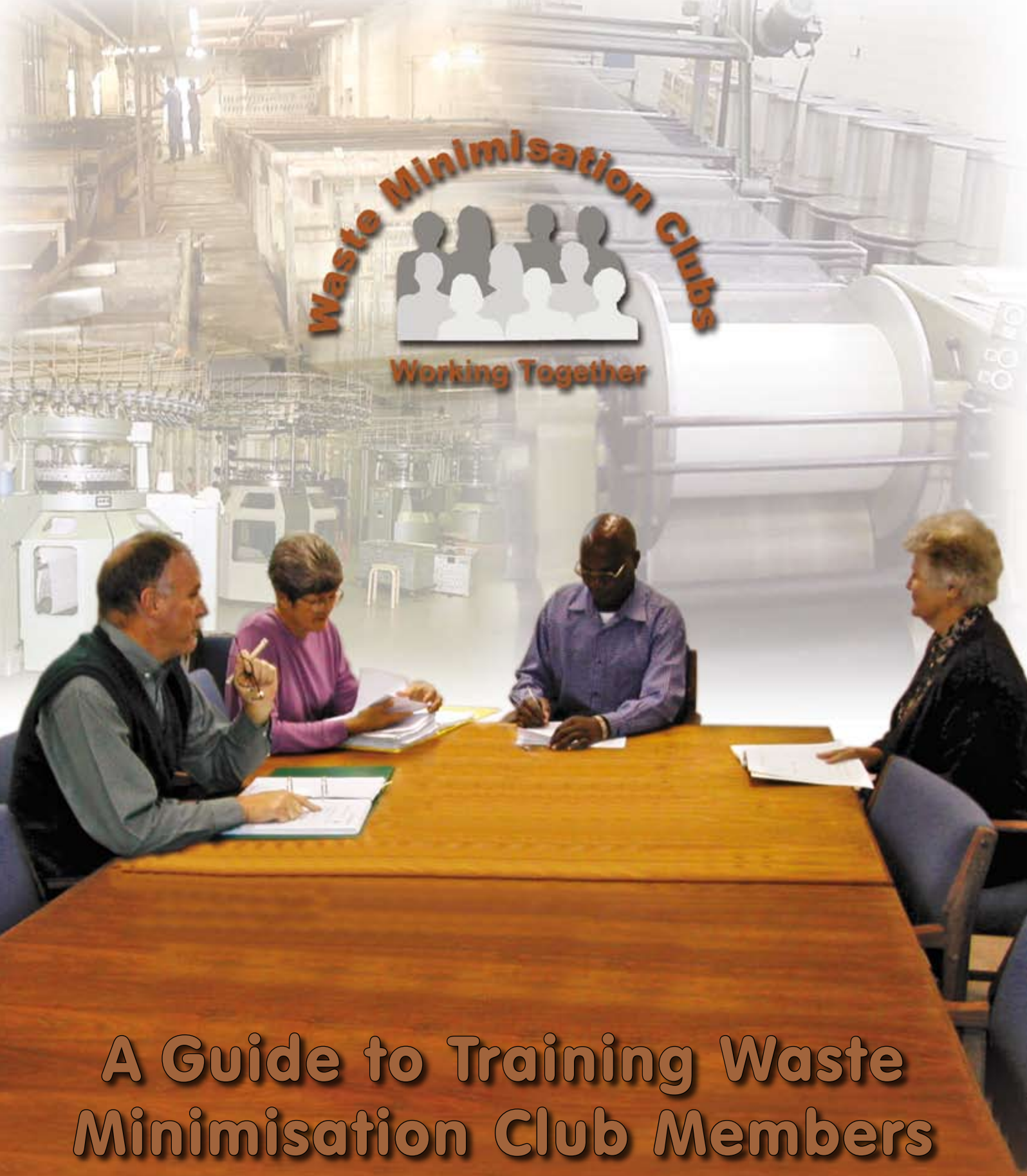

A Guide to Training Waste Minimisation Club Members (Training Manual)

Susan Barclay & Chris Buckley

TT 284/07

Water Research Commission

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(Training Manual)

Report to the Water Research Commission

by

Susan Barclay and Chris Buckley

on behalf of

Pollution Research Group

University of KwaZulu-Natal

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Preface

The Water Research Commission sponsored a project from 1998 to 2000 to investigate the feasibility of establishing waste minimisation clubs in South Africa to promote cleaner production to industry (WRC Project 973). This project was carried out by the Pollution Research Group (PRG) and two pilot waste minimisation clubs were established – one in the Metal Finishing sector in the greater Durban Metropolitan Area, and the second one, a cross-sectoral club in the Hammarsdale region. These clubs proved to be a success, with open sharing of information and ideas amongst the club members, financial benefits to the companies and a reduction in their environmental impact. A report on this project has been completed and is available from the WRC on request. The experiences gained during the course of this project are important lessons for others who wish to establish and manage further waste minimisation clubs in South Africa.

This project was co-funded by the European Union Directorate General XVII for Energy (Thermie) which made provision for the involvement of two European consultants, namely Enviros March (now Enviros Consulting, United Kingdom) and Cowi (Denmark). Enviros Consulting focussed on energy savings and technical training, while Cowi's involvement was through the South African organisation, Kagiso Trust, and focused on general environmental awareness training for management and shop floor employees.

Training is an important aspect of a waste minimisation club, and it is essential that Club Facilitators have access to training material, which can demonstrate the importance of waste minimisation to the members. This Training Manual has therefore been prepared to assist Club Facilitators and consists of the training material supplied by Enviros Consulting under WRC Project 973 in the form of workbooks, exercises and solutions. This Training Manual provides information on waste minimisation in general, how to conduct a waste minimisation audit, how to identify waste minimisation options, guidelines on conducting a feasibility analysis, and the importance of monitoring and targeting.

The enclosed CD Rom contains the training material in Microsoft Power Point format, the Workbooks, the exercises, answers and this Training Manual.

We trust that Club Facilitators find the Training Manual helpful in the running of waste minimisation clubs. All feedback is welcomed.

Susan Barclay

Project Leader

Pollution Research Group

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- Mr Keith Webster of Enviros Consulting (formally March Consulting) for allowing the use of the training material which forms the basis of the Training Manual.
- Chris Buckley for his guidance and suggestions
- Members of the Project Steering Committee for their advice and recommendations

The members of the steering committee were:

Mr GN Steenveld	Water Research Commission
Mr JN Bhagwan	Water Research Commission
Mr L du Preez	Water Research Commission (Committee Secretary)
Mr B Kothuis	BECO-Institute for Sustainable Business
Mr L Bredenhann	Department of Water Affairs and Forestry
Mr T Aab	Department of Water Affairs and Forestry
Mr CE Fennemore	Umgeni Water
Mr WH Smith	Industrial Development Council of South Africa
Ms SY Dittke	City of Cape Town
Ms K Lundbo	Royal Danish Embassy
Mr M Koefoed	Royal Danish Embassy
Ms M Pressend	Environmental Monitoring Group
Ms SA Freeman	Durban Solid Waste
Mr B Pfaff	eThekwini Municipality
Mr R Loots	Department of Water Affairs and Forestry
Mr M Mitchelson	Department of Trade and Industry
Mr I Ndlovu	Department of Environmental Affairs and Tourism
Dr AR Pitman	Johannesburg Water (Pty) Ltd.

How to use this Manual

This Training Manual is made up of a number of parts; namely:

- ✓ The Training Manual
- ✓ Microsoft Power-Point presentations
- ✓ Workbooks
- ✓ Exercises
- ✓ Solutions
- ✓ Extra Handouts

The Manual is divided into a number of Modules, each of which address and aspect related to the implementation of a waste minimisation programme within an organisation. These modules can be delivered as a whole training session, or broken down into smaller training sessions depending on the requirements of the Club. In addition, not all material will be relevant for every waste minimisation club. Guidance is therefore provided in each module as to determining the best method in which to deliver the training material and reference to other sources of information and sector-specific guidelines provided.

The Training Manual has been prepared to be used together with the Workbooks, presentations and exercises. Each section in the Manual refers to the same section within the relevant Workbook. Most of the information required by the trainer to explain each training module is provided in these Workbooks, however, extra information, explanations and references to local information is provided in the Manual to give additional guidance to the trainer. Assistance with determining the solutions to the exercises is also provided.

It must also be remembered that these training modules only provide the basis for a waste minimisation training manual, and can be built on as required.

Table of Contents

Module 1
Introduction to Waste Minimisation

Outline of Module 1

This Module provides and introduction to the concept and benefits of waste minimisation, and the environmental pressures on business today that requires that all companies take a preventative approach to reducing the generation of waste.

On conclusion of this Module, participants should have and understanding of:

- The concept of waste minimisation
- The benefits of waste minimisation
- The importance of commitment
- The role of the project champion and the project team
- Possible barriers that can exist to waste minimisation
- The potential savings that can be achieved

Item	Title	Approx. Time required
Training	Introduction to waste minimisation	30 minutes
Group Exercise	Identifying barriers and drivers	20 minutes
Workshop 1.1	Determining the potential to save	30 minutes
TOTAL		**80 minutes**

Content of Workbook

The workbook for Module 1 as supplied on the CD Rom was developed by March Consulting (now Enviros Consulting) and has been used here with the permission of Enviros Consulting. It can be used to hand out to the participants to make notes for their use. Additional tips for the trainer are provided in this section of the Training Manual under the same headings as provided in the workbook.

