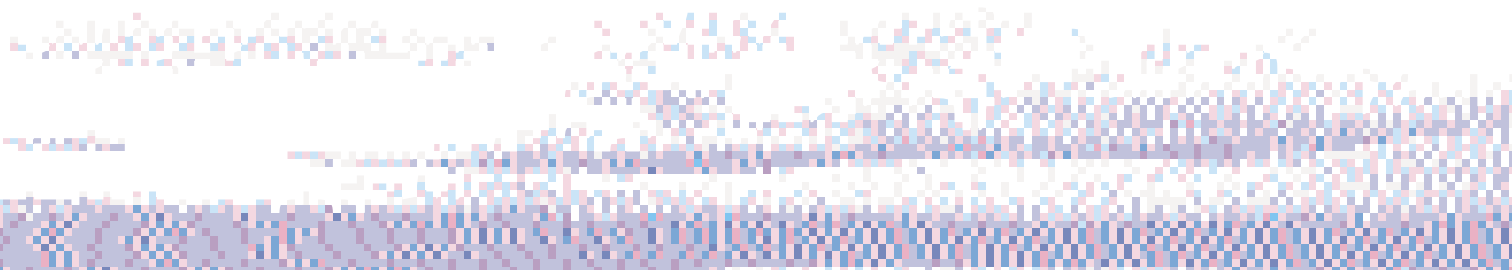




**ENVIRONMENTAL  
TECHNOLOGY  
BEST PRACTICE  
PROGRAMME**

# CUTTING COSTS BY REDUCING WASTE:

## A self-help guide for growing businesses



# SUMMARY

## How will reducing waste help your business?

- It will save you money - typically up to 1% of business turnover, either as extra profit or as reduced production costs.\*
- It will give you more control over your disposal costs.
- It will be cheaper for you to comply with environmental regulations.
- It can improve your standing with customers who seek assurance that their suppliers are operating on a sound environmental basis.

## WHAT'S IN THE GUIDE?

This Good Practice Guide contains practical advice to help you develop your own waste reduction programme. The self-help approach consists of four main stages:

- Getting started** Initial steps to help you decide whether your business would benefit from a waste reduction programme.
- Quick savings** How to identify and implement some initial waste reduction measures for immediate savings.
- Key techniques** Detailed guidance on two key techniques that will help make quick savings.
- The future** A framework for developing a more systematic approach to waste reduction to make long-term savings - and where you can get more free advice.

Use the Guide to develop your own priorities and to identify areas where you need specialist help or training. If you need further advice, contact the Environmental Helpline on freephone 0800 585794.

You will find loose blank worksheets to photocopy and other useful information inside the front cover of this Guide (the worksheets are also bound into the Guide and can be found after the Appendices). **Use these to discover how much money a waste reduction programme could save your business.**

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\* If your company provides services instead of making a product, think of these services as your product and the steps you take in supplying them as your process.





**ENVIRONMENTAL  
TECHNOLOGY  
BEST PRACTICE  
PROGRAMME**

The Environmental Technology Best Practice Programme is a joint Department of Trade and Industry and Department of the Environment, Transport and the Regions programme. It is managed by AEA Technology plc through ETSU and the National Environmental Technology Centre.

The Programme offers free advice and information for UK businesses and promotes environmental practices that:

- **increase profits for UK industry and commerce;**
- **reduce waste and pollution at source.**

To find out more about the Programme please call the Environmental Helpline on freephone 0800 585794. As well as giving information about the Programme, the Helpline has access to a wide range of environmental information. It offers free advice to UK businesses on technical matters, environmental legislation, conferences and promotional seminars. For smaller companies, a free counselling service may be offered at the discretion of the Helpline Manager.

