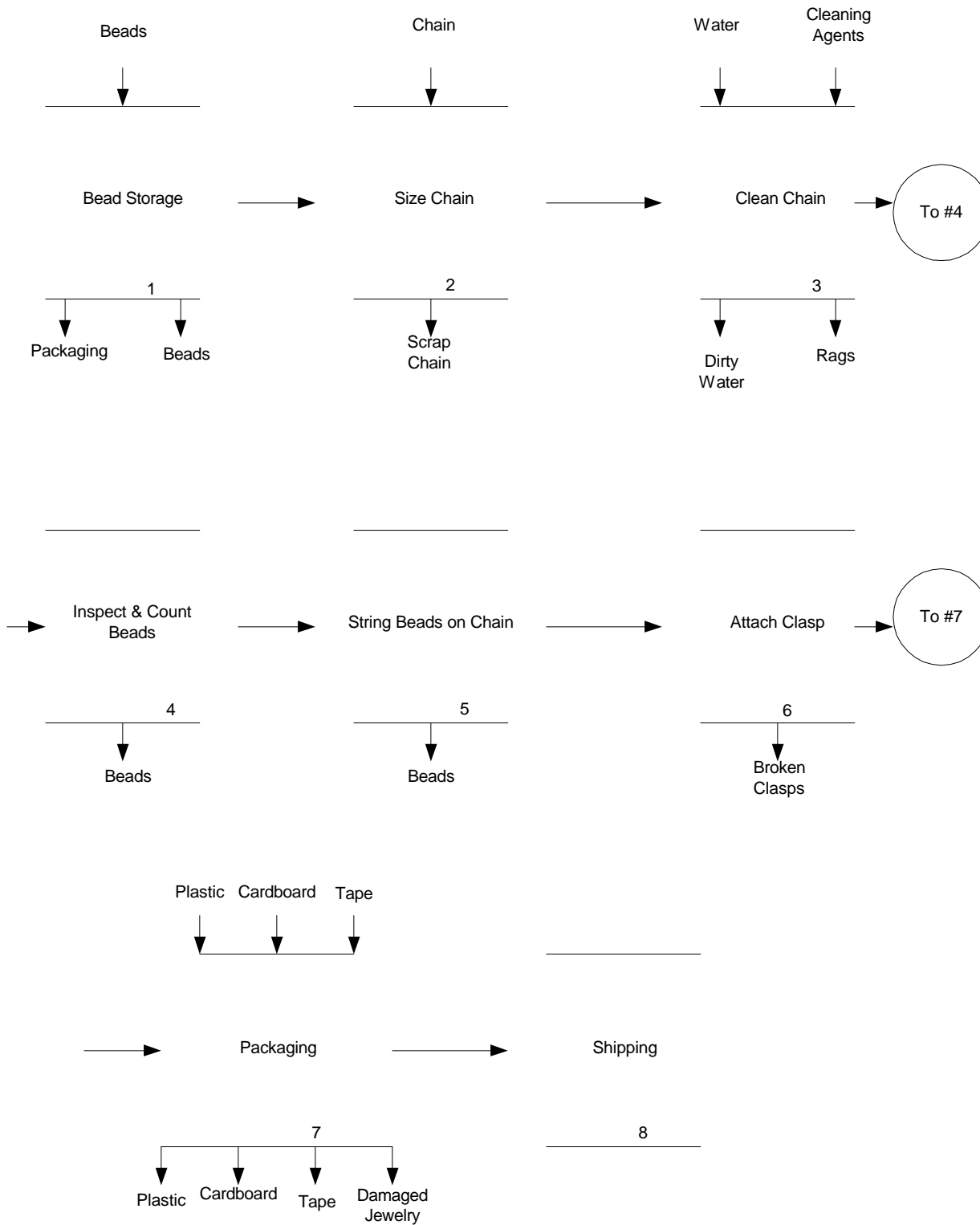


Figure 2: Cause and Effect Diagram

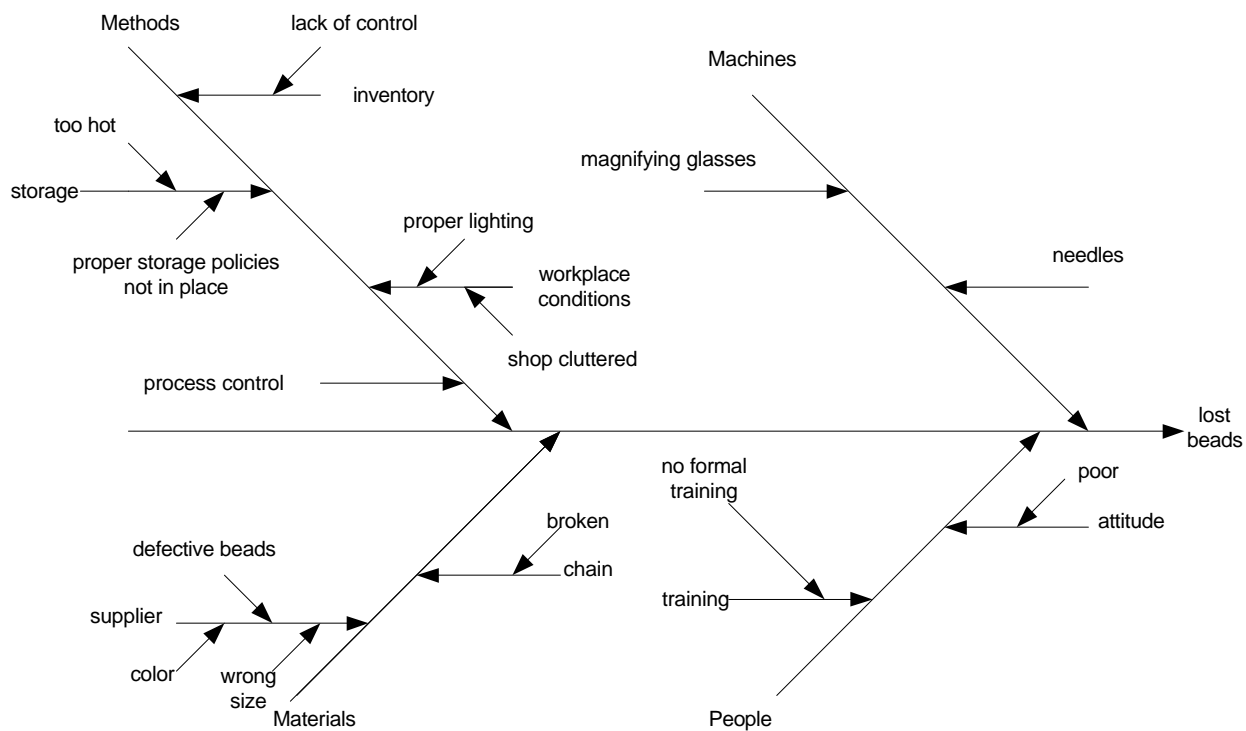


Figure 3: Dear Abby Letter

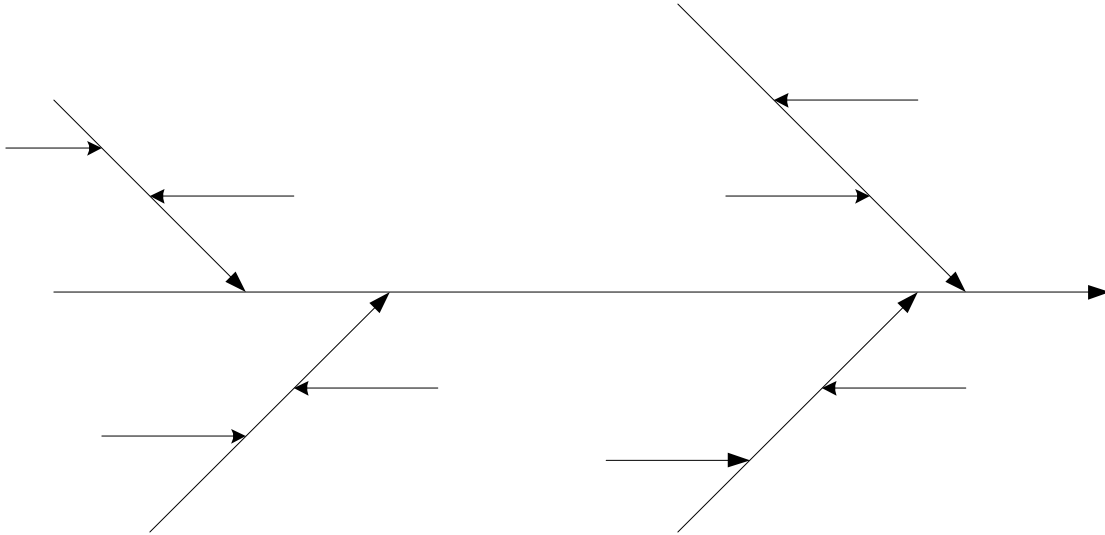
Dear Abby,

I'm losing my beads!! I make and sell high quality beaded jewelry. The cost of the beads keeps rising and my profits keep going down. I'm afraid more beads are landing on the floor and being thrown away than are going into the jewelry. I'm losing a lot of money especially when the shop is busiest. Finding well trained employees is very difficult. My employees work very hard but they do not realize the importance of being cautious when working these high-priced items. I guess I'm not communicating this to them effectively. Maybe I need to conduct training sessions to really make them understand. I hope you can give me some advice.

Sincerely,

Beadless in Belen

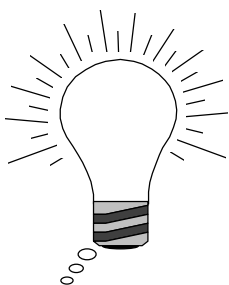
Root cause analysis: Fishbone Diagram



Tutorial 4: Brainwriting

To address an opportunity effectively, it is important to recognize all alternatives. Very rarely is there one "right" way of preventing pollution. Instead, there are many different potential solutions. This tutorial presents a technique of listing many different alternatives for an opportunity.

Warm-up Exercise



You know the old adage “two heads are better than one”. This is especially true when trying to come up with new ideas. When you generate ideas in a group you will notice that each member of the group brings their unique set of experiences and strengths to the table.

Try the following exercise with your group. Look at the picture below (turn it on it's side and upside-down). What does it remind you of? Write down all the images that come to mind—even images that seem crazy should be included. Now go around the room, each person sharing one image with the group. One person should volunteer to keep a list of all the images. Repeat this step until every member of the group is out of images. How many images did the group come up with? How does this compare with the number of images you generated alone?

Introduction

In the last tutorial you evaluated all the probable causes of a loss and determined the underlying reason, or root cause. Once the root cause has been identified, you may be tempted to jump to a premature solution. When you address a loss without considering all the alternatives of prevention you may be overlooking the most appropriate option(s).

Looking for alternatives for pollution prevention by addressing its root cause is the next step towards addressing an opportunity. There are several tools available to help groups develop alternatives. You already explored one tool during the warm-up exercise. In this exercise you will explore another method-brainwriting. Brainwriting requires maximum interaction and creativity between group members. All possible alternatives, regardless of how far-fetched they appear, are considered by the group. Alternatives raised by the group may seem contradictory, or they may build on one another making them better. A comprehensive list of alternatives can then be compiled.

During this exercise you will:

Objectives

- Conduct a brainwriting session.
- Develop a list of all possible alternatives for an opportunity.

Basic Instructions

- This tutorial should be completed by your Green Zia Group.
- Please read aloud from here on.
- Allow 90 minutes to complete.

Brainwriting and *Sam's Garage*