1.1 What is waste minimisation?

Slide 2 introduces the concept of waste minimisation and emphasises the need for reducing waste at source. Information in the workbook relates to the UK situation, therefore information on the need for waste minimisation in South Africa can be stressed by referring to aspects such as:

- ✓ Only 8.6% of annual rainfall is available as surface water (of 500 mm per year)
- ✓ All majors rivers have been dammed or modified to meet the demand
- ✓ Demand for water is to increase by 50% over the next 30 years

- ✓ 2.6 million m^3 of wastewater (domestic and commercial) is treated every day – does not include industrial and agricultural wastewater
- ✓ Over 42 million m^3 of solid waste is generated annually (0.7 kg per person per day)
- ✓ Over 5 million m^3 of hazardous waste is generated annually
- ✓ Shortage of landfill space in 5 provinces expected over next 10 years
- ✓ Our limited water resources
- ✓ The increasing costs of water, energy and effluent discharge
- ✓ New regulations such as aspects under the Water Act (1998), the Water Services Act and the National Environmental Management Act (NEMA) where penalties are imposed for polluting activities, and which encourage waste minimisation

Trainer's Tip:

These items can be discussed in the WMC, or you can prepare further slides to emphasise these points. Information can be obtained on the State of the Environment Reports for both South Africa and for each province depending on where the WMC is established.

Information on National policy can be found from:

- The Department of Environmental Affairs and Tourism
- The Department of Water Affairs and Forestry
- The Department of Minerals and Energy
- The Department of Labour

Information on the local regulations can be sourced from the local municipality. These regulations will provide guidance as to the standards for compliance. Use this information from the legislation and regulations to highlight the importance of waste minimisation.

1.2 The Scope of Waste Minimisation

Slide 3 explains where waste minimisation can be applied – in other words, to all aspects of a process. Not included in this workbook is the Process Model (slide 4) shown in Figure 1.

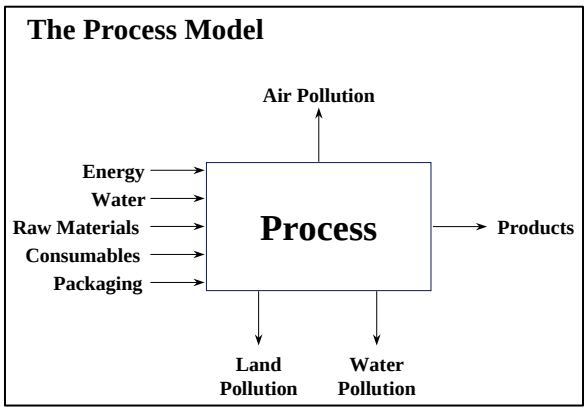

Figure 1: The process Model diagram

This model is useful to explain what you are trying to achieve through implementing waste minimisation. Mention that the block represents the factory / company / process. On the LHS are the inputs, and the aim of the factory / company / process is to convert as much of these inputs into the Product as possible. However, waste is going to occur that can take the form of emissions to land, water or air. Waste minimisation aims to reduce these emissions as far as possible, to maximise the conversion of input materials into product, such that waste is reduced and profits are maximized.

ACTIVITY:

Under the Activity aspect in the Workbook, ask the group to think about the true cost of waste. Some items include:

- The cost of raw materials
- Labour
- Management time
- Energy
- Water costs
- Etc.

This aspect is dealt with in more detail in Module 2.

1.3 Benefits of waste minimisation

These are explained well in the workbook. Perhaps you can add to this by providing examples of success stories from South Africa. These area available from studies carried out under WRC Project 973; the Danida Projects (Metal Finishing, Textile Manufacture and Fish Processing); and from BECO-Institute for Sustainable Business.

APPROACHES TO ENVIRONMENTAL IMPROVEMENT

This is explained in the workbook with reference to the UK environmental legislation. Emphasise that the move to source reduction is promoted in South Africa through legislation and the National Waste Management Strategy.

Slide 6 shows that the previous approach to waste management all involved adding cost; whereas the new source reduction approach was aimed at saving money.

ACTIVITY: HIERARCHY OF WASTE MANAGEMENT PRACTICES

There are 2 slides related to this activity. In slide 7, only 2 of the items are provided. Ask the group to identify what the other items are. The answer is provided in slide 8. Emphasise that the aim is to eliminate the generation of waste all together, although this is not always possible.

Slide 9 lists the approaches to implementing waste minimisation – by new technology; source reduction; and recycling (both on-site and off-site). Emphasise that waste minimisation focuses on source reduction techniques such as housekeeping, process changes and input material changes.

1.4 Waste Minimisation Methodology

Slides 10 to 16 relate to this topic in the Workbook. They go through each stage of implementing a waste minimisation programme within an organisation. These slides provide an overview of the main stages and will be discussed in more detail in this and following Modules. The main points to emphasise here include:

- ✓ It is a structured approach comprising of a number of steps
- ✓ Preparation is important (Module 1)
- ✓ There are two stages in conducting an audit (Modules 2 and 3) and collection and analysis of data is essential to a waste minimisation programme
- ✓ Once data has been analysed, options for improvement can be determined (Module 4)
- ✓ Once options have been identified, a feasibility analysis must be undertaken (Module 5)
- ✓ Based on this assessment, actions for implementation must take place (Module 6)
- ✓ Systems must be put in place to provide feedback to ensure a continuous process (Module 7)

BARRIERS TO COMMITMENT / COMMITMENT AND HOW TO GAIN IT

The first stage that is covered in this Module is the preparation for action, and in particular the barriers that can exist in an organisation. This section is very interactive where you would like input from the Club as to what barriers they have already encountered, and what others they may think could occurs. Section 4 in the Facilitator's Manual provides an exercise in this regard and also discussions on how to overcome barriers which is useful to provide in this Module.

Once the aspect of barriers has been discussed, it is also good for the Club to identify the drivers. Again, Section 4 in the Facilitator's Manual provides guidance in this exercise. Slides 17 to 25 give some examples of barriers experienced in implementing waste minimisation. Discuss these with the WMC.

THE PREPARATION – ORGANISATION FOR ACTION

This section deals with the role of the various stakeholders in the WMC, and is covered in detail in Section 2 of the Facilitator's Manual. It describes the role of the Project Champion and the Project Team. The structure of the team is also important and you can discuss with the WMC as to who they think should be on the team.

ACTIVITY:

Ask the club members to given some ideas on their role as the Project Champion, and also the ideal make-up of their Project Team.

Trainer's Tip:

If you are working with an in-house WMC, you could ask them to develop a project team with people's names.

1.5 Assess the scope of savings

This section deals with determining the potential savings that are possible through implementing waste minimisation. Included in the presentation in slide 31 (and not in the workbook) is a Scope to save table (see Table 1). This table gives an indication of the percentage savings that are possible in each area if no waste minimisation has been undertaken in a company. It is cross-sectional and although developed in the UK, is applicable to South African industry as proved in numerous case studies. You can again use examples where savings have been achieved that correlate with this table.

Table 1.1: The scope to save through waste minimisation

Utility	Scope for Saving (%)
Raw materials	1 to 5
Packaging	10 to 90
Ancillary materials	5 to 20
Consumables	10 to 30
Electricity	5 to 20
Heat for process and space heating	10 to 30
Water	20 to 80
Effluent	20 to 80
Solid Waste	10 to 50

WORKSHOP 1.1: IDENTIFYING THE SCOPE TO SAVE

In order to demonstrate the potential savings that can be achieved, an exercise has been developed whereby club members are asked to determine the scope to save for a fictitious company called Dricoates. The case study as well as the blank worksheet is provided on the CD for you to print out.

Ask the club members to work in small groups of 2 to 3 – it is best if you select these so that there is a mix of participants working together.

Give them some time to read through the example and then to start making the calculations. All information is provided, but some of it needs to be calculated from other information given in the case study. The club members need to determine the annual costs.

Calculations (refer to answer sheet)

Cloth: Information provided

Dye: Information provided

PU Solids: this information needs to be calculated as follows:

1. calculate the square meters of cloth = 3 x 100 = 300 m^2
2. determine the total number of m^2 = 300 x 10 184 (the number of bales)
   = 3 055 200 m^2
3. the product contains 0.049 kg PU solids / m^2, so therefore the total amount of PU solids used is given by: 3 055 200 x 0.049 = 128 tons
4. the cost of the PU Solids is provided and the annual cost can be calculated by multiplying 128 tons by this cost.

Packaging: Information provided

Solvent: this information needs to be calculated from the stock figures, plus the amount bought, less the amount left at the end of the year: 2 800 + 224 000 – 4 655 = 222 135 litres

Effluent: take 10% of the water costs

All other information is given.

Discussions:

At the end of the exercise, ask the Club to shout out the top 3 priorities they have identified and their reasons for choosing them. The majority will answer:

1. *cloth*
2. *heat*
3. *water*

In principle this is right – they have looked at where the greatest potential savings lie. However, you must point out to them that the number one priority should be water and effluent combined, as water used is effluent out – and therefore if water is saved, effluent will be saved giving a double saving.

Another point to highlight is to ask how many of them worked as a team, or whether each person in the small group did all the calculations and in which case, did not finish– emphasise that is important to work as a team and delegate tasks – one person cannot do everything.

The exercise also shows that even the information is not obviously available, you can in most cases, calculate it from other information provided.

1.6 Homework Task

At the end of this module, ask the Club to go back to companies and undertake the following tasks before the next meeting:

- ✓ identify a project champion (if it is not them)
- ✓ determine the structure of their project team
- ✓ determine the level of commitment from management
- ✓ undertake a scoping study using the financial data for the last year and the worksheet as a guideline

Trainer's Tip:

At the beginning of the each WMC meeting, before the next training session is started, it is important to allow feedback on the results of the tasks set at the previous meeting, or on general progress. This provides a forum for further discussions, interaction and sharing of ideas and solutions to problems.

Trainers Checklist

Module 1

- Understand the principles of waste minimisation
- Read Section 1 of the Facilitator's Manual
- Familiarise yourself with Section 4 in the Facilitator's Manual on how to identify barriers and drivers
- Print out sufficient workbooks and worksheets
- Prepare additional slides as required
- Obtain information on South African case studies
- Familiarise yourself with the South African Legislation

Module 2
Data Gathering

Outline of Module 2

This Module provides and introduction to data gathering and analysis and underlines the importance of measuring and monitoring.