This Guide was prepared with assistance from:

William Battle Associates

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# OPPORTUNITY CHECKLIST

Department	Area	Possible waste			
Incoming materials	Loading docks, pipelines, receiving areas	Packaging/containers	<input type="checkbox"/>		
		Off-spec deliveries	<input type="checkbox"/>		
		Damaged containers	<input type="checkbox"/>		
		Spill residue	<input type="checkbox"/>		
		Cleaning rags, etc	<input type="checkbox"/>		
		Pallets (non-returnable)	<input type="checkbox"/>		
		Gloves, overalls, etc	<input type="checkbox"/>		
Storage (raw materials, parts, final products)	Tanks, silos, warehouse, drum storage, yards, storerooms	Tank bottoms	<input type="checkbox"/>		
		Off-spec materials	<input type="checkbox"/>		
		Excess materials	<input type="checkbox"/>		
		Damaged containers	<input type="checkbox"/>		
		Empty containers	<input type="checkbox"/>		
		Leaks from pumps/valves/pipes	<input type="checkbox"/>		
		Out-of-date materials	<input type="checkbox"/>		
		No-longer-used materials	<input type="checkbox"/>		
		Damaged products	<input type="checkbox"/>		
		Production	Melting, curing, baking, distilling, washing, coating, forming, machining	Washwater	<input type="checkbox"/>
Solvents evaporating	<input type="checkbox"/>				
Still bottoms in tanks	<input type="checkbox"/>				
Off-spec product rejects	<input type="checkbox"/>				
Catalysts	<input type="checkbox"/>				
Empty containers	<input type="checkbox"/>				
Sweepings	<input type="checkbox"/>				
Ductwork clearout	<input type="checkbox"/>				
Additives	<input type="checkbox"/>				
Oil	<input type="checkbox"/>				
Process solution dumps	<input type="checkbox"/>				
Rinsewater	<input type="checkbox"/>				
Excess materials	<input type="checkbox"/>				
Filters	<input type="checkbox"/>				
Leaks from tanks/pipes/valves	<input type="checkbox"/>				
Spill residue	<input type="checkbox"/>				
Swarf/off-cuts	<input type="checkbox"/>				
Sludge	<input type="checkbox"/>				
Drag-out from baths	<input type="checkbox"/>				
Packaging of dispatched goods	<input type="checkbox"/>				
Support services	Laboratories, maintenance shops, garages, offices	Chemicals	<input type="checkbox"/>		
		Samples and containers	<input type="checkbox"/>		
		Solvents	<input type="checkbox"/>		
		Cleaning agents	<input type="checkbox"/>		
		Degreasing sludges	<input type="checkbox"/>		
		Sand blasting waste	<input type="checkbox"/>		
		Lubricating oils and greases	<input type="checkbox"/>		
		Scrap metal	<input type="checkbox"/>		
		Caustics	<input type="checkbox"/>		
		Filters	<input type="checkbox"/>		
		Acids	<input type="checkbox"/>		
		Batteries	<input type="checkbox"/>		
		Office paper, etc	<input type="checkbox"/>		
		Energy	Buildings, processes, boiler plant and plant distribution system	High temperatures	<input type="checkbox"/>
Lights left on	<input type="checkbox"/>				
Taps left running	<input type="checkbox"/>				
Doors left open	<input type="checkbox"/>				
Air leaks from compressor lines	<input type="checkbox"/>				
Heat loss through roof/doors/windows	<input type="checkbox"/>				
Money wasted through buying electricity, gas and water at high tariffs	<input type="checkbox"/>				
Discharge lamps beyond economic life	<input type="checkbox"/>				
Poorly controlled or inefficient heating/hot water systems	<input type="checkbox"/>				
Electric motors over five years old	<input type="checkbox"/>				
Process heat not re-used	<input type="checkbox"/>				
Water	Processes, toilets, kitchens			Urinals flushing continually	<input type="checkbox"/>
				Underground leaks	<input type="checkbox"/>
				Taps left running	<input type="checkbox"/>
		Wasteful wash-downs	<input type="checkbox"/>		
Other	Consumables	Detergents	<input type="checkbox"/>		
		Overalls	<input type="checkbox"/>		
		Gloves	<input type="checkbox"/>		

# OPPORTUNITY CHECKLIST

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Production	Melting, curing, baking, distilling, washing, coating, forming, machining	Washwater	<input type="checkbox"/>
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Sludge	<input type="checkbox"/>		
Drag-out from baths	<input type="checkbox"/>		
Packaging of dispatched goods	<input type="checkbox"/>		

- Demonstrate to senior management that waste reduction is an excellent cost-saving opportunity. Stress that it can also:
  - help the company comply with environmental legislation;
  - enhance product quality;
  - improve the efficiency of the whole business operation.