Sam Rogers, the owner of *Sam's Garage*, provides automobile maintenance at his shop. One of the regular, most profitable services he provides is oil changes. Looking for ways to further increase the profitability of this operation, Sam mapped out this process, indicating all losses. (see *Figure 1*) Sam discovered that 80% of the environmental costs associated with changing oil were due to oil spillage. Not only is oil expensive, but because it is considered a hazardous waste, Sam must handle these spills very carefully.

The largest spills take place when the oil is being added. After evaluating all of the possible causes for oil spillage during the "Add Oil" stage of the process, Sam determined the root cause for this loss. The quart-size containers that are currently used are difficult to pour into the small fill cap.

Sam shared this information at his Green Zia Group meeting.

"As you can see," Sam said after explaining the process to the group, "during the 'Add Oil' stage of this process, a lot of oil is being lost. This loss translates into less profit for the Garage. I created a cause and effect diagram with the mechanics and we decided that the oil containers are awkward and hard to pour from. We thought of a few things we could do to reduce spills, and I already think I know the best solution, but I was hoping the group could help me think of some additional alternatives."

"I have an idea," said Cecilia. "I was reading about a method of listing alternatives called brainwriting. The goal is to write down as many ideas as possible regardless of how crazy they seem. In fact, to make it more interesting we can give a prize to the person that comes up with the craziest idea. Since there are five of us here today, I will use six sheets of paper. Each sheet is divided into two columns and five rows, making a total of ten boxes on each sheet. Each box is numbered. I'm going to place these sheets in the center of our circle. Each person should take a sheet and write two alternatives on it and then place the sheet back in the center. Then take another sheet of paper and write two more alternatives on it. Every time you

pick up a sheet of paper read what others have written and try to make improvements to the alternatives listed. You can even say you think someone's idea is completely out in left field, if you try to make it better. Keep repeating this process until everyone runs out of ideas.”

The group performed this exercise. A lot of laughing and talking took place during the free flow of ideas. This is a key sign of a successful brainwriting session. (*see Figure 2*)

“Now we can list all the alternatives that were discovered,” said Sam.

The alternatives on each sheet of paper were read and discussed. Many of the ideas were the same and some had small variations. The group debated these small variations and eliminated the impossible alternatives. One comprehensive list was developed-each idea was only written once, although all variations of the same idea were included.

“We talked about a couple of these alternatives at the Garage,” said Sam, “but this definitely helped me come up with some additional things. I really like the idea of ordering the oil in bulk and running a fill line overhead. That will help keep the shop clean too. Employee training is also a good thought. I was hoping that by including the mechanics in this exercise I could also be providing some training.”