On conclusion of this Module, participants should have and understanding of:

- How to undertake an preliminary audit
- How to identify missing information
- How to collect the missing information
- Where to focus waste minimisation efforts
- The importance of collecting baseline data

Item	Title	Approx. Time required
Recap	Recap of items covered in Module 1	5 minutes
Training	Data gathering	30 minutes
Workshop 2.1	Process mapping	20 minutes
Workshop 2.2	Identifying missing data	10 minutes
	Water Metering	10 minutes
Workshop 2.3	Determining the true cost of waste	20 minutes
TOTAL		**110 minutes**

Trainers Tip:

If you would like to take more time over this module, it may be necessary to split it into smaller modules and cover this aspect over more than one training session. It is vital that the club members understand the importance of data gathering. This may be especially necessary if you are dealing with a sector-specific WMC where you would like to spend more time on the data collection specific to that industry using other worksheets and information. You may also like to spend some time with the WMC developing a data collection worksheet that is specific to their needs. There are a number of other exercises that can be used to ensure the club members have grasped the concepts covered in this Module, and reference to these are provided.

Content of Workbook

The workbook for Module 2 as supplied on the CD Rom was developed by March Consulting (now Enviros Consulting) and has been used here with the permission of Enviros Consulting. It can be used to hand out to the participants to make notes for their use. Additional tips for

the trainer are provided in this section of the Training Manual under the same headings as provided in the workbook.

2.1 Process Mapping

This section deals with the first step in data collection – namely, the drawing of process flow diagrams (or process maps). An example of how to draw a process map for the Excellent Bean and Ketchup Company has been provided in the workbook (slides 2 to 7).

Points to emphasise include:

- ✓ Start with the site: identify all the inputs and outputs for the company as a whole to determine what is being used overall, and what types of waste are being generated.
- ✓ Break this down into departments – this starts to give an indication of what is used where within the company. Overlaps of material use and waste production can be identified. In this way, the company can start determine which areas to investigate. For example, in this case, if they were investigating chemical use, they would need to look at the beans and ketchup department where the cleaning chemicals are used.
- ✓ When the company has decided which are to focus on more clearly, the map can be broken down further into each process within the departments, as is shown here for the bean process. As can be seen, more detail is provided about where the inputs are used.

ACTIVITY: MAKING AND DRINKING A CUP OF COFFEE

A good way to start the group thinking of process mapping is to ask them to prepare a process map for the activity of making and drinking a cup of coffee. The best way of carrying out this exercise is for you to prepare a cup of coffee in front of them and ask them to watch closely and prepare a process map. It may not always be possible to have a kettle in front with you, but you can ask them to imagine the process of filling and boiling the kettle. You then make the cup of coffee in front of them. The following actions can be included:

- Spill on purpose to see if they identify this as an output
- Add milk, taste and add more milk. See if they identify this as a separate step of quality control
- Don't drink all the coffee so that there is excess left that has to be discarded
- Wash the cup and spoon in front of them if possible, or tell them to imagine you are washing it as this adds other inputs
- Ask them watch out for any possible recycle streams

Discussions

As a group, draw up the process map for the site (see Slide 8). Then ask them to break it down into departments (see Slide 9) and ask for inputs and outputs. Get one Club member to draw his/her answer on the board and invite comments from the other members. Highlight the two recycle streams for them – namely, the cup and spoon and the water that is left in the kettle. Table 2.1 lists some possible inputs and outputs that you can use to guide the discussion.

Table 2.1: Process mapping for making and drinking a cup of coffee

Department	Input	Output
Fill kettle	Water	Overspill
Boil kettle	Energy	Steam; excess hot water
Prepare cup	Sugar; coffee	Spillages; packaging
Fill cup	Boiled water	Steam; spills
Quality control	Milk	Spillages; excess milk; packaging
Drink coffee	-	Spillages; excess to requirements
Wash up	Hot water; detergent	Effluent
Recycle streams	Cup and spoon	
	Hot water in kettle	

WORKSHOP 2.1: PROCESS MAPPING

Provide the Club members with the Dricoates case study. As them to work in pairs or small groups again. From the information provided in the case study, ask them to prepare a process map for:

- The site
- Per department

Trainer's Tip

The answer has been provided on the CD. This answer is given in detail (in some cases the departments are broken further into processes) but you can provide it to the WMC in the form of site and department. Give the club members 20 minutes to attempt the exercise, and then do it as a group exercise on the board. Again, if the WMC is a sector-specific club, you may like to use an example that relates to this sector, or, after this exercise, create a process map specific to that sector as another exercise. You may like to use one club member's site as an example (if they are happy to do so).

2.2 Fitting Known Data

It is very important to emphasise that you cannot manage what you can't measure! If nothing else, the club members should take this message home with them at the end of this training session. It is vital that a company measures what it is using and the product and waste it is generating in order to be able to quantify the savings from implementing a waste minimisation programme.

The process map is used as the starting point for determining the data that is available. The process map show what is used where, the data fitting process will give an indication of how much. If the data is not known, this must be noted for further investigations.

2.3 Data Sources

This information is dealt with in slides 13 to 17 and highlights where information can be found within a company.

THINGS TO WATCH OUT FOR

Slide 18 highlights areas where data could be inaccurate such as checking on suppliers, that units are the same, and that the manner in which costs are reflected in the accounts do not allow for items to be hidden. Quite often it has been reported that undertaking a scoping audit shows areas where items have been incorrectly allocated and initiates further investigations.

AUDIT PLANNING SESSION

A worksheet is provided in the workbook that outlines the need for data based on the preliminary audit – in other words, for each item, how much information is available, what further information is required, and how difficult it is going to be to obtain this information. The activity described in the workbook can be set as a homework task. This worksheet will be used for Workshop 2.2.

2.4 Recognising Missing Data

Once the company has completed the first step in data collection – i.e., determining what information they have to fit to the process map for the areas under investigations – the next step is to determine exactly what information is missing, and plan for the collection of this information. In order to determine if new data collection is necessary, the company must first make sure that it is important to have this information, and that it cannot be obtained from other sources.

WORKSHOP 2.2

Task 1: Identifying missing data requirements

Using the same case study for Dricoates as Workshop 2.1, ask the club members to use the Audit Planning Sheet to determine what data is missing and to give an indication of how this information can be obtained. Ask them to do this in pairs / small groups, and at the end of the allocated time, get each group to report on their findings.

Trainer's Tip:

There is no correct answer to this workshop – it is just important that they realise the importance of looking in detail at each aspect and thinking about what further information they require. In general, there is quite a large amount of information missing, especially on a process level. If meters are required, then it could potentially lead to a large capital investment. If it is a matter of putting procedures in place, then this may be difficult to do, as it requires a change in attitude, but won't necessarily cost anything. You could conduct this exercise as a group exercise rather than as an individual exercise.

Task 2: Measuring water use

Following on from this, inform the group that Dricoates wants to start their waste minimisation programme by focusing on their water use. In order to do this, they need to measure how much water is used in each area. The club members are provided with a water map and are asked to place water meters in appropriate areas in order to measure the water use. Tell them they must use the minimum number of meters that will still give them a sufficiently accurate water measurement.

Trainer's Tip

Side 22 provides an answer which shows one way of positioning the water meters such that the main water users are measured directly and the others can be determined by subtraction. This exercise is revisited in Module 3 where a water balance is carried out. The aim of this exercise is to get the club members thinking about positioning of meters to obtain the missing information that was required in Task 1. Again, you can carry this out as a group exercise, or ask them to do it in pairs with each pair reporting on their answer with an explanation as to why they chose that specific positioning.

2.5 Data Collection

Once the missing information has been determined, it may be necessary to conduct what is called a live audit to obtain this information. In other words, some plan of action needs to be developed to collect the information required to complete the process map.

There are a number of steps required to undertake a live audit, and these are covered in the workbook and slides 23 to 27. The following points should be emphasised:

- ✓ The importance of good planning and the design of data collection worksheets
- ✓ Training of the people responsible is important otherwise the data will be worthless
- ✓ Make sure you have identified all the items that require measurement
- ✓ If taking measurements of utility use for a particular department or process, remember to measure the production over the same time period so that there is something against which to measure the usage (e.g. if production decreases, water use will decrease – if production is not known, then there will be no indication of why the water use decreased). This aspect is dealt with in more detail in Module 3.

2.6 Introduction to Data Analysis

This section very briefly introduces the participants to the analysis of the data that has been collected and fitted to the process map. It starts to ask questions about how accurate the data is and if there are further investigations necessary. It introduces the concept of mass balancing, which is discussed further in Module 3.

This section also highlights the importance of determining the true cost of waste. If questioned, many organisations only see the cost of waste as the charge that is levied to take away the skip or to discharge effluent to drain. However, this is only a very small portion of the total cost of that waste, as there are other losses to take into account.

This is described accurately in the form of the Waste Cost Iceberg shown in slide 31.

Trainers Tip:

This example is best done on a board as a group exercise, where you can write disposal costs at the top and underline this. Then ask the club members to shout out other items they think contribute to the cost of waste and these can be written below the line. At the end, you can draw an outline around all of this to show the iceberg shape, and explain that many companies only see the tip of the iceberg when looking at the cost of waste generation.

WORKSHOP 2.3: THE TRUE COST OF WASTE

Using the case study that has been used for the previous examples, ask the Club to calculate the true cost of waste for Dricoats, focussing only on solid waste. They can work in the same pairs or small groups.

Calculations:

Incineration costs:

Total mass of PU solid wasted converted to tons x cost per ton

16.544 tons x R 5 000 / ton = R 82 720

Waste PU Solid:

The PU solid is made up of 40% PU rubber and 60% solvent.

Waste PU Rubber costs: 40% of total mass x cost per ton

40/100 x 16.544 tons x R 7 500 = R 49 640

Waste Solvent costs:

Take 60% of the total mass of waste PU solid to give the mass of waste solvent. This needs to be converted into litres as the cost of solvent is given in R/litres.

60/100 x 16 544 = 9 926.4 kg

1 litre of solvent weighs 0.85 kg

therefore, 9 926.4 kg equals (9 926.4 / 0.85) 11 678 litres

total cost = 11 678 x R 6 / litre = R 70 068 (or R 70 070 if rounded to the nearest 10)

Cloth loss:

Total m2 purchased – total m2 sold x cost per m2

Total m2 purchased = 300 m2 x number of bales

Total m2 sold – given

Cost per m2 = cost per bale / 300

Cloth loss = (3 055 200 – 2 843 860) x R 8.33 / m2 = R 1 769 500

Trainers Tip:

If you like, you can prepare a blank worksheet outlining the items you would like them to full in or calculate.