Strong personal commitment from senior management can:

- demonstrate visible leadership;
- encourage employee participation;
- set clear waste reduction targets;
- draw up an environmental policy statement to promote a company-wide waste-reduction programme;
- lead to including environmental information in the company's annual report.

## CHOOSING A CO-ORDINATOR

Someone from the staff should be selected to co-ordinate your waste reduction programme, since reducing waste in one area of the business may require action in other areas.

The co-ordinator needs three essential qualities:

- management seniority/authority or direct access to senior management;
- enthusiasm and the ability to motivate people;
- a working knowledge of waste management or a willingness to learn.

Depending on the type and size of your company, this person could be the Managing Director, Production Manager or Quality Manager.

The co-ordinator's main responsibilities are:

- co-ordinating waste segregation and measurement;
- identifying opportunities to prevent waste;
- locating priority action areas within the business;
- setting up waste reduction team(s);
- allocating the 'ownership of waste' to various departments or individuals;
- raising waste reduction awareness within the workplace;
- creating monitoring systems that provide regular feedback to both managers and the workforce - this is essential for success;
- working with suppliers to identify areas for materials reduction or recovery.

This may sound a lot of work, but remember that the co-ordinator's role is to **co-ordinate and facilitate**. It will be your waste reduction team, or teams, who will actually achieve the results.

If you have been chosen to be a programme co-ordinator, you may find it helpful to read Good Practice Guide (GG27) *Saving Money Through Waste Minimisation: Teams and Champions*. This Guide, which describes the role of team leader or 'champion' in more detail, is available free through the Environmental Helpline on 0800 585794.

The first task is to identify the main priority areas for action, in order to make a 'fast start' on the more obvious waste reduction opportunities.

As soon as a number of quick and cheap cost-saving measures have been implemented, they will provide you with evidence of the **real** benefits to your company - whether you supply products or services - of following a systematic approach to waste reduction.

## STEP 1 GATHERING AVAILABLE INFORMATION

To identify these 'fast starts', you need to obtain some information about your site and its activities. At this stage, concentrate on collecting information that is easily available.

### Key actions

- Walk round and review your site or, perhaps initially, just one or two areas.
- Where possible, write down the quantities and direct costs to the company associated with any 'wastes' that you can see. Fill in as much as you can of Worksheet 1 as you go round - you will find blank worksheets in the pocket inside the front cover and bound into the Guide after the Appendices. A fictitious example of a completed worksheet is shown in Fig 1.
- From Worksheet 1 identify **major** sources of waste material - such as packaging, lubricants, energy, water and rework.
- Don't be put off if information is in short supply. Where quantity/cost details are not available, make 'best' estimates or take simple measurements to provide approximate information. Alternatively, make a note to come back to the problem later.

### Tip

Try taking some photographs of waste and where it is being produced as you go round. They will indicate just how much waste there is now, and help for comparison with future improvements.



### Useful further actions

- When estimating costs, remember to go beyond the obvious, eg wasted material, and estimate consequential costs/values of wasted process time, handling and disposal costs.
- If possible at this stage, try to identify the main areas and quantities of energy, water and raw materials use. Then compare these values with the total use by the site or department. If there are major discrepancies, try to understand **why**. An unexplained use of energy, water or raw material may be one of your biggest sources of waste.

To make sure you have identified all the wastes, you may find it useful to read the first part of Section 3 and to go through the **process flowsheet** with a few key members of staff.



**Tip**

Good communication is essential to success. Involve people in reducing waste and tell them about successes.