“That gave me a thought for another alternative,” said Cecilia. “Maybe you could provide some sort of incentive for employees who achieve pollution prevention.”

“I’ll add that to the list of things to consider,” said Sam. “Any by the way, who thinks I could get Ford to change the way they design their engines!?! That gets my vote for the craziest idea.” (*see Figure 3*)

Discussion Questions/Activities

1. Why is it important for Sam to consider alternative methods for preventing an oil spill (even though he thinks he knows the best alternative)?
2. What are the advantages of an exercise like brainwriting? How does it help members of a group work together?
3. Make "brainwriting sheets" for each member of the group plus one extra, using the attached example as a model.
4. Review the root cause for your loss discovered in the last exercise and state it aloud.
5. Conduct brainwriting sessions for each business represented. Spend at least 5 minutes on each session.
6. When all the brainwriting sessions are completed compile a list of alternatives for your business.
7. Did you find this tutorial useful? Why or why not?
8. Were the tutorial exercises clear? If not, please specify which ones were unclear and why.

The next tutorial will present 'bubble-up-bubble-down' a method for selecting the best option to prevent loss.

Figure 1: Oil change-Process Map

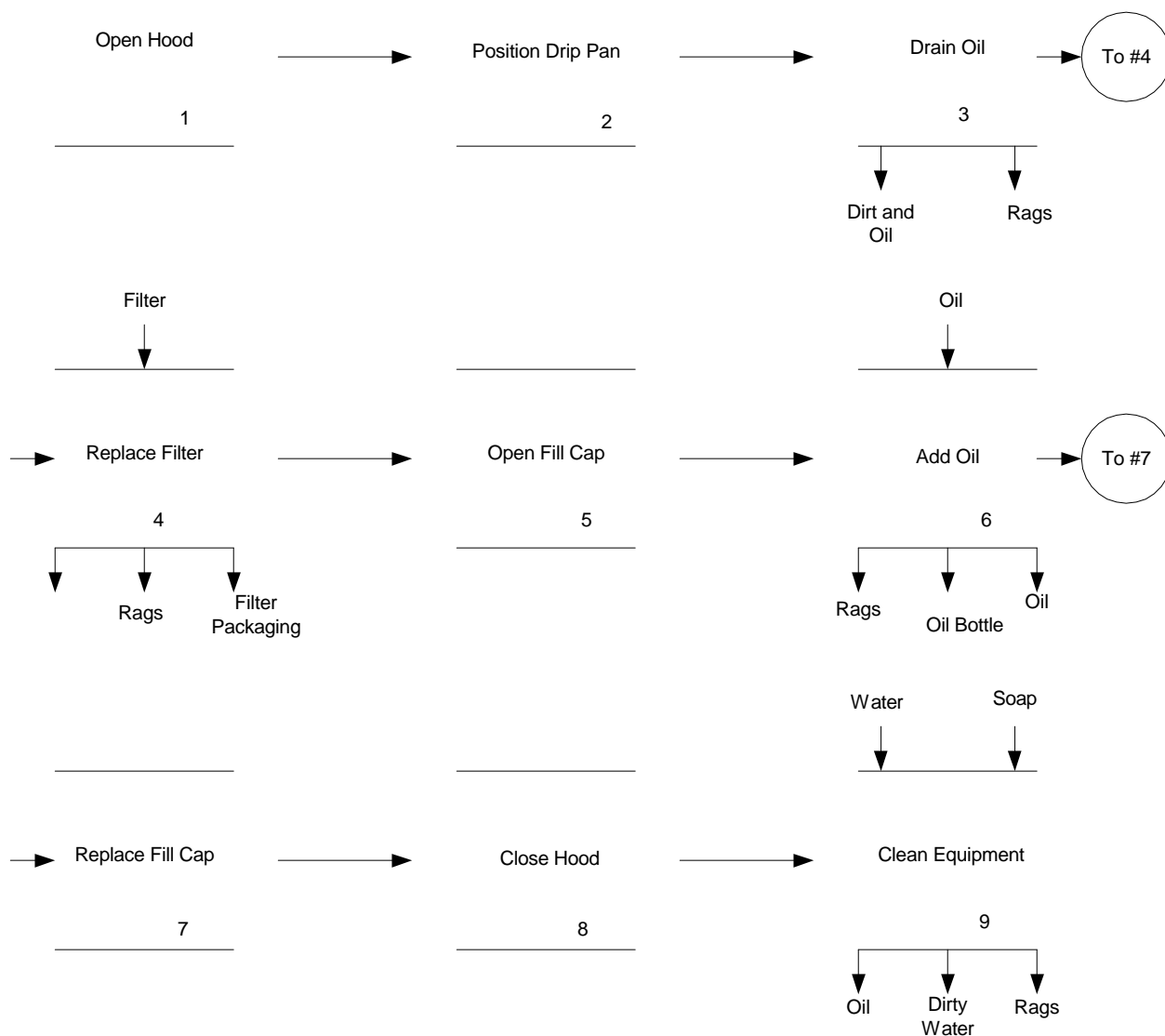


Figure 2: Sample of brainwriting

1. Use smaller oil containers that are easier to maneuver.	2. Buy oil containers that have a spout.
4. Place a drip pan under the engine to reclaim the oil that is lost.	5. Use larger oil containers so there is less residual wastes.
6. Put a spout on the container before you pour the oil.	7. No longer provide oil changes at the Garage.
8. #6 You would lose a lot of customers how about attracting more business so you can afford better equipment?	8.
9.	10.

Figure 3: List of alternatives

- Contact companies that package oil and request a different lip or spout on the quarts of oil.
- Fit a reusable spout onto the quarts of oil.
- Use smaller containers of oil that can be used more carefully.
- Buy larger containers to avoid residual waste.
- Pump oil from 100 gallon containers.
- Fill oil using an overhead line.
- Stop providing the oil change service in garage.
- Use a drip pan to reclaim spilled oil.
- Place a funnel on the fill cap.
- Write the automobile manufactures requesting that the location of the fill cap be moved to a more approachable area in the engine.
- Place suction hoses around the fill cap to reclaim spilled oil.
- Meter oil dispensing only what is needed.
- Train workers on pollution prevention and ways to reduce and reclaim spills.
- Provide incentives for employees who reduce losses.
- Measure thickness of oil ensuring oil is not changed unless it needs to be.
- Attract more customers for oil changes and invest in better equipment.

Figure 4: Brainwriting Sheet

1.	2.
3.	4.
5.	6.
7.	8.
9.	10.

Tutorial 5: Bubble-up-bubble-down

You have now generated a list of alternatives for preventing an environmental loss in your business. But how do you choose the best alternative? This tutorial presents one method of prioritizing alternatives to ensure that the most appropriate alternative is selected.

Warm-up Exercise



Most of us use lists from time to time to make sure that we don't forget to do the things that we need to get done. Without a shopping list, for example, we may return from the store without milk, the reason why we went in the first place. Certain limitations, like time or money, may cause us to drop things off our list. We often need to prioritize and make sure that the most important things get done.