Discussions:

Ask the club members to report on their answers and how they calculated these. Highlight for them that the true cost of waste in this case is actually 10 times the cost of disposal. In many cases, companies are not aware of this figure and it can be used to motivate to management for commitment to implementing waste minimisation.

At the end of the exercise, emphasise that this only relates to solid waste and that if the total true cost of waste was to be determined, you would have to include the water and effluent costs, the energy costs that went into making the dyed fabric, and all the dyes and chemicals that are discarded with the off-cuts and off-spec product.

Trainers Tip:

An excellent exercise that can be used to summarise all the aspects covered in Module 2 (process mapping and determine the true cost of waste) is the Peanut Case Study, which you can find in the UNEP web site under training for setting up of a National Cleaner Production Centre.

The reference is provided in the Reference section of this Manual

2.7 Homework Tasks

Ask the Club members to carry out the following tasks:

- ✓ Prepare process map for the site and per department.
- ✓ Identify what data they have already, and what is missing
- ✓ Start planning how to collect the missing information

Trainers Checklist

Module 2

- o Understand the principles of process mapping
- o Read Section 1 of the Facilitator's Manual
- o Print out sufficient workbooks and exercises
- o Prepare additional slides as required

Module 3
Identification of Opportunities

Outline of Module 3

Module 3 aims to introduce some of the tools of data analysis such that opportunities for waste minimisation can be identified.

On conclusion of this Module, participants should have and understanding of:

- The concept of mass balancing
- The importance of monitoring and targeting
- How to start identifying waste minimisation opportunities

Item	Title	Approx. Time required
Recap	Recap of items covered in Module 1 and 2	10 minutes
Training	Data Analysis	30 minutes
Workshop 3.1	Water balance	10 minutes
Workshop 3.2	Cloth balance	10 minutes
Workshop 3.3	Monitoring and targeting	30 minutes
TOTAL		**90 minutes**

Content of Workbook

The workbook for Module 3 as supplied on the CD Rom was developed by March Consulting (now Enviros Consulting) and has been used here with the permission of Enviros Consulting. It can be used to hand out to the participants to can make notes for their use. Additional tips for the trainer are provided in this section of the Training Manual under the same headings as provided in the workbook.

3.1 Identification of Opportunities

On completing the data gathering stage, there is a large amount of data that needs to be sorted, collated and analysed in order that waste minimisation opportunities can be identified. This module outlines the techniques that are available to convert this data into useful information. Stress that it only covers the basics of these tools to provide guidance for further decision-making. Slides 2 and 3 summarise the discussions in the workbook.

3.2 Data Analysis Techniques

This section deals with some of the techniques that can be used to analyse data.

MASS BALANCING

Slides 4 to 11 provide an explanation of how to conduct a mass balance and where to find the data required to complete the mass balance.

Emphasise the basic concept of a mass balance:

What goes into the process must equal what comes out of the process

If this balance does not exist taking into account the stock changes, then this difference provides an indication of the losses that are occurring from the system, which must be identified. Losses represent inefficiencies within a process and therefore provide an opportunity for waste minimisation.

This mass balance can be carried out on a site, department or process level depending on the focus area. If the company is aiming to investigate all options for water reduction, they first need to look at a site level and then slowly break it down to the process level.

It is essential that all the correct data has been obtained to allow for the losses to be determined accurately. When beginning data analysis, it may be necessary for further data collection to take place to complete the required information.

WORKSHOP 3.1:

Task 1: Water balance

Using the case study for Dricoates, and the data that is provided for water meter readings, ask the club members (working in pairs) to complete the water balance for the company by determining how much water is used in each stage of the process. Remind them that there is a meter on the dye vessel already. A blank water balance sheet is provided on the CD for the exercise.

Ask one club member to come up and give his/her answers. Ask for comments from the others.

Discussions:

As a group, brainstorm solutions to reducing water use within the company. Some points which can be raised include:

- Emphasise that once this water balance is carried out and the company is happy that there are no losses, the next step is to question whether this volume of water is necessary for each stage in the process and what could be done to minimise the overall water use. They must start **questioning the norms**.
- Cascade rinsing in the process
- Reusing effluent from bleaching in the scouring
- Capturing the water from the vacuum pump
- Checking that the water used in the vacuum pump is reasonable – should it be this value or much less?
- Put meters on the effluent to obtain a more accurate water balance for the site
- Suggest reading the site water meter before and after a shut down period to determine if any losses are occurring when no processes are running. This will highlight leaks.

WORKSHOP 3.1 CONTINUED:

Task 2: Cloth balance

Using the same case study provided for Task 1 and the information provided on the cloth production at each stage in the process, ask the club members to determine the cloth losses at each stage in the process. A blank cloth balance sheet is provided on the CD.

Discussions:

Ask the club members to brainstorm reasons for the losses at each stage and how this could be reduced. Some points to note include:

- *The greatest loss is between the warehouse and the first process – this example is based on a real case where after this balance was carried out, it was found that this loss was due to stealing! This emphasizes the importance of monitoring and measuring.*
- *Ask the members if they think the losses at each stage are reasonable. If not, then there must be ways of reducing the losses.*
- *Most improvements can be made by looking at improving housekeeping issues – better management, better control etc.*

Answers to Workshop 3.1 are provided in slides 14 and 15.

Trainer's Tip:

Another good exercise which can be used to demonstrate the use of process mapping, fitting data to the map and mass balancing is given in the Envirowise Good Practice Guide GG229 which is referenced in the Reference section of this Manual.

You might also like to make up similar exercises using examples that are more appropriate to the WMC that you are training.

MONITORING AND TARGETING

Monitoring and targeting (M&T) is a very important aspect of waste minimisation. Stress that this tool is the most powerful one that can be used to implement a waste minimisation programme. This section just highlights the main aspects of the tool and how it can be used to monitor utility use within and organization.

M&T basically involves measuring utility use (e.g. water use) against a suitable variable on which it depends, e.g. production volume, relating the two to one another and setting a target utility use per unit variable such that a reduced consumption is achieved.

Trainer's tip:

Ask the club members how they measure the performance of one car against another. Do you say "I used 100 l of petrol" or do you need to measure this against the distance traveled in order for it to make any sense and be able to compare it to the volume of petrol used by another make of car? The same is true of water / energy use. You have to compare it to some variable in order for performance of the company to be assessed.

XY Scatter Plot

A xy scatter plot is the best way of comparing utility use against a suitable variable. In most cases, production is used as the variable, but in others this may not be relevant. For example, if you are trying to determine the water use on a piece of equipment that has to run continuously regardless of production throughput, it may be better to use something such as production hours. The best variable has to be determined before undertaking M&T otherwise the results will be meaningless.

In order to analyse an XY scatter plot, the following is required:

- ✓ At least weekly data on the utility you are measuring and the relevant variable (and these MUST relate to the same time period)
- ✓ At least 10 weeks worth of data is required before an analysis of the data can take place accurately.

The simplest way of explaining how a xy scatter plot can be used to analyse data and set targets, is to prepare a graph on a board using fictitious data. It is easiest to say that you are going to compare water use in litres, to production in kg.

- ✓ Take 10 simple water use data points and related production data points. Make sure there is sufficient scatter. E.g. use 200 l vs. 20 kg; 250 l vs. 15 kg etc.
- ✓ Plot these on a graph with water use as the y-axis, and production as the x-axis.

- ✓ Ask the Club how they would determine what the average water use per unit production is? Easy – draw a best-fit line through the points, making it intersect with the y-axis.
- ✓ Ask the Club what the intercept with the y-axis represents to them. It gives the amount of water used when there is no production. In other words, even when the company is operating, there is this amount of water being used. This is the first place to start asking the question, why? Should this volume of water be used when there is no production? Can they switch of the machine when there is no production etc?
- ✓ Ask the Club what the slope of the line indicates to them. It gives the amount of water required to produce one unit extra of production. It therefore gives some indication of the efficiency of the plant. Go over how to calculate the slope of a line (change in y divided by a change in x).
- ✓ Ask the Club what the scatter of the points represents. This gives an indication of how much control there is over the operation of the process. If the data points are all in the same area, it means that there is good control as nearly always the same amount of water is used per unit production. However, if there is a large scatter of points, it indicates very little control
- ✓ Inform the Club that this best fit line is really the target for the process. In other words, the aim is to get all the points fitting this line as closely as possible. There should be no reason why different water volumes are used for the same unit of production.
- ✓ Get them to calculate the target equation: i.e. the equation of the line: y=mx+c. C = intercept with the y-axis and m is the slope of the graph.
- ✓ Take some other data points where production has been measured. Again use fictitious data. Substitute the x value in the equation for each production data point, and calculate the y value from the equation. Compare this y value to the actual water use measured, and you can immediately see if there are any differences and you can start asking WHY? In this way, better control is achieved over the process and variations can be identified on a weekly basis and corrected immediately.

Once the performance is consistently better than the target, it will be necessary to reset the target to further improve the performance.

Slides 18 to 22 show a summary of these points.

Trend Graph and Trend Analysis

Another method of showing performance is to use the Trend Graph. Show slide 24 and ask the Club to tell you what it indicates. It gives only an indication of how the water use changed over a period of time and that water use is higher in the winter months. It also tells you that you used less water in the second year than in the first, but gives no indication of the reason.

This leads to the second graph – a Trend analysis (slide 25). In this graph, the target and actual consumption are compared on a weekly basis using the same production value. In this way, you can see on a weekly basis how the company is performing against the target. When the actual consumption is above the target, it means that performance is worse. The difference between these two values is the variance.

Variance Graph

Following on from the Trend Analysis Graph, a Variance graph can be plotted that shows the *"actual consumption less the target consumption"*. A positive variance means that the company is performing worse than the target, and a negative means performing better. For each week, this variance can be plotted as shown in slide 27. This clearly shows when a change in the process took place for the better (around week 5) but that things got worse again towards week 10.