These actions should help to highlight areas for improvement.

section  
2

<b>WORKSHEET 1</b> <b>OPPORTUNITIES FOR SAVING MONEY:</b> <b>MAJOR SOURCES OF WASTE</b>				
<b>NAME:</b> <i>B. Green</i>		<b>DATE:</b> <i>26/11/97</i>		<b>SHEET:</b> <i>1 of 1</i>
<b>Process or activity</b>	<b>Type of waste</b>	<b>Estimated amount of waste produced week/month/year*</b>	<b>Estimated cost including disposal, raw material purchase costs, utilities, added value/week/month/year*</b>	<b>Current waste reduction activities (if any)</b>
<i>Deliveries</i>	<i>Cardboard boxes</i>	<i>About 200 boxes/week (10 000/year)</i>	<i>£2 800/year</i>	<i>Compacting for disposal</i>
	<i>Wooden pallets</i>	<i>150/year broken of various sizes</i>	<i>£350/year</i>	<i>None</i>
<i>Process 1</i>	<i>Chipboard</i>	<i>5 tonnes off-cuts/week</i>	<i>£8 000/year</i>	<i>Incineration</i>
	<i>Wash-down water</i>	<i>20 000 litres/week 1 000 m<sup>3</sup>/year</i>	<i>£2 000/year</i>	<i>None</i>
<i>Process 2</i>	<i>Off-spec products (lost time and storage)</i>	<i>2.5%</i>	<i>£3 000/year</i>	<i>None</i>
	<i>Scrap metal (mixed)</i>	<i>20 tonnes/year</i>	<i>£18 000/year (£20 000 minus £2 000 scrap value)</i>	<i>Segregation and re-sale</i>
<i>Process 3</i>	<i>Oil leaks</i>	<i>150 litres/year</i>	<i>£500</i>	<i>None</i>
	<i>Sludge</i>	<i>600 litres/year</i>	<i>£300</i>	<i>None</i>
<b>NET ANNUAL COST</b>			<i>£34 950/year</i>	

\* Indicate timescale

**Fig 1 Completed Worksheet 1**

## STEP 2 IDENTIFYING PRIORITIES

The next stage is to generate some ideas for reducing major wastes to achieve immediate savings. Decide on your priorities to ensure some early successes.

- Find the major sources of waste from Worksheet 1.
- Identify the areas to look at first. These may be:
  - largest quantities going to waste, eg effluents or solid waste to landfill;
  - highest net costs, eg disposal costs, energy consumption, raw material wastage, off-spec products, packaging.
- Talk to the key staff involved in the activity producing the waste to understand why the waste is produced. Is it because:
  - no-one had seriously considered there was a problem?
  - an established practice may no longer be relevant?
- With the help of a waste reduction team and other staff, come up with ideas for preventing major wastes being generated. Simply asking staff for ideas can often be very useful. For some teams, informal 'brainstorming' sessions are the best way of generating ideas. If possible, estimate the savings you will achieve from the best ideas.

### Tip

Simple ideas are often most effective. The list of waste reduction prompts given in Appendix 1 may help stimulate ideas. You may also find it helpful to look at ET30 *Finding Hidden Profit - 200 Practical Tips for Reducing Waste*, available free through the Environmental Helpline on 0800 585794.

- Focus on a **few** major areas where:
  - the largest financial savings can be made;
  - there are practical ideas for making changes.

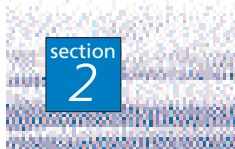
**In one day you should be able to identify actions with the potential to make immediate savings and put them in order of priority.**

## STEP 3 MAKING THE FIRST SAVINGS

To make your first savings:

- Make an action plan. Introduce some of the ideas for reducing waste that will produce immediate savings, based on your list of priority areas.
- Agree who is going to do what and by when. The 'cause and effect' method in Section 3 will help to show what the key actions are and who has to do them.
- Involve the 'front line'. Involve staff controlling operations that produce waste in defining aims and priorities, as well as allocating responsibility. This will help you obtain good results.

Now set the plan in motion, and remember to review progress against the plan's aims.



## STEP 4 MEASURING SAVINGS

To demonstrate that savings are being made, it is necessary to measure:

- Waste production.      **Examples**  
Skips per month.  
Bins per week.  
Effluent in m<sup>3</sup> per month.
- Raw material use.      How much do you order per month?  
How many consumables do you order per month, eg gloves, boxes of paper, oil, solvent?
- Utility use.      How much was your last bill?