Make a list of the things that you need to get done tomorrow (try to list at least ten things). List these items in the order that they come to mind. Now prioritize this list by putting the most important items on the top of the list and the least important items on the bottom. You should now have a “rank ordered” list. If you only have time to complete one of the items on your list, which would it be? You should have answered the item on the top of the list the most important item.

Introduction

A comprehensive list of pollution prevention alternatives was developed in the last tutorial using a technique called brainwriting. The alternatives generated during this tutorial can range from operational changes, such as employee training and inventory control, to technology changes, such as automating a process. The next step is to choose one alternative that is capable of being worked with successfully. Additionally, it is important to select the optimal solution for your business. To accomplish this, you must consider the *feasibility* of each alternative. Such factors as effectiveness, implementability, cost, and potential ramifications of each alternative should be discussed. Personal preferences and biased information should not enter into the decision-making process.

There are several tools available to aid a group in selecting an alternative and avoid bias. These tools allow a group to rank and prioritize alternatives using a systematic approach. When all the alternatives are listed, suggestions are made by the group to improve even the worst alternatives. At this point, many of the alternatives may be eliminated: every realistic alternative remains on the list. These remaining alternatives can then be sorted based on the factors presented above and any other factors that may effect a particular business. The method of selection presented in the exercise is the bubble-up-bubble-down. This tool uses a forced pair comparison to rank alternatives. Using this method you will be able to find the most effective solution to the selected loss.

During this exercise you will:

Objectives

- Evaluate all alternatives.
- Use the bubble-up-bubble-down method to reach a decision on the best alternative.

Basic Instructions

- This tutorial should be completed by your Green Zia Group.
- Please read aloud from here on.
- Allow 60 minutes to complete.

Bubble-up-bubble-down and *Creative Cabinets*

Lany Weaver has been operating *Creative Cabinets* for ten years. To remain competitive in this business, she has been forced to cut prices on her line of colored cabinets. In order to realize greater profit margin, Lany has been evaluating her process attempting to reduce losses and improve process efficiency. Streamlining and cost containment will counteract the squeeze on profit margin. Lany presented her case at her Green Zia Group meeting.

“The competitive environment for colored cabinets has been increasing,” Lany began. “I was forced to drop my prices and watch my profit margin decrease. I hope I can put these pollution prevention tools to work in my operation and improve the efficiency of my operation without jeopardizing the quality of the cabinets.”

Lany described the process of making these cabinets to her group. She receives precut cabinet doors from a vendor. The cabinets are then cut, sanded, and routed to meet customer's specifications. Components are loaded onto a conveyor where they move through open primer and painting booths and enclosed driers. Finally, the cabinets are assembled, packaged, and shipped. (see *Figure 1*)

“After evaluating my losses, I was able to demonstrate that 80% of all the environmental costs were due to one part of my operation-painting. I use a series of wet spray booths to apply the paint. Operators apply the paint using a spray gun. Over spray, or the paint that does not land on the cabinet, ends up in a washwater system; the resultant paint sludge gets shipped offsite for disposal.”

“There are many costs associated with this activity. First, there is the cost of the paint that is wasted. This paint waste is considered hazardous waste under RCRA federal law so disposal fees are very high. Plus, I have to spend a great deal of time completing paper work. I also have high cleaning costs and associated down time. My washwater system often gets clogged with excess paint, interrupting the process. I have to keep the spray guns clean to

keep them from getting clogged. There are several other costs too-I've just listed the major ones," said Lany.

"Have you determined the root cause for this loss?" asked Jim

"Yes," replied Cecilia, "I held a meeting with all the employees working in the paint process and we constructed a cause and effect diagram. We determined that the method of paint application was the root cause for the paint loss. We also held a brainwriting session and developed a list of alternatives for achieving pollution prevention in this process. We already eliminated the ideas that were not feasible. Now all that is left is choosing the best alternative. I really want to be cautious when I chose a solution since picking the wrong alternative could cost me a lot of valuable time and money, and could also damage employee morale." (see Figure 2)

Lany presented the alternatives to the group and explained the pros and cons of each. Some of the alternatives such as converting to a dry filter system, required a sizable capital expenditure. Other alternatives, such as contracting out the painting would put several of her employees out of work and may also end up costing her more.

Jim provided a suggestion on how to proceed. "You need to use a tool for rank ordering these alternatives," said Jim. "Try using the bubble-up-bubble-down method. Take the list of alternatives and compare the first two alternatives. Decide which of the two is the best and move this alternative to the top of the list. Go to the next, or third alternative and compare it to the second. If it is better than the second, move it up and compare it to the first, if not, leave it in the third position. Continue this process until all the alternatives are rank ordered. Make sure you listen to everyone's opinions and objections."

"I suggest you include all of the members of the paint group just as you have up to this point. That way you will be able to reach a decision that all the key players agree upon. In order to get an alternative to work you must have their buy-in. You may need to compromise in order to reach a solution that will be successful."

Lany held another meeting with all the employees of the paint process. She explained the bubble-up-bubble-down method of rank ordering alternatives. Forced comparisons were made between the alternatives. A great deal of discussion and even some arguments were heard. The painters, some with up

to ten years experience, were insulted at the suggestion that they may need to be trained on the best method of applying paint. The manager, Sal, was upset at the suggestion of moving to aqueous based paint. Sal had tried switching paint once before and it was a disaster. He let his objections be heard and did not let the other members of group forget that if there was a problem, he would be the one that would take the blame for it. Sal did agree that perhaps they were behind on the technology and using a dry filter system would be a lot more efficient.

The decision was reached. The group determined that the best alternative was to convert to using a dry filter system. They also decided that they would conduct another brainwriting and bubble-up-bubble-down session after the new system was installed in order to continually improve the painting process.

Discussions Questions/Activities

1. What are some of the potential problems associated with choosing the wrong alternatives?
2. Why was it important for Lany to include all the members of the paint group in the bubble-up-bubble-down exercise? Why is it necessary to compromise?
3. How did Lany's Green Zia Group help her work through selecting the best alternative?
4. Refer to the list of alternatives generated during the brainwriting session.
5. Take turns listing the alternatives on the board (or on a piece of paper).
6. Perform a bubble-up-bubble-down exercise for each list of alternatives. As you proceed with this ranking method, explain in detail the positive and negative attributes of each alternative.

7. Did the bubble-up-bubble-down method work for you? How did your business group help?
8. Were the exercises clear? If not, please specify which ones were unclear and why.

The next step is to develop an action plan.