Cusum Plot

Ask the Club how they would determine the performance of the company over the whole 10-week period. How would they determine what the savings where over this time? This really means adding all the variances together and plotting the cumulative total for each week. You can then multiply the consumption by the unit cost of the utility and plot this value to determine the savings over the 10-week period. Slide 29 shows the end result. Remember that positive result is a loss, and a negative result is a saving. This shows that over the 10 week period, the company saved 1 000 UK pounds.

Trainer's Tip

This concept is often very difficult to explain and to grasp. It may be best to follow through your fictitious example as used in explaining the x-y scatter plot step by step through each stage so that the same data points are used. Break down the conversion of the variance into the cusum using first consumption data, and then cost to make it easier to understand.

WORKSHOP 3.2: INTRODUCTION TO MONITORING AND TARGETING

This workshop gives the club members a chance to use what they have just learned in an example. The question sheets and answers are provided on the CD.

Ask the club members to work in pairs and at the end, get each pair to give their answer. They are required to read the case study and then carry out the following:

- Comment on the given Trend Graph
- Draw a best fit line on the XY scatter plot and determine the target equation
- Calculate the weekly variance from the target
- Comment on the target

Discussion:

Trend Graph:

You cannot get much information from the Trend Graph. The consumption in week ending 4/2/96 was relatively high, but was this because production was high?

Target Equation:

The equation of the line is ***y=57x + 6000***

57 is the gradient, m, which is (diff in y)/(diff. in x)

6000 is the baseload, c, which implies 6000 kWh per week consumption for zero production hours. A priority for this site would be to investigate, and remove, this baseload. The target would then be re-set.

Variance:

The answers are provided in the table where the target energy use is calculated for each production variable and the variance calculated. It shows that there is a cyclical variance.

Comment:

The scatter or "variance" of the points about the line suggests control problems or possibly different working practices between shifts.

An accurate statistical analysis would need more data points (>10).

Trainer's Tip:

There is M&T software available for keeping track of this data, but a spreadsheet system that can generate graphs is usually sufficient.

A number of guides on monitoring and targeting exist that can be used to build on this section. Refer to the Reference section for details.

BENCHMARKING

Benchmarking is a term that many companies are familiar with whereby they can compare their performance to other companies in the same sector using the same processing. It is also often referred to as the KPI, Key Performance Indicator. It is only meaningful if there is a standard against which to compare this figure. This can be done on an international or local basis, although mention that local information is not readily available. The WMC could consider approaching their industrial association for information.

STATISTICAL PROCESS CONTROL

SPC s a method of monitoring certain inputs and outputs to or from a process to build up a picture of how the process is varying. It is a tool that is often used by companies internally. Slides 35 to 40 give an overview of how the system works. In most cases, this aspect of the module can be left for the members to read through themselves. It is far more important that they understand the concept of M&T.

3.3 Generating Options for Improvement

At the end of this module, the club members should be in a position to be able to start identifying options for improvement. These may have come as a result of the scoping study, the data collection phase, mass balancing or through implementing an M&T programme.

3.4 Opportunity Recording and Record Keeping

It is important that the club members keep a record of the options that have been identified, even if they may not be feasible at that particular time. They can always be revisited at a later date. An opportunity worksheet is provided as an extra handout which can be used to store this information. It can be adjusted for their particular needs, or a database created to contain the same information.

3.5 Homework Tasks

This module builds on Module 2. Once the area of focus has been selected and the data collected, the Club member can start analysing the data and identifying areas for improvement. The homework from Module 3 is a continuous process as new data is collected and analysed. Some pointers for the participants to take into account include:

- ✓ Start constructing mass balances to identify losses
- ✓ Start collecting data to be able to implement an M&T programme.
- ✓ Keep an accurate record of any improvement options identified

Trainers Checklist

Module 3

- o Understand the principles of mass balancing
- o Understand the principles of Monitoring and targeting
- o Print out sufficient workbooks and exercises
- o Prepare additional slides as required
- o Read further guides on Monitoring and targeting

Module 4
Structured Problem Solving

Outline of Module 4

Module 4 provides an outline of the tools that can be used to identify solutions to waste minimisation opportunities.

On conclusion of this Module, participants should have and understanding of:

- The methodology of structured problem solving
- How to conduct a brainstorming session
- How to use root cause analysis procedures

Item	Title	Approx. Time required
Recap	Recap of items covered in Module 1, 2 and 3	10 minutes
Training	Structure problem solving	30 minutes
Workshop 4.1	Root cause analysis	20 minutes
TOTAL		**60 minutes**

Content of Workbook

The workbook for Module 4 as supplied on the CD Rom was developed by March Consulting (now Enviros Consulting) and has been used here with the permission of Enviros Consulting. It can be used to hand out to the participants to make notes for their use. Additional tips for the trainer are provided in this section of the Training Manual under the same headings as provided in the workbook.

4.1 The need to Solve Problems

Slides 2 to 5 give a definition of a problem and provides and understanding of why a procedure is need to solve a problem. Slide 6 gives provides a summary of the stages that are involved in the problem solving cycle. Explain that you will go through each stage with them.

4.2 The use of Teams in Problem Solving

This section is best demonstrated by a group exercise.

ACTIVITY

Put up slide 7 and ask each club member to write down 3 things they think it could be. Give them 3 minutes and then get them to shout out their answers writing them on a board. Compare the variety of the answers and indicate that as one person their ideas where limited, but look at how many were generated as a team.

4.3 Problem Identification

This section deals with how to identify when there is a problem and this is explained well in the Workbook. Go through each example with them, using South African examples where necessary such as the future legislation.

4.4 Problem Definition

This section deal with the importance of defining the problem so that it is clear what is being set out to be solved. Stress the importance of describing the current situation and if there is a need to go out and collect more information to be able to answer the questions What, Where, When, Why and Who?

It is also important that the risks involved in not solving the problem are clearly understood and if there are any time constraints involved.

4.5 Identifying Causes

Emphasise that in order to find a solution to the problem, it is important the real problem is solved and not just a symptom of the problem. One way to make sure that the root cause has been found is to ask the question WHY? At least 5 times. A good example is provided in the workbook.

One way of determining the root cause is by using a cause and effect diagram, or fish-bone diagram. The club members may already be familiar with this system of identifying causes. It is important to stress that the outcome of the analysis may be that there is more than 1 possible root cause and that each of them has to be assessed for its applicability. Slides 13 to 18 cover this aspect.

WORKSHOP 4.1: ROOT CAUSE ANALYSIS

Ask the club members to think about a car driving along a road and skidding out of control, and as a group prepare cause and effect diagram. Some suggested starting points and answers are provided in slides 20 and 21. As a group, select the most likely root causes for further analysis.

4.6 Solution Generation

Now that probable causes have been identified, a procedure is required to generate solutions to solve the problem. In order to do this, criteria for solution generation need to be developed and these should relate to timescale, cost, required performance and disruption to the other processes.

Once these criteria have been set, solutions can be generated. One way of doing this is by brainstorming. The workbook covers this aspect in detail and it is also one method that is commonly used in companies to solve problems.

Ask the group how brainstorming works in their organization and how successful this approach is.

Trainer's Tip

It may be useful for you to ask the Club if there is a particular problem they would like to analyse as a group, or else make one up that you think is applicable to the WMC. Then use this example at each stage to demonstrate each aspect of problem solving. People think more clearly if they have an actual example to work with rather than just talking theoretically.

4.7 Solution Selection

Once a number of possible solutions have been generated, the most suitable solution needs to be selected. This is done by putting them through a selection criteria process, which is described in the workbook. At the end of this process, each solution should be rated by relevant personal as the applicability.

A decision then needs to be taken and it is essential that all those people who are likely to be affected by the decision are consulted.

4.8 Plan for Implementation

Planning implementation is very important to ensure that the process goes smoothly. It is important to identify what the possible barriers are.

Trainer's Tip:

If you have been using a particular example for this module, you may like to ask the Club members to identify what barriers may be experienced when trying to implement the chosen solution (s).

4.9 and 4.10 Implement and Test and Continue to Improve

Emphasise the aspect of continuous improvement.

Trainer's Tip:

You may like to at this point cover some waste minimisation options that are suitable for the WMC that you are training. Reference is given to a number of sector-specific guides that can be used for this aspect. You may like to provide the Club with a list of relevant guides that they can consult. There are also a number of generic guides such as how to reduce water use, raw material use and energy consumption. These are all referenced in the Reference Section.

Trainers Checklist

Module 4

- Understand the principles of problem solving
- Print out sufficient workbooks
- Prepare additional slides as required
- Prepare exercises on root cause analysis relevant to your WMC
- Prepare an exercise on brainstorming relevant to your WMC

Module 5
Project Evaluation

Outline of Module 5

This module aims to provide the Club members with an overview of the tools that can be used to assess the feasibility of a waste minimisation option.

On conclusion of this Module, participants should have and understanding of:

- How to assess the technical feasibility of a project
- How to assess the economical feasibility of a project
- How to use these tools to prioritise further action

Item	Title	Approx. Time required
Recap	Recap of items covered in Module 1, 2, 3 and 4	15 minutes
Training		30 minutes
Workshop 5.1	Payback	10 minutes
Workshop 5.22	Return on investment	10 minutes
Workshop 5.3	Net present value	10 minutes
Workshop 5.4	Comparison of methods	10 minutes
TOTAL		**85 minutes**

Content of Workbook

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5.1 Course Objectives

This section introduces the module and explains some of the reasons why industry is hesitant to embark on waste minimisation projects. These barriers may have already been identified in Module 1.

Trainer's Tip:

Some generic worksheets that can be used to undertake a technical and economic evaluation of a project can be found in the WRC publication: Waste Minimisation Self-assessment Guide for the Textile Industry – a step towards cleaner production, Volume 2 (see References).