Utility	Amount/month	Cost (£/month)
Gas	m <sup>3</sup>	£
Water	m <sup>3</sup>	£
Electricity	kWh	£
		<b>Total £</b>

As part of your action plan, you should make sure that simple measuring systems are in place. These must be both cost-effective and appropriate for your process. Decide on the level of measurement necessary to check on progress, and include regular checks in your plan.

Existing simple methods of obtaining the necessary information include:

- stock control information;
- installed meters for energy and water - are there enough meters to make sense of patterns of use in the site or department?

Carry out some simple checks such as:

- separating different types of important solid waste to allow you to measure waste simply by weight or volume;
- counting waste containers - which may be helpful for less important wastes, but is not as effective as weighing;
- timing how long it takes to fill a bucket and multiplying up the time to estimate continuous liquid flows over a day or week.

Record measurements and retain them for reference.

## STEP 5 ACHIEVING MORE SAVINGS

After a few months, progress reviews will provide concrete evidence that waste reduction is really worth the commitment and effort. Take some more photographs to record any visible changes.

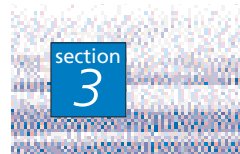
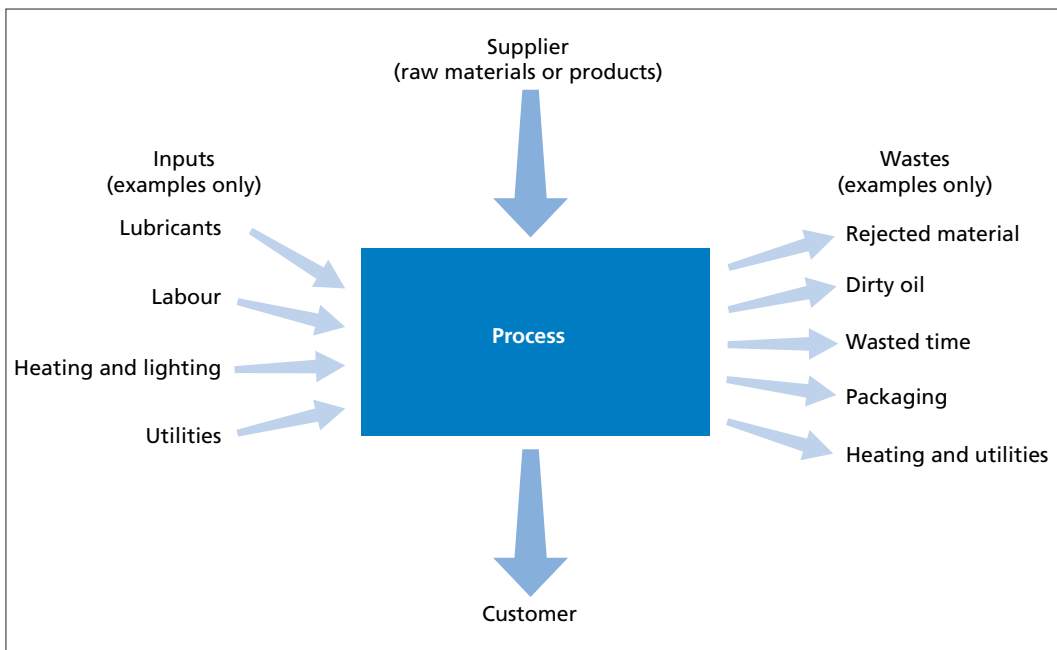
Use this evidence to convince management and employees that a full-blown waste reduction programme will be worthwhile for your company.

# KEY TECHNIQUES FOR MEASURING YOUR WASTES AND QUANTIFYING THEIR REAL COSTS

The two key techniques and key advice below will help you make quick savings and will also help you develop a systematic approach for sustained long-term savings.

## KEY TECHNIQUE 1 - USING A PROCESS FLOWSHEET

A **process** is any task or operation that you do to prepare a product or to deliver a service. A generalised model of a process is shown in Fig 2.