Process Map

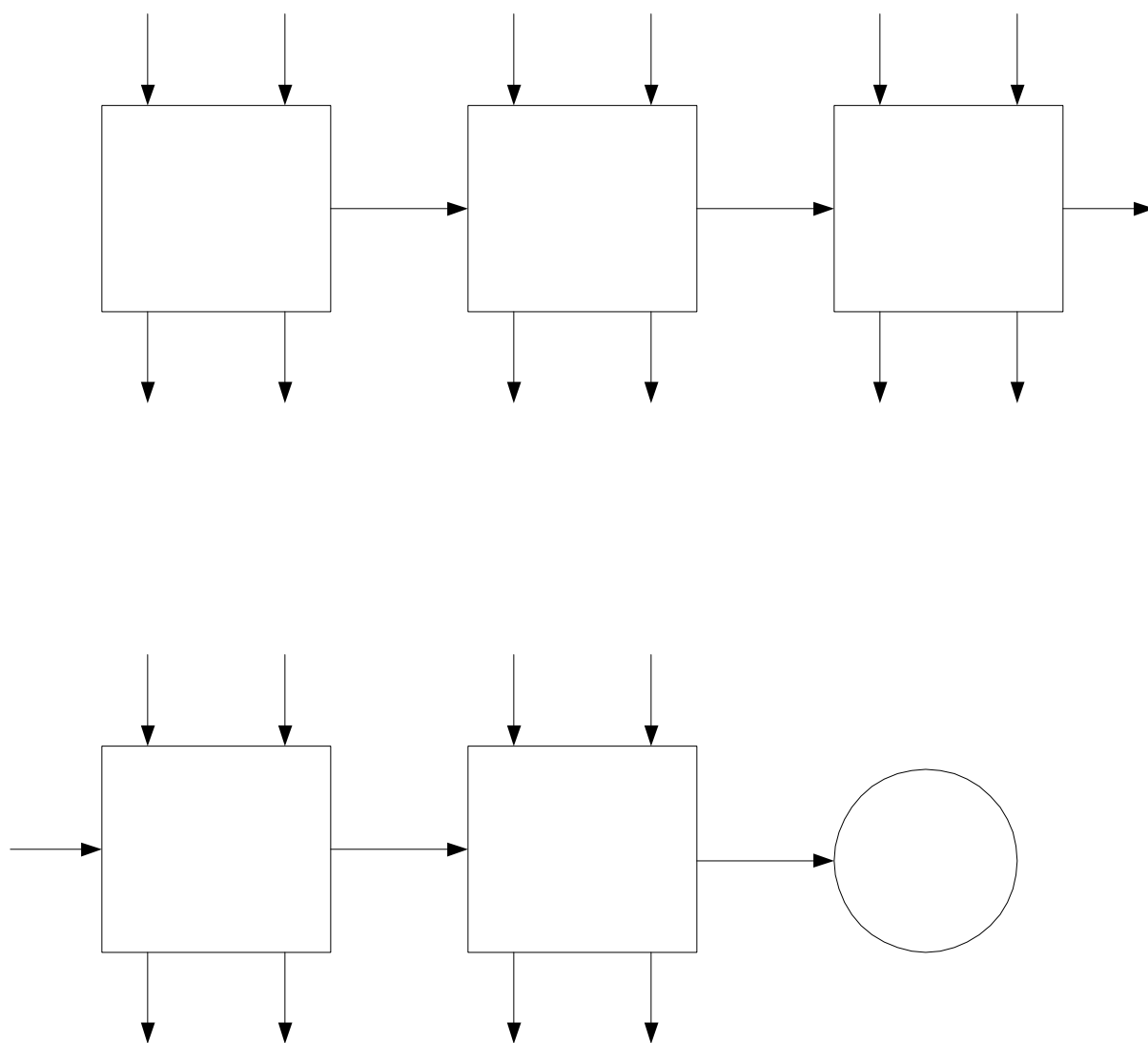


Figure 1: Cabinet making-Process map

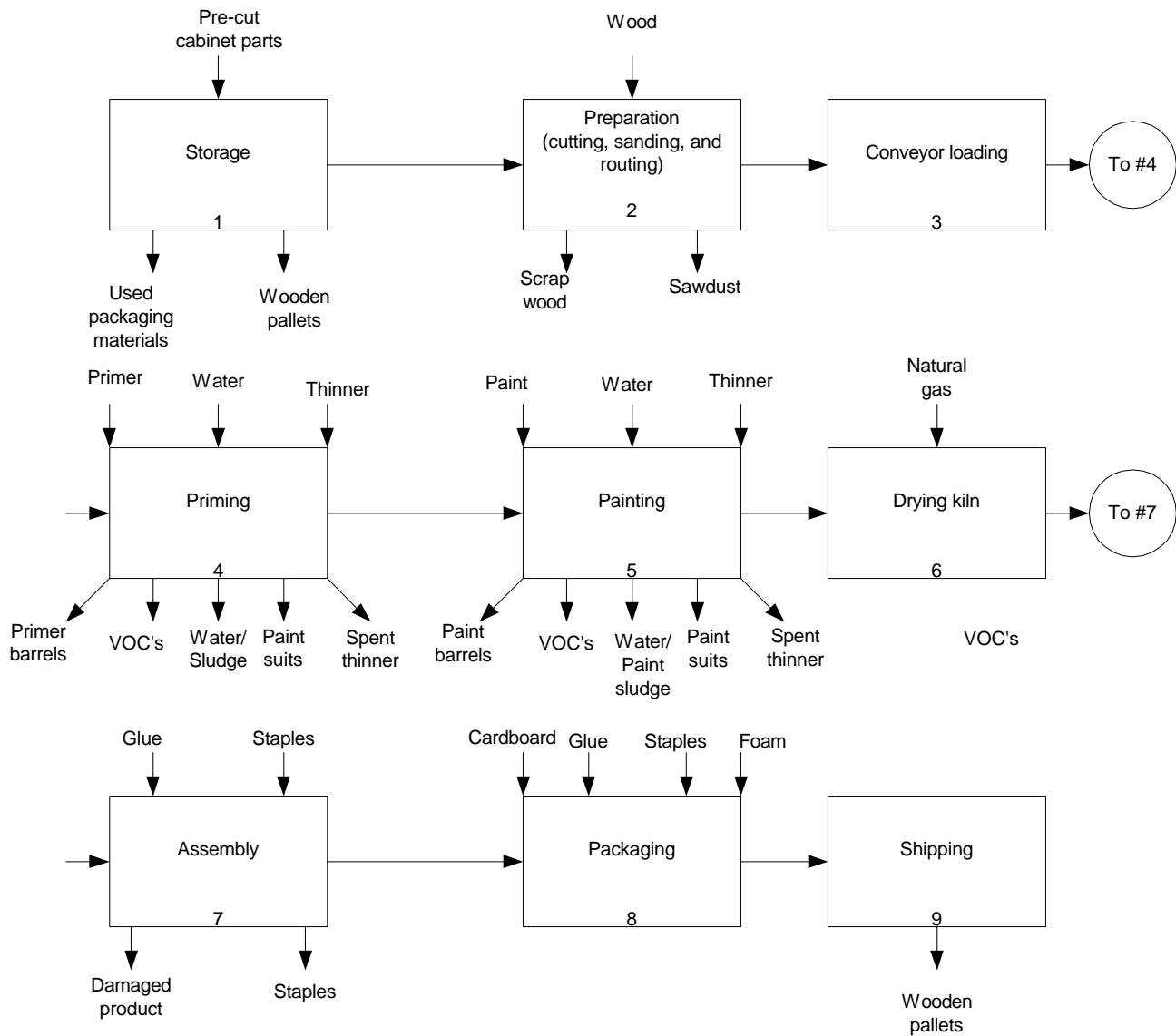


Figure 2: List of alternatives

1. Switch to an aqueous-based paint.
2. Use more efficient spray guns.
3. No longer provide painted cabinets.
4. Contract a professional painting facility to paint the cabinets.
5. Convert to a dry filter system.
6. Train employees on the best methods of applying paint.
7. Dewater the paint sludge to decrease the volume of sludge being disposed.
8. Enclose the painting booth preventing the paint from entering into the work area.
9. Dip cabinets into a tub of paint for cleaner application.
10. Recover the overspray and reuse.