5.2 Technical Evaluation

A technical evaluation involves assessing if the identified option fulfills a number of criteria, all of which are covered in slides 4 to 9. A detailed discussion is covered in the workbook and you can use this information to expand on each slide in more detail, making reference to relevant examples are required.

5.3 Economic Evaluation

There are a number of aspects to take into account when undertaking an economic evaluation. These are explained in detail in the workbook and covered in slides 11 to 16, and won't be repeated here. It is suggested that you read through the information provided and prepare extra slides as required to ensure a complete description of the process of evaluating a project.

Trainer's Tip:

When explaining the cash flow table, it is best to do it step by step on the board so that the Club members can see how it is drawn up rather than just being shown the end product.

5.4 The Main Investment Appraisal Techniques

This section covers the 4 common techniques that are used to assess the economic feasibility of a project. It describes the difference between non-discounting and discounting techniques and provides an example of how a discount factor table is used.

PAYBACK

The most commonly used technique is that of **PAYBACK** and you can ask the club members what their company's view is on payback. In many cases, companies use this method as a measure of whether or not to implement a project and generally have a cut off period in the region of 2 years. In other words, if the payback is more than 2 years, then the project is shelved.

Trainer's Tip:

When explaining how to calculate the payback, it is best to do a calculation on the board using very simple numbers to demonstrate the process.

WORKSHOP 5.1: PAYBACK

In the workbook information on Project A and Project B is provided for the club members. Ask them to calculate the payback for each project and to select which is the most feasible based on this information.

Calculation:

Payback is given by the capital investment divided by net savings (given by gross annual savings less the annual operating costs).

The answers to this workshop are provided on the CD and in slide 26.

RETURN ON CAPITAL EMPLOYED (ROCE)

Ask the club members if they have used this system to assess projects. Many companies do make use of it, although still often use payback as the selection criteria.

When using ROCE, the company will get an indication of the % return on their money if they invested in a certain project. They can then compare this % to that offered by a bank for example, and determine if it makes more business sense to invest in the project or to put the money in the bank and accrue interest.

Trainer's Tip:

Again, it is best to work through the explanation using simple numbers to demonstrate the process.

WORKSHOP 5.2: ROCE

Using the same information for Projects A and B, ask the Club members to calculate the ROCE for the projects and compare the results.

The answers to this workshop are provided on the CD and on slide 31, including the calculations.

NET PRESENT VALUE

NPV is the first discounted cash flow technique that is explained.

You can explain the concept of money being worth less in the future by saying that if given the option of R100 now or R100 in a years time, people will take it now as it can buy more than it will in a years time. The discount factor table is required to determine how the value of money changes over a certain time period.

The example given looks at a project over a 4 year period and at a 10% interest rate should the money be invested in the bank. The time period and the interest rate can be used to determine the discount factor for this calculation from the discount factor table. Ask the club members to look it up so that they understand how to use the table. The cash flow is first calculated and then discounted by multiplying by the discount factor and the total will give an indication of the value of the investment in 4 years time. If the NPV has a value greater then zero, then it is viable. The larger the number, the more feasible the option.

WORKSHOP 5.3: NPV

Using the information provided for Projects A and B, and using an interest rate of 10%, ask the Club members to calculate the NPV for both projects.

The answers are provided on the CD and in slide 36.

INTERNAL RATE OF RETURN (IRR)

IRR represents the rate of interest that the money would have to earn elsewhere to be a better investment than investing in the chosen project. It provides an indication of the discount rate at which the NPV equals zero. In other words, it is the point at which the discounted cash flow equals the capital that has been outlayed. There is no simple way of calculating the IRR and many companies have computer programmes that make these calculations easily. It basically involves determining the NPV for the projects at different interest rates until zero is reached. This would then be the interest rate that would have to be earned elsewhere to get the same ROI.

IRR is basically a tool for a company to determine if it's worth investing in the project or putting the money elsewhere.

WORKSHOP 5.4: COMPARE METHODS

Look at the answers that have been calculated for Projects A and B using Payback, ROCE and NPV. Ask the club members which project is the most feasible.

Based on Payback and ROCE, Project A is more attractive, but based on NPV, Project B is a better option.

5.5 Risk Analysis

Highlight that a company needs to look at what risks are involved in investing in projects and what the effect on the project could be.

Trainer's Tip:

You should also include some aspects of an environmental evaluation. For example, in some cases the project may have a longer payback period than is normally acceptable, but it has to go ahead to avoid legal action.

Trainers Checklist

Module 5

- Understand the principles of the techniques covered in Module 5
- Print out sufficient workbooks and exercises
- Prepare additional slides as required
- Prepare simple examples that can be used to explain each technique on the board
- Obtain copies of the generic worksheets for carrying out technical and economic evaluations
- Identify aspects that may require an environmental assessment

Module 6
Project Management

Outline of Module 6

This module provides an outline of some of the tools used to assist in managing projects correctly. The participant will understand the importance of good communication, well defined tasks and problems that can arise.

On conclusion of this Module, participants should have and understanding of:

- How to break down tasks into definable commands
- How to prepare Gantt charts
- How to undertake a network analysis
- The problems that can arise in managing projects

Item	Title	Approx. Time required
Recap	Recap of items covered in Module 1, 2, 3, 4 and 5	15 minutes
Training	Project Management	30 minutes
Workshop 6.1	Work break down Structure	10 minutes
Workshop 6.2	Gantt Chart	10 minutes
Workshop 6.3	Network analysis	20 minutes
TOTAL		**85 minutes**

Content of Workbook

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6.1 Project Management

This section gives an overview of the need for managing projects correctly such that they are completed on time, within budget and provide the correct quality. Section 6.1.2 provides a list of the aims of project management – the points to emphasise are:

- ✓ Project management aims to identify and pursue the correct objectives, often aided by stating it in terms of the problem to be solved;
- ✓ Project management aims to assist in the recognition of the project stages and the need for specific end results of each milestone;
- ✓ Project management aims to define and understand all responsibilities;
- ✓ Project management aims to recognize all budget requirements and agree on them in advance.

The various stages of project management are outlined and each will be discussed in turn.

Trainer's Tip

It is often useful to choose a waste minimisation project to refer to throughout the module in each stage: for example the installation and commissioning of a new piece of machinery that is going to save the company R1 million per year but for which there needs to be a new area built etc. This can put the module into context.

6.2 Project formulation

This section deals with defining the objectives of the project to be implemented and planning the resources. Sections 6.2.2 to 6.2.6 (slides 7 to 14) deal with preparing tenders and sub-contracting. It is often not necessary to cover these aspects in the training, as most companies have a department that deals with tendering etc. and it would not fall to the responsibilities of the project champion to deal with these aspects. Check if the WMC would like to cover these items and prepare accordingly, otherwise refer them to the workbook for their own information and focus on the other sections.

6.3 Project Teams

This section deals with the issue of project teams and the problems that can arise. Emphasise that a company needs to have an "organic" approach when dealing with waste minimisation projects as it involves new and innovative thinking.

Slide 16 outlines how running more than one project can cause management problems, especially when one person may be answerable to more than one manager. It underlines the importance of clearly defined roles.

ACTIVITY 1:

Ask the club members to look at slide 16 and identify who Mr A answers to. It is evident that he has to answer to the engineering manager; Project X manger and Project Y manager. If there is no well defined role for Mr A, he is going to be a very confused team member!

ACTIVITY 2:

Ask the club what problems they think could arise when managing project teams? Some ideas include:

- People have more than one boss
- People are not used to team work
- There is a lack of co-operation between project managers
- There needs to be a sense of personal accountability

(see also the extra handouts on the CD)

6.4 Project Planning and Monitoring

This section of the module outlines the tools that can be used to properly plan project implementation and also the need for monitoring the performance of a project. Some aspects that are covered here by means of exercises are:

- ✓ Work break down structure (WBS) – involves breaking the project into smaller tasks.
- ✓ Gantt charts – time limits are placed on each task identified in the WBS
- ✓ Network analysis – identifies the sequence of events
- ✓ Critical path analysis – identifies which is the critical step that can effect project completion.

WORKSHOP 6.1: WORK BREAK DOWN STRUCTURE

Ask the Club members to read the case study provided in the workbook (or you can hand it out separately as provided on the CD). There are 2 parts to this exercise:

- Using the table where the tasks have been identified, the participants must complete the number of week required for each task
- Using the WBS flow chart, they must complete the tasks for each item.

Answers are provided on the CD and slides 23 and 24.

Once the tasks have been identified, the next step is to identify who is responsible for each stage. This is carried out in the form of a Task / Responsibility Matrix.

Trainer's Tip:

It is useful to prepare this matrix on the board so that the Club can see how it is carried out. Draw a table as shown below with the tasks on the y-axis, and the person on the x-axis and then complete for each task whether that person has a prime (leading) role, or whether they have a supportive (secondary) role.

Task 1	S	P	S	
Task 2			P	S
Task 3	S	P		S
Task 4	P	S	S	P
	Miss A	**Mr B**	**Mr C**	**Ms C**

WORKSHOP 6.2: GANTT CHART

The Gantt chart provides an indication of the time scale for each task such that it can be identified which task has to be completed before the next one can be started. The exact time required for each task is indicated by a solid line and those tasks that can be extended without affecting any other tasks can be indicated by a dashed line.

Ask the Club members to complete the Gantt chart for the project. The answer is provided on the CD and slide 28.

Points to highlight include:

- No other task can be started before the first 5 week feasibility study has been completed
- Recruitment can start at the same time as ordering the computer
- Implementation will be complete after 27 weeks.
-

NETWORK ANALYSIS AND CRITICAL PATH ANALYSIS

This section deals with breaking down the project tasks in such a way as to identify how they are interrelated. In other words, which tasks depend on others to be completed before they can be carried out. It assists in monitoring the progress of a project as it allows for delays to be identified.

Trainers Tip:

Go through slides 29 to 33 slowly explaining the use of arrows, events and nodes and how they are linked to one another. Indicate how delays also need to taken into account – in other words items such as waiting for water pipes to be installed needs to considered as a task. Understanding the construction of a network is important before moving onto the critical path analysis. The workbook can guide you in your explanations.