**Fig 2 Generalised process model**

Each step of a process adds value to a product and incurs a **cost** from the labour, materials and utilities (gas, water, electricity, compressed air, etc) used in that process.

The true cost of waste includes the cost of wasted resources and the cost of rejects at each stage in the process. The cost of rejects includes the value added to the material by the time it is rejected. This means that the cost of rejects increases as the material progresses towards the final product.

You will find it helpful to put information into a **process flowsheet** to help identify and track waste. We will call this process flowsheet a **'waste tracking model'**.

### How to use the waste tracking model to identify costs

First consider your business operation as a series of separate processes. Each internal process (see Fig 3) is considered to have its own individual inputs, outputs and waste. Those areas which are outside your area of *direct* control are suppliers and customers. **Fill in a blank process and waste flowsheet (Worksheet 3) for your own process(es).** You will find blank worksheets in the pocket inside the front cover and bound into the Guide after the Appendices.

Now fill in a copy of **Worksheet 2** for each of your identified processes within your manufacturing or service unit. Add up the total costs to give the overall cost of waste to your business. A fictitious completed version of Worksheet 2 is shown in Fig 4.

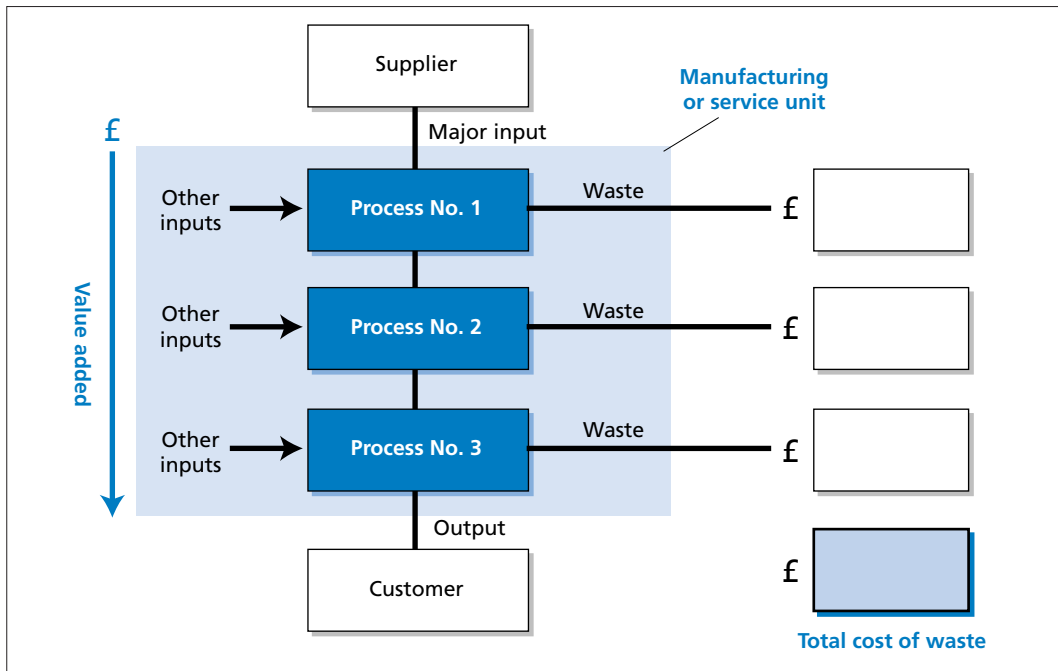


Fig 3 The waste tracking model (use in conjunction with Worksheet 3)