Tutorial 6: Action Plan

Being able to successfully manage a project is important when trying to accomplish a task, especially when you are under a deadline. You need to set up a schedule, ensure that you have the necessary resources, and assign the right person to each part of the job. In this tutorial you will create an “action plan” for the implementation of an alternative to prevent pollution.

Warm-up Exercise



Your group has been assigned the task of making chocolate chip cookies. The cookies need to be ready in one hour and the cooking time is twelve minutes. Pick a person to manage this project. The manager must then assign the ten tasks listed below to individuals in the group.

You will need to know how much time is required for each task, what tasks need to be accomplished before others, what resources (i.e. bowls, flour etc.) are required, and what the most efficient way of organizing these tasks (and remember the clock is ticking). Create a schedule.

Making chocolate-chip cookies:

- Mix dry ingredients
- Mix wet ingredients
- Add chips
- Put the batter on the pan and put pan into the oven
- Combining wet and dry ingredients
- Turn on the oven
- Taste cookies
- Wash tools and utensils
- Grease pan
- Take cookies out of the oven

An Action Plan for *Prints by Marcy*

Marcy's screen printing business has been in operation for 25 years. Her largest client, the Nature Conservancy, has questioned her on the environmental impact of her business. When their contract came up for renewal, the Nature Conservancy asked Marcy to demonstrate her commitment to preserving the environment. Marcy had been attending the Pollution Prevention sessions with her Green Zia Group. She identified the loss in her process responsible for the greatest amount of environmental costs, and determined the best alternative for dealing with this loss. Although Marcy has not yet defined an action plan for implementing this change, she is confident that the Nature Conservancy would look favorably on this effort.

The process map for Marcy's business *Prints by Marcy, Inc.* is shown in Figure 1. Marcy determined that by incorporating a more sophisticated cleaning process she could reduce the chemical loss associated with screen reclamation. She was not sure how to proceed with the implementation. Marcy discussed her concern at her Green Zia Group meeting.

"I have a new reason to implement a pollution prevention change in my business. My biggest client wants me to demonstrate my commitment to preserving the environment. I'm going to send them all the output from our previous meetings on pollution prevention from my process map to the bubble-up-bubble-down exercise. But I still need to develop a concrete plan to implement the process change," Marcy explained. "I'm having a problem getting started."

"Why don't you briefly describe the process and how you intend to modify it," said Jim.

"I use screen printing techniques to print images on fabrics to make clothing, bags, and tapestry. It's really a simple process. First, mesh is placed over a frame, making a screen. Then a stencil is used to block parts of the screen, producing the image. The screen is placed on the fabric and a squeegee, or rubber blade, is drawn over the screen forcing ink into its porous portions.

Since the screens are expensive, I reuse them. The screen reclamation technique that I currently employ is a three step process. The ink is removed first by wiping an ink remover over the screen and then rinsing it with water. Next, the emulsion, or stencil, is removed. The emulsion remover is sprayed on, rubbed in with a brush, and rinsed off with water. Finally, the haze, which is the ghost image that remains on the screen, is eliminated. The haze remover is brushed on the surface and then the screen is rinsed one last time.” said Marcy.

“I contacted the Screen Printing Association International (SPAI) for some cleaning alternatives and after discussing these and many other approaches with members of the staff, we decided we were going to introduce a high-pressure screen washer. An emulsion remover will be applied to the screen. Ink and stencil will then be removed by a high pressure water blaster. Ink remover will no longer be needed. A haze remover will then be applied, only if needed. We have read about other companies' successes using this system and believe we can drastically reduce our chemical use and reduce the risk of chemical exposure to employees. Our reclamation costs will decrease due to the reduction in the amount of chemicals used and safety measures that need to be taken. Labor costs associated with this task will also be less, and this will free up the staff to complete other tasks, thus, increasing our production rate. I also expect my cleaning costs will go way down since I will be using at least one-third less rags.”

“Before you begin to implement your alternative you should complete this questionnaire,” said Jim. “It will ensure that you are being thorough in your planning and have considered all the important issues that may arise such as the resources that are needed and the problems that could may occur.” (*see Figure 2*)

Marcy took a few minutes to answer all the questions and read her responses to the group. (*see Figure 3*) When she finished she emphasized the important considerations. “My schedule is pretty flexible and I have already ensured that I will have all the resources that I need. But I do have two major concerns about implementing this new washer. First, I must maintain consistent high quality cleaning. If the screens are not completely clean, I could end up with an entire batch of defective products. My senior employee, Doug, is responsible for checking the quality of the screens so he will be monitoring this closely. Second, it's important that I have the cooperation of all my employees. Currently, I employ three additional full-

time people, Pat, Jean, and Paul, plus my husband, John, and sisters, Donna and Carol, help out when we get busy. There may be some problems in beginning-change always brings resistance. I will be ready to answer all questions and concerns. I think the training session and the group meetings will help ensure open communication.”

“Can you explain how you intend on tracking the success of this new technology?” asked Bob.

“Well, I'll be keeping a record of the amount of chemicals and water that are used each day. I can compare these numbers to the resource usage required using the current cleaning system. I will also monitor the service life of each screen to make sure that the water blaster does not cause excessive damage to the screens. If I find a problem, I can adjust the water pressure, temperature, or the chemicals used. Additionally, I intend to compare production rates and per screen reclamation costs. I expect my production rate to go up and my costs to decrease, after the capital expense of the new system is paid off, of course.”

“It sounds like you have thought it all out. Now put all this information in an Action Plan Form. Most of the information you need should come from your answers to the questionnaire. The specific task, or step, to be accomplished is written in the first column under “Action.” In the following column list the person who is responsible for completing this task. A performance standard should then be provided. This standard is a way of establishing how well a task needs to be performed. Under “monitoring technique” enter a measurable goal or target used to track the plan's implementation. A firm deadline should then be set, and finally, indicate the resources that are needed to perform each task. This form will help you organize your thoughts, keep track of all the actions that need to be completed, and ensure that the proper quality is being maintained” said Jim. (*see Figure 4*)

“I can definitely see how this form will help me keep track of the implementation of the high-pressure washer,” said Marcy. “I'm sure once this washer is in full operation I'll notice a significant reduction in the amount of chemicals I use. My demand on other resources, such as laundry services, will also decrease. The Nature Conservancy will certainly be happy about that, and it makes me feel good about my Company. Plus, I'm sure it will save me a lot of money!”