Once the network has been constructed, it can be used to identify the critical path: In other words, the longest path through the network, any delay in which will setback the project. There may be more than one critical path, but the examples used here will only show one.

ACTIVITIES:

The two activities under this section introduce the concept of Earliest Event Times and Latest Even Times.

Remember that **EARLIEST** event time means the shortest time in which the task can be completed. E.g. in the first example, you are asked to determine the earliest even time for Tasks 2, 3, 4 and 5. In the case of Tasks 2 and 3, this is easy it can only be 7 weeks and 2 weeks respectively. However, for Task 4, there are 2 ways of getting to this point, and therefore the earliest time it can be completed is the longest pathway – in other words, by following task 1 to task 2 to task 4 (10 weeks). Complete this for all the tasks. In total, you should have 13 weeks as the end answer.

The **LATEST** event time gives an indication of the amount of extra time is available for each task assuming that the total number of weeks to complete the project is the same as that determined by the earliest even time. In this example it is 13 weeks. The latest even time is then determined by subtracting the durations of each task from the previous figure along the paths. Remember again to follow the longest path when calculating the even time. In the end, task 1 must have an earliest and latest event time of "0".

The difference between the latest and earliest even times for each task gives you an indication of the float time that is available to complete that task. Activities with no float are **CRTITICAL**.

Trainer's Tip:

If possible, make overhead copies of slides 35 and 36 and carry out the activity step by step with the club members.

WORKSHOP 6.3: NETWORK ANALYSIS

A network structure for the case study has been provided. The Club members must determine the earliest and latest event times, and the critical path. They are also asked to determine what action should be taken to ensure the project is completed in the required time and at least cost.

The answers are provided on the CD and slide 38.

***Discussions**:*

The following points can be raised:

- As it stands, the project can only be completed in 28 weeks, and not the 26 weeks that have been requested. This has a cost implication of an extra R 300 000.
- The cheapest way of achieving the deadline is by shortening systems analysis by one week at a cost of R50 000, and writing programmes by one week at a cost of R75 000. Total cost R125 000.
- Shortening systems analysis alone by 2 weeks would only cost R90 000, but would reduce the overall project timescale by only 1 week since recruiting and training the programmers would then take longer than recruiting the systems analysts and carrying out the systems analysis.

6.5 Schedule and Cost Control

This section emphasises the importance of monitoring the progress of a project as delays have a budget implication. This information can be added to the network structure. This issue is dealt with in detail in the workbook.

6.6 Project Completion

This is the final stage of the project management procedure and involves commissioning the plant, training people, reviewing performance and evaluating the results.

ACTIVITY:

Ask the club members what factors could lead to poor project performance. Some ideas include (slide 43):

- Too many projects
- 'Impossible' objectives
- Poor control over changes
- No or wrong Project manager
- Poor planning, scheduling, control
- No project cost accountability
- Project Manager reports to wrong levels
- Resources over committed
- Conflict between project and functional departments

An extra handout is provided that discusses reasons for poor project performance and some possible solutions.

Trainers Checklist

Module 6

- o Understand the principles of Project Management
- o Print out sufficient workbooks and exercises
- o Prepare additional slides as required

Module 7
Sustaining the Programme

Outline of Module 7

This module provides an overview of the work carried out in the previous 6 modules and is conducted through discussing the experiences of the participants in implementing waste minimisation in their organisation. The importance of motivating people is also covered and some tips provided on how to involve the staff in reducing waste at source.

On conclusion of this module, the participants should be able to prepare an action plan for implanting a waste minimisation programme on their site based on the information that has been covered in all modules.

On conclusion of this Module, participants should have and understanding of:

- The theory of motivational techniques
- How to implement an awareness raising programme in-house

Item	Title	Approx. Time required
Training	Sustaining the programme	30 minutes
Discussions	Discussions on experiences at each stage of implementing the waste minimisation programme	10 minutes
TOTAL		**85 minutes**

Trainer's Tip:

A relevant addition to this section would be the inclusion of how to raise staff awareness. An excellent source of information is a manual prepared by the UK Environment Agency on raising awareness with respect to waste minimisation. It is suggested that this manual be used to prepare some slides for presenting the information and club members be encouraged to download the manual from the internet. See the Reference section for more details.

Content of Workbook

The workbook for Module 7 as supplied on the CD Rom was developed by March Consulting (now Enviros Consulting) and has been used here with the permission of Enviros Consulting. It can be used to hand out to the participants to make notes for their use. Additional tips for the trainer are provided in this section of the Training Manual under the same headings as provided in the workbook.

This module is aimed to be very interactive with a large amount of discussions at each stage of the training regarding problems that have been encountered.

7.1 Introduction

This section deals with a recap of the waste minimisation procedure. You can add extra slides in on the concept if you would like to remind the Club of the benefits etc. Emphasise that waste minimisation is a continuous process which is why they need to continue to look at how they sustain the momentum.

Trainer's Tip:

If possible, this would be an ideal stage to invite a person from an organization that has successfully implemented waste minimisation to address the Club on his successes and how he/she manages to maintain the process even though they have been implementing changes for the last 3 to 5 years. It often helps to have an industry person speaking to other industry persons to show that it can be done.

7.2 Barriers to Success

Recap the barriers that the Group identified at the beginning of the Training and ask them to talk about others that they have encountered. Get some discussions going as to how some barriers had been overcome and also if barriers emerged that they did not expect.

Emphasise the importance of commitment from senior management and ask if all the members have this support. If there are some that have not as yet received the full backing of management, ask the other members how they achieved this.

7.3 The Role of the Champion

Ask the members to think about their role as the Project Champion. What have they been doing to date, and how do they see their future role. Refer to Section 2 in the Facilitator's Manual for some ideas to lead the discussions. Slides 9 to 12 cover the recommended roles.

7.4 Behavioral Theories

This section deals with the theory behind what motivates people to work and how these theories can be used to assist a company in identifying the motivating forces with the work place. The workbook covers the theories in detail and you can be guided by these discussions in your presentation of the theories (slides 13 to 16).

You can then lead the discussions around the problems experienced by the club members in motivating their teams and workforce in reducing waste. If a club member has been successful in motivating his/her workforce, ask them to share some ideas with the WMC as to how this was achieved.

7.5 Motivation

Slides 18 to 28 cover various aspects related to increasing motivation within an organisation. The importance of good communication and leading by example are discussed. Some extra handouts are provided on the CD which gives some suggestions for improving motivation within a company.

Ask the club members to brainstorm some ideas as to how they could increase staff motivation on their site. This may be a particularly useful exercise if running an in-house WMC.

7.6 Waste Minimisation Teams

The role and structure of waste minimisation teams is revised in slides 29 to 35. Lead discussions around the manner in which the WMC teams were selected and who is represented on these teams. The importance of training team members, the co-ordination of teams (if more than one exists) and modifying the team structure are covered in the workbook.

The last activity in the workbook asks the team members to create and action plan to maintain motivation and improvements on their sites. This is a particularly good exercise to carry out with an in-house WMC or to use as a homework task in other WMC. You must again stress the importance of including all staff members in implementing waste minimisation.

Trainers Checklist

Module 7

- Recap for yourself the material covered in the previous modules
- Print out sufficient workbooks and exercises
- Prepare additional slides as required to cover the discussion items

References

This section provides reference to further information that can be used to assist in the training activities. The majority of this information is available off the Internet, and home pages for these sites are provided where possible. Other useful Internet references are provided in the Facilitator's Manual.

South African Legislation / regulations

Title	Source
National Government	
South African Government	www.gov.za
Department of Environmental Affairs and Tourism	www.environment.gov.za/
Department of Water Affairs and Forestry	www.dwaf.gov.za
Department of Trade and Industry	www.dti.gov.za
Department of Minerals and Energy Affairs	www.dme.gov.za
Provincial Government (Environment)	
Eastern Cape Province: Department of Economic Affairs, Environment and Tourism	http://www.ecprov.gov.za/ department_overview.asp?departmentID=3
Gauteng Province: Department of Agriculture, Conservation, Environment and Land Affairs	http://www.dacel.gpg.gov.za/
KwaZulu-Natal Province: Department of Agriculture and Environmental Affairs	http://agriculture.kzntl.gov.za/
Limpopo Province: Department of Finance, Economic Affairs, Tourism and Environment	http://www.limpopo.gov.za/depts/
Northern Cape Province: Department of Agriculture, Land Reform, Conservation and Environment	http://www.northern-cape.gov.za/departments/
North West Province: Department of Agriculture, Conservation and Environment	http://www.nwpg.org.za/Agriculture/
Western Cape Province: Department of Environmental Affairs and Development Planning	http://www.westerncape.gov.za/environmental_cultural_affairs/ default.asp
Local Government	
Local Government Home Page	www.local.govt.za
Durban (eThekwini)	www.durban.gov.za
Cape Town	www.capetown.gov.za/
Johannesburg	www.joburg.org.za/
Pretoria (Tshwane)	www.Tshwane.gov.za
Port Elizabeth (Nelson Mandela)	www.pecc.gov.za
East Rand (Ekurhuleni)	www.ekurhuleni.com

Generic Waste Minimisation Training Workshops

Title	Source	Comments
How to prevent waste and emissions in your company – a self-help guide	Clean Technology Centre Training and Awareness Raising Products www.ctc-cork.ie	
GG106: Cutting costs by reducing waste – running a workshop to stimulate action	Envirowise www.envirowise.gov.uk	A good source of material for a basic introduction to waste minimization
GG174: Profiting from practical waste minimisation – running a workshop to maintain the momentum	Envirowise www.envirowise.gov.uk	Useful hints for how to keep a waste minimisation programme going
GG229: Profiting from reducing water use – running a workshop to stimulate action	Envirowise www.envirowise.gov.uk	Some good exercises for demonstrating process mapping and mass balancing (Modules 2 and 3)
Cleaner Production: A training resource package	UNEP IE, March 1996 www.unepie.org	Can download off the site or order in hard copy
Principles of pollution prevention and cleaner production: an international training course (Trainers and participants manuals)	US EPA – Office of International Activities, 1999 www.epa.gov	Available to download off the web site

