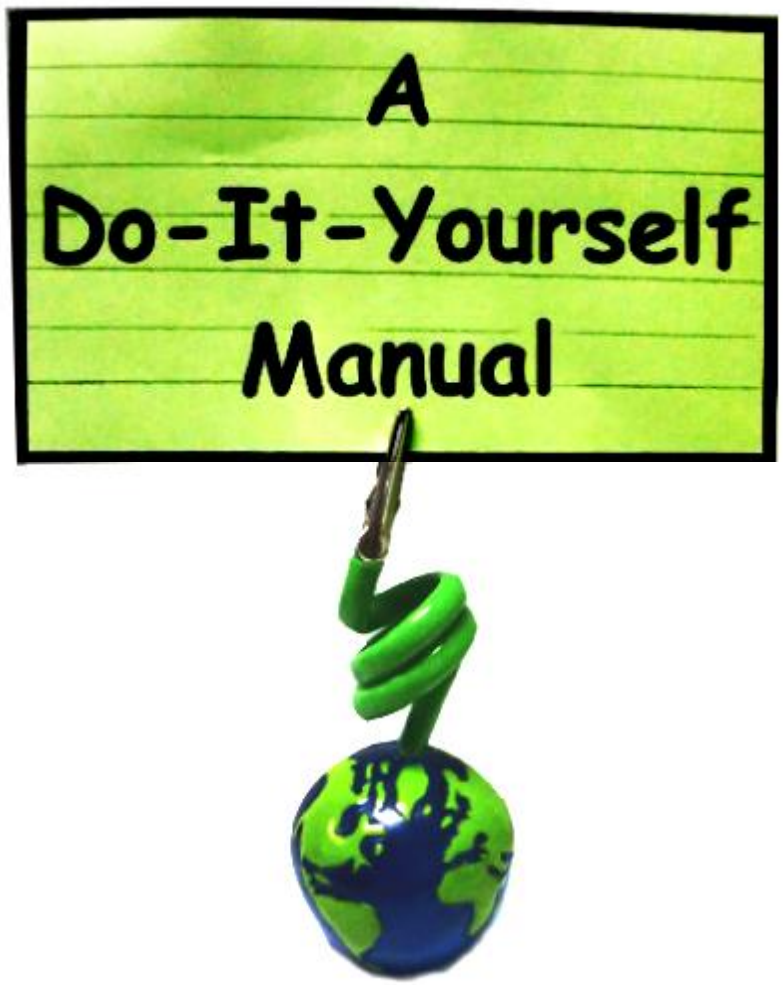
Technical Guidance Series Number: DOE-CP-1

CLEANER PRODUCTION



DEPARTMENT OF ENVIRONMENT
MINISTRY OF NATURAL RESOURCES & ENVIRONMENT MALAYSIA

First Edition 2010

CLEANER PRODUCTION:

A Do-It-Yourself Manual

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- Application System for Evaluation and Implementation of Cleaner Production: Cleaner Production Implementation Tool (User Guide)
- Multimedia VCD: Cleaner Production in Malaysia

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ABBREVIATIONS

CP	Cleaner Production
DANIDA	Danish International Development Agency
DOE	Department of Environment
IRR	Internal Rate of Return
NPV	Net Present Value
SIRIM	Standards and Industrial Research Institute of Malaysia
SMI	Small and Medium Industries
UNEP	United Nations Environment Programme
UPUM	University of Malaya Consultancy Unit

PREFACE

Pollution prevention and resource efficiency have become the ethos for the present day industries. Although the industrial response was initially attributed to regulatory pressure, the current 'buy-in' has been due to overwhelming evidence of tangibles like improved economic performance, better safety practices and last but not least, a positive public image and re-branding as an environmentally-conscious industry.

Cleaner Production (CP) belongs to the family of Pollution Prevention. It was formally defined by United Nations Environment Programme (UNEP) as an integrated strategy for increasing efficiency and minimization of residuals and risks for products, processes and services back in 1989. The adoption of CP by manufacturing entities worldwide has been phenomenal.

In Malaysia the CP concept was first launched in 1996 under the auspices of several parties spearheaded by the Department of Environment Malaysia (DOE), Standards and Industrial Research Institute of Malaysia (SIRIM) and international funding agencies such as Danish International Development Agency (DANIDA). Yet, the adoption of CP by most companies, in particular, Small and Medium Industries (SMIs) are yet to be seen due to a lack of awareness and finances.

This document entitled "Cleaner Production: A Do-It-Yourself Manual" is the result of a project called CP Implementation Demonstration Through Cleaner Production Virtual Centre (CPVC) conducted by the team of CP experts from the University of Malaya for the DOE. It was decided that a manual comprising easy to follow directions on the practices of CP would be handy for people to begin their journey in implementing CP in their workplace. This manual consists of 6 chapters which begins with an introduction to CP followed by 'how to get started' and steps to collect data; generating CP options

and it ends with the important act of monitoring and making a continuous improvement section.

We hope that this manual will pave the way for a profitable and enjoyable journey to implementing CP at the workplace at your own pace and convenience.

DATO' HAJAH ROSNANI BINTI IBARAHIM

Director General

Department of Environment

Ministry of Natural Resources and Environment, Malaysia

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INTRODUCTION TO THE MANUAL

If you are reading this page, congratulations! Soon you will be resourceful enough to implement Cleaner Production (CP) in your premise. The "Cleaner Production: A Do-It-Yourself Manual" is developed by the Department of Environment (DOE), Malaysia to introduce and encourage understanding and the implementation of "Cleaner Production" concept in Malaysian industries, particularly for the small-and-medium scale industries. The general aspects of CP implementation are similar in various industries, therefore, this manual will be useful to all small and medium industries (SMI) in Malaysia.

Besides defining CP, this manual also looks at the advantages and challenges in implementing CP. Readers are taken through a step by step procedure to implement CP in their premises. Relevant and additional information like references, examples and tips are also included in the side bar of each page in the manual. This arrangement will help readers, including those without an engineering or science background to comprehend the materials in the manual with ease.

The manual is written based on the experiences of consultants who were engaged by the Department of Environment. The procedures developed in the manual are written in a general way so some modifications may be required for successful implementation in your own premise.

We hope you will enjoy the manual and try to implement CP in your premise. For more information, contact the "Cleaner Production Unit" in the Department of Environment, Malaysia.

Good Luck!!!

CLEANER PRODUCTION:

A Do-It-Yourself Manual

CHAPTER 1

INTRODUCTION TO CP

CHAPTER 1: INTRODUCTION TO CP

This manual is about Cleaner Production or in short, CP. In Bahasa Malaysia it is called **Pengeluaran Bersih.** If you have not heard about the word "CP", do not be alarmed! This manual will take you through the concept and show you how it can be implemented in your premise with relative ease. This manual can also be called **CP Do-It-Yourself** akin to "**CP for Dummies**".

CP is a relatively new concept which focuses on the well being of the environment while not ignoring the $ and cents (or some say dollars and sense) of business enterprises.

So what is CP?

As the word suggests, production in industries should be done in a ***cleaner*** way. What do you understand by the terms "cleaner" and "production"? Both simply mean to make your operations cleaner, safer, more sustainable, less polluted and to avoid waste.

Do you think that increasing productivity can be considered as a cleaner production activity?

Yes by increasing productivity, lesser time, materials, utilities and human resources per unit product or services are used.

CP info

1. CP was introduced in Malaysia in January 1996.
2. DOE is spearheading the CP implementation programme and this manual writing is also sponsored by DOE through a consultancy project with UPUM.

CP is friendly to Mother Nature simply by consuming pollutants and less waste. By reducing our demands on non-renewable resources and by recycling and re-using products and resources, we can reduce the impact on our natural environment.

This manual is intended for everyone to gradually implement CP option in their premises without the need to have CP experts' assistance. You are the best candidate to implement CP in your premise as you know about your own premise better than anyone else.

CP Terms

Readers are to focus on the word "cleaner" which is a relative term. It is not "clean" which may mean an absolute state. For example, if a process produces 4.0 kg of water per ton of product, any effort to reduce it to a lower level with reference to wastewater generation would be termed as CP.

Are you already implementing CP in your premise?

It is very possible that you are already implementing CP in your premise. If this is the case, congratulation! Keep up the good work. However, you may still go through this manual as a means to enhance your knowledge on various aspects of CP implementation.

It is also possible that many premises are already implementing the CP concept without calling it a CP initiative.

You can perform a simple test to confirm if you are already implementing CP programmes in your premise by taking a one minute test (see side bar).

Most likely you will realize that your organization has already embarked on a CP initiative for some time. You may have used other terms as those given in the side bar. Now, it is just a matter of re-branding to make it more systematic and to give it an environmental flavor. This manual will assist you in doing this systematically. It is organized in a chronological order and you will need to read it from Chapter one. For a more effective implementation, do not skip the Chapters.

Take a "One Minute Test"…

Have you done any of the following activities in your premise?

- ✓Made a systematic effort to reduce utilities?
- ✓Made a systematic effort to reduce wastage of raw materials and by-products?
- ✓ Improved housekeeping and safety aspects of the plant operation?
- ✓Opted for environmental friendly products?
- ✓Initiated programmes such as 3R, 5R, 5S ?

If any of the above answers is **YES**, then your premise has already started a CP programme. You just need to enhance and initiate a formal CP programme!

How does CP differ from other environmental concepts?

One may argue that there are already so many environmental concepts that can be described as "cleaner" in terms of environment. If so, why is there a need to introduce yet another concept called CP? You are right in a way but CP is a general concept which requires tools to realize it. Environmental audits, 3R, 5R, 5S, minimization and reduction programmes, and others are all tools to develop a cleaner environment hence, you become a Cleaner Production practitioner when you implement any of these in your premise.

Furthermore, CP emphasizes on prevention. Any other concepts that have prevention components are essentially a CP concept/tool as well.

Why should you implement CP now?

The answer to this question is probably very apparent. There can be one or many reasons for implementing CP in your premise. Unlike other concepts, CP emphasizes on environmental performance without ignoring the economic and productivity aspects in the premise. In this module examples will be given on how it is possible to reduce costs via implementation of CP. It is possible to be environmental friendly with economic sense. Some of the reasons for implementing CP could be due to:

CP Terms

3R

- ✓ Reduce
- ✓ Reuse
- ✓ Recycle

5S

- ✓ Sorting
- ✓ Straightening
- ✓ Systematic cleaning
- ✓ Standardizing
- ✓ Sustaining

KAIZEN

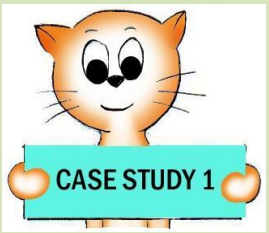
- ✓ Teamwork
- ✓ Personal discipline
- ✓ Improved morale
- ✓ Quality circles
- ✓ Suggestions for improvement

- ✓ Meeting regulations
- ✓ Reducing pollution
- ✓ Increasing productivity
- ✓ Reducing costs
- ✓ Increasing safety aspects
- ✓ Reducing risks
- ✓ Branding your premise as environmental friendly
- ✓ Increasing quality
- ✓ Increasing reputation of company
- ✓ Increasing motivation of staff

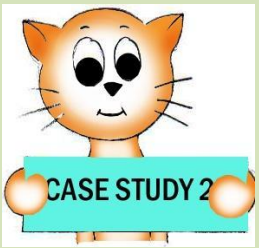
Can you name one reason why your company may want to implement CP? Please do not include the following reason in your answer:

"Because the Department of Environment wants us to implement it"

While the monetary aspect will bring sustained progress for the company, the environmental aspects will help to reduce many effects such as those shown in ***Figure 1-1***.