“That's great,” said Jim. “Since pollution prevention is a continual process, do you have any thoughts on future pollution prevention projects?”

“You're right,” Marcy responded. “I'm sure I can decrease my process losses even further. The alternative that came in second during the bubble-up-bubble-down exercise is prompt cleaning of screens. If the screens are washed before the ink dries, much less water and chemicals are needed to clean them. Once the first alternative is in place, I intend to start implementing a “Timely Screen Washing” Program.”

Discussions Questions/Activities

1. Why is it important to develop an action plan?
2. What are some of the key issues that are addressed in the action plan?
3. Recall your selected alternative from the previous exercise.
4. Answer all questions on the Activity Planning Questionnaire
5. Fill in the attached Action Plan Form
6. What do you see as the biggest problems in implementing this alternative? When this alternative is fully implemented, what are you expecting to accomplish?
7. How has developing an action plan improved your ability to prevent loss?
8. Did you find developing an action plan useful? Why or why not?
9. Were the exercises clear? If not, please specify which ones were unclear and why.

Congratulations!!! You have completed the Pollution Prevention Training. Now it is time to put these tools to work and remember pollution prevention is an ongoing process. If you continue to implement pollution prevention in your business, you will increase the efficiency of your process while helping the environment.

Figure 1: Screen Printing-Process map

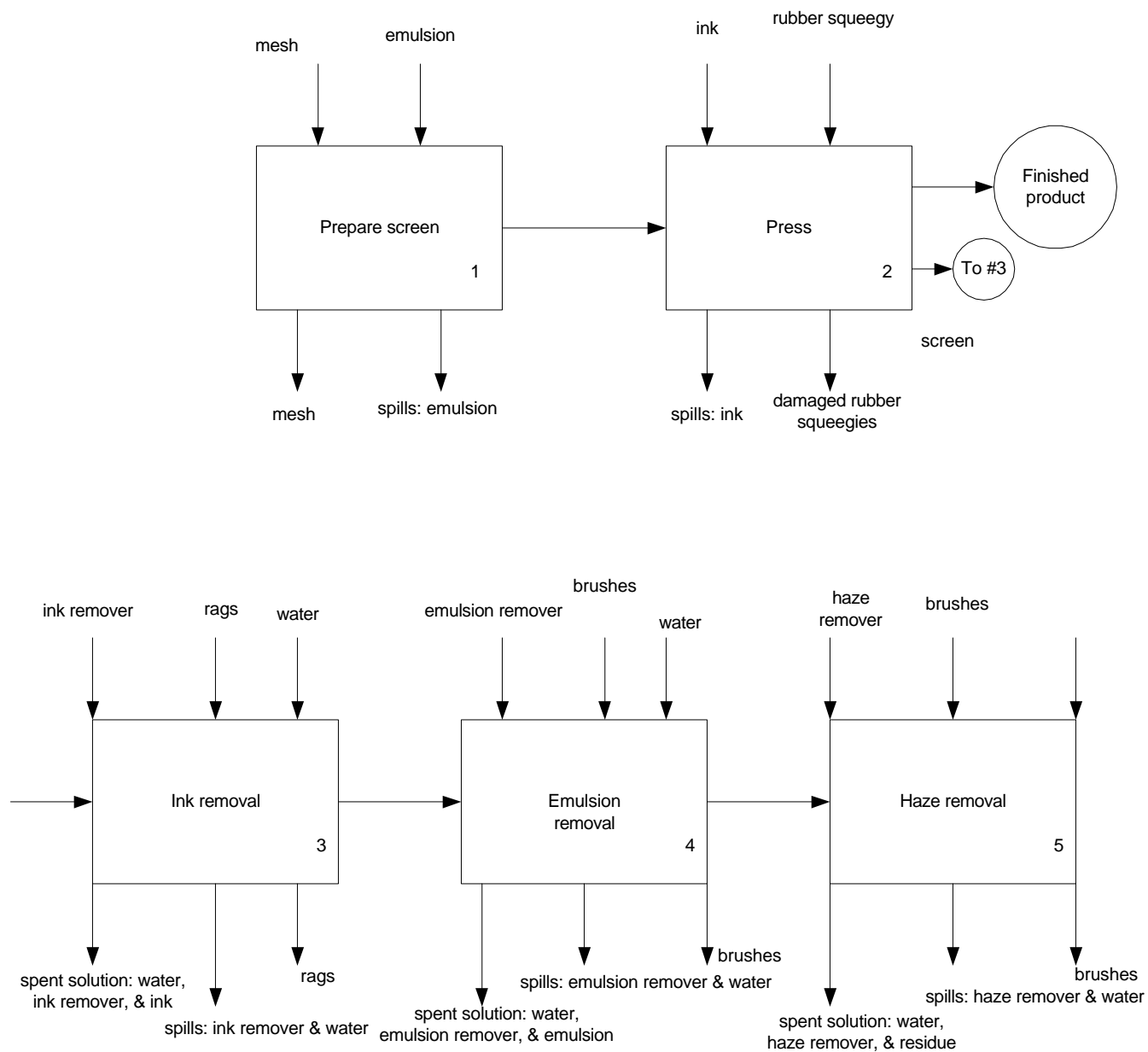


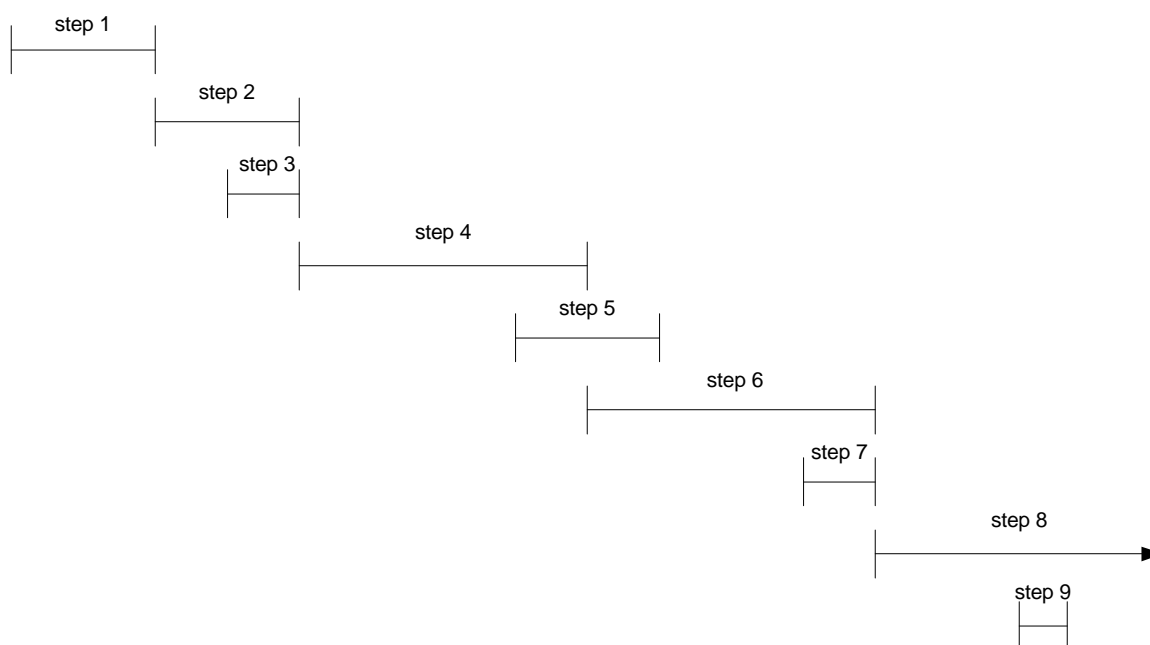
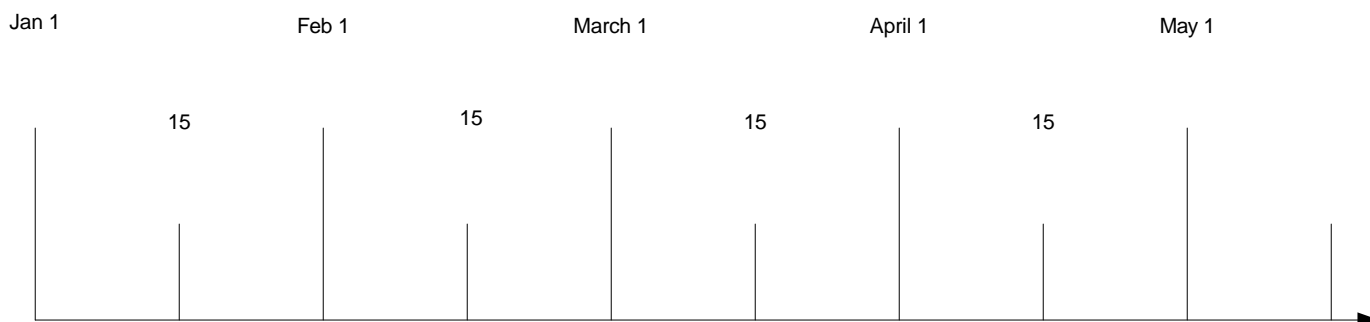
Figure 2: Action Planning Questionnaire

1. What is the overall objective and ideal situation'
2. What steps are needed to get there from here?
3. What actions need to be done?
4. Who will be responsible for each action?
5. What is the best sequence of action?
6. How long will each step take and when should it be done?
7. How can we be sure that earlier steps will be done in time for later steps that depend on them?
8. What training is required to ensure that all staff have sufficient know-how to execute each step in the plan?
9. What standards do you want to set?
10. What volume or quality is desirable?
11. What resources are needed and how will you get them?
12. How will you measure results?
13. How will you follow up each step and who will do it?
14. What checkpoints and milestones should be established?
15. What are the make/break vital steps and how can you ensure they succeed?
16. What could go wrong and how will you get around it?
17. Who will this plan affect and how will it affect them?
18. How can the plan be adjusted without jeopardizing its results for the best response and impact?
19. How will you communicate the plan to generate support?

Figure 3: Responses to Action Planning Questionnaire

1. To install a high-pressure screen washer, reducing per unit production costs and chemical use.
2. Install the high-pressure screen washer and train employees on its use.
3.
 - 1) Call suppliers of this technology for equipment and installation costs;
 - 2) Identify vendor that will be used and draw up contract;
 - 3) Meet with employees to discuss the new cleaning process-understand concerns and any hesitation-address outstanding issues;
 - 4) Perform installation;
 - 5) Perform employee training;
 - 6) Test new cleaning system and work out any problems;
 - 7) Contact vendor of current cleaning products and make necessary changes in orders;
 - 8) Monitor water use and chemical use;
 - 9) Schedule pickup of unused ink remover.
4.
 - Step # 1 Carol
 - 2 Marcy
 - 3 Marcy & Doug
 - 4 Vendor