**Company process**

Supplier

Goods reception

Storage

Heat treatment

Cleaning

Assembly

Packaging and dispatch

Customer

**WORKSHEET 2  
IDENTIFYING WASTE USING  
THE WASTE TRACKING MODEL**

**NAME:** *Andy Smith*      **DATE:** *12/12/97*      **SHEET:** *1 of 1*

**PROCESS DESCRIPTION:** *Heat treatment*

**Supplier/Input:** *Storage*

Resource/ Material/Utility (from Worksheet 3 Ref no. ....)	Quantity Wasted	Monthly Cost (including purchase and disposal)
<i>Processed steel</i>	<i>8 tonnes/month</i>	<i>£8 000*</i>
<i>Lubricants</i>	<i>80 litres/month</i>	<i>£180</i>
<i>Electricity</i>	<i>10 000 kWh/month</i>	<i>£650</i>
<i>Gas</i>	<i>20 000 kWh/month</i>	<i>£210</i>
<i>Water</i>	<i>approx 150 000 litres/month</i>	<i>£176</i>
<i>Off-spec product</i>	<i>—</i>	<i>—</i>
<i>Labour at changeovers</i>	<i>1½ hours x 25/month</i>	<i>to be costed</i>
<i>Overalls</i>	<i>7 per month</i>	<i>£56</i>
<i>Cleaning materials</i>		<i>£8</i>
<b>TOTAL</b>		<b><i>£9 280</i></b>

**Customer:**  
(or next process) *Cleaning*

\* including income from recycling

Fig 4 Completed Worksheet 2

If the information you need is not available, either make a 'best' guess or carry out some simple measurements. At the same time, decide whether improved information collection is justified.

You should now have a good picture of the 'waste cost' basis of your business. Bring together all the details obtained during the waste tracking exercise and see if there are any discrepancies in overall values, ie between *identified* and *total actual* water use, and raw material and energy consumption. Dig deeper if there are major discrepancies. They may represent a major cost - and a major savings opportunity!

## KEY TECHNIQUE 2 - USING THE 'CAUSE AND EFFECT' METHOD

A 'cause and effect' diagram (see Fig 5) can be used to identify opportunities for eliminating waste within each process.

'Cause and effect' diagrams are useful when you need to identify the possible causes of a problem in a structured manner. For each effect (ie 'too much process waste' in Fig 5) there are likely to be several causes.

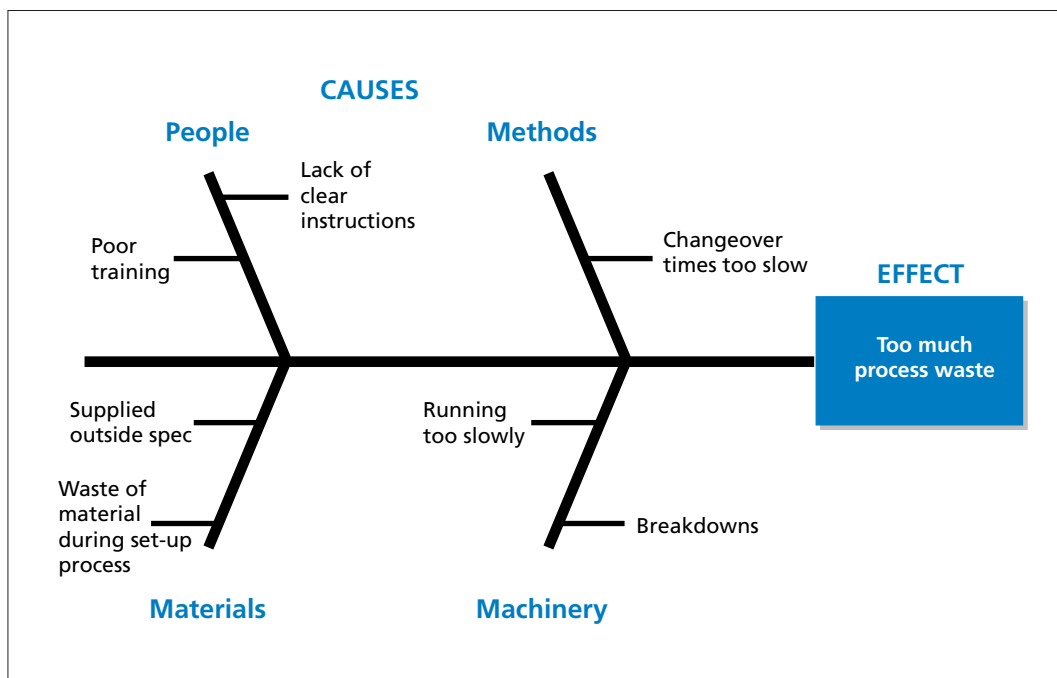
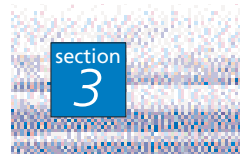


Fig 5 'Cause and effect' diagram

In manufacturing industry, the key causes are:

- people;
- methods;
- materials;
- machinery.

Why is the waste generated? Remember to look for ways to cure the cause, or causes, of the problem and not just the symptoms.

'Cause and effect' diagrams are a standard tool for quality improvement. The best recipe for success is to:

- ask the people who work on the process to suggest reasons (without recrimination) for the problem;
- list their suggestions against each cause;
- involve everyone in the development of solutions;
- implement no-cost measures as soon as possible.

## Generating ideas

When considering ways to reduce waste generation and utility consumption, start with the 'bigger' issues and then work down to smaller problems.

- Challenge existing practices. Ask **why** things are done in a particular way.
- Draw up a shortlist of options for improving performance, in conjunction with the key staff in each department/unit. Select those options that emphasise cost saving and efficiency.
- Assess possible savings.
- Consider the practicality and timescale for making the necessary changes.
- Where possible, allocate responsibility to staff in each department/unit for assessing and recommending opportunities. This encourages 'ownership' of the solution.

At this point, take another look through the list of waste reduction prompts in Appendix 1. Does anything on the list strike a chord? You may come across further ideas in ET30 *Finding Hidden Profit - 200 Practical Tips for Reducing Waste*. This collection of wastebusting tips covers:

- invisible losses;
- waste and materials management;
- material handling;
- process control and management;
- examples from specific industrial sectors showing how to reduce process losses.

To obtain a free copy of ET30, contact the Environmental Helpline on 0800 585794.

For the best long-term benefits, **look** for solutions in the following order:

- **Waste prevention.** This may involve a fundamental change in process, operation, product or raw material, so that the basic process produces less waste.
- **Waste reduction.** This may mean streamlining processes, better housekeeping and low-cost changes to avoid unnecessary waste from the existing process.
- **Waste re-use/recycle.** This is about getting value from waste materials that otherwise would have a disposal cost. It is more cost-effective to limit the production of waste in the first place.

Implementing changes outside your direct control may require discussions with other departments to ensure that the proposals conform with company strategy.

Improving the efficiency of your production methods may mean changing the way products are made. Remember to ensure that product quality is maintained.

### Key advice

To manage waste effectively and pinpoint where savings can be made, you must identify:

- all the different types of waste produced by each of your company's activities;
- the stage in the process at which they are produced.

Remember, the 'product' in a service company is the service your company provides. The 'process' is the series of steps you take in providing the service.

### Important considerations

- Consider your business operations as a number of separate processes, such as:
  - receipt/dispatch;
  - fabrication;
  - paint shop;
  - stores;
  - offices.
- Consider all forms of wastage. This means:
  - identifying where and why wastes arise;
  - monitoring utility consumption in different areas and identifying users of gas, water and electricity.
- Consider installing more meters, but only where the cost is justified by the potential benefits. As a rule of thumb, savings will be 5%, 10% and 20% of the amount of electricity, gas and water respectively that would register annually on the new meters.
- Pin down waste generation and utility use to individual processes/ departments. This is not to allocate 'blame', but to see where opportunities exist for reducing waste.
- Consider the time of day when wastes arise. Is waste production related to machine changeover, process cycles, startup/shutdown, etc?

Talk to operators of equipment and the people actually carrying out the process. Encourage 'ownership' of waste - this makes it easier to collect information. At this stage, information will probably be collected by several key employees and not just the programme co-ordinator.

A successful waste reduction programme changes people's attitudes to waste. They come to realise that the true cost of waste includes conversion and rework costs, in addition to material and disposal costs. **Everyone** within the company must appreciate that waste is a measure of operational efficiency that has a direct impact on the profitability, survival and growth of the business.

As you worked through Section 2, you will have made some early savings and begun to develop the attitude your company needs to build upon these achievements.

A more detailed systematic approach to waste reduction is discussed in a series of three complementary Guides, available free through the Environmental Helpline on 0