A manufacturing industry company has reduced its premise waste from 85 drums/month to 10 drums/month. It has also reduced the raw material usage. Their net annual savings cost is RM453,927.00.



Another manufacturing company has reduced the usage of surface (treated) water and it uses fewer chemicals such as HCl and NaOH for regeneration.

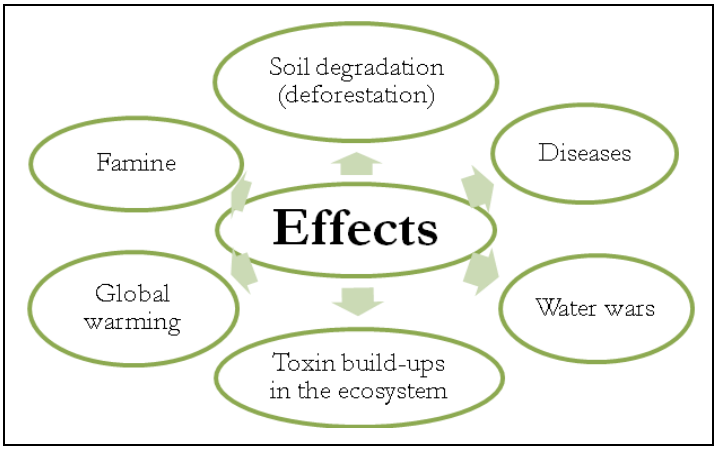
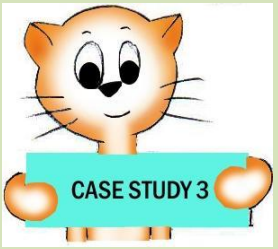


Figure 1-1: Effects of pollution towards environment.

When can you start CP?

You can start its implementation at any time. What you need is actually the willingness to give it a go with a positive mind. You can start the initiative with current existing human resources.



A semiconductor industry sector company has succeeded in conserving energy. It produces less sludge and less general waste was dumped into the landfill. Its net annual saving is about RM150,000.00.

Is it for you?

Yes definitely! CP is for everyone.

It is applicable for all types of activities. It can even be applied in the house and on cars. So whether you are in the manufacturing, servicing industry or as a consultant with offices and computers, you can use CP to make your operations cleaner. As long as the following features are available in your premise, CP can be implemented.

- ✓ Full commitment from your bosses,
- ✓ Company makes CP a company policy/direction,
- ✓ Participation and cooperation from all levels of employees,
- ✓ Desire to adopt CP as a means to implement continuous improvement programmes.

Once initiated, CP is an ongoing commitment!!!

CP on cars

- ✓ In the morning, raise the temperature of air conditioners to the level that you feel comfortable so that the work load of the compressor can be reduced.
- ✓ When driving a car that is parked under the Sun for a long time, open the window to release the hot air for a few minutes before turning on the air conditioner. This can reduce energy usage.
- ✓ Do not bring unnecessary things to increase the load.
- ✓ Allocate a small dustbin to collect the rubbish to avoid accumulation of rubbish in the car.

Is it difficult?

This is a difficult question to answer either with a Yes or No. It depends on you! If you think it is difficult… it is! If you think it is easy... it is! Of course there are challenges to implementing CP in your premise, especially if it involves resources (money, workers, utilities, etc). However with commitment and cooperation from everyone in the premise, it is not impossible to initiate a CP programme. Clearing some of the following misunderstandings would be helpful!!

? Need expertise

You do not need to have any CP expertise in your premise. Anyone can be the candidate to implement CP in the premise. What you need is this manual!!!

? High investment

Not all CP implementation requires money. CP can be implemented in your premise with minimum investment. In fact, sometimes without any financial investment at all.

? Time consuming

This may be true but any improvement initiative requires time! You can start implementing CP immediately once you have identified the simple CP options. Options that require further research and consideration may need a longer time and planning.

CP in restaurants

- ✓ Only switch on the fan when there are customers at the table.
- ✓ Wash dishes by using a big pail to reduce water usage.
- ✓ Always keep the doors closed to avoid AC wastage.

CP in homes

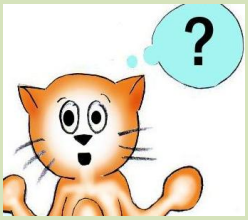
- ✓ Use natural sunlight for lighting in the day time to save electricity.
- ✓ Reuse water from laundry for cleaning floors.

Let's move on!!!

You have taken a big leap in CP implementation by reading this manual. By now you should be convinced that:

- ✓ CP is good for $ and environment
- ✓ CP is for everyone and it can be implemented in your premise
- ✓ CP is a general concept and you may use any tool to implement it
- ✓ CP does not require in depth expertise
- ✓ CP can be implemented immediately
- ✓ CP does not require huge amount of $ to be implemented
- ✓ You only need to shift your paradigm in accepting CP

Frequently Asked Questions



1. Is it a regulatory requirement to implement CP?
   No, at least not yet! It is one of the "prevention approaches" that DOE is promoting to the SMI.

2. Is there any award given if I implement CP in my premise?
   No, not yet. Until today, DOE would not give any award to the premise that implements CP. But, it is a step towards getting an award like the Prime Minister's Hibiscus Award from Ministry of Natural Resources and Environment.

CHAPTER 2

GETTING STARTED

CHAPTER 2: GETTING STARTED

Who should initiate the CP programme?

There are two ways to initiate a CP programme in a premise; top down or bottom up. In top down initiative, the instruction to go ahead with CP programme will come from the bosses. In the bottom up initiative, the efforts to implement CP come from the employees (probably someone who attended a road show or a seminar on CP).

If it is a top-down initiative, the bosses need to identify a person to lead the CP initiative. Otherwise the boss himself can lead the initiative.

In the bottom-up initiative, the person who initiated the effort may be selected to lead the effort if suitable candidates cannot be identified.

Technically, CP implementation in a premise is best headed by someone with a supervisory role. He/ she can be called as the CP coordinator. The person in charge should have the following characteristics:

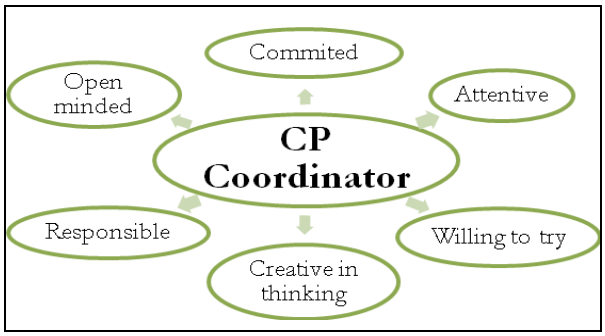


Figure 2-1: Characteristics of a CP coordinator.

If you want to accomplish anything in life, you cannot just sit back and hope it will happen. You have got to make it happen!!!

Is it ok if the person who is leading the initiative is a new staff in your company?

Yes, it is good to have a new person even though he/she does not really know/understand the whole operation in the premise. This is because he/she may be able to observe every area with a different perspective compared to the senior staff in the premise.

What to expect from the CP Coordinator?

The CP coordinator's role is to get the ball rolling. Generally the responsibilities are as follows:

- ✓ Forming a CP team
- ✓ CP awareness among members of CP team
- ✓ Empowering the CP team
- ✓ Resources
- ✓ CP promotion
- ✓ CP progress documentation

Activity 1

List the things to do in this column:

No	Things to do
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

Forming a CP team

The first thing that the coordinator may do is to form a CP team or teams. Teams can be formed based on the following category:

- ✓ Areas or sections (storage, production, packaging, etc)
- ✓ Problem to be solved
- ✓ Departments (quality control, production, maintenance, administration)
- ✓ Random selection

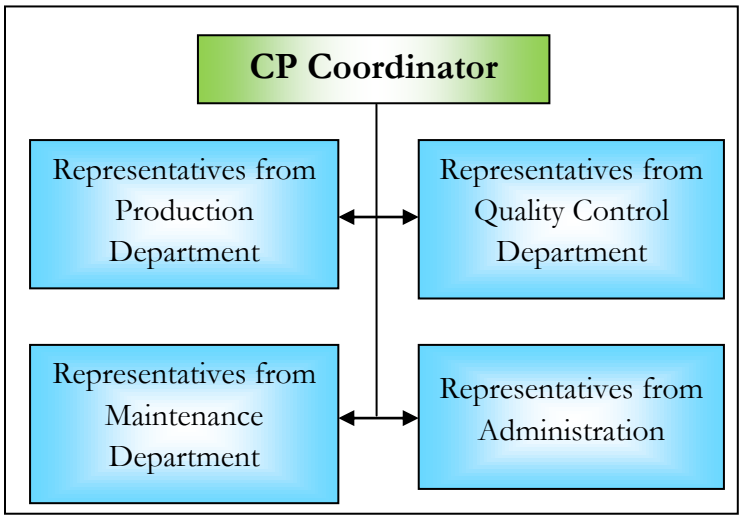
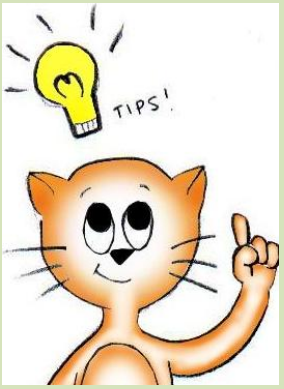


Figure 2-2: Example of CP team formation.

Typically the number of members in the team is very much dependent on the size of the premise. A group can be between 3-10 persons depending on the number of teams formed. Preferably, each team may be presented fairly based on the following categories, whichever is applicable:



Tips to develop an effective team:

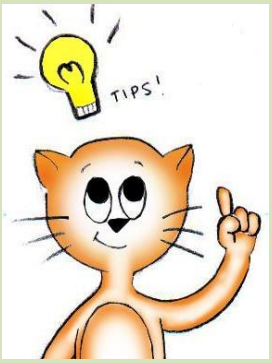
1. Listen to your team members for ideas
2. Sacrifice some of your personal time
3. Share all information
4. Communicate politely
5. Be prepares to work hard
6. Learn to convince others

- ✓ Levels (eg: manager, supervisor, operators)
- ✓ Areas (eg: production, quality, administrators, accounts)
- ✓ Seniority (experienced and new staff)
- ✓ Other appropriate category

CP awareness among members of CP team

CP awareness among the team members is a prerequisite. If they do not have any knowledge on CP, the CP coordinator has to take this as his/her responsibility. The CP coordinator can create and distribute a survey form to the team members to identify their level of knowledge in CP. Some questions about the basic concepts of CP, environmental rules and regulations can be included into the form. The CP coordinator can then train the team members based on the results get from the simple survey.

"Coming together, sharing together, working together, and succeeding together"



Tips on how to spend your time wisely:

- ✓ Think about tomorrow, today.
- ✓ Get organized.
- ✓ Get the bad stuff done first.
- ✓ Make a "To Do" list.

Empowering the CP team

The team must be empowered with the following items:

- ✓ Time allocation to be involved in the CP activities (conducting brain storming)
- ✓ Authority to conduct relevant activities (measurements, etc)
- ✓ Expose to CP training or workshop
- ✓ Integration into the reward system if CP is successfully implemented
- ✓ Specific role of each team member
- ✓ Desired responsibilities of each team member

Resources

Before getting started, the CP team has to list down the resources needed. The list of resources needed is as follows:

- ✓ Finance
- ✓ People or manpower
- ✓ Information and references materials (reference book, guideline, brochure and etc.)
- ✓ Measuring equipment for data collection (to measure temperature, pressure, humidity, size and etc.)

"Nobody has the time. Time cannot be owned. Time is free to everyone!"

CP promotion

Promoting CP initiatives is an important aspect of the overall CP programme. Everyone must at least be informed of the following aspects:

- ✓ What CP is
- ✓ What the company wishes to achieve
- ✓ Activities planned
- ✓ Persons involved
- ✓ Contributions from everyone

The promotion can be done in many ways depending on the set-up of the premise. The following modes of promotion can be implemented:

- ✓ Display banners and buntings
- ✓ Produce special posters or fliers
- ✓ Issue of badges
- ✓ Construct a special notice board
- ✓ Include it in the electronic board
- ✓ Announce it in the company bulletin or through the PA system
- ✓ Include CP as an agenda in the department or section meeting

CP promotional roles can be divided into 2 categories:

(i) Management/ CP coordinator:

Preparation of promotional material/ activities (booklets, bulletines, brochures and etc.)

(ii) Staff in the premise should:

- Have awareness of the CP programme in work premises
- Show support for all the CP activities conducted in the premise
- Have positive thinking on the changes in practice and working
- Follow Standard of Operation
- Showing their cooperation

- ✓ Raise the awareness through a special programme
- ✓ Any other means

It is important that everyone in the premise is aware of the CP concept and of the activities being implemented!!!

CP Progress Documentation

Like any other project undertaken, it is important for the CP implementers to document the progress. This will be helpful in monitoring the continuous improvement aspects which are emphasized strongly in CP. The following documentation modes are possible:

- ✓ Video and audio recording of events
- ✓ Paper documentation (forms, records, reports and etc.)
- ✓ Photographs (3 stages: before implementation, during implementation and after implementation)

All the documentation modes should fulfill the following criteria:

- ✓ Clearly show the objects/ events
- ✓ Clearly show all the steps taken
- ✓ Note down all the important points
- ✓ Avoid disturbances during video or audio recording

How to identify issues?

Issues can be identified in several ways. They are as follow:

- ✓ Walk-through inspection
- ✓ Internal complaints (complaints from staff, the working environment, difficulties faced during an operation)
- ✓ External complaints (complaints from customers, residents around the premise)
- ✓ Complaints from the enforcement department
- ✓ Incidents recorded in the premise (accidents, high water bills, operation emergency shut down and etc.)

It all depends on the plans that you have decided to implement. You can start by choosing any issues in the premise. Examples are as follows:

- ✓ Operating issue(s)
  - o High operating temperature
  - o High operating pressure
  - o Insulation
  - o Energy loss
- ✓ Quality issue(s)
  - o Product quality is not stable
  - o Any regulatory problems

Activity 2

List the 10 most important issues that you may want to tackle in your premise.

No	Issues
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

- ✓ Utilities issue(s)
  - High water consumption compared to benchmark (cleaning, quenching, rinsing)
  - High electricity consumption (machineries, lights, heater, air conditioning)
  - High fuel consumption (petrol, diesel, natural gas, coal, wood)
- ✓ Safety and risk issue(s)
  - High risk activities
  - High risk area
  - High possibilities of accidents
- ✓ Housekeeping issue(s)
  - Conditions of the floor
  - Arrangements in the storage area
- ✓ Management issue(s)
  - Staff placements
  - Employer-employee issues
  - Motivational issues
  - Hierarchical systems used

Activity 3

List all the returns that you may achieve by solving all the issues mentioned in Activity 2.

No	Returns
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

- ✓ Waste and emission issue(s)
  - Handling of the waste produced
  - Understanding of hazardous gas emissions
- ✓ Common facilities issue(s)
  - Pantry room
  - Canteen
  - Kiosk
- ✓ Premise layout
  - Convenience
  - Safety
  - Easy accessibility

Can you think about any other issues? Besides the above, you can try to talk to the staff in your premise (operators, cleaners, technicians, supervisors, managers) or even the boss. You may also want to include suppliers and clients. This will indirectly help to promote CP awareness to all stakeholders. ***Table 2-1*** can be used to summarize the issues identified.

"Failing to plan is planning to fail."

Table 2-1: Summary of issues and problems identified (example).

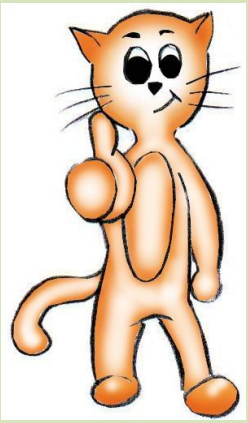
No	Issues	Scope	Problems
1	Energy consumption	Process A	High electricity bills
2	Water consumption	Process A	High water bills

The next move

After the teams have been formed and the theme has been selected, you may ask each team to do the following:

- ✓ Identify the problem or the improvement that you want to obtain from the CP initiative.
- ✓ Elect a leader for each team.
- ✓ Have a brain storming session to define the scope and objective of the CP initiative. (Tips on defining the objective and scope will be discussed in Chapter 3 of this manual).
- ✓ Have a brief plan of execution for a period of three months (at least).
- ✓ Plan for a detailed CP audit.

By planning ahead you can see where and how you choose to spend your time. Just as you choose how to "spend" your money, you also choose how to "spend" your time. Once it's gone, it's gone. Choose to spend it wisely.



CP implementation plan

By now, you should be able to list down all the items in your planning into a **CP Implementation Programme Schedule** and to estimate the time that can be allocate for each item. This helps you to make sure that your work is within the planning time period. The following table illustrates.

Table 2-2: CP implementation programme schedule (example).

Step	Item	Jan	Feb	Mar	Apr	May	Jun
1	Set up a CP team						
2	Training schedule						
3	Routine meetings (role and responsibility of team members)						
4	CP audit						
5	Routine meetings (CP option generation)						
6	Routine meetings (CP option implementation)						

Tips on getting started

1. Choose something that you really want to solve.
2. Research and make a plan.
3. Ask yourself: What is the worst that could go wrong and try to avoid it.
4. Make work easy on yourself and your team.
5. Motivate yourself and your team.
6. Find encouragement and get help from other people.
7. Learn about time management.

Let's move on!!!

Your premise has now identified a CP coordinator, formed a team, and selected themes for the team to work on. Congratulations! You have taken a great leap and have gone through a major paradigm shift. At this stage, please ensure that the following has been done:

- ✓ The team has been trained on CP
- ✓ The initiative has been approved by the management
- ✓ The required appointment letter for the team members have been issued
- ✓ Promotion activity in the premise has been conducted
- ✓ Feedback from other staff have been obtained
- ✓ Plans for documenting the CP initiatives are in place
- ✓ Each team has scheduled activities for at least the next three months

CHAPTER 3

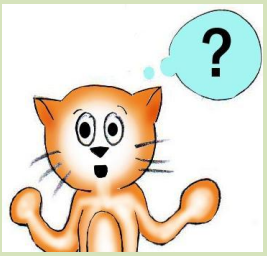
COLLECTING INFORMATION AND ANALYSIS

CHAPTER 3: COLLECTING INFORMATION AND ANALYSIS

This chapter needs to be read by all the team members, especially the leaders. By now you should have gathered a team and identified the various themes to work on. Whether you choose an issue or an improvement item as a theme, the data needed for initiating a CP implementation programme are the same. You may start the ball rolling by having a brainstorming session.

Brainstorming session

- ✓ Objective of brainstorming session
  - o To generate a large number of ideas through an interactive process
  - o To allow for the free exchange of ideas
  - o To develop a prioritized list of ideas for further review
- ✓ The location to have a brainstorming session should have the criteria as suggested below:
  - o A comfortable condition (eg: with air conditioner, suitable lighting)
  - o Sufficient space for the whole team
  - o Equipped with presentation facilities (eg: projector, white board)
  - o Within every team members vicinity



What is brainstorming?

Brainstorming is a technique designed to generate a large number of creative ideas through an interactive process in a group.

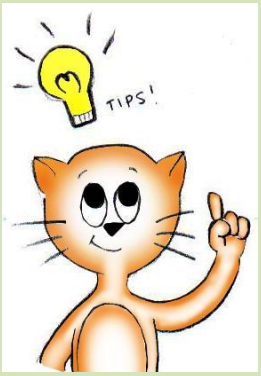
✓ Tips on brainstorming

- Make sure that all team members fully understand the objective of the brainstorming session
- Develop a high energy and an enthusiastic climate
- List all ideas presented prior to discussing
- Record all ideas exactly as presented on a flipchart, possibly using two recorders
- Generate a discussion to avoid slowing down when the ideas come to a standstill

✓ Do's and Dont's of a brainstorming session

The following are some major **Do's** when conducting a brainstorming session in your premise:

- Think creatively and be open minded
- Never criticize
- Welcome all ideas
- Adhere to the time schedule
- Use attentive body language
- Protect secrecy and confidentiality
- Stay focused to the objective and scope
- Adhere to the company rules and regulation
- Limit to information and documents required



Suggested agenda for a brainstorming session:

1. Objectives
2. Discussion items
3. Discussion process
4. Session rules
5. Brainstorming exercise
6. Next step

The following are some major **Dont's** when conducting a brainstorming session in your premise:

- ✘ Boss around
- ✘ Be pushy
- ✘ Be judgmental
- ✘ Be argumentative
- ✘ Expect favors
- ✘ Behave like an expert
- ✘ Ask for confidential documents
- ✘ Make unreasonable comparisons
- ✘ Question integrity of the premise operators
- ✘ Be secretive when conducting the audit

Can you add anymore Do's and Dont's?

Remember…

"The group owns the ideas, not the individuals"

Information collection

The very first step in information collection is to collect the general information of the premise such as name of premise, history of premise, organization chart, operating days per annual and etc.

Next, you can proceed to collect the information on the process in the premise. The list of information that can be gather from a processing area is as follows:

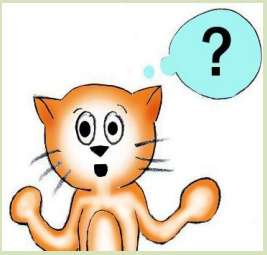
- ✓ Raw materials
- ✓ Additives
- ✓ Products and by-products
- ✓ All the unit operations involved
- ✓ All the activities involved
- ✓ All the ancillary operations (cooling, steam and compress air)

Generally, the information collection process need to address the following aspects:

1. Well defined objectives and scope

The objective and scope of the CP programme need to be clearly defined. Objective is the target of achievement (%, amount, etc) and scope is the coverage (whole plant or specific section), unit operation, or even a specific problem.

Activity 4



For the main issue that you have identified in Chapter 2, list all the data /information that you wish to collect.

No	Data
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

For example:

"To reduce water in the processing area by 5% in the period of three months."

The objective must be measurable. General objectives are not advisable. For example:

"Reduce water usage in the factory."

2. Well defined activities and milestones

It is extremely vital that the activities and milestones are drafted out at the beginning clearly. Milestones are big achievements whereas activities are items done to achieve those milestones. Examples are as ***Table 3-1***.

Table 3-1: Well defined activities and milestones.

Milestones	Activities	
Completion of problem identification	1	Gather complaint list in the past six months.
	2	Talk to all operators and line supervisors.
	3	Perform a written survey.
Completion of data collection	1	Compile relevant documents.
	2	Analyze documents for supporting data.
	3	Draw charts and diagrams.

Examples of well defined objectives and scope:

- ✓ To reduce electricity usage in the processing area by 10% in the period of 6 months.
- ✓ To reduce waste generated in the premise by 20% in the period of 3 months.
- ✓ To eliminate/ reduce the material loss to 0.5% in the period of 3 months.

3. Type of data required

Data required are mainly dependent on the type of initiative and objectives and scope of the initiatives. Once the objectives and scope are defined clearly, the data required are easier to be determined. For example, if electricity reduction is the theme then the following data probably need to be gathered:

- ✓ Electricity bill
- ✓ Usage hour
- ✓ kW ratings
- ✓ Operators in charge

Here, you can develop a table of **Information Collection Methodology** ***(Table 3-2)***. By having this table, you can easily get the information needed (list down information needed, the sources, and department in charge).

Table 3-2: Information collection methodology (example).

No	Information	Source	Action by
1	Water usage	Water bills	Administration
2	Electricity usage	Electricity bills	Administration
3	Complaints	Complaint records	Administration

Type of data required for:

1. Water usage
   - ✓ Water bill
   - ✓ Water capacity used in each operation
   - ✓ No of operators in charge
2. Waste generated
   - ✓ Type of waste
   - ✓ Rate of generation
   - ✓ Causes of generation

Here is another example ***(Table 3-3)*** for you to summarize the data needed and the target to achieve. And, ***Table 3-4*** is suggested for data collection on water usage.

Table 3-3: Summary of data and target to achieve (example).

No	Data	Time period	Objective	Scope	Target
1	Water bills	Past 6 months	To reduce water usage	Processing area	Reduce 5% of usage
2	Electricity bills	Past 6 months	To reduce electricity usage	Processing area	Reduce 5% of usage
3	Complaints received	Past 6 months	To solve the problems faced	Producrt quality	To achieve "0 complaint"

Table 3-4: Examples of data needed for water usage.

No	Appliances	Flow rate	Time in use	Daily consumption	Cost per month	% of total
1	Domestic use					
2	Rinse bath					
3	Plating bath make-up water					

Activity 5

Can you try to develop a table of data and target to achieve for the issues identified in Chapter 2? You can refer to ***Table 3-3*** given in the main text.

4. Time schedule

Just like any other initiatives it is healthy if the activities and milestones are attached with a definite time schedule which can be reviewed continuously if requirement exists.

Table 3-5: Time schedule for CP implementation (example).

Month	1st				2nd				3rd			
Week	1	2	3	4	1	2	3	4	1	2	3	4
Data collection	▨	▨										
Data analysis			▨	▨								
Option generation					▨	▨						
Option prioritization							▨	▨				
Option implementation									▨	▨	▨	▨

Activity 6

By refering to ***Table 3-5***, please convert your CP implementation planning into a time schedule.

5. Sources of data

Data can be obtained through the following sources:

- ✓ Measurements
- ✓ Estimations/Approximations
- ✓ Past records
- ✓ Bills and receipts
- ✓ Interviews
- ✓ Observations
- ✓ Video recordings
- ✓ Complaints and analysis of complaints
- ✓ Relevant literatures, books

6. Resources required

The initiative may require resources at various levels such as:

- ✓ Office rooms to conduct discussions and brain storming sessions
- ✓ Allocation for training and awareness programme
- ✓ Addition staff hours to make measurement, estimation, observations, etc

Data that you can get from **measurement**:

- ✓ Temperature
- ✓ Flow rate
- ✓ Pressure
- ✓ Sizing

Data that you can get from **estimation/ approximation**:

- ✓ Electricity usage
- ✓ Water usage

Data that you can get from **bills**:

- ✓ Water bill
- ✓ Electricity bill

Prioritizing your issues

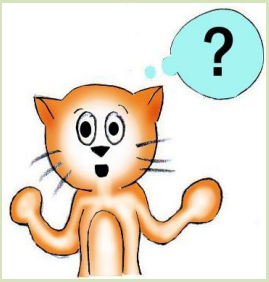
If you have many issues to be sorted out with the CP concept, how would you choose the first one to be tackled? You should consider few criteria as follows:

- ✓ The current condition of your premise
- ✓ The ease to solve the issues
- ✓ The time needed to solve the issues
- ✓ The cost needed
- ✓ The manpower required
- ✓ The urgency of the issue

Is accurate data mandatory?

It depends on your premise target. If you do it on your own, then the accuracy of the data collected around ±20% is tolerated. But, if accurate data is already available in your premise, just use it!

Activity 7



To solve the major issues identified in Chapter 2, you would need to gather as much data as possible in order to find a solution (a CP solution) later. List all the tools that you may require to gather sufficient data.

No	Tools
1	
2	
3	
4	
5	

Tips on material & energy loss quantification

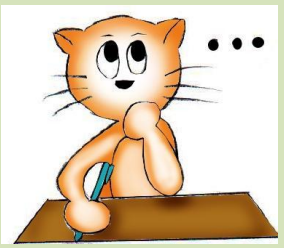
1. Amount of materials (solid and liquid)

Materials can be quantified either in volumetric and mass units. Alternatively, materials are quantified in terms of numbers. There are also premises where the production rates are reported in terms of volumetric rates (m^3/day).

For liquids, mass flow meter can be used to quantify mass rate (kg/s). In most cases, mass rates are estimated indirectly by measuring the volumetric rates (m^3/s). The formula of conversion to mass rate is as follows:

Mass Rates (kg/s) = Volumetric rate (m^3/s) x density (kg/m^3)

In cases where the volumetric or mass flow meters are not available, the rates can be determined by capturing a sample for a specific time if it is possible. By measuring the volume and mass of the captured sample and dividing it by time taken to capture the sample, one can determine the volumetric and mass flow rates.



Try this!!

It was found that the volumetric flow rate of a liquid in a pipeline is 23m^3/hr. Find the mass flow rate (kg/s) if the density of the liquid is 1250 kg/m^3.

Answer = 0.8 kg/s

2. Gases

Gases are difficult to quantify, especially if it is emitted openly (not through chimney or pipelines). Volumes of gas is dependent on the pressure and temperature therefore, the volumetric rates for CP audit purposes may involve some complexity. Some premises may measure volumetric rates of the gases. With this rate, one would require the information on pressure and temperature to estimate a mass flow rate. The following formula is provided.

$$\dot{m} = \frac{P\dot{V}M}{8.314\,(T)}$$

Where

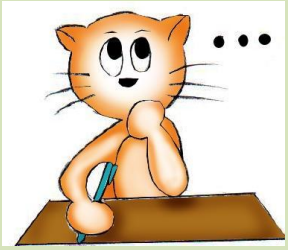
P = Pressure in atm x 1.0132 x 10^5

$\dot{V}$ = Volumetric flow rate (m^3/s)

M= Molecular weight (29 gram/mole for air)

T = Temperature in Celsius + 273 (K)

Mass rates for gases and vapors can be also determined by a simple mass balance. For example, the amount of vapor released from hot water contained in a container can simply be determined by measuring the weight of the whole container before and after the vaporization. The difference in the mass is equal to vapor loss.



Try this!!

Calculate the heat loss from a tank with 10m^2 exposed areas if the surface temperature is 35°C. Assume h to be 30 W/(m^2K). The surrounding temperature is 28°C.

Answer: 2100 kW

3. Energy wasted from hot surfaces to the surrounding

Heat is emitted from hot surfaces through radiation and conduction to the surrounding. The formula to calculate the heat conduction to the surrounding are as follows:

$$Q = hA(T_{surface} - T_{surrounding})$$

Where

Q = heat transferred (kJ/s)

h = heat transfer coefficient, where the value for air is between 10 to 100 W/(m^2K)

A = area of the surface (m^2)

$T_{surface}$ = temperature of hot surface (K or °C or °F)

$T_{surrounding}$ = temperature in surrounding (K or °C or °F)

4. Energy lost from hot or cold materials

Cooling and heating requires energy, therefore any materials which have temperatures lower or higher than the surrounding temperature can be considered as containing energy. A simple formula which can be used to estimate these energies is as follows:

$$Q = mC(T_{material} - T_{surrounding})$$

Where

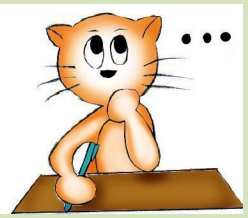
Q = amount of heat (kJ)

m = mass of material (kg)

C =heat capacity of that material (kJ$kg^{-1}K^{-1}$)

T =temperature (K or °C or °F)

Note: If Q is calculated in kJ/s or kW, the m in the formula should be replaced with mass flow rate (kg/s)



Try this!!

Calculate the heat loss with 1kg/s condensation at 42°C discarded to the drain.

Useful information: Surrounding temperature is 28°C.

Answer:

Q = 58.52 kJ/s

Data analysis

Analyzing data may be as difficult as getting the data or at times more difficult. Once you have all the raw data available you need to analyze the data accordingly. Two major reasons for analyzing the data are:

- ✓ To identify the major issues with the aim to quantify the issues at hand. (Example: What is the current electricity usage per ton of product and how much more is it than the benchmark practised in the particular industry?)
- ✓ To help determine the sources of the problem. (Example: If total water consumption is too high, data on distribution of water usage by various areas would be useful.)

Analytical Tools

Data can be analyzed manually or by using simple computer software like MSExcel. There are also many specialized tools available in analyzing the data/issues.

Types of data presentation

a. Percentage

You can use percentage to present the result outcomes after an analysis of an issue has been done such as making a comparison of the electricity bills incurred for the past few months. A percentage variation in the bills may mean that there are some operational problems happening in your premise which need attention.

Activity 8

By now you would have probably gathered a lot of data which are ready to be analyzed and interpreted. List down what you want to identify from the analysis.

No	Types
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

b. Various types of graph and chart

1) Line Graph

An example is given in ***Table 3-6*** and ***Figure 3-1*** below.

Table 3-6: Data for water usage in 5 months after CP options implementation.

Month	Usage (RM)	CP options implementation
Jan	1000	No
Feb	950	Use energy saving bulb in the premise
Mar	920	Fix timer at all the air conditioner
Apr	880	Use transparent roof instead of light
May	850	Increase the awareness among staff

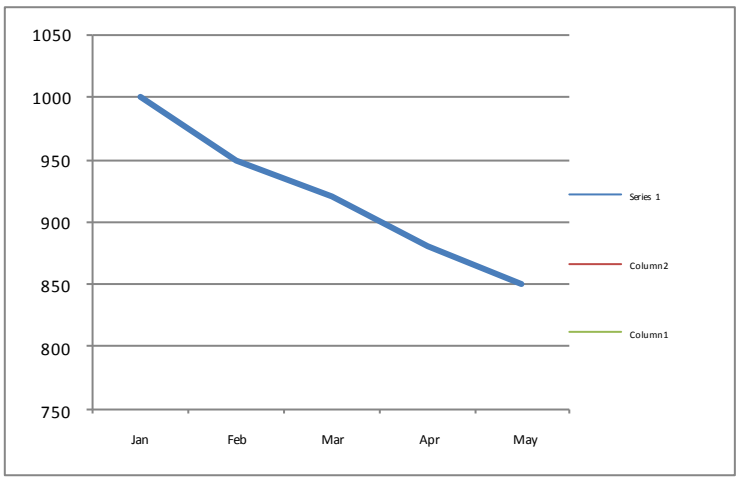


Figure 3-1: Analysis of water usage after CP options implementation by using line graph.

Activity 9

List down all the sources of your data/information.

(Hint: electricity bills, actual measurements, etc.)

No	Data	Sources
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

2) *Bar Graph*

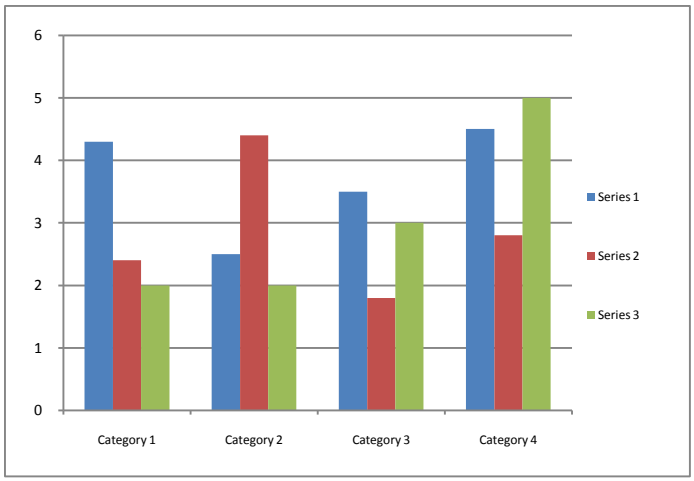


Figure 3-2: Example of bar graph.

3) *Pie Chart*

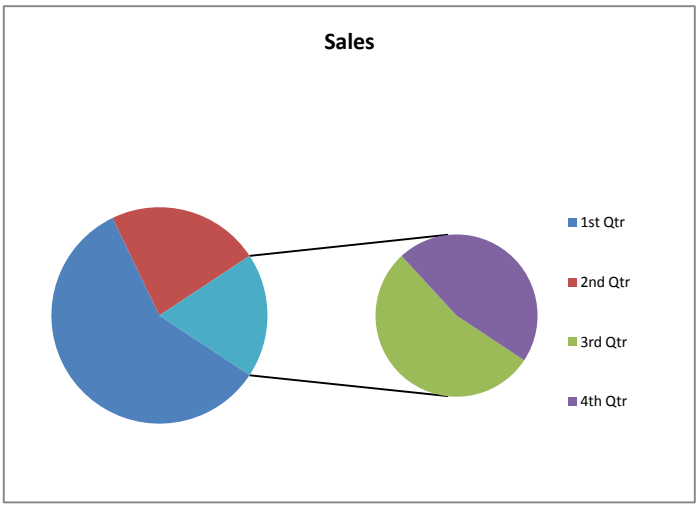


Figure 3-3: Example of pie chart.

Activity 10

Can you draw a fish bone chart for one of the issues mentioned in Chapter 2?

Equipment:

No	Causes
1	
2	
3	
4	
5	

4) Fish-bone chart

A simple example is given in ***Table 3-7*** and ***Figure 3-4***. This example is about the causes of carton damage.

Table 3-7: Causes of carton damage.

No	Area	Causes
1	Equipment	Other sharp edge
		Loading bay door
		Conveyor belt
2	Environment	Accident zone
		Dripping water
		Wet floor
3	Employees	Improper lifting
		Box too empty
		Heavy box on top
		Box overloaded
4	Transport	Leaky truck roof
		Shifting load

Manpower:

No	Causes
1	
2	
3	
4	
5	

Materials:

No	Causes
1	
2	
3	
4	
5	

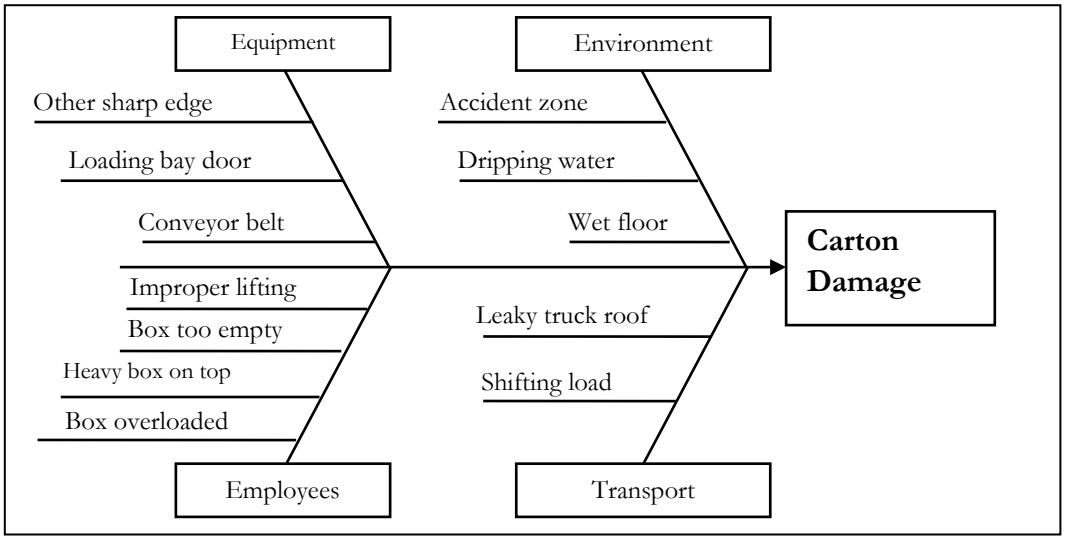


Figure 3-4: Fish-bone chart for causes of carton damage.

Let's move on!!!

By now you should have completed the following:

- ✓ Conducting brainstorming sessions to make decisions
- ✓ Collected all the required information
- ✓ Prioritized the issues according to appropriate criteria
- ✓ Analyzed the data by using suitable methods

CHAPTER 4

GENERATING OPTIONS FOR ISSUES

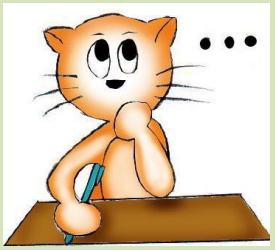
CHAPTER 4: GENERATING OPTIONS FOR ISSUES

By now you would have analyzed the data collected, identified, and prioritized issues objectively. It is time to think about how to create ***CP options*** to overcome those issues! CP options are available methods, means, changes, improvements, modifications, elimination, addition, substitution, and other ways that can be used to achieve objectives set out in the Cleaner Production (CP) programme.

Generic options available

CP options can be generated based on several categories. All these categories are able to help you generate a wider range of CP options. Some of the generic categories that can be used are listed below:

1. Process/activity optimization
2. Process/procedure change
3. Design change/modification
4. Housekeeping
5. Material substitution
6. Technology change
7. Recycling and reuse
8. Training and awareness programme for staff



Can you think of other means to generate CP options?

1. Process/ activity optimization

There are many parameters and variables that can be optimized for processes or activities. In many industries, processes/activities are conducted based on general recommendation from the suppliers or on norms/experiences which may not be ideal or optimal. Therefore, there is a need for processes and activities to be optimized which will result in material and energy savings and even increase in productivity. Optimization conditions can be obtained through research and appropriate studies.

Some examples are listed as follows:

- ✓ To optimize temperature and pressure for reactors
- ✓ To optimize concentration of chemicals used for cleaning
- ✓ To optimize curing and sterilization temperature

2. Process/ procedure change

Process/ procedure change is another useful category to generate CP options. Changes in time, temperature, pressure, and general standard operating procedures are among the process change that you can do. Some examples are given below:

- ✓ Reduction in number of washings
- ✓ Increase in temperature in cold rooms
- ✓ Using vacuum systems instead of blowing systems

You should ask yourself the following questions:

1) Is there anything that I can do in a shorter way/time without compromising quality?
2) Can I eliminate any steps in my process?

3. Design change/ modification

Design change refers to modifications or changes made to the equipment used for processes and activities. It may bring about significant results if implemented properly. Some examples of design change/ modification are as follows:

- ✓ Increase or decrease in pipe sizing
- ✓ Adding special trays to prevent spillage
- ✓ Modifying the filler head
- ✓ Adding special conveyors to transport materials

4. Housekeeping

Do you like to work in a clean and safe premise? Surely your answer is "YES". With a nice working environment, the staff will work more effectively and productivity will increase. Loss of materials can also be minimized.

Housekeeping options that can be applied in the premises include doing the following:

- ✓ Repair leakage
- ✓ Keep equipments clean and dry
- ✓ Do not mix wastes
- ✓ Label items properly
- ✓ Do not over stock raw materials
- ✓ Always keep the floor clean and dry
- ✓ Maintain hygiene in the workplace

5. Material substitution

Are all the raw materials used in your company environmentally friendly?

If NOT, can you start to replace them with better alternative raw material without compromising quality?

Material substitution is one of the major categories that can be used to generate CP options. The materials include raw materials, additives, and other chemicals used in production, laboratory, administration offices, and the whole premise. The list also includes cleaning solutions used for toilets, fuels etc. You may start the process by studying the characteristics of the existing materials. If you find that the materials can be substituted with a less polluting and an environmental friendly one, then there is an opportunity for you to replace the existing material. But, you have to make sure that the quality of the product will not be affected.

You can consider the following characteristics when selecting materials as replacements. If you replace existing materials with materials of the characteristics lised below, you are becoming CLEANER!

- ✓ It should generate benign by-products/ waste.
- ✓ It should be more environmentally friendly.
- ✓ It is less toxic.

Examples of material substitutions:

- ✓ Replace "high waste" raw materials with "low waste" ones
- ✓ Replace chemicals with a "high environmental impact" with chemicals with a "low environmental impact"
- ✓ Replace inorganic acids and alkalis with organic acids and alkalis where possible

6. *Technology change*

There are many technologies available in reducing material and energy consumption. There are also technologies that can minimize waste generation and increase productivity. Examples are:

- ✓ Membrane technology for water recycling
- ✓ Solar panel system for generating heat
- ✓ Automated systems (compared to manual)
- ✓ Use of LNG instead of diesel in the boiler

7. Recycling and reuse

Most probably you are familiar with these options already. Now try to think, are there any materials that you can reuse or recycle. It may be from the process, offices and from any part of the premise.

Examples of recycling and reuse:

- ✓ Paper reduction through more effective use (less reports, less forms)
- ✓ Recycle all the rejected packaging materials
- ✓ Use waste hot air from rapid and final cooling in the vertical dryer

8. Training and awareness programme for staff

The staff could be one of the main reasons leading to waste generation and a reduction in productivity. Therefore, staffs need to be trained continuously and be exposed to CP concepts. Some examples of these training are:

- ✓ Safety and health in work place (for all staff)
- ✓ Material handling
- ✓ Housekeeping

Training programmes can help to:

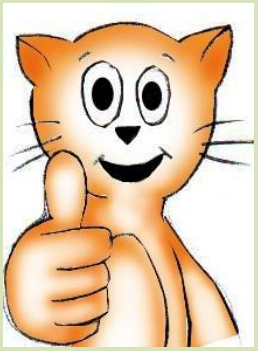
- ✓ Upgrade the skills of staff in implementing CP options.
- ✓ Change the staff's culture and thinking towards positive development.

Awareness among staff can also determine the success of your CP programme, so awareness programmes are necessary. You may invite experts on CP to carry out a series of activities to increase the awareness/ knowledge on CP. These activities can help the staff to have a clearer view and a better understanding of the benefits of CP.

The premise has to support these awareness activities on environment or the CP programme organized by other organization through seminars, workshops, talks and etc.

It is not hard to make decisions when you know what your values are.

~Roy Disney~



Prioritizing options

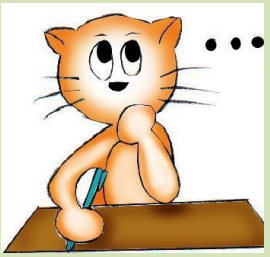
You may be able to generate many options in your premise. However not all options can be implemented simultaneously. If that is the case, how do you choose the ones that ought to be implemented first?

There is a tendency to say that the first option is the one that gives the best return of monetary investment. You are right! However, you must also understand that there are many options which can be implemented without incurring any financial investment. In some premises, up to 30% of the options fall into this category. Some examples of those options are:

- ✓ Reducing electricity bill by switching off the lights when not in use.
- ✓ Reducing operational time.
- ✓ Increasing cold room temperatures.

Of course, you still need some form of investment in implementing CP options! If your CP options are based solely on financial returns, then the investment required against savings achieved must be evaluated. The reduction or increase in operational costs before and after the CP implementation should be also taken into consideration.

The cost benefit analysis can be done by using the items given in the ***Table 4-1***.



By now, you should be able to categorize all the CP options based on the types of criteria listed below:

Type 1: Implement immediately

Type 2: Implement within 6 months

Type 3: Implement only if finance is available

Type 4: Keep it as a future plan

Type 5: Drop it for at least 10 years

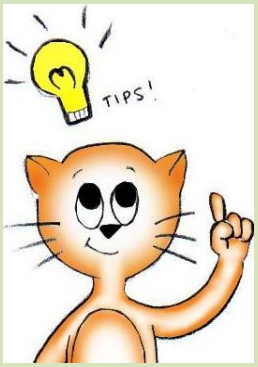
Type 6: Ignore it

Table 4-1: Cost benefit analysis.

Investment Cost, A	**Items**
	1. Electrical work
	2. Purchasing equipment
	3. Construction work
	4. Shut down loss
	5. Man power cost
	6. Other costs
Additional operational cost due to change/ modification (monthly rate), B	**Items**
	1. Man power
	2. Electricity
	3. Steam
	4. Fuel
	5. Maintenance
	6. Treatment
	7. Others
Savings (monthly rate), C	**Items**
	1. Man power
	2. Electricity
	3. Steam
	4. Fuel
	5. Maintenance
	6. Treatment
	7. Others
Payback period	A/(C-B) months

If the payback period is acceptable to you and your management, you can go ahead and implement a particular option. Normally, pay back period below two years is an accepted financial practice in many industries.

Even though the payback period method is one of the easiest to use, it however, does not consider items such as the time value of money, opportunity cost, potential risks, and other factors. If these factors are important then you can use the net present value (NPV) and internal rate of return (IRR) method.



Further screening of CP options which belongs to Type 1, can be done based on the following benefits:

- ✓Improved quality
- ✓Improved image
- ✓Safer operations
- ✓Less risky operations
- ✓Better motivation
- ✓Better working environment
- ✓Less environmental issues
- ✓Reduction in carbon footprints

When evaluating a CP option, the benefit (potential output) must be estimated and compared with the input required. The outputs are not just limited to the issues addressed in the CP audit objectives but may also include intangible or indirect outcomes, for example, improvements in aesthetics or better reputation and image for the company. Other than the financial returns, the major outputs are:

- ✓ Improved quality
- ✓ Safer operations
- ✓ Less risky operations
- ✓ Better working environment
- ✓ Lesser environmental issues
- ✓ Reduction in carbon footprints
- ✓ Increased performances/output/quality
- ✓ Improve reputation of the company
- ✓ Increment in staff morale

Table 4-2: Example on benefits of CP options implemented.

Issues	CP options implemented	Benefits	
		Before	After
High water consumption	Fix nozzle at the water source (pipelines)	Photographs/ data	Photographs / data

Lets us look at some simple CP options. The following CP options can be used to reduce water consumption at your premise:

- ✓ Use high pressure water rather than high flow.
- ✓ Reuse clean waste water for washing purposes.
- ✓ Fix a nozzle at the end of a hose for cleaning purposes.
- ✓ Collect rain water for cleaning purposes.

Let's move on!!!

By now, you should be able to move on to the next step and acquire the following information:

1. Generate CP options based on generic categories
2. Prioritize CP options generated by considering the following criteria:
   - ✓ Financial returns
   - ✓ Increasing product quality
   - ✓ Improving company image
   - ✓ Reducing risk in premise

CHAPTER 5

IMPLEMENTATION OF CP OPTIONS

CHAPTER 5: IMPLEMENTATION OF CP OPTIONS

At this stage, you are equipped with a list of CP options in the prioritized sequence. So what will be your next step? Now, it is time for implementation of the CP options chosen. There are a few steps that you can follow to start the ball rolling. ***Figure 5-1*** shows the important steps in implementing CP options.

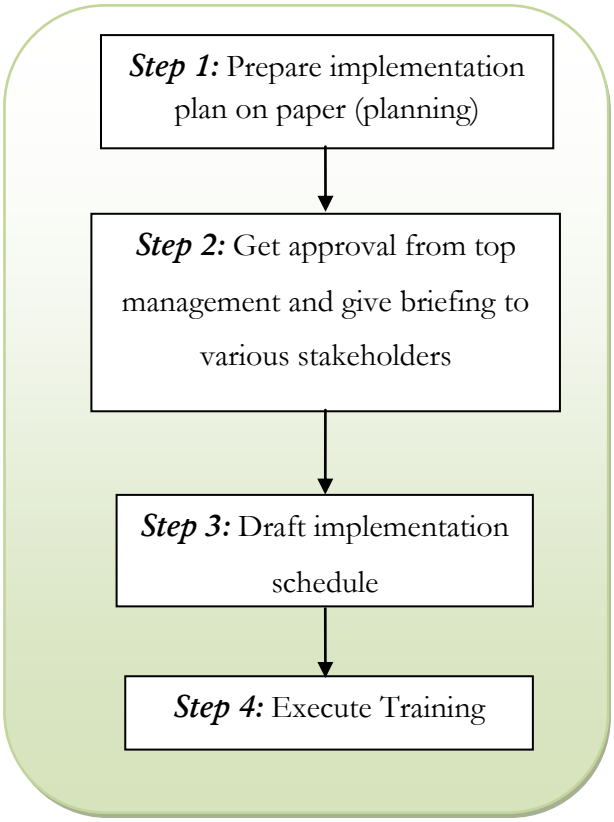


Figure 5-1: Steps during CP options implementation.

Based on a CP option to reduce water usage in your premise, you plan to install a pressure line to carry out all the cleaning activities. You have decided that the staff from the workshop will carry out the project.

- ✓ What will be your list of materials & equipment required?
- ✓ Will there be any interuptions in the production operation?

Step 1: Prepare implementation plan on paper (planning)

You need to plan your implementation program to avoid issues and unwanted problems. You can use the following items in planning your work.

1. Checklist

Prepare a checklist which may include;

- ✓ A complete CP option evaluation form attached in appendix
- ✓ The resources needed (materials, equipments, expertise)
- ✓ The implementation plan. (The plan should include complete frame work, personnels in charge, timeline, and targets.)
- ✓ The logistics preparation
- ✓ The identification of support personnels

2. Decide on sub-team responsibilities

Assign implementers according to their fields of work (leader of CP implementation project, operators, suppliers, contractors).

- ✓ What items would you be documenting and how?
- ✓ Do you forsee any circumstances where your boss stops the CP option from being implemented?
- ✓ What would be your target for this option?
- ✓ Is there a need to communicate the option implementation with quality and sales department?
- ✓ What sort of training would you be giving to the operators?

3. *Look out for ways to avoid difficulties during implementation by doing the following:*

- ✓ Make sure that funds are available for each option
- ✓ Make sure that all the resources required are ready
- ✓ Make sure that the site for implementation is properly prepared
- ✓ Prepare engineering drawings if required

4. *Routine meeting*

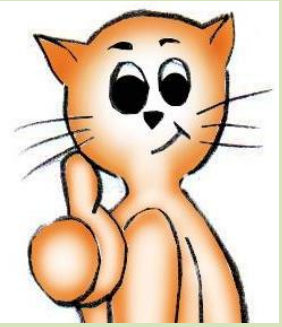
Items need to be addressed in routine meetings are shown in *Table 5-1*.

Table 5-1: Items to be addressed in routine meetings.

Item	Details
Frequency	Depends on the programme planning/ timeline and need.
Discussion Topic	1) Progress of the CP options implementation. 2) Problems encountered during the implementation.
Documentation	Record down all the meeting details.

Effective leadership is putting first things first. Effective management is discipline, carrying it out.

~Stephen Covey~



The following ***Table 5-2*** can be used to summarize the implementation status of the CP options during meetings.

Table 5-2: Table to summarize implementation status of CP options.

Item	Implementation plan	Status	Issues and problem	Remarks

Step 2: Get approval from top management and give briefing to various stakeholders

A complete proposal/plan should be submitted to the top management for approval before implementation. The following items should be included in the proposal:

- ✓ The complete CP option evaluation form
- ✓ The implementation schedule
- ✓ The investment required (if applicable)
- ✓ The payback period (if applicable)
- ✓ All the resources needed

Activity 11

By refering to ***Table 5-2***, please develop a table to summarize implementation status of CP options in your premise.

*Note: You can prepare this before attending routine meeting.

Step 3: Draft implementation schedule

When the approval for implementing CP options is received, there are a few things you need to do in order to complete the implementation schedule. You smoothly can do the following:

- ✓ Hold a promotion or make an announcement to the entire premise
- ✓ Document the progress of the implementation (paper, audio and video)

Promotion/ announcement

Staffs in the premise need to be made aware of the CP implementation initiative so some promotion activities or announcements should be made to achieve this. The following needs to be communicated:

- ✓ What is the target of the implementation?
- ✓ Why is there a need to implement the CP option?
- ✓ Where is the location involved?
- ✓ Who are the staff involved?
- ✓ What are the details on schedule?

With this kind of announcement, cooperation from the staff will be much more forthcoming.

Means of Communication:

Banner

Bunting

Bulletin

Documentation of the progress

During implementation, you are recommended to document all the work done. Progress documentation includes all the records involved, from getting started until the CP options are implemented completely. The records of the documentation should include:

- ✓ CP assessment forms
- ✓ Bills
- ✓ Forms used for data collection
- ✓ Notes
- ✓ Photographs
- ✓ Video recordings
- ✓ Minutes of meetings
- ✓ Letters in correspondences
- ✓ Records of seminars/ workshops

All these will help during the evaluation of the implemented option. With all these documents, you can now prepare a CP Implementation Report as an overall documentation which can be submitted to top management.

Means of Communication:

Notice board

Badges

Step 4: Execute training

The implementation of CP options may involve change in technology, operating and safety procedures and many other aspects. Therefore, training and familiarization programs need to be conducted. Training may include providing information on the changes to be conducted for matters like:

- ✓ Operations
- ✓ Design features
- ✓ Inspections
- ✓ Maintenance
- ✓ System troubleshooting
- ✓ Instrumentation and controls

Knowing is not enough; we must apply.

Willing is not enough; we must do.

~ Goethe~

Let's move on!!!

In this chapter, you were given a list of guidelines for implementing CP options. You can use them as a reference and create a new list of "Things To Do" based on the need of your own premise.

CHAPTER 6

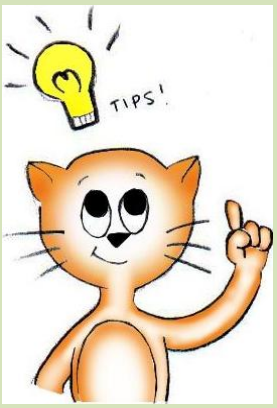
MONITORING AND CONTINUOUS IMPROVEMENT

CHAPTER 6: MONITORING AND CONTINUOUS IMPROVEMENT

Successfully implementing CP options does not mean the end of the program. CP emphasizes on continuous improvements. A cleaner process should now undergo another cycle in order to go to the next level of CP. Monitoring and evaluation works are needed to assess the level of achievement within one cycle. There are three main steps in this regard and they include:

- ✓ Monitoring of CP options implemented
- ✓ Evaluation on CP options implemented
- ✓ Report generation for documentation purposes

"CP is a JOURNEY not a DESTINATION"



P-D-C-A Steps

(Plan-Do-Check-Act)

Step 1: Plan

In the scope of CP, planning is where we begin the cycle for CP implementation.

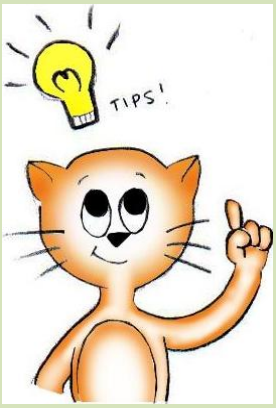
Monitoring of CP options implemented

Monitoring schedule

You need to develop a monitoring schedule for each option. The monitoring period for each option may differ. At the initial stage the monitoring may be done more frequently. When success of the implementation can be ascertained, you may even stop monitoring once the objective has been achieved. A simple CP option monitoring form is given in ***Table 6-1*** for reference.

Table 6-1: CP option monitoring form.

Option: use rain water collected for floor cleaning			
Water bill		**Amount (RM)**	
Before implementation		1050	
After implementation		**Reduction (compared with before implementation)**	**Target achievement**
1 month	1000	4.76%	yes
3 months	900	14.3%	yes
6 months	870	17%	yes



P-D-C-A Steps

(Plan-Do-Check-Act)

Step 2: Do

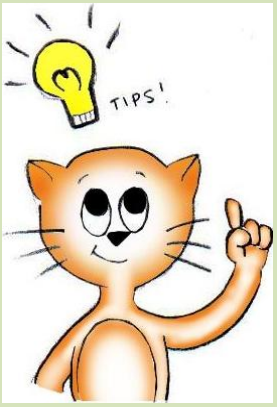
In CP, some options do not require an extensive test, but some options, such as the one that involves major modification to the system or process, may necessitate proper test and experimental analysis. This will ensure that profits and security of the system are not lost.

Data collection

You can create a systematic form before you start your data collection. The form should be simple and easy to fill in. The data collected should be analyzed in order to evaluate the success of the implementation. If there are issues in getting the expected outcome, pay attention to correcting these issues.

Photos/ Video recordings

During the monitoring process, it is helpful if you can take relevant photos or video recordings of the implementation carried out (especially before and after the events). This would be helpful in maintaining documentation and executing the training process.



P-D-C-A Steps

(Plan-Do-Check-Act)

Step 3: Check

A thorough analysis is needed to examine the result of experimental testing. Results in the form of charts, tables, and calculations need to be checked for comparison and for finding the most feasible condition to be applied.

Interviews

Interviews can be also conducted to gauge the effect and success of the CP implementation.

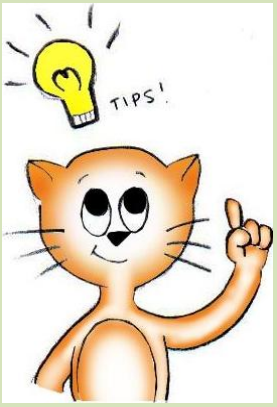
1. Staff/ operators

During the monitoring process, you can interview the staff like the operators involved in the implementation project. Below is a list of simple questions that you can use during the interview session.

- ✓ Has the CP implementation improved your productivity?
- ✓ Are you working more efficiently now?
- ✓ What do you think of the overall CP program?
- ✓ Has CP change your perception on work?
- ✓ Did you encounter any problem from the CP programme implemented?

2. Customers/Suppliers

What information can you get from your customers and suppliers? They can supply valuable information about your products which can be very useful to you.



P-D-C-A Steps

(Plan-Do-Check-Act)

Step 4: Act

This phase transforms the proposed changes into integrated practices within your regular business processes.

Evaluation on CP options implemented

In the evaluation process, you should:

- ✓ Analyze the data collected so as to determine the improvements accomplished (compare with previous data) in related aspect
- ✓ Compare the result with the required/ expected result
- ✓ Benchmark the comparisons
- ✓ Detect the issues that need improvement

Report generation for documentation purposes

When the CP options which have been implemented show the required result, it means that the monitoring and evaluation job at this stage are completed. Now you can prepare a detailed report for each option and send it to the top management for review. This report should be attached with all the data collected (complete with analysis) during monitoring, the photos and videos recorded, the interview results and other related matters.

Benchmarking is a specific method used to make comparison and to see the level of improvements made. It provides a performance snapshot and can be used to improve processes, systems, and activities continuously. There are 5 types of benchmarking which you can do:

- ✓ Internal
- ✓ Time based improvement
- ✓ Competitive
- ✓ Functional
- ✓ Generic

USEFUL LINKS

USEFUL LINKS

For more information, you can visit the following web pages:

1. http://cp.doe.gov.my/
2. http://cp.doe.gov.my/cpvc/
3. http://cp.doe.gov.my/cpit/login.php
4. http://www.unido.org/
5. http://www.unep.org/

APPENDIX A

CP OPTION EVALUATION FORM (EXAMPLE)

CP OPTION EVALUATION FORM (EXAMPLE)

Issues	Pet bottles were damaged when received	
Area	Packaging materials (Storage Area)	
Source or/& reasons	Supply issue/unloading issue/storage/ others	
Option	Purchasing department to discuss with supplier to minimize rejects	
Category of option	Substitution of input materials	
Challenges	**Type of challenges**	**Tick √**
	1. No expertise	
	2. Top management's commitment	
	3. Production cannot be stopped	
	4. Too risky	
	5. May have effect on quality	
Input required	**Input required**	**Tick √**
	1. Technology	
	2. Man power	
	3. Training	
	4. Awareness	
	5. Process change	
	6. Operation parameters change	
	7. Material change	
	8. Design change	
	9. Standard operating procedure	
	10. Monitoring	
	11. Additional control	
	12. R&D	
	13. Approval	
Investment Cost, A	**Item**	**Amount Required (RM)**
	1. Electrical work	
	2. Purchasing equipment	
	3. Construction work	
	4. Shut down loss	
	5. Man power cost	
	6. Other costs	
	Total	

Additional operational cost due to change/modification (monthly rate), B	**Item**	**Amount Required (RM)**
	1. Man power	
	2. Electricity	
	3. Steam	
	4. Fuel	
	5. Maintenance	
	6. Treatment	
	7. Others	
	Total Costs	
Savings (monthly rate), C	**Item**	**Savings (RM)**
	1. Man power	
	2. Electricity	
	3. Steam	
	4. Fuel	
	5. Maintenance	
	6. Treatment	
	7. Others	
	Total Savings	
Payback period	A/(C-B) months	
Other possible benefits	**Benefit Type**	**Tick √**
	1. Improved quality	
	2. Improved images	
	3. Safer operation	
	4. Less risky operation	
	5. Better motivation	
	6. Better working environment	
	7. Lesser environmental issues	
Merit of implementation	**Merit**	**Tick √**
	Implement immediately	
	Implement within six months	
	Implement only if finance is available	
	Keep it as a future plan	
	Drop it for at least 10 years	
	Ignore it	
Documentation required if implemented	**Type of documentation**	**Tick √**
	Paper documentation	
	Video documentation	
Monitoring plan		
Document prepared by		
Document confirmed by		
Other comments		

APPENDIX B

SUGGESTED CP OPTIONS

SUGGESTED CP OPTIONS

It is impossible to generate an exhaustive list of all the options available for all equipment, processes, and activities. However, the following are suggested examples of CP options which are grouped into categories based on their focal points of the audit:

Focal points	CP options
Products	✓ Reduce or eliminate "high waste cost" products. ✓ Reduce levels of reprocessing. ✓ Reduce levels of by-products (low grade, or defective products). ✓ Improve turn-arounds and to produce products only when required (lower stocks for warehousing).
Raw Materials	✓ Order raw materials that are easier to handle and which do not degenerate easily. ✓ Replace "high waste" raw materials with "low waste" ones. ✓ Negotiate with suppliers to take back surplus materials. ✓ Negotiate for the use of reusable packaging systems. ✓ Regenerate raw materials where possible. ✓ Set up quality improvement incentives. ✓ Return defective raw materials to suppliers. ✓ Do not over-order raw materials, especially those that may spoil. ✓ Buy raw materials in bulk if possible or when practical.

Focal points	CP options
	✓ Control bulk tanks to avoid overflows. ✓ Check on material weights to conform to orders. ✓ Bund liquid tanks to contain spillage. ✓ Use tanks that will drain fully. ✓ Use seals to avoid evaporative losses.
Plant	✓ Reduce down time. ✓ Reduce cleaning requirements. ✓ To reduce transport of materials internally. ✓ Purchasing criteria to include processing efficiencies. ✓ Buy quality equipment which will last longer and require less cleaning. ✓ Improve the maintenance regime to prevent losses and down time. ✓ Improve the system of reporting of faults and the responses to those reports. ✓ Use variable speed drives on motors.
People	✓ Make all employees aware of the reasons for waste reduction. ✓ Train all employees on the principles of cleaner production. ✓ Provide incentives for cleaner working practices. ✓ Provide opportunities for suggestions to be registered with management.

Focal points	CP options
	✓ Create improvement teams. ✓ Provide rewards for waste reduction.
Chemicals	✓ Eliminate chemical additions where possible. ✓ Identify opportunities to reduce chemical consumption. ✓ Reduce chemicals used in recipes progressively. ✓ Substitute chemicals with a "high environmental impact" with chemicals with a "low environmental impact". ✓ Replace inorganic acids and alkalis with organic acids and alkalis where possible. ✓ Replace sodium salts with calcium, or magnesium where possible. ✓ Use highly biodegradable chemicals. ✓ Minimize the number of times materials are moved on site. ✓ Check transfer lines regularly for leakages and spillage.
Cleaning	✓ Replace chemical attacks with water pressure, or heat in cleaning. ✓ Use vacuum systems instead of blowing systems where possible. ✓ Minimize rinsing with reduced water volumes.
Administration	✓ Use a process monitoring system to ensure that waste measurements are kept in each major process. ✓ Use electronic communications where possible.

Focal points	CP options
	✓ Reduce paper usage through more effective use (less reports, less copies, use the complete page, better quality control, reduce form work, reduce financial reports, print changes only, use both sides of paper). ✓ Reuse binding systems. ✓ Use refillable pens, pencils and others as office equipment. ✓ Maintain low waste products through low packaging products. ✓ Use up-gradable computers.
Energy	✓ Run systems at lower temperatures where possible. ✓ Include energy efficiency as a plant purchasing criteria. ✓ Establish auto shut off of power in idle equipment. ✓ Fit variable speed drives to motors. ✓ Recover and reuse steam condensate. ✓ Recover heat from "hot" waste streams. ✓ Insulate "hot" equipment to reduce radiant heat losses. ✓ Use energy efficient lighting systems. ✓ Use "smart lighting" switch off systems in offices.
Water	✓ Reduce water consumption of processes progressively. ✓ Use high pressure rather than high flow. ✓ Reuse clean waste water for wash down.

Focal points	CP options
	✓ Minimize treatment of water wastes. ✓ Balance acid and alkaline waste water streams to neutralize pH. ✓ Recycle cooling water for hot water inputs.
Transport	✓ Consolidate loads to reduce deliveries. ✓ Reuse packaging systems. ✓ Position plant to reduce transport to markets. ✓ Maintain fleets to reduce pollution and improve fuel efficiency.
Electric Motors	✓ Turn off equipment when not in use. ✓ Have 'Switch Off' notices placed near machines. ✓ In the instances of high operating hours, use high efficiency motors in preference to standard units. ✓ Match motor capacity to load requirements. ✓ Use variable speed drives in preference to damper control with fans and valve control with pumps. ✓ Carry out regular maintenance checks.
Compressors	✓ Repair air leaks promptly. ✓ Determine the minimum pressure required for all operations. ✓ Ensure that compressors are not oversized. (An oversized compressor wastes both capital and operating costs.)

Focal points	CP options
	✓ Operate compressors near maximum capacity. ✓ Switch compressors off when not in use. ✓ Ensure that air inlets are situated in a cool, dry, and clean location. (The warmer the air intake, the lower the volume of compressed air delivered.) ✓ Where possible, utilize heat from cooling and after-cooling stages. (This can be used effectively for space heating.) ✓ Clean all filters regularly. ✓ Institute adequate maintenance of compressors.
Boilers	✓ Attempt to improve load factor and efficiency by operating as near to the designed rating as possible. (Boilers are most efficient at the designed rating.) ✓ Try to anticipate sudden demand changes by using appropriate controls. (If possible, use steam headers for heavy demands.) ✓ Operate boilers at designed pressure. (This is when they would usually operate at their peak efficiency.)
Combustion Process	✓ Make sure combustion is complete. If not, check for: o Flame impingement o Inadequate air-fuel mixing o Inadequate atomization o Inadequate air for combustion ✓ In case of incomplete combustion, energy losses can be very large.

Focal points	CP options
	✓ Avoid letting excessive fuel moisture enter the burner. Evaporation of water can absorb a considerable amount of heat. ✓ Seal all cracks and holes in boiler flues to prevent air infiltration. ✓ Clean tubes and other fire side heat exchange surfaces throughly, at regular intervals. Any deposits will rapidly reduce heat transfer efficiently.
Feed Water Treatment	✓ Ensure proper feed water treatment is carried out. Incorrectly treated water will affect heat transfer, steam quality and plant life. ✓ Keep flow down to minimum. ✓ Recover as much condensate as possible. This substantially reduces feed water heating requirements and water treatment costs.
Control & Maintenance	✓ Maintain boiler records to follow trends and changes in conditions. Analyze records regularly; any substantial changes usually mean heat losses. ✓ Carry out combustion tests frequently. Measure CO and flue gas temperature (and O_2). These tests not only ensure optimum plant efficiency but also give you a better understanding of your boiler operation. ✓ Ensure boiler sundry equipment is regularly maintained. ✓ Regularly calibrate all instruments. Instruments quickly become inaccurate if not regularly calibrated.
Utilization of Steam	✓ Check for leaks in steam lines, valve glands etc, and repair promptly.

Focal points	CP options
	✓ Ensure that the correct steam trap is used for the application. ✓ Ensure that all steam pipes and flanges are adequately lagged. ✓ Arrange for adequate insulation of all process vessels, drying cylinders and steam chests. Radiation losses can be large and insulation is a one-time expenditure which is usually quickly recovered by the savings achieved. ✓ Check that the feed water tank is adequately insulated and covered to prevent evaporation. ✓ Investigate whether direct heating of any process is cheaper than steam heating. Direct heating, if applicable, eliminates the inefficiency of converting primary energy to steam. ✓ Eliminate any steam losses from any process as far as possible. ✓ Ensure there are lids on all vats, tanks etc. To prevent evaporation. ✓ Ensure all steam piping slopes downward to prevent water hammer. This ensures that all condensate is efficiently drained. ✓ Institute adequate maintenance of all valves, steam traps and accessories.
Ovens	✓ Ensure that ovens are adequately insulated. ✓ Check that the oven combustion is at the optimum level efficiency in gas operated ovens is at the optimum level. ✓ Reduce start-up preheating period for ovens. ✓ Investigate the possibility of using Radio Frequency

Focal points	CP options
	heating systems instead of convection heating.
Refrigeration and Air Conditioning	✓ Ensure that the refrigeration system is operating at the optimum design condition. Operate at the lowest condensing temperature and the highest evaporating temperature. ✓ Carry out regular maintenance on the refrigeration equipment. ✓ Reduce cool room losses. ✓ Ensure that the condenser surfaces are clean. ✓ Defrost fan coil units at regular intervals. ✓ Ensure correct zoning of air conditioning controls.
Process Heat Recovery	✓ Establish a heat balance and calculate the amount of heat, which could be recovered. There may not be sufficient waste heat from al already efficient process. ✓ Determine whether waste heat can be usefully employed in the plant. It is pointless to recover heat unless there is a clear use for it. ✓ Before heat recovery equipment is installed check whether waste heat can be used directly. ✓ Maintain the heat recovery plant in good condition. ✓ Clean heat exchanger surfaces regularly. ✓ Investigate the possibility of incorporating a heat recovery system into the incineration process.
Factory Heating and Cooling	✓ Check whether insulation of roof and walls is feasible and economical.

Focal points	CP options
	✓ Close all unnecessary openings to the building. ✓ Use plastic strip curtains, automatic doors or air curtains in large or much trafficked doorways. ✓ Install door closers on all doors. ✓ Determine the degree of heating required – do not overheat. ✓ Do not heat areas which do not need heating. Rooms, which are infrequently used or occupied for short period, should not be heated. ✓ Consider the use of spot or localized heating (radiant heating). ✓ Ensure that areas with different heating requirements are partitioned off from each other. ✓ If practical, use wind assisted ventilators in preference to fans. ✓ If evaporative cooling is used, keep cooling pads in clean condition, and service water circulation pumps and fans regularly. ✓ Switch off unnecessary lights. ✓ Check luminance in all areas and ascertain that it is in accordance with but is no greater than as specified in AS 1680. ✓ Integrate daylight with the electric light systems. Ensure that lights in areas that receive daylight are separately switched. ✓ Explore the use of light-sensing devices for controlling the lighting in areas which receive daylight. Photoelectric devices are inexpensive and effective.

Focal points	CP options
	✓ Consider replacing incandescent lamps with higher efficiency fluorescent units. New low energy fluorescent lamps can save a further 8–16% in power costs and they give same amount of light output. ✓ Regularly clean all luminaries, lamps and windows. ✓ Consider the most energy efficient gaseous discharge lamps (mercury vapor, mercury halide, sodium vapor lamps).
Transport	✓ Log fuel consumption data on vehicles. ✓ Carry out regular maintenance checks. ✓ Motivate drivers to maintain proper speed limits. ✓ Inflate tires to recommended pressure. ✓ Prevent fuel spillage during refueling.

APPENDIX C

FREQUENTLY ASKED QUESTIONS

FREQUENTLY ASKED QUESTIONS

No	Question	Answer
1	What is the meaning of Cleaner Production?	It is the continuous application of an integrated preventative environmental strategy to processes and products to reduce risk to humans and the environment.
2	Is CP a new concept for the industry?	No. It has been around in the industry but is known by others terms.
3	Since when was CP introduced as an integrated concept into Malaysia?	CP was introduced into Malaysia since 1996.
4	What is the difference between CP and end-of-pipe treatment?	CP is a preventive approach which minimizes the generation of waste at the sources while end-of-pipe treatment is a concept of treating waste that is generated.
5	Is the CP concept already implemented in my premise without any notice?	Yes, most premises normally use other terms of CP such as KAIZEN, 5S, 3S and etc.
6	Will CP increase the premises' productivity?	Yes. CP helps to increase awareness among the staff through proper training.
7	How do I determine the effectiveness of the CP implementation?	You can evaluate the effectiveness through several factors, such as: increase in productivity and quality, improvement in safety, reduction in risk, reduction in production cost and etc.

No	Question	Answer
8	Does CP look at safety and risks?	Yes.
9	Can I implement CP on my own?	Yes, definitely.
10	Is CP a onetime application?	No. It is a continuous application.
11	Where can I get help during the implementation of CP?	You can contact DOE or other consultants in UPUM for assistance.
12	What basic knowledge do I need to have before implementing CP?	You only need to understand the concept of CP and with the assistance of this manual, you can start to implement CP.
13	How will Cleaner Production help?	Cleaner Production activity will make your industry more competitive and profitable. It will reduce your production costs too.
14	Do I need to stop my production while implementing Cleaner Production?	No. Most CP options can be implemented in a running plant without affecting the productions. Wherever major CP options are required to be implemented, productions may have to be stopped for some time. In other cases, you may find that productions from the same plant and same machinery increase drastically.
15	Do I need to have any engineer in my industry to implement Cleaner Production?	It is not essential that an engineer or a professional be in your premise in order to implement CP because only you and the persons working on the plants would

No	Question	Answer
		know more about your industry.
16	Do I need extensive laboratory facilities?	Certainly not. Only few basic measurements and monitoring facilities are needed. (i.e: Infrared Thermometer, PH meter, Electrical Analyzer, Boiler Efficiency Tool kit, Amino meter etc.)
17	I have some specific problems in my premise; can I get advisory service from the Cleaner Production Unit at the Department of Environment, Malaysia?	Definitely. You can get such services from the Cleaner Production Unit at the Department of Environment, Malaysia. Just contact us.

DEPARTMENT OF ENVIRONMENT

MINISTRY OF NATURAL RESOURCES & ENVIRONMENT MALAYSIA

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