 - 5 Vendor & Doug
 - 6 Doug
 - 7 Carol
 - 8 Doug
 - 9 Carol
5. Steps outlined in question #3 are in proper order.

6. Time line



7. Time estimates allow for delays--start-up date can be pushed back if needed .
8. Training will be provided to all staff members. Issues discussed will include: Best operating practices, water conservation, maintenance, and communication of problems.
9. Would like to eliminate ink remover from facility and reduce other chemical use by 10% in year 1 while maintaining quality cleaning.
10. Need to clean 25-35 screens per day.
11. Vendor list provided by SPAI. Adequate floor space is currently available. Funds required not expected to exceed \$5000-will come out of operating budget.
12. Results will be measured based on the reduction of chemicals used and the quality of the cleaning from the new system.
13. The person responsible for each task will report findings to me upon completion.
14. Checkpoints and milestones: by March 1 the high-pressure screen washer will be installed; by April 1 the washer will be in full-operation.
15. Vital steps:
 - 1) Getting employee cooperation. Training sessions should provide a means of voicing all objections and concerns about the new cleaning technique.
 - 2) Ensuring quality cleaning. The use of the high-pressure screen washer will be phased in over a one month period. All problems should be worked out during this period.
16. Product could fail. We will keep inventory for the current cleaning method in stock until we are sure the new method is a success.
17. Plan will affect all workers responsible for screen reclamation and equipment maintenance and office manager whose responsibilities include ordering stock. Doug will need to continually monitor the success of the washer and the reduction in chemical use.
18. For the first year after implementation, staff meetings will include a discussion of the washer. Employees will be encouraged to make suggestions towards improving the process and Doug will report on the reduction in chemical use and the per unit cost of cleaning.
19. See #15 and #18.

Figure 4: Action Plan Form

Overall Target: Install high-pressure washer					
Action	Responsible person	Performance standard	Monitoring technique	Completion deadline	Resources needed
1. Call suppliers	Carol	List of 510 providers	Discuss results	Jan 15	List of vendors
2. Contract with vendor	Marcy	Signed contract	None	Feb 1	Action #1 complete
3. Meet with employees	Marcy & Doug	Highly interactive meeting	Question employees before and after	Feb 1	Firm date for meeting
4. Perform installation	Vendor	Complete installation	On-time and on-budget	March 1	Floor space
5. Employee training	Vendor & Doug	Employees able to use and maintain washer	Doug evaluates work	March 7	Training material from vendor
6. Test and debug	Doug	High quality washing with least amount of chemicals	Check all washed screens for cleanliness	April 1	Action #4 complete
7. Change orders	Carol	Inventory as needed	Document inventory	April 1	None
8. Monitor resources used	Doug	Demonstrate changes in resource use	Check chemical & water use	Ongoing	Action #4 complete
9. Pick up ink remover	Carol	All ink remover disposed of or returned	Follow-up with memo to Marcy	April 18	Action #4 complete

Overall Target					
Action	Responsible person	Performance Standard	Monitoring Technique	Completion Deadline	Resources Needed
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					

Here are a few suggestions to make pollution prevention continue to work for you:

- *Return to the Nothing to Waste activities and concepts as you make business decisions.*
- *Schedule regular pollution prevention reviews of your business.*

Remember: Pollution Prevention saves resources, saves money, and prevents accidents!