INTERNATIONAL WORKSHOP
ADVANCES IN CLEANER PRODUCTION

São Paulo - Brazil - May 20-22 - 2009

WORKSHOP

"SYSTEMS APPROACH TOOLS FOR POLLUTION PREVENTION (PP)"

By

JAVIER ESQUER-PERALTA, Sc.D.

javierep@rtn.uson.mx

WORKSHOP

"SYSTEMS APPROACH TOOLS FOR POLLUTION PREVENTION (PP)"

Based in

An Organizational Guide to Pollution Prevention.

U.S. EPA. (2001). EPA/625/R-01/003. Cincinnati, Ohio.

The Nothing to Waste Program: Incorporating Pollution Prevention into Small Businesses.

Green Zia Environmental Excellence Program. New Mexico.

Systems Approach Tools for PP

BENEFITS OF P2 (or PP)

- Reduced operating costs
- Improved worker safety
- Reduced compliance costs
- Increased productivity
- Increased environmental protection
- Reduced exposure to future liability costs
- and more…

IMPEDIMENTS TO P2 USE

- Capital requirements
- Specifications
- Regulatory issues
- Product quality issues
- Customers' Acceptance
- and more…

INTEGRATING THE NEW P2 PROGRAM INTO CORE BUSINESS PRACTICES

When getting started with a P2 program, look around to see what other types of “prevention” programs already exist in the organization.

Typical Prevention Programs in Industry

- Environmental management systems (EMS)
- Quality management initiatives
- Preventive maintenance
- Health and safety programs (H&S)
- Insurance/risk management

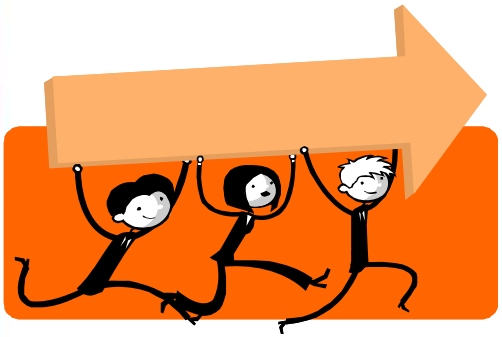
DEALING WITH CHANGE

- Instituting a P2 program can facilitate change in an organization.
- Technical ability and operational knowledge are not sufficient by themselves.

Always you are going to find someone in disagreement!

Seven things to be considered when starting a P2 program

- Present reason for change.
- Offer a compelling vision.
- Show results quickly!
- Communicate, then communicate some more.



- Build a strong, committed management P2 guiding team.
- Add some level of complexity to the P2 program.
- People do not resist their own ideas. Therefore, involve the organization's members in the change.

P2 Program Planning

Questions to Consider During the P2 Planning Process

- Where are we right now?
- Where do we want to go?
- How do we get there?
- When do we want to arrive?
- Who will get us there?
- What will it cost?
- How do we measure results?
- Who will help accomplish the plan?
- When will each goal be completed?
- What are the expected results?

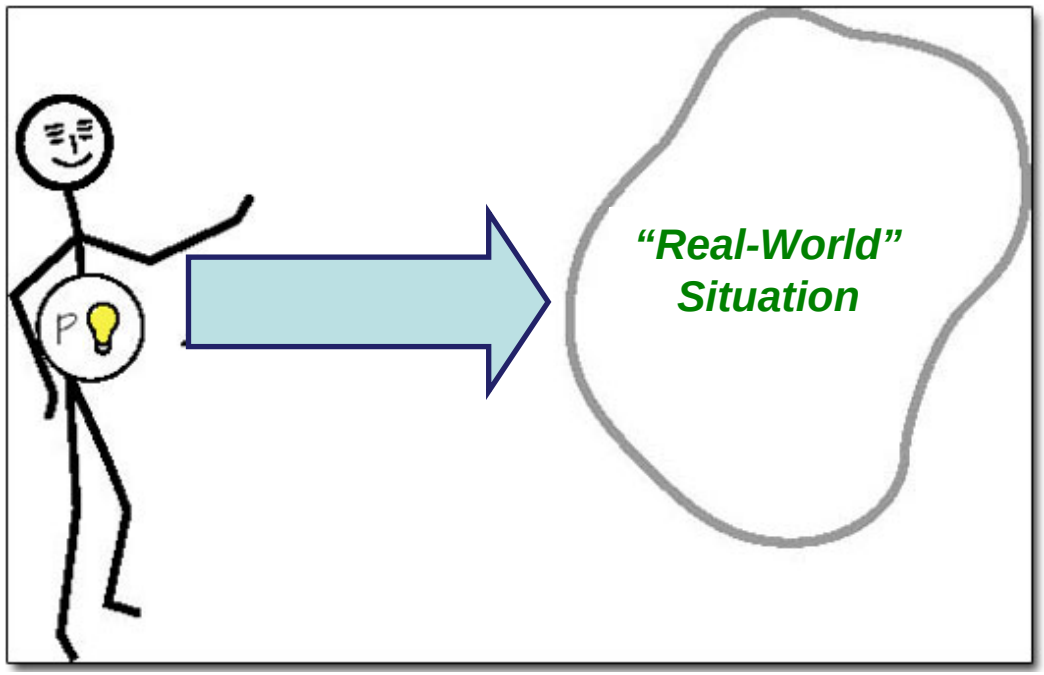
SYSTEMS APPROACH TOOLS FOR PP

USING P2 TOOLS

- Different problem-solving and decision-making tools available.
- Most of these tools have been used for more than 50 years (Quality).
- Environmental managers are often unfamiliar with such tools.
- More organizations seek to integrate environmental programs into their core business practices.

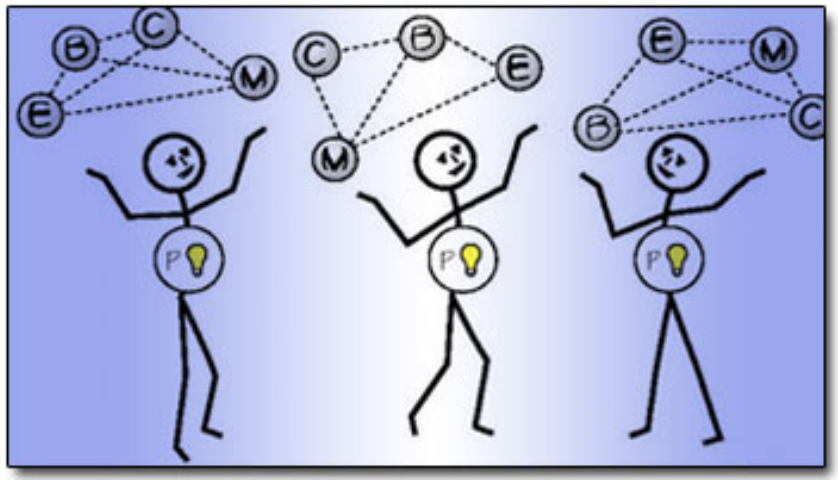
SYSTEMS APPROACH TOOLS

- An organization acts as a system.
- The **Systems Approach** looks at the whole organization, and the parts, and the connections between the parts.



SYSTEMS APPROACH TOOLS

The functionality of the parts depend on how they are connected.



SYSTEMS APPROACH TOOLS

Processes that use resources and generate wastes do not always provide synoptic information clearly suited for checklist-style presentation.

SYSTEMS APPROACH TOOLS

The Systems Approach relies on intra-organizational teams, not individual experts, to make decisions.

SYSTEMS APPROACH TOOLS

It is important to identify the process-related reasons for resource use and loss

In this context, the Systems Approach provides management with a reasonably accurate profile of process problems.

Using the Systems Approach Tools

- Process Mapping (Process characterization)
- Determining the Cost of the Loss (Activity-Based Costing)
- Selecting P2 Opportunities (80/20 Pareto Principle)
- Analyzing Root Causes (cause and effect, fishbone, diagram)
- Generating Alternative Solutions (Brainwriting)
- Selecting an Alternative for Implementation (Bubble-up/ bubble-down)
- Action Planning

Using the Systems Approach Tools

- Process Mapping (Process characterization)
- Determining the Cost of the Loss (Activity-Based Costing)
- Selecting P2 Opportunities (80/20 Pareto Principle)
- Analyzing Root Causes (cause and effect, fishbone, diagram)
- Generating Alternative Solutions (Brainwriting)
- Selecting an Alternative for Implementation (Bubble-up/ bubble-down)
- Action Planning

Using the Systems Approach Tools

Process Mapping

An effective means to characterize processes is with a hierarchical process map.

In most organizations, process documentation is typically organized into categories such as company, facility, product line, and department.

This information may take the form of process flow diagrams, flow charts, value stream maps, etc.

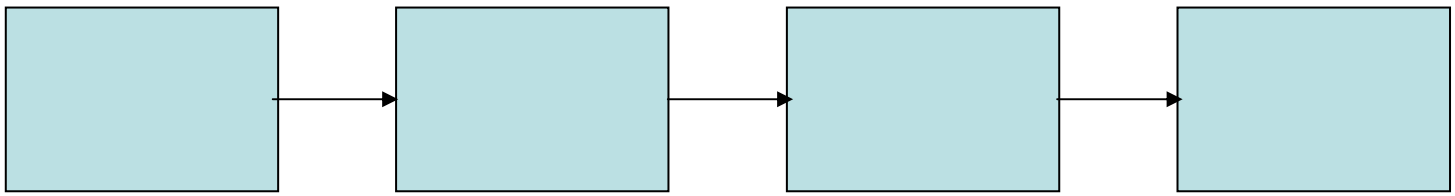
Using the Systems Approach Tools

Process Mapping

Hierarchical process maps allow only three (3) to six (6) objects on a page.

The entire process must be depicted in three to six boxes.

Sub-processes can be used to provide detail at the next level but are also restricted to the three-to-six-box rule.



Using the Systems Approach Tools

Process Mapping

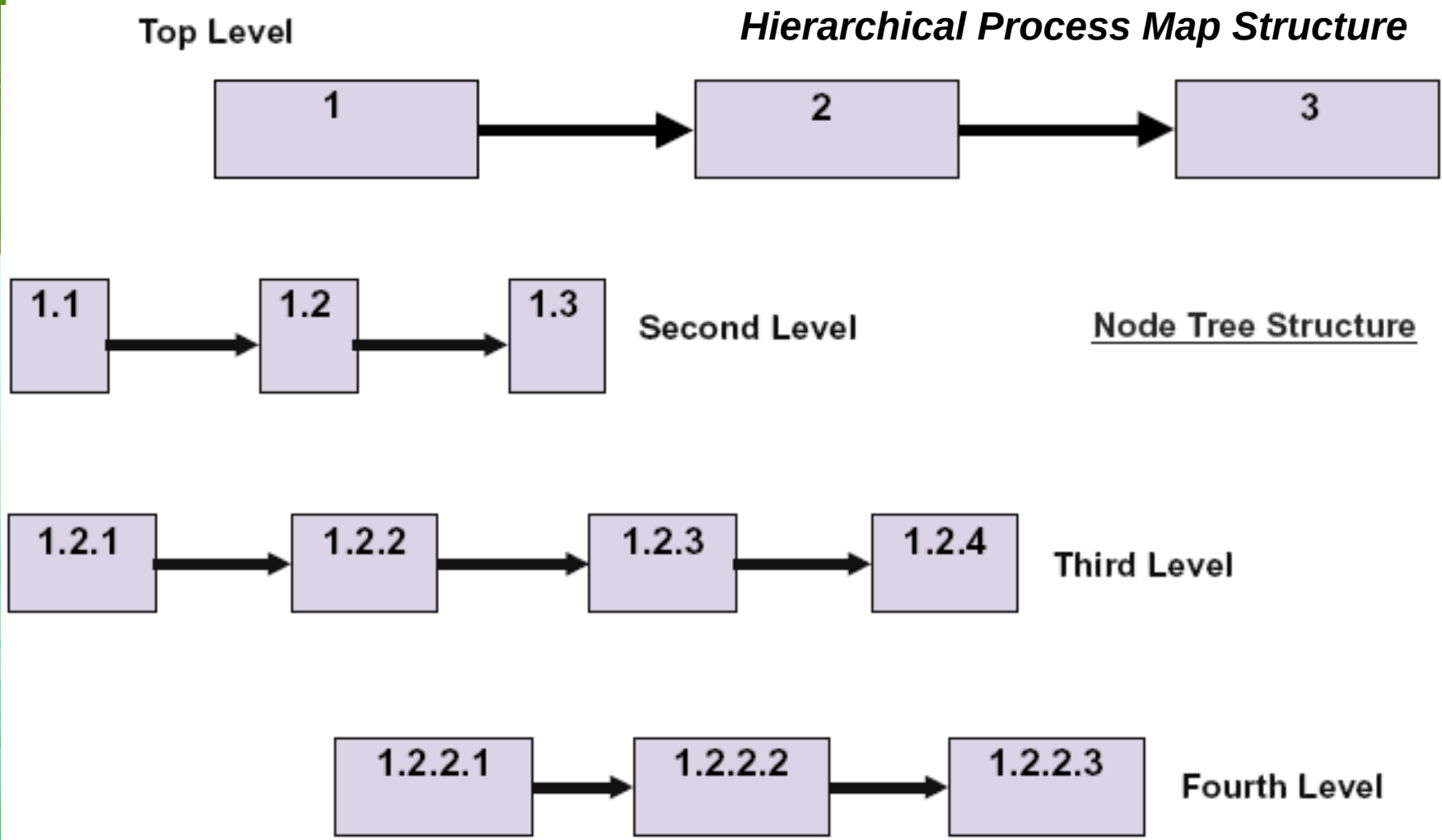
In a Systems Approach, every work step is connected to every other work step in this diagram, which depicts the entire system. There are two very important rules associated with process mapping:

1. The process maps must help the P2 team understand the process better than they could through other means.

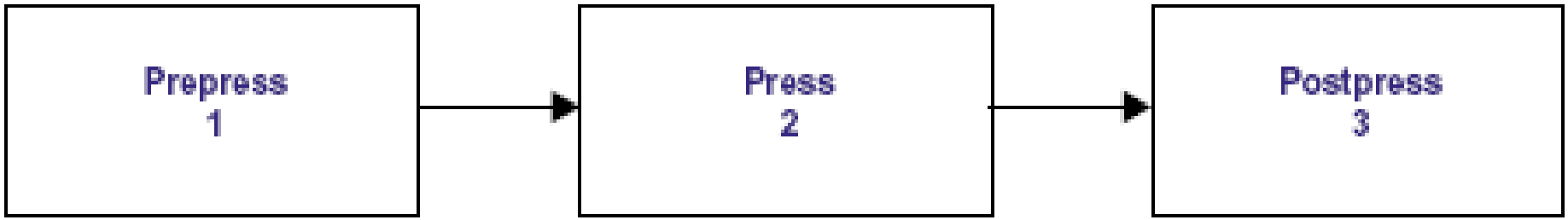
2. These same process maps must help the P2 team communicate what they plan to accomplish to management and other interested parties.

Using the Systems Approach Tools

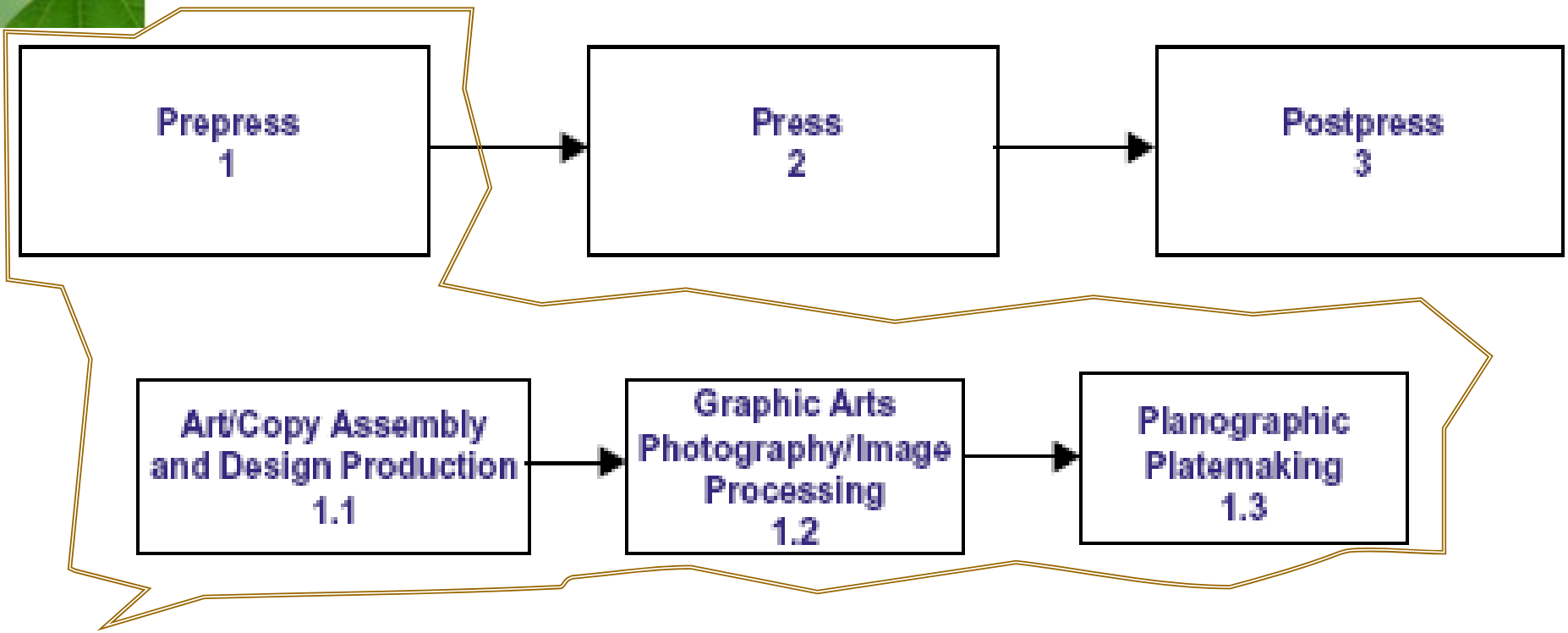
Process Mapping



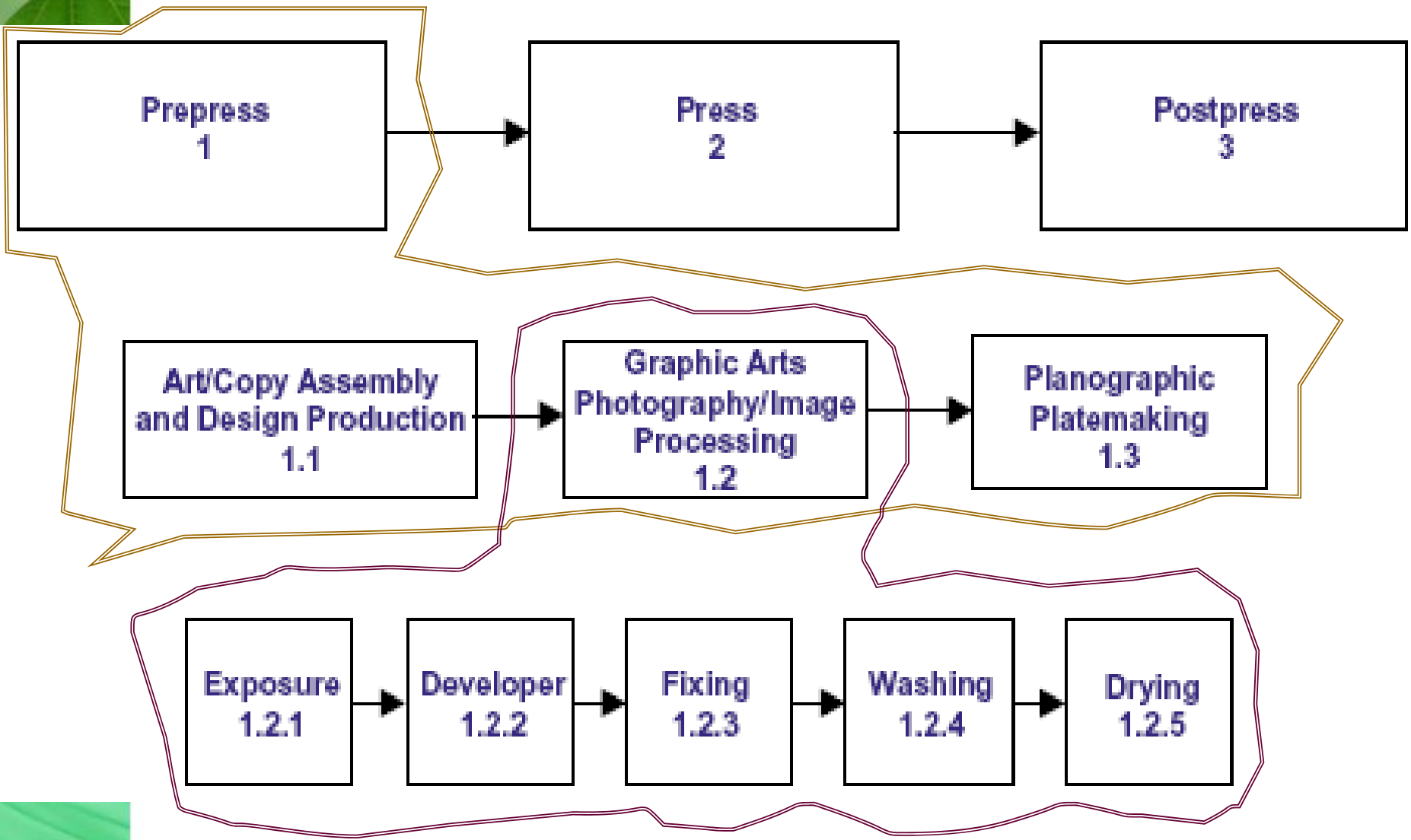
Process Map for a Photo-developing procedure



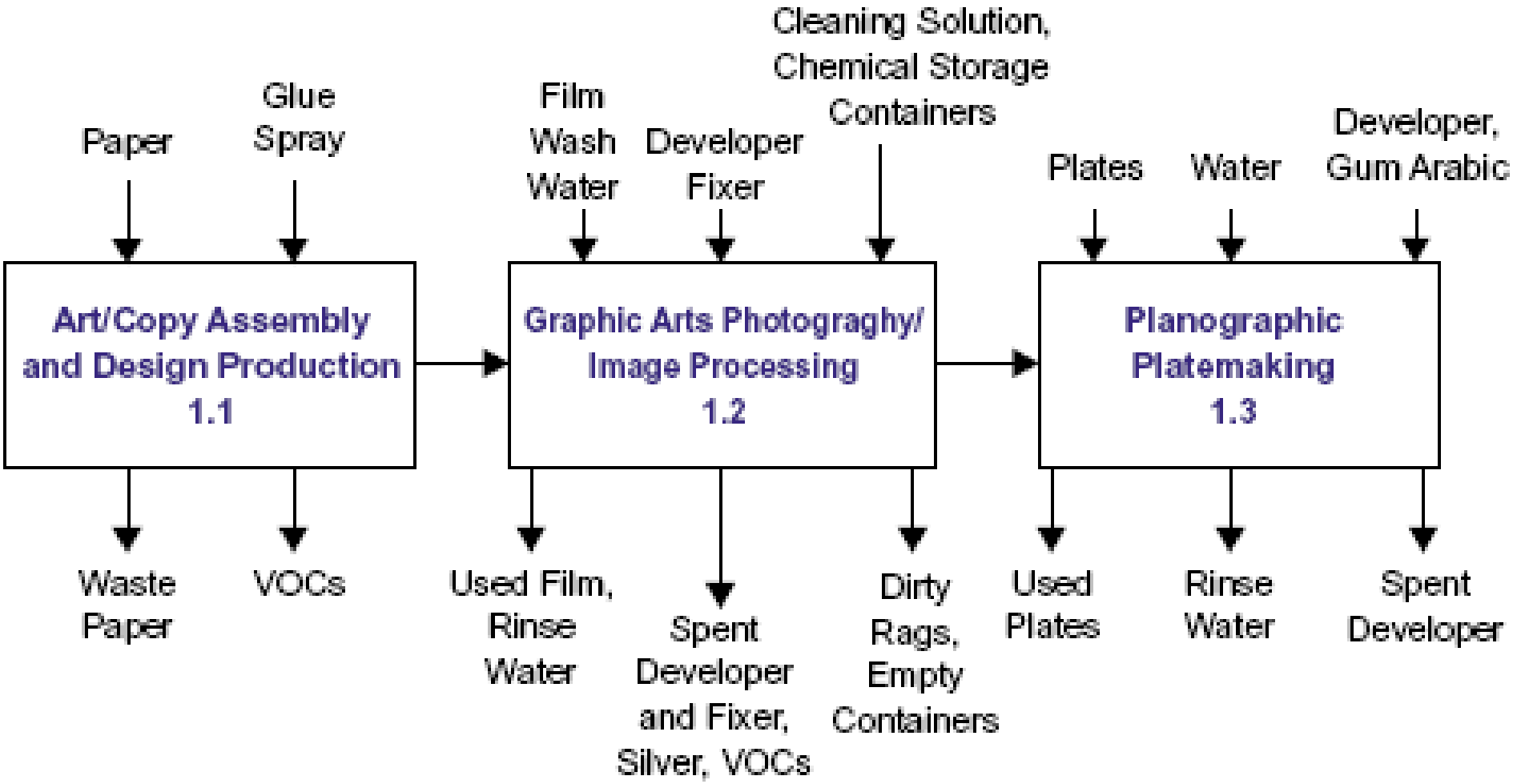
Process Map for a Photo-developing procedure



Process Map for a Photo-developing procedure

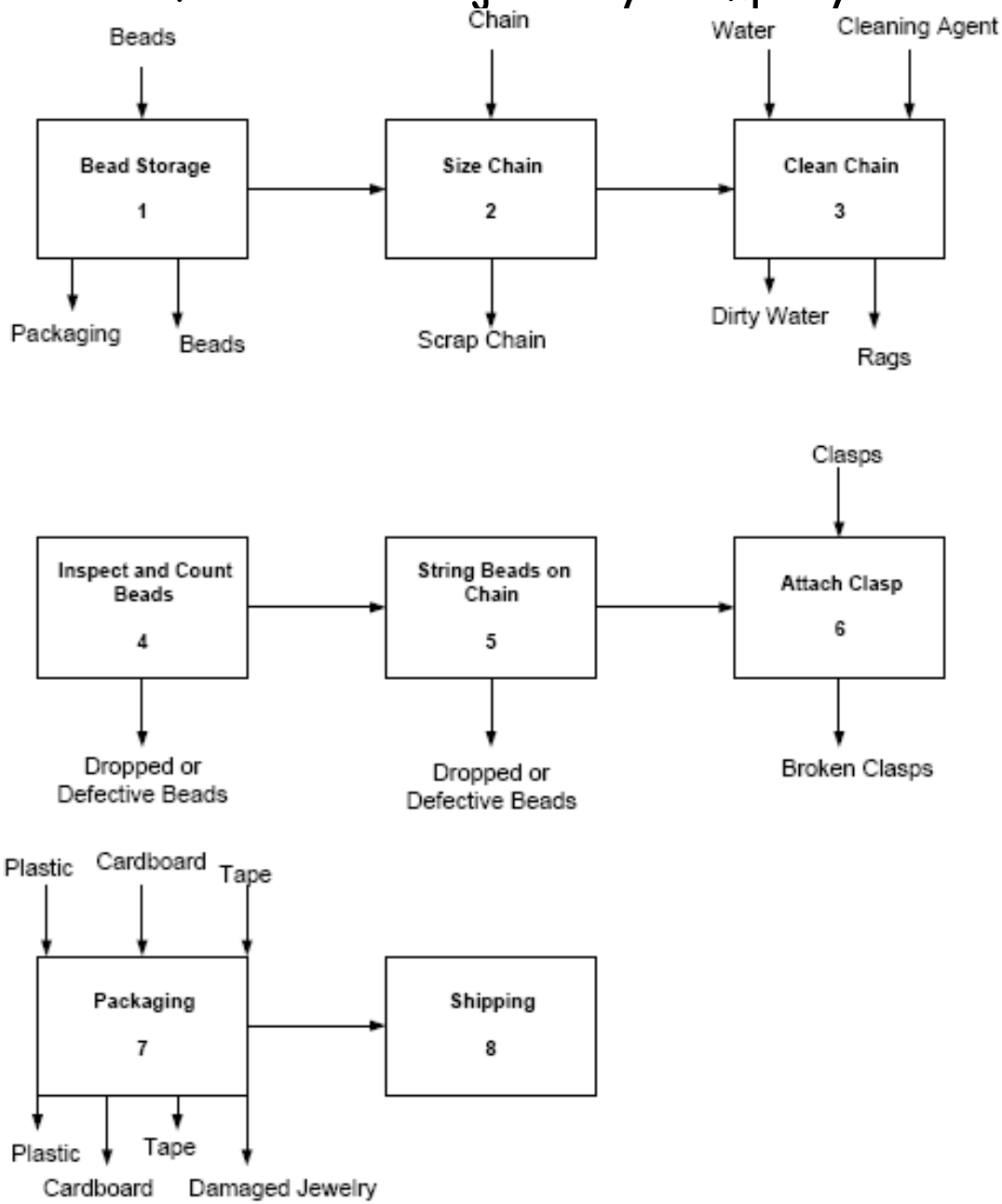


Process Map for a Photo-developing procedure

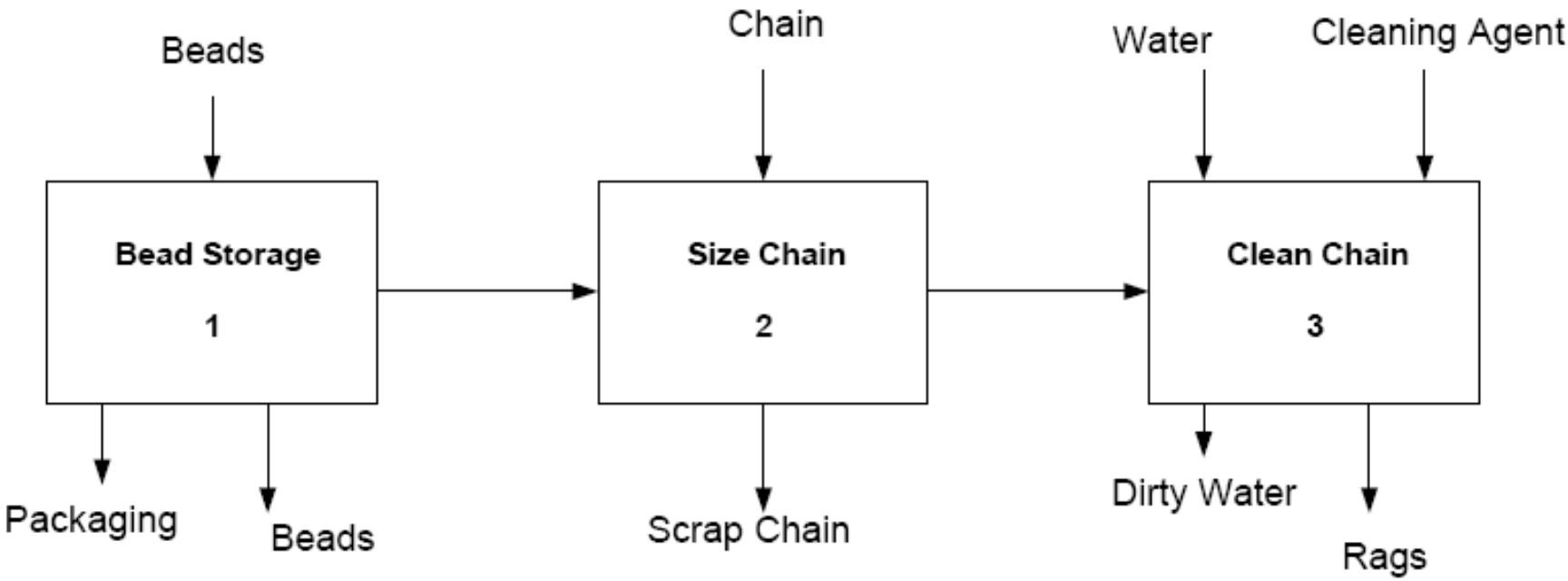


non-product losses

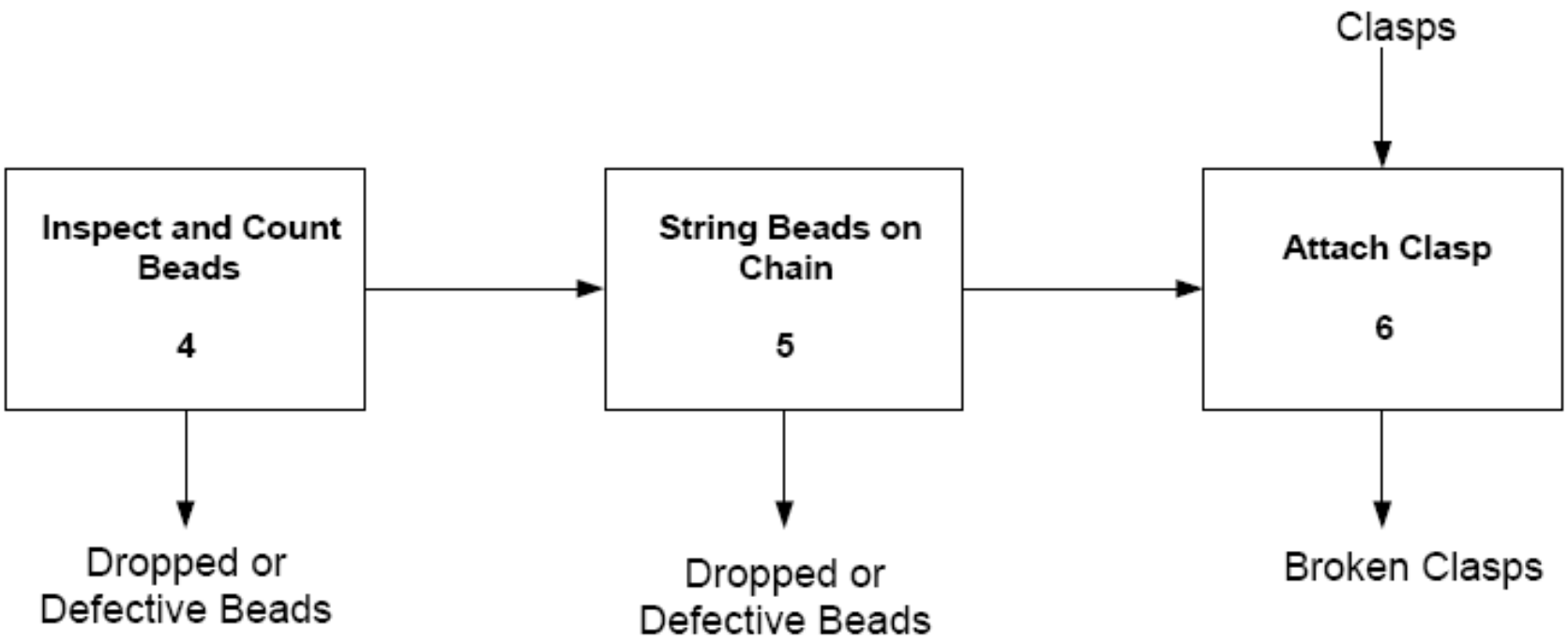
Process Map for a Handcrafted beaded jewelry company



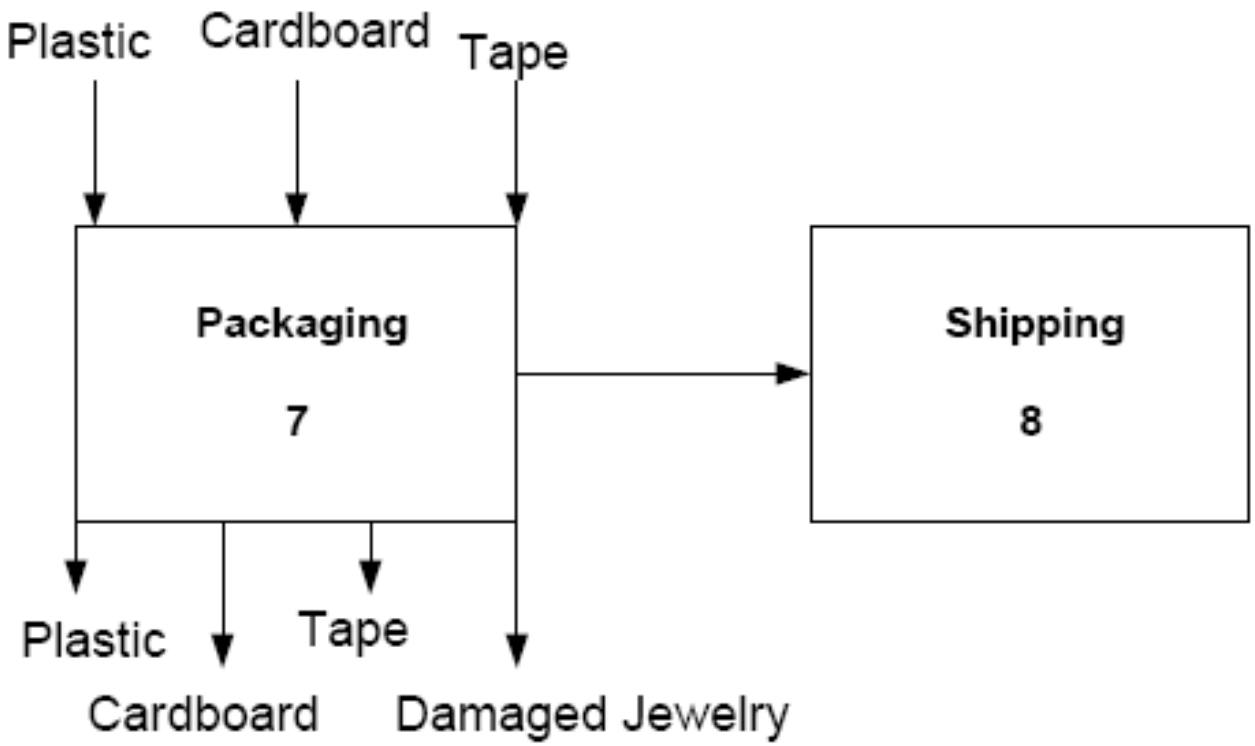
Process Map for a Handcrafted beaded jewelry company



Process Map for a Handcrafted beaded jewelry company



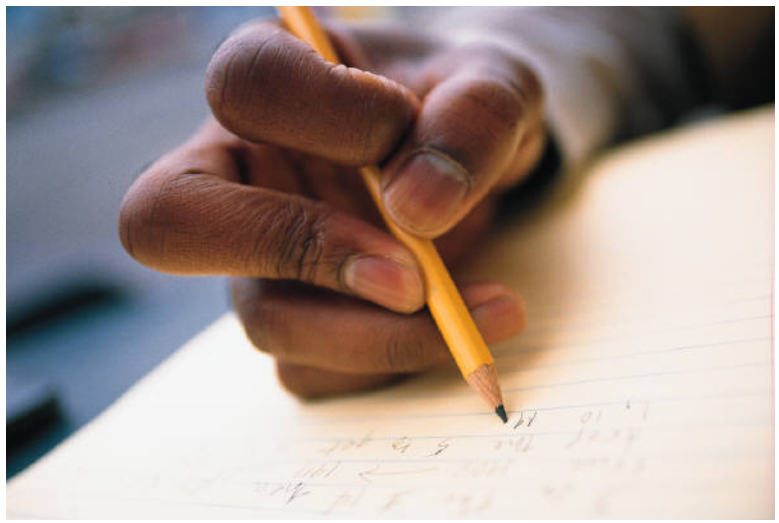
Process Map for a Handcrafted beaded jewelry company



Using the Systems Approach Tools

Process Mapping

Exercise



Exercise

Using the Systems Approach Tools

Process Mapping

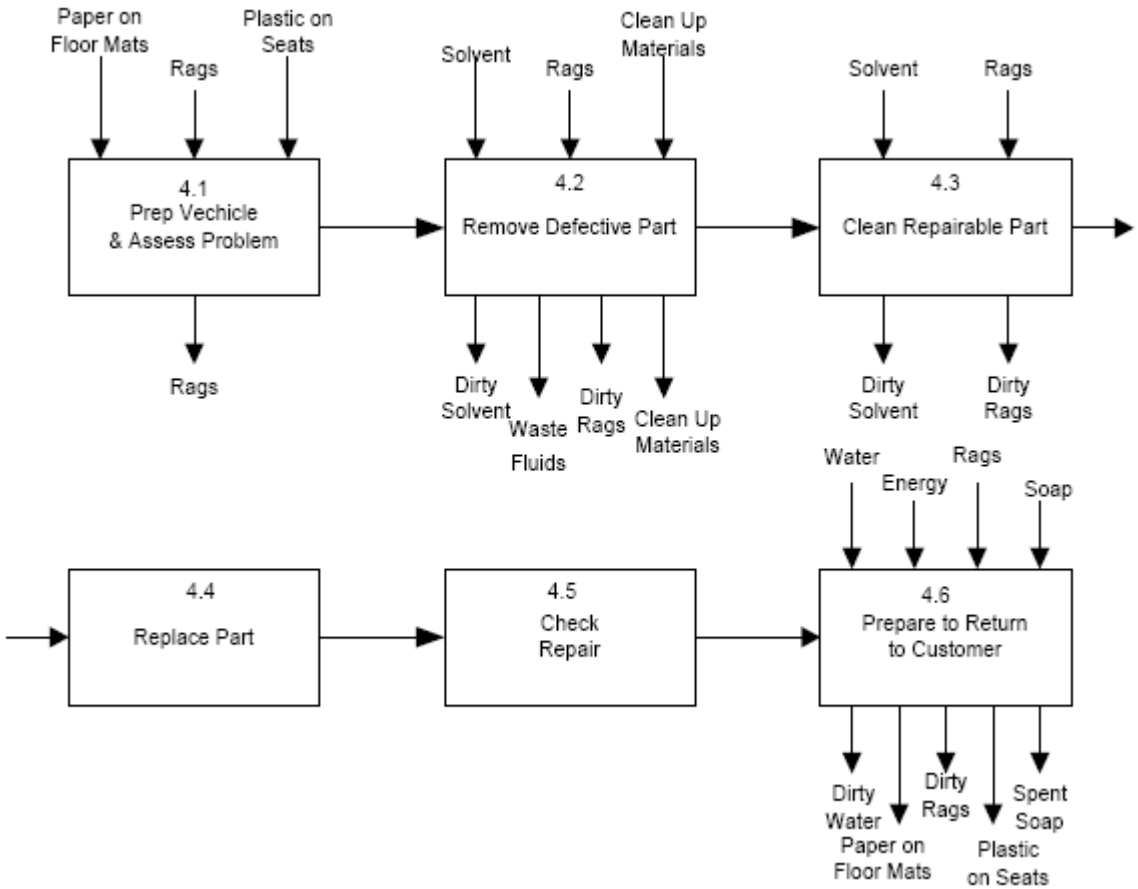
Create a Process Map for a

General Auto Repair Shop

Example

Using the Systems Approach Tools

Process Mapping

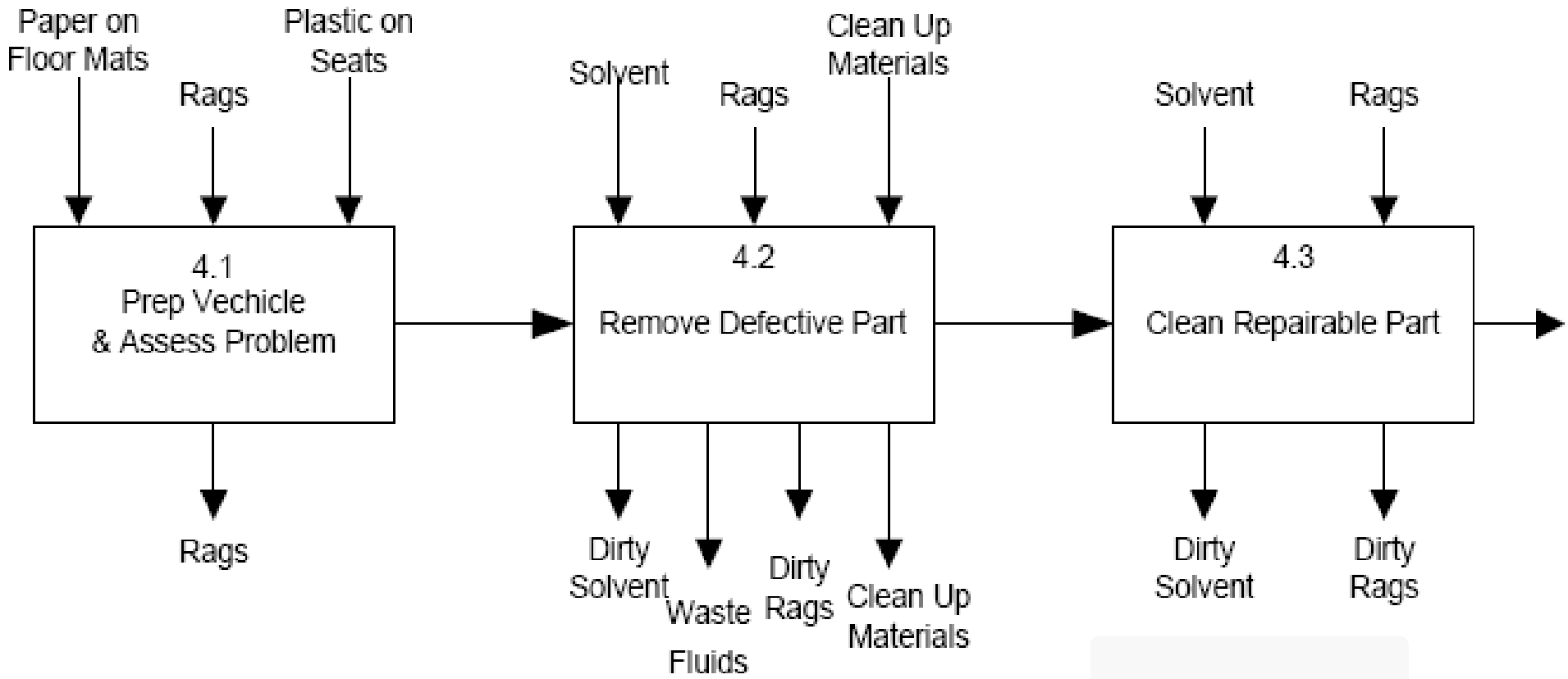


Example

Using the Systems Approach Tools

Process Mapping

Process Map for a General Auto Repair Shop

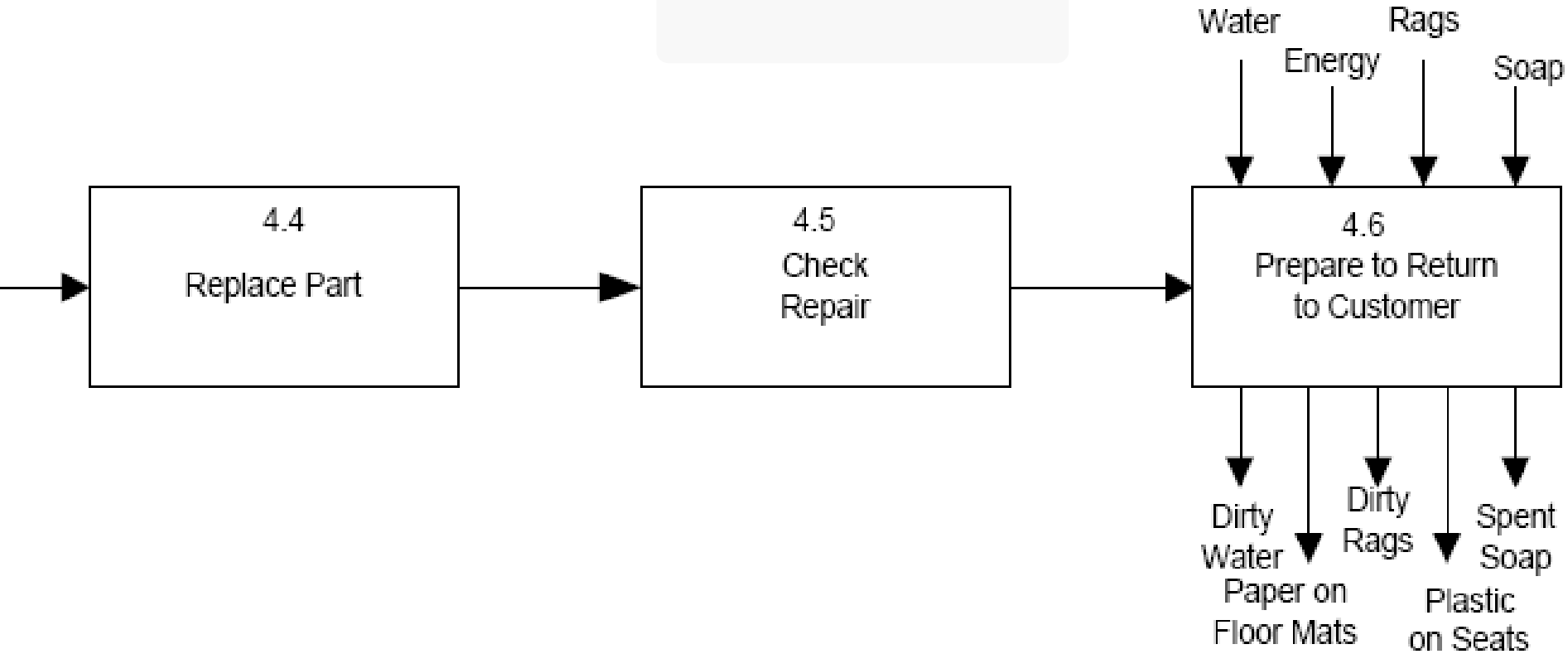


Example

Using the Systems Approach Tools

Process Mapping

Process Map for a General Auto Repair



Using the Systems Approach Tools

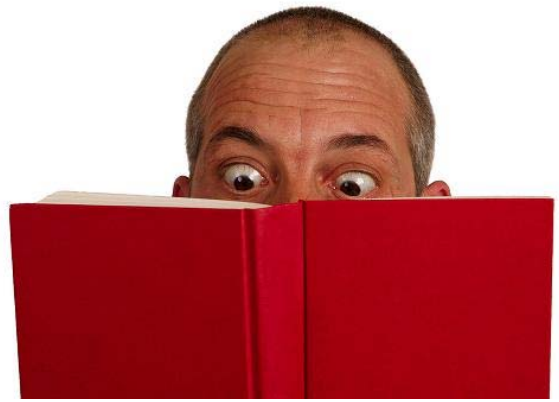
- Process Mapping (Process characterization)
- Determining the Cost of the Loss (Activity-Based Costing)
- Selecting P2 Opportunities (80/20 Pareto Principle)
- Analyzing Root Causes (cause and effect, fishbone, diagram)
- Generating Alternative Solutions (Brainwriting)
- Selecting an Alternative for Implementation (Bubble-up/ bubble-down)
- Action Planning

Using the Systems Approach Tools

Determining the Cost of the Loss

Gathering accurate cost information is important for justifying investment in P2 alternatives.

Three types of costs:



1. General ledger costs
2. Cost of the lost resources
3. Activity-based costs associated with the management of the non-product loss

Using the Systems Approach Tools

Determining the Cost of the Loss

1. General ledger costs

For example, if an organization generates solid waste, there may be a cost for the disposal contractor in the general ledger. The chart of accounts provides a vendor number and/or other code for this payment category.

Using the Systems Approach Tools

Determining the Cost of the Loss

2. Cost of the lost resources

For example, when a part is spray painted, some of the paint does not end up on the part. This overspray is probably captured on a paint filter in the ventilation system. If 60% of the paint is incorporated on the part, 40% of the paint is lost from the work step (i.e., ***non-product loss***).

Using the Systems Approach Tools

Determining the Cost of the Loss

3. Activity-based costs associated with the management of the non-product loss

You first must determine all the activities that must be performed for the non-product losses from each work step at the lowest level in the process map.

Then you must estimate the cost associated with each of these activities.

The total activity-based cost associated with each loss is added to the total cost of the loss associated with the general ledger cost and the cost of the lost resources.

Using the Systems Approach Tools

- Process Mapping (Process characterization)
- Determining the Cost of the Loss (Activity-Based Costing)
- Selecting P2 Opportunities (80/20 Pareto Principle)
- Analyzing Root Causes (cause and effect, fishbone, diagram)
- Generating Alternative Solutions (Brainwriting)
- Selecting an Alternative for Implementation (Bubble-up/ bubble-down)
- Action Planning

Using the Systems Approach Tools

Selecting P2 Opportunities

Information gathered in the process-mapping phase of the P2 program can be used to select P2 opportunities on which to focus for problem solving and decision-making.

Using the Systems Approach Tools

Selecting P2 Opportunities

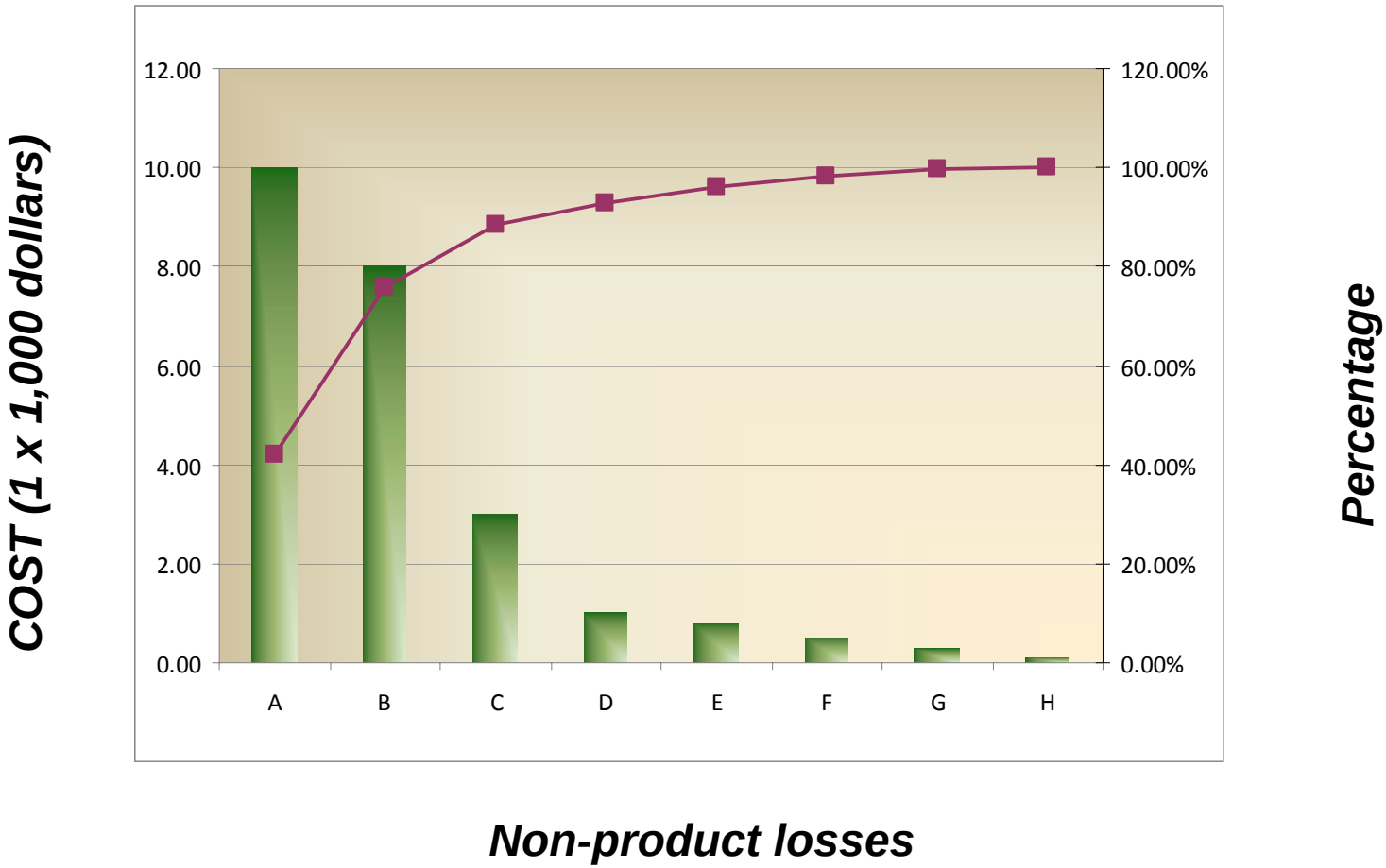
If all the P2 opportunities identified in the process maps were arranged in order of their true cost to the organization, the 20% of the P2 opportunities provide approximately 80% of the cost benefits.

In most cases, you will find the 80/20 rule (also called the Pareto Principle) to be a great guide for selecting P2 opportunities.

Using the Systems Approach Tools

Selecting P2 Opportunities

PARETO DIAGRAM SHOWING TRUE COST VERSUS WASTE TYPE.

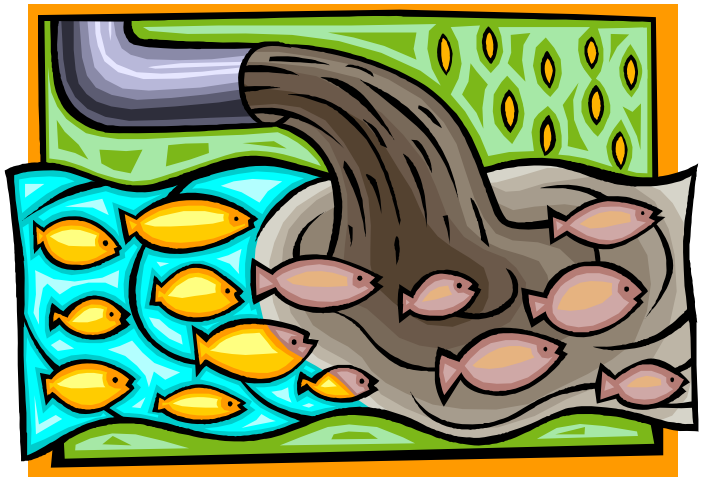


Using the Systems Approach Tools

Selecting P2 Opportunities

Pareto analysis is a rank-ordering tool.

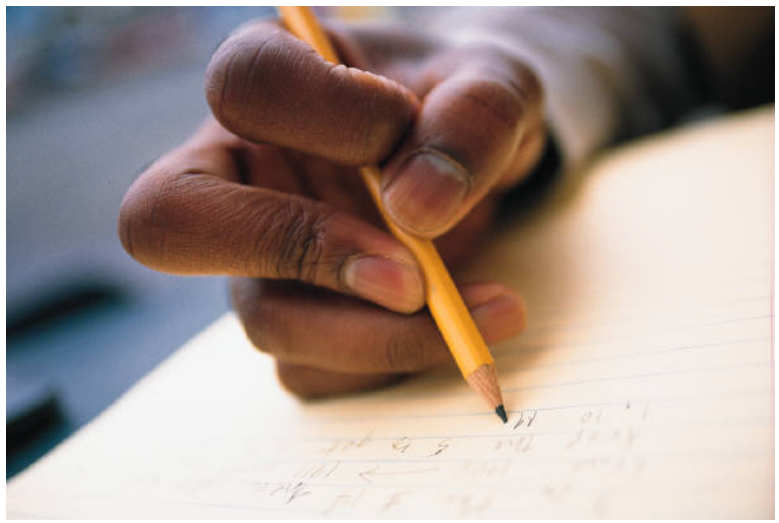
It is interesting to note that focusing on wastes by volume or weight may cause the P2 team to overlook some important wastes. In some cases, small volume wastes may be responsible for the highest costs.



Using the Systems Approach Tools

Determining the Cost of the Loss &Selecting P2 Opportunities

A Case Study



Using the Systems Approach Tools

A Case Study

Determining the Cost of the Loss &Selecting P2 Opportunities

The case of a General Auto Repair

› 1st. Handout ‹

The case of a General Auto Repair

A Case Study

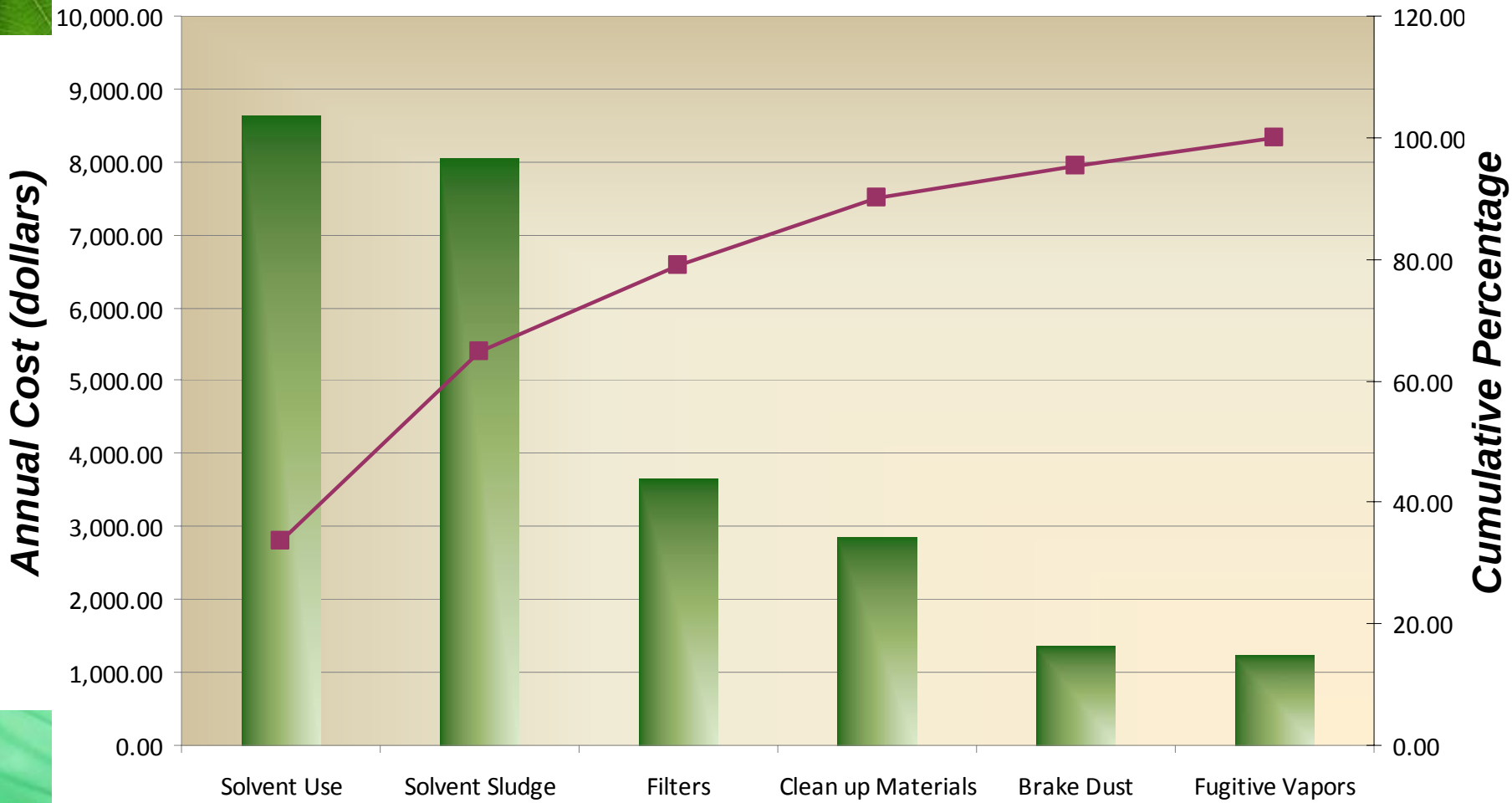
Workstep							
Costs /Losses	Fugitive Vapors	Solvent Sludge	Brake Dust	Solvent Use	Filters	Clean Up Material	Total
Labor		$1,000	$700		$800	$600	$3,100
Raw material				$5,000	$850	$1,500	$7,350
Disposal fees		$2,500	$500			$100	$3,100
Other ledger costs						$150	$150
Hidden Costs	**($1,240)**	**($4,550)**	**($150)**	**($3,650)**	**($2,000)**	**($500)**	**($12,090)**
Total	**$1,240**	**$8,050**	**$1,350**	**$8,650**	**$3,650**	**$2,850**	**$25,790**
%of Total	4.8	31.2	5.2	33.5	14.2	11.1	

Fugitive Vapors					
Activities/Cost Factors	Materials	Space	Utilities	Services	Labor
Monitoring	X ($200)				X ($1040)
Reporting	x				x
Repairs	x			x	x
Total hidden costs for vapors					***($1,240)***
Solvent sludge					
Muck out/disposal	x				X ($2,050)
Spill clean-up	x	x			x
Storage	x	x			x
Record keeping	x			x	X ($1,000)
Generator fees	x				X ($1,500)
Total hidden costs for sludge's					***($4,550)***
Brake Dust					
Storage	x	X ($150)			x
Total hidden costs for brake dust					***($150)***
Solvent Use					
Record keeping	x				x
Permit fees	x				
Permit				X ($3,000)	X ($650)
Storage	x	x	x		
Spill/clean-up	x			x	x
Total hidden costs for new solvent					***($3,650)***
Filters					
Disposal	x			x	X (1,500)
Repairs	x			x	X ($500)
Total hidden costs for filters					***($2,000)***
Clean Up Materials					
Handle/dispose	x				X ($500)
Total hidden costs for clean up materials					***($500)***

Workstep							
Costs /Losses	Fugitive Vapors	Solvent Sludge	Brake Dust	Solvent Use	Filters	Clean Up Material	Total
Labor		$1,000	$700		$800	$600	$3,100
Raw material				$5,000	$850	$1,500	$7,350
Disposal fees		$2,500	$500			$100	$3,100
Other ledger costs						$150	$150
Hidden Costs	**($1,240)**	**($4,550)**	**($150)**	**($3,650)**	**($2,000)**	**($500)**	**($12,090)**
Total	**$1,240**	**$8,050**	**$1,350**	**$8,650**	**$3,650**	**$2,850**	**$25,790**
%of Total	4.8	31.2	5.2	33.5	14.2	11.1	

Activities/Cost Factors	Materials	Space	Utilities	Services	Labor
Solvent Use					
Record keeping	x				x
Permit fees	x				
Permit				X ($3,000)	X ($650)
Storage	x	x	x		
Spill/clean-up	x			x	x
Total hidden costs					***($3,650)***

Environmental Costs



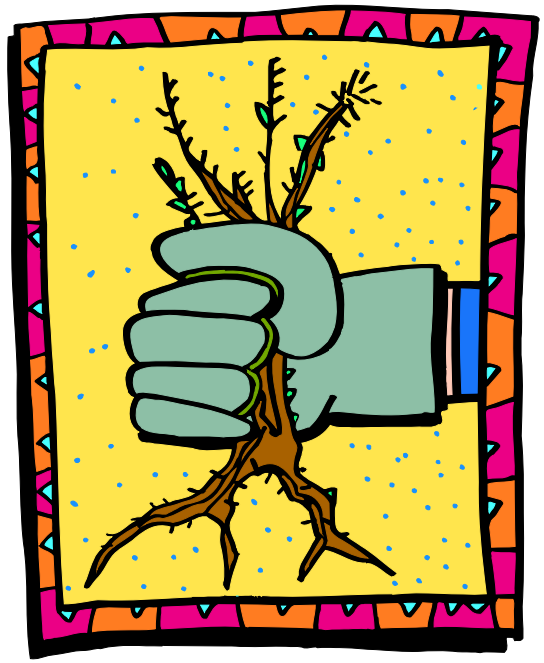
Using the Systems Approach Tools

- Process Mapping (Process characterization)
- Determining the Cost of the Loss (Activity-Based Costing)
- Selecting P2 Opportunities (80/20 Pareto Principle)
- Analyzing Root Causes (cause and effect, fishbone, diagram)
- Generating Alternative Solutions (Brainwriting)
- Selecting an Alternative for Implementation (Bubble-up/ bubble-down)
- Action Planning

Using the Systems Approach Tools

Analyzing Root Causes

"Root cause" is the basic reason that a resource is being used or a process loss is occurring. If this cause can be eliminated, the resource use or loss would be prevented. This approach is the very basis of P2.



Using the Systems Approach Tools

Analyzing Root Causes

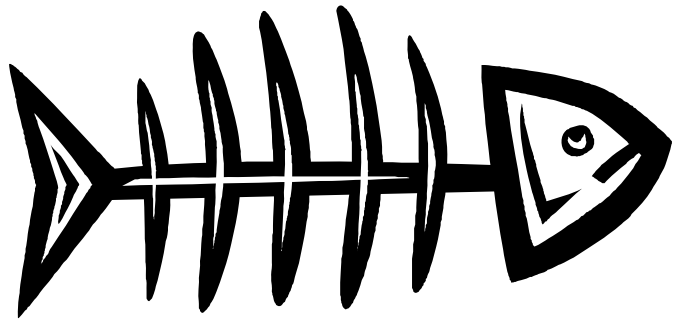
Root cause analysis teaches organizations to look at all potential causes:

- Materials,
- Machines (technology),
- Methods (work practices), and
- People.

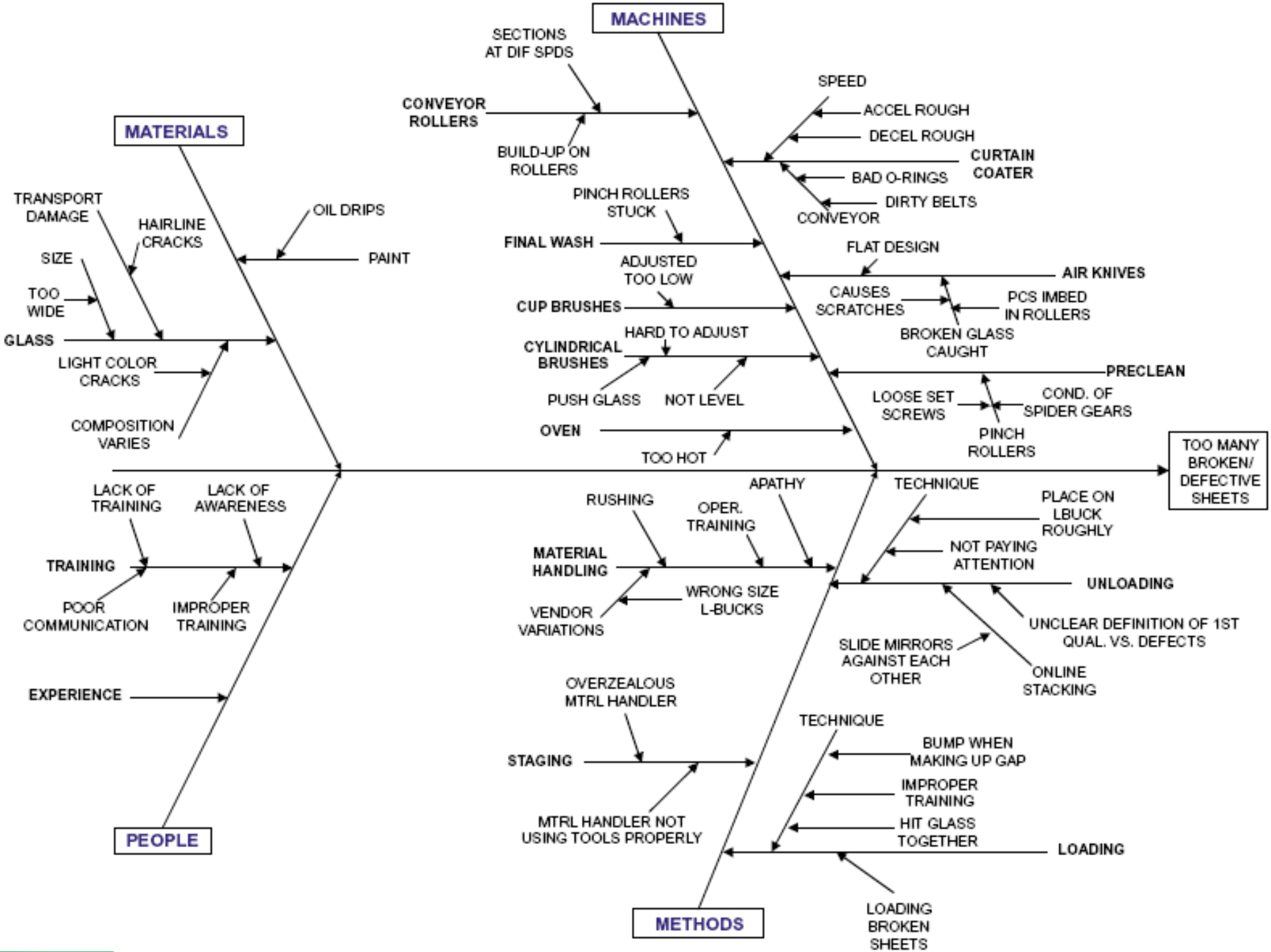
Using the Systems Approach Tools

Analyzing Root Causes

The cause and effect diagram (also known as a fishbone diagram) provides an effective tool for conducting root cause analysis. Studies have found that this tool is the most widely used problem-solving tool in the world.



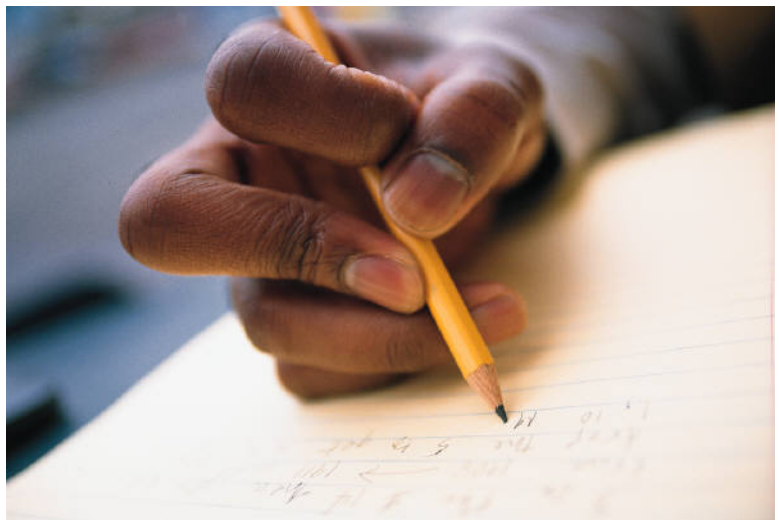
The 80/20 rule can be used to help focus on the most probable causes by drawing circles around the 20% of the causes that may account for 80% of the problem.


MACHINES
SECTIONS AT DIF SPDS
CONVEYOR ROLLERS
BUILD-UP ON ROLLERS
SPEED
ACCEL ROUGH
DECEL ROUGH
CURTAIN COATER
BAD O-RINGS
DIRTY BELTS
CONVEYOR
PINCH ROLLERS STUCK
FINAL WASH
ADJUSTED TOO LOW
CUP BRUSHES
HARD TO ADJUST
CYLINDRICAL BRUSHES
PUSH GLASS
NOT LEVEL
OVEN
TOO HOT
FLAT DESIGN
AIR KNIVES
CAUSES SCRATCHES
PCS IMBED IN ROLLERS
BROKEN GLASS CAUGHT
PRECLEAN
LOOSE SET SCREWS
COND. OF SPIDER GEARS
PINCH ROLLERS
MATERIALS
TRANSPORT DAMAGE
HAIRLINE CRACKS
SIZE
TOO WIDE
GLASS
LIGHT COLOR CRACKS
COMPOSITION VARIES
OIL DRIPS
PAINT
TOO MANY BROKEN/ DEFECTIVE SHEETS
LACK OF TRAINING
LACK OF AWARENESS
TRAINING
POOR COMMUNICATION
IMPROPER TRAINING
EXPERIENCE
PEOPLE
RUSHING
OPER. TRAINING
APATHY
MATERIAL HANDLING
VENDOR VARIATIONS
WRONG SIZE L-BUCKS
TECHNIQUE
PLACE ON LBUCK ROUGHLY
NOT PAYING ATTENTION
UNLOADING
UNCLEAR DEFINITION OF 1ST QUAL. VS. DEFECTS
SLIDE MIRRORS AGAINST EACH OTHER
ONLINE STACKING
OVERZEALOUS MTRL HANDLER
STAGING
MTRL HANDLER NOT USING TOOLS PROPERLY
TECHNIQUE
BUMP WHEN MAKING UP GAP
IMPROPER TRAINING
HIT GLASS TOGETHER
LOADING
LOADING BROKEN SHEETS
METHODS

Using the Systems Approach Tools

Analyzing Root Causes

Exercise



Exercise

Using the Systems Approach Tools

Analyzing Root Causes

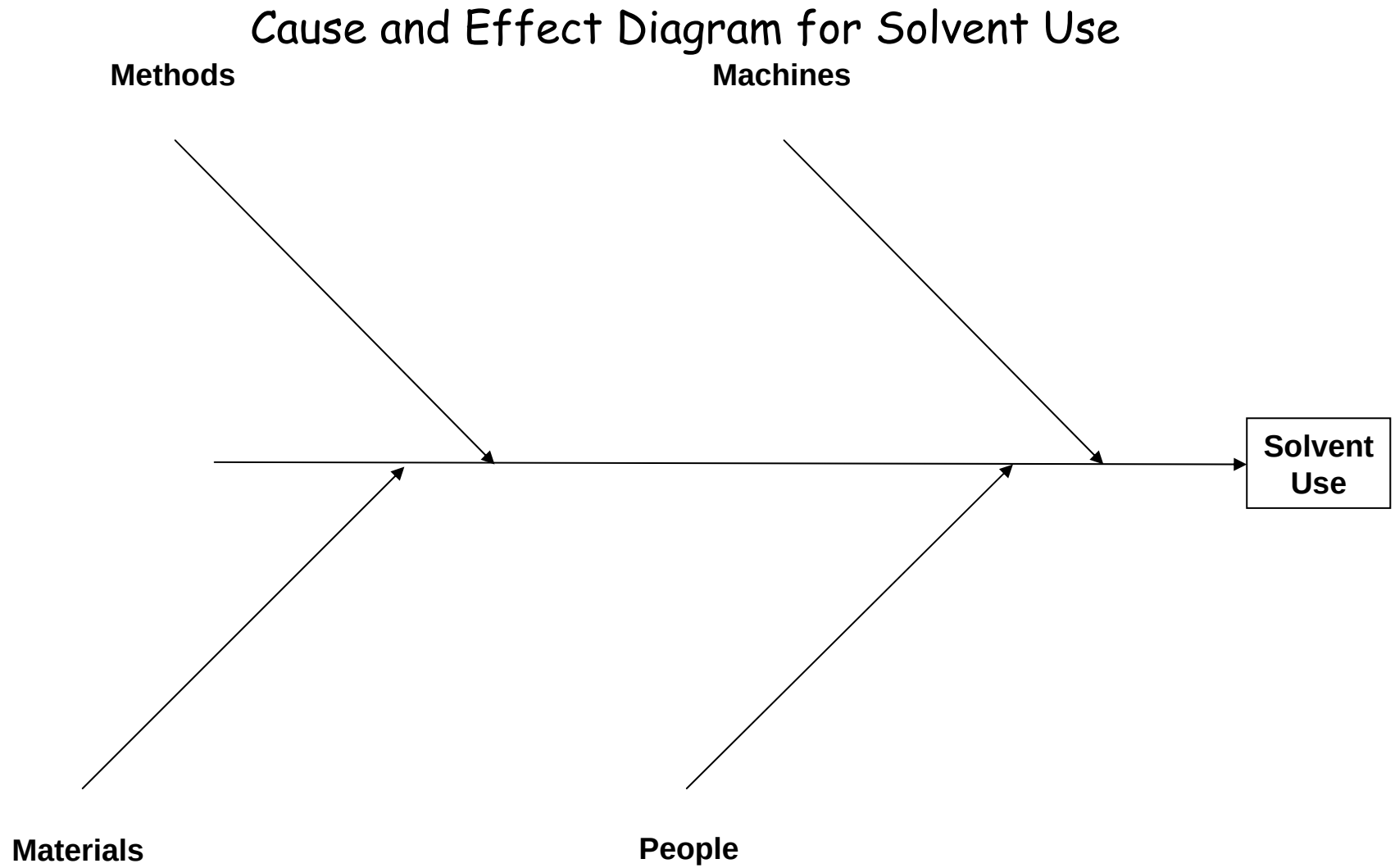
Design a Cause and Effect Diagram for Solvent Use

in the General Auto Repair case

Exercise

Using the Systems Approach Tools

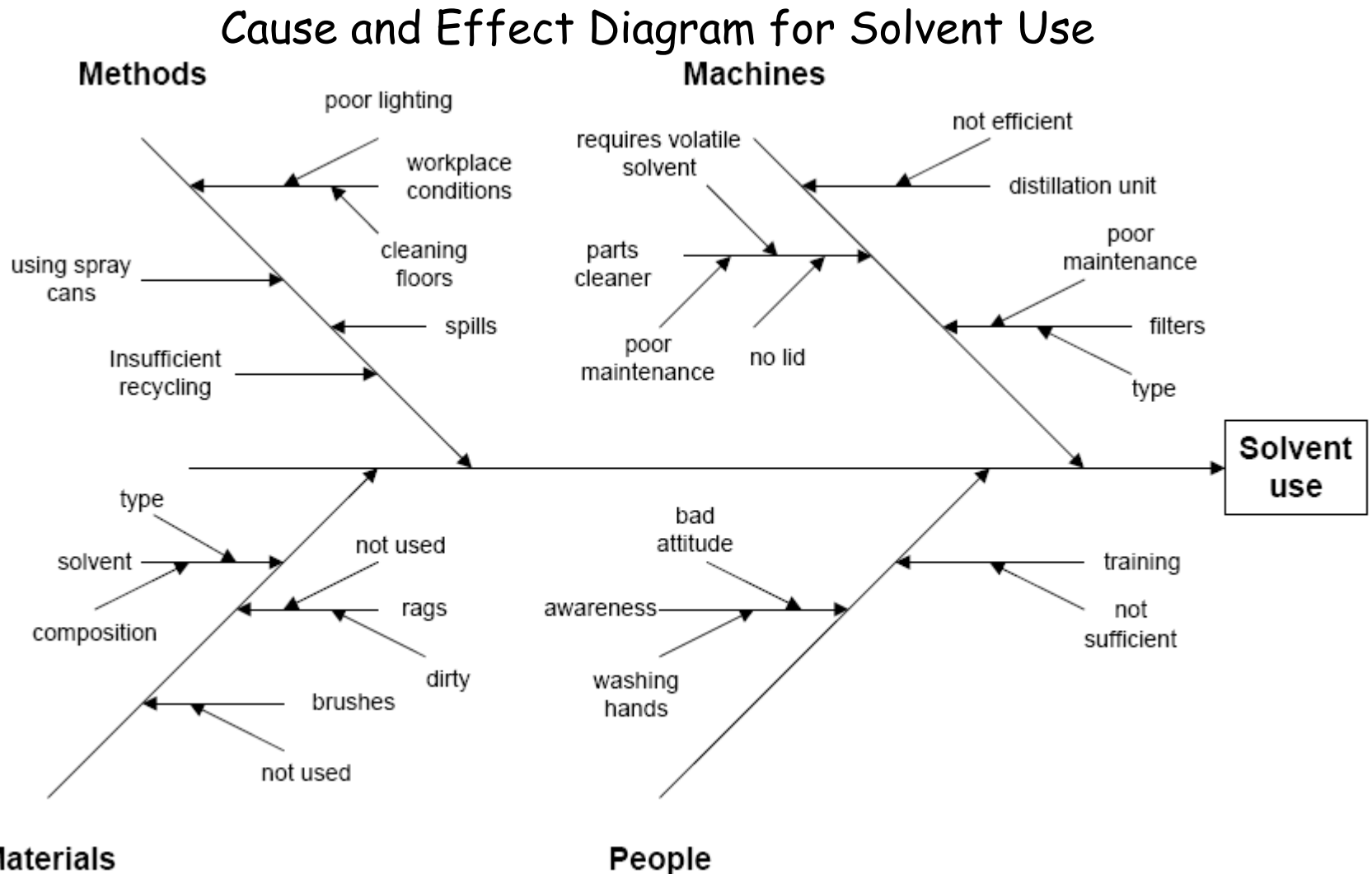
Analyzing Root Causes



Example

Using the Systems Approach Tools

Analyzing Root Causes



Example

Using the Systems Approach Tools

Analyzing Root Causes

Cause and Effect Diagram for Solvent Use

Dear Consultant,

We run a small auto repair shop. Use of solvent is our most expensive business issue. Solvents are highly regulated and we must comply with lots of regulations from air quality to hazardous waste to health and safety. Some auto repair shops have had to pay lots of money for clean up of contaminated sites, which has put them out of business. These are issues that we wish to take seriously.

Example

Using the Systems Approach Tools

Analyzing Root Causes

Cause and Effect Diagram for Solvent Use

Our group did root cause analysis and we believe that our biggest problem is our **parts cleaning equipment** that requires the use of volatile solvents. Employees affect solvent use when cleaning parts from leaving the **lid open** to not pre-cleaning the parts. There is also the issue of making sure we are in compliance with regulations. However, as you know, changing equipment can be expensive and would probably require retraining of our employees.

Can you help us?

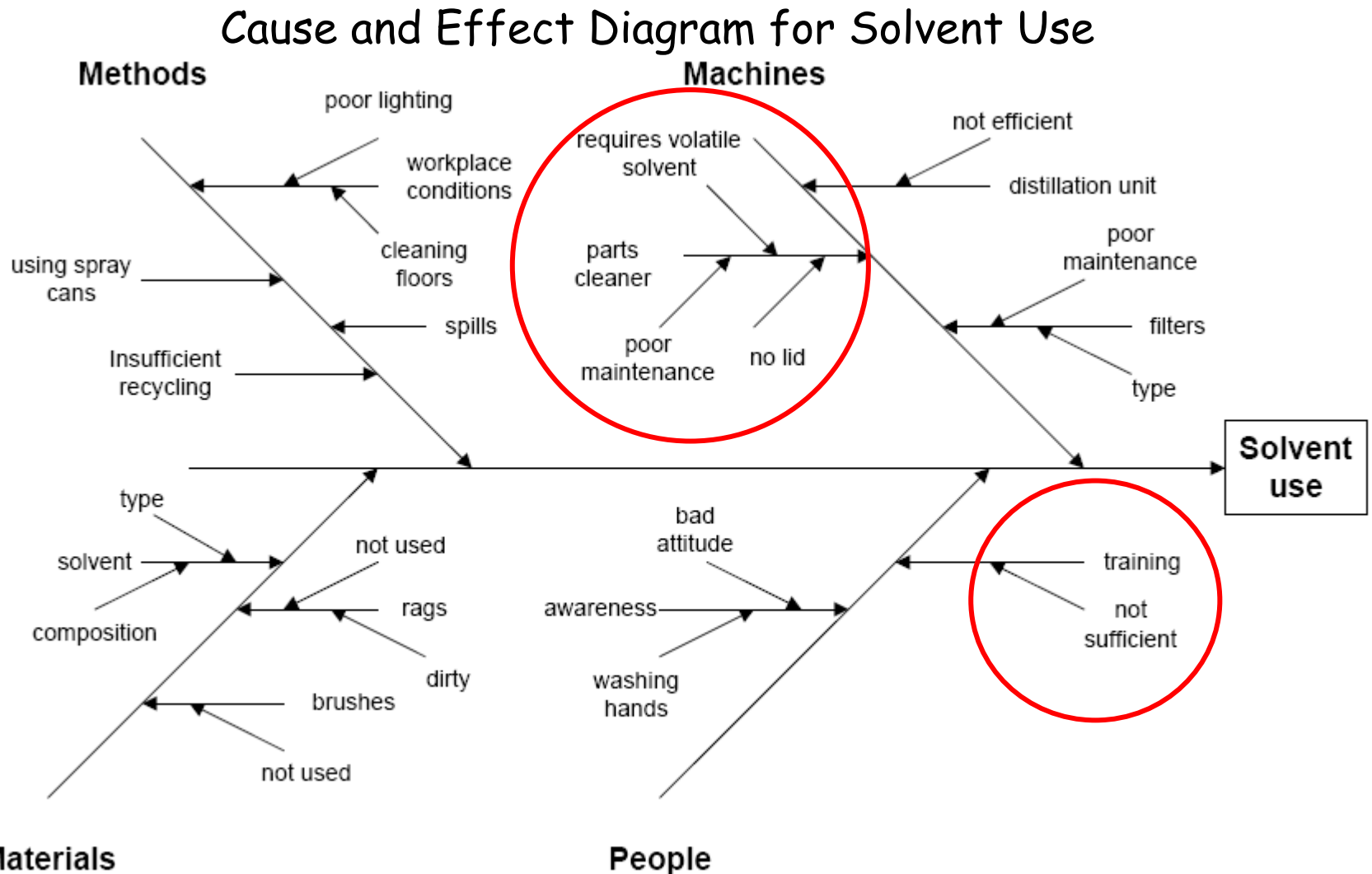
Signed,

General Auto Repair Co.

Example

Using the Systems Approach Tools

Analyzing Root Causes



Using the Systems Approach Tools

- Process Mapping (Process characterization)
- Determining the Cost of the Loss (Activity-Based Costing)
- Selecting P2 Opportunities (80/20 Pareto Principle)
- Analyzing Root Causes (cause and effect, fishbone, diagram)
- Generating Alternative Solutions (Brainwriting)
- Selecting an Alternative for Implementation (Bubble-up/ bubble-down)
- Action Planning

Using the Systems Approach Tools

Generating Alternative Solutions

The Systems Approach operates on the theory that “the only way to find a good P2 alternative is to have many P2 alternatives.”

A good method for generating alternatives is “brainwriting,” a technique similar to brainstorming, but tends to be less restrictive.

Brainwriting is a written form of brainstorming that uses forms like that shown in next slide.

It takes advantage of the fact that many people are much more likely to write down their ideas than say them.

Using the Systems Approach Tools

Generating Alternative Solutions

1	2
3	4
5	6
7	8
9	10

Using the Systems Approach Tools

Generating Alternative Solutions

This brainwriting technique allows resource people (i.e., those not on the P2 team, vendors, or technical assistance personnel) to lend their expertise in generating alternatives.

Using the Systems Approach Tools

Generating Alternative Solutions

To help encourage P2 team members to "think outside the box," it is important to get each team member to express the "most outrageous alternative that just might work."

This gets everyone involved in using a bit of creativity to address the P2 problem at hand.

Generating Alternative Solutions for an

Automated Car Wash

Generating Alternative Solutions for an Automated Car Wash

- Install a closed-loop (fully recycling) system.
- Fully automate the system to control drive speed.
- Use water-saving nozzles.
- Wash less frequently.
- Put dehumidifier in room to collect water vapor.
- Use high-pressure jet spray (rinse/clean in one step).
- Redesign water application.
- Hand wash.
- Reduce evaporation by lowering room temperature.
- Try to collect evaporated water.
- Use multistage washing process.
- Only use undercarriage spray in winter.
- Only wash vehicle once a week
- Dip vehicles in a tub-like device.
- Lower temperature of water to decrease evaporation.
- Use drying apparatus so vehicles do not drip dry.
- Use a switch to activate/deactivate each step.
- Close garage door before starting washing process.
- Spit shine.
- Use a squeegee to scrape off excess water.
- Change soap application method.
- Use alternative to city water source.
- Use fewer absorbent sponges (less water trapped).
- Use rental cars (rental agency will wash).
- Redesign collection of water.
- Drive through faster.

Using the Systems Approach Tools

- Process Mapping (Process characterization)
- Determining the Cost of the Loss (Activity-Based Costing)
- Selecting P2 Opportunities (80/20 Pareto Principle)
- Analyzing Root Causes (cause and effect, fishbone, diagram)
- Generating Alternative Solutions (Brainwriting)
- Selecting an Alternative for Implementation (Bubble-up/ bubble-down)
- Action Planning

Using the Systems Approach Tools

Selecting an Alternative for Implementation (bubble-up/ bubble-down)

Selecting a P2 alternative for implementation is facilitated with decision-making tools.

The bubble-up/bubble-down tool in particular is an excellent means for prioritizing and selecting an alternative to implement from a long list of possibilities.

Using the Systems Approach Tools

Selecting an Alternative for Implementation (bubble-up/ bubble-down)

Alternatives that "bubble up" to the top are typically easy to implement and have a relatively low cost.

These alternatives may be characterized as the low hanging fruit or quick wins. Little or no capital is required to implement these alternatives and work can begin right away in most cases.

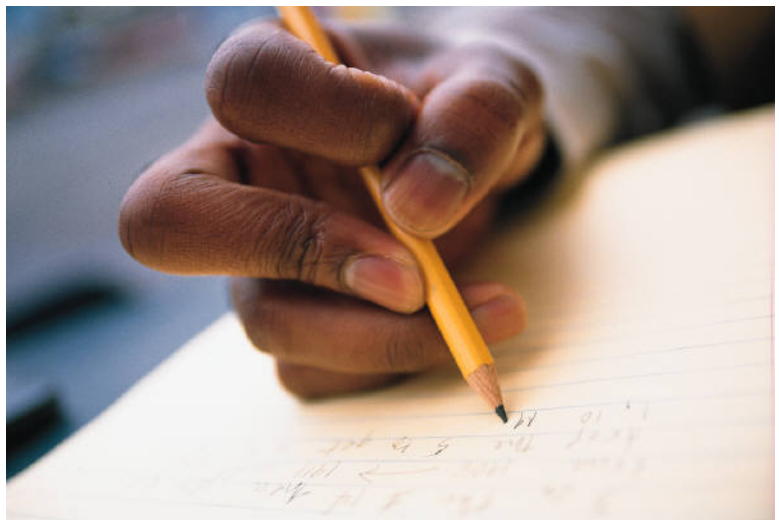
Selecting an Alternative for Implementation for an Automated Car Wash

1. Simply reduce the soap input in the car wash
2. Use high-pressure water instead of soap
3. Alter the soap application step
4. Use degradable soap
5. Install a closed-loop system
6. Use alternative cleaning materials
7. Use a local, off-base car wash
8. Locally treat the water before discharge to sewer
9. Reuse dirty/soapy water
10. Install a new/improved car wash
11. Use a softening agent to take the soap out of the water
12. Hand-wash the cars
13. Use ultra-filtration to filter the water
14. Dry-clean the cars
15. Do not clean the cars at all

Using the Systems Approach Tools

Generating Alternative Solutions &Selecting an Alternative for Implementation (bubble-up/ bubble-down**)**

Exercise



Exercise

Using the Systems Approach Tools

Generating Alternative Solutions &Selecting an Alternative for Implementation (bubble-up/ bubble-down**)**

The General Auto Repair case

Generating Alternative Solutions

The General Auto Repair case

Example

- Use non-toxic solvent to eliminate all environmental problems.
- Train people to maintain filtration and distillation systems better.
- Pre-clean parts with rags or brushes
- Start a “clean shop” program to train employees to keep work areas clean to prevent spills and waste.
- Use old solvent to pre-soak parts
- Begin an employee incentive program to reward best operating practices for operating a clean work area.
- Replace existing parts cleaner with new equipment that uses non-solvent cleaning solution.
- Don’t use solvent to clean shop floor.
- Pay employees small bonus for keeping good environmental records including hazardous waste and air quality records.
- Test solvent to see if we are replacing too soon.
- Create an employee problem-solving team to deal with waste of all kinds on a regular basis.
- Convert to steam cleaning.
- Train workers on pollution prevention and ways to reduce and reclaim spills.
- Provide incentives for employees who reduce losses.
- Invest in better equipment.
- Keep lid on parts cleaner closed when not in use.
- Place parts cleaner nearer to work areas.
- Drain excess solvent from parts before removing from parts cleaner.

Selecting an Alternative for Implementation

(bubble-up/ bubble-down)

Example

The General Auto Repair case

1. Replace existing parts cleaner with new equipment that uses non-solvent cleaning solution.
2. Use non-toxic solvent to eliminate all environmental problems.
3. Pre-clean parts with rags or brushes
4. Use old solvent to pre-soak parts
5. Test solvent to see if we are replacing too soon.
6. Drain excess solvent from parts before removing from parts cleaner.
7. Keep lid on parts cleaner closed when not in use.
8. Place parts cleaner nearer to work areas.
9. Train people to maintain filtration and distillation systems better.
10. Begin an employee incentive program to reward best operating practices

Selecting an Alternative for Implementation

(bubble-up/ bubble-down)

Example

The General Auto Repair case

11. Don’t use solvent to clean shop floor.
12. Pay employees small bonus for keeping good environmental records including hazardous waste and air quality records.
13. Create an employee problem-solving team to deal with waste of all kinds on a regular basis.
14. Convert to steam cleaning.
15. Train workers on pollution prevention and ways to reduce and reclaim spills.
16. Provide incentives for employees who reduce losses.
17. Invest in better equipment.
18. Start a “clean shop” program to train employees to keep work areas clean to prevent spills and waste.

Using the Systems Approach Tools

- Process Mapping (Process characterization)
- Determining the Cost of the Loss (Activity-Based Costing)
- Selecting P2 Opportunities (80/20 Pareto Principle)
- Analyzing Root Causes (cause and effect, fishbone, diagram)
- Generating Alternative Solutions (Brainwriting)
- Selecting an Alternative for Implementation (Bubble-up/ bubble-down)
- Action Planning

Using the Systems Approach Tools

Action Planning

Finally, a formal action plan should be prepared for every P2 activity that is planned for each year of a P2 program.

In the rush to implement, P2 practitioners should not overlook the need to formalize their action plans.

Each action plan should list the P2 alternative that will be implemented and show the sequence of steps necessary to implement the alternative.

Using the Systems Approach Tools

Action Planning

The person responsible for ensuring that each step is completed should be indicated in the action plan.

Performance of that step must have some recognizable goal that must be reached.

A metric should be devised to measure the progress toward meeting that goal and to provide a time frame for reaching the goal or completing that step.

Finally, an indication of the resources required to reach the goal should be included in the formal action plan.

Using the Systems Approach Tools

Action Planning

ALTERNATIVE SELECTED: Date:

Action	Responsible Person	Performance	Monitoring Technique	Completion Deadline	Resources Needed
1					
2					
3					
4					

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

Action Planning

> 2nd. Handout <

Example

The General Auto Repair case

Action	Responsible person	Performance standard	Monitoring technique	Completion deadline	Resources needed
1.Investigate sources of equipment	Tom	List of vendors	Discuss list with Steve the owner	Jan 15	Team of Tom, Steve and Harry
2. Bring in equipment for review	Tom	Approved list of vendors by Steve	Steve allocates time for employees	Feb 1	Shop employees
3. Employees try out equipment and write up results	Harry	How good does the equipment clean parts	Time to clean parts	March 1	Shop employees
4. Have team review results and select vendor	Harry	Compare against existing equipment	Time, quality and cost	April 15	Team of Tom, Steve and Harry
5. Purchase equipment	Steve	Delivery schedule	Steve allocates funds	April 30	Capital funds
6. Train employees on how to use new equipment	Harry	Time and quality of cleaning parts	Costs of new equipment versus old	June1	Employees time

Reminding the Systems Approach Tools for PP

- Process Mapping (Process characterization)
- Determining the Cost of the Loss (Activity-Based Costing)
- Selecting P2 Opportunities (80/20 Pareto Principle)
- Analyzing Root Causes (Cause and effect, fishbone diagram)
- Generating Alternative Solutions (Brainwriting)
- Selecting an Alternative for Implementation (Bubble-up/ bubble-down)
- Action Planning

JAVIER ESQUER-PERALTA, Sc.D.

javierep@rtn.uson.mx

University of Sonora (UNISON)

Industrial Engineering Department

www.uson.mx