Generic Waste Minimisation Guidelines

Title	Source	Comments
GG296: Cleaner production design: a practical approach	Envirowise www.envirowise.gov.uk	
GG125: Waste minimisation pays – five reasons for reducing waste	Envirowise www.envirowise.gov.uk	
GG067: Water saving devices	Envirowise www.envirowise.gov.uk	Practical information on devices that can be used to save water
ET225: Waste account	Envirowise www.envirowise.gov.uk	
ET219: Waste mapping – your route to more profit	Envirowise www.envirowise.gov.uk	Useful for pre-assessment training in how to identify sources of waste
ET030: Finding hidden profit – 200 tips for reducing waste	Envirowise www.envirowise.gov.uk	Some practical waste minimisation ideas
GG38C: Cutting costs by reducing waste: a self-help guide for growing businesses	Envirowise www.envirowise.gov.uk	
GG25: Saving money through waste minimisation – raw material use	Envirowise www.envirowise.gov.uk	

Title	Source	Comments
GG26: Saving money through waste minimisation – reducing water use	Envirowise www.envirowise.gov.uk	
Money for nothing and your waste tips for free	UK Environment Agency www.environment-agency.gov.uk	Booklet that accompanies a video on waste minimisation.
Waste minimisation: an environmental good practice guide for industry	UK Environment Agency www.environment-agency.gov.uk	
Waste minimisation – getting staff involved	UJ Environment Agency www.environment-agency.gov.uk	An excellent source of information on how to raise awareness in an organization. Useful for Model 7.
Tool: Waste minimisation interactive tool	Envirowise www.envirowise.gov.uk	A computer programme that assists in monitoring progress in waste minimisation
Guide to industrial assessment for pollution prevention and energy efficiency	US EPA, EPA/625/R-99/003 June 2001, www.usepa.com	
Audit and reduction manual for industrial emissions and waste	UNEP and UNIDO Technical report No. 7, 1991	
Waste minimisation opportunity assessment manual	US EPA, 1998 www.usepa.com	The fist use of self-assessment worksheets for identifying waste minimisation opportunities

Guides for Monitoring and Targeting

Title	Source	Comments
GG112: Monitoring and Targeting in large companies	Energy Efficiency Best Practice Programme www.energy-efficiency.gov.uk	
GG125: Monitoring and Targeting in Small and Medium-sized companies	Energy Efficiency Best Practice Programme www.energy-efficiency.gov.uk	
GG148: Monitoring and targeting in the textiles industry	Energy Efficiency Best Practice Programme www.energy-efficiency.gov.uk	

Sector Specific Waste Minimisation Guidelines

Title	Source	Comments
Textiles and Leather		
GG237: Waste Minimisation in the Leather Industry	Envirowise www.envirowise.gov.uk	
Tanneries and the Environment	UNEP IE, Technical Report no. 4, 1991 www.unepie.org	
Best Management Practices for Pollution Prevention in the textile industry	US EPA, EPA/625/R-96/004 September 1996	
Beat Available Techniques for the Textile Industry (BAT)	http//eippcb.jrc.es	Can download off the web site. Contains detailed information on BAT for textiles. Other BAT documents are available.
Quick Reference Guide to BAT for Textile Processing	Danida, 2004 www.ctelc.co.za	A short reference guide for the BAT publication mentioned above. Order from the Clothing and Textile Environmental Linkage Centre.
GG42: Waste minimisation in the worsted and knitwear sectors GG62: Water and chemical use in the textile dyeing and finishing industry GG79: Reducing cost through waste management: the woolen sector GG84: Reducing cost through waste management: the cotton and man-made fibre sector GG86: Reducing cost through waste management: the garment and household textiles sector EG98: Water use in textile dyeing and finishing How to set up an environmental management system in the textile industry	Envirowise www.envirowise.gov.uk	All useful guides for investigating waste minimisation in the textile sector. Available to download or to order. Registration on the site required, but there is no charge.
Cutting your energy costs: a guide for the textile dyeing and finishing industry	Energy Efficiency Best Practice Programme www.energy-efficiency.gov.uk	
Cleaner Production in textile wet processing: A workbook for trainers	UNEP IE, March 1996 www.unepie.org	Can download off the web site or order in hard copy
Waste minimisation self-assessment guide for the textile industry: a step towards cleaner production (volumes 1 and 2)	Water Research Commission www.ukzn.ac.za/wasteminclubs	Download off the website or order from the Water Research Commission
Cleaner technology transfer to the Polish textile industry	Danida, 1999	CP ideas for textile processing.
Natsurv 13: Water and waste water management in the textile industry	Water Research Commission www.wrc.org.za Project 145 (TT 50/90), 1990	Available to order from the WRC
The textile industry and the environment	UNEP IE, Technical Report no. 16, 1993 www.unepie.org	

Title	Source	Comments
Metals and Metal Finishing		
GG270: Reducing Energy Costs for aqueous-based metal treatment processes GG118: Environmental management systems workbook for metal finishers EG72: Paint and powder coating use in the metal finishing industry EG46: Acid and water use in the metal finishing industry EG44: Acid use in the metal finishing industry Tool: IT265: Electroplaters plant performance optimization tool	Envirowise www.envirowise.gov.uk	
International waste minimisation approaches and policies to metal plating	US EPA, EPA530-R-96-008 August 1996	
Natsurv 2: Water and waste water management in the metal finishing industry	Water Research Commission www.wrc.org.za Project 145 (TT 34/87), 1987	Available to order from the WRC
Chemical Processing		
EG105: Water use in the manufacturing of speciality chemicals EG123: Speciality chemicals manufacture: staying competitive through environmental management systems GG120: Cost effective vessel washing GG126: Increasing product output in batch chemical manufacture Tool: Benchmarking environmental performance in the chemical industry	Envirowise www.envirowise.gov.uk	
Food and Drink		
GG233: Reducing water and effluent costs in poultry meat processing GG349: Water minimisation in the food and drink industry	Envirowise www.envirowise.gov.uk	
Natsurv 9: Water and waste water management in the poultry industry	Water Research Commission www.wrc.org.za Project 145 (TT 43/89), 1989	Available to order from the WRC
A Guide to water ad waste water management in the poultry abattoir industry	Water Research Commission www.wrc.org.za Project 127 (TT 46/90), 1993	Available to order from the WRC
Cleaner production assessment in fish processing Cleaner production assessment in meat processing	UNEP IE www.unepie.org	Available to download from the web site
GG242: Reducing waste for Profit in the Dairy industry	Envirowise www.envirowise.gov.uk	
Cleaner production assessments in diary processing	UNEP IE www.unepie.org	Available to download from the web site
Cleaner production in Breweries: A workbook for trainers	UNEP IE, March 1996 www.unepie.org	Can download off the web site or order in hard copy

Title	Source	Comments
Pulp and Paper		
GG111: Practical water management in paper and board mills	Envirowise www.envirowise.gov.uk	
Natsurv 12: Water and waste water management in the paper and pulp industry	Water Research Commission www.wrc.org.za Project 145 (TT 49/90), 1990	Available to order from the WRC
Cleaner Production in Pulp and Paper Mills: A Training Package	UNEP IE, April 1998 www.unepie.org	Can download off the web site or order in hard copy
Retailers		
GG365: easy money – a self-help guide for small retailers	Envirowise	
GG325: Profiting from waste reduction in retail stores	www.envirowise.gov.uk	
GG324: Increasing profits by reducing waste in managed shopping centers		
GG308: Furniture workbook- cut waste, cut costs		

Energy Aspects

Title	Source	Comments
GG18: reducing energy consumption costs by steam metering	Energy Efficiency Best Practice Programme www.energy-efficiency.gov.uk	Available to order from the web site
GG30: Energy efficient operation of industrial boiler plant		
GG126: Compressing air costs		
GG84: Managing and motivating staff to save energy		
GG85: Energy management training		

Other Sources of Useful Information

Title	Source	Comments
Envirowise	www.envirowise.gov.uk	Excellent source of guides, case studies, fact sheets etc for various sectors. Should be the first place to source data.
Energy Efficiency Best Practice Programme	www.energy-efficiency.gov.uk	Download the publication list and order relevant guidelines. Some guides are available for download on the site
Action Energy	www.actionenergy.org.uk	A number of useful publications on energy use to download.

Title	Source	Comments
UK Environment Agency	www.environment-agency.gov.uk	Publications for download on the web site.
Green Profit	www.greenprofit.net	Case studies for a number of sectors
World Bank	www.worldbank.org	Links to sources of information on waste minimisation and cleaner production
United Nations Environment Programme (UNEP)	www.unep.org Access the library to download documents on cleaner production in various sectors and also on how to set up a cleaner production centre	Links to all UNEP Cleaner production centers worldwide. Each centre has information and training on cleaner production that can be accessed. In the training material on how to set up a CP Centre there is an exercise on process mapping and the true cost of waste which is excellent for Module 2.
Canadian Centre for Pollution Prevention	www.c2p2online.com	Useful publications
Centre of Excellence in Cleaner Production	Htpp://cleanerproduction,curtin.edu.au	Useful information on CP
Target Zero	www.ccc.govt.nz/targetzero	Publications, case studies, guides etc. to download.

Where to go for Help

The following organisations may be of assistance to you in providing training within a waste minimisation club.

Pollution Research Group	School of Chemical Engineering University of KwaZulu-Natal, Durban, 4014 South Africa	**Chris Buckley** + 27(0)31 260 3375 buckley@nu.ac.za
Susan Barclay CC	PO Box 1310, Forest Hills, 3624 South Africa	**Susan Barclay** + 27 (0)31 763 5219 suebar@iafrica.com
BECO **Institute for Sustainable Business**	PO Box 12485, Mill Street, 8010 South Africa	**Bas Kothuis** +27 (0)21 689 7117 bkothuis@beco.com
Enviros	PO Box 1310, Forest Hills, 3624 South Africa	**David Mercer** + 27(0)72 218 0854 mercer@mweb.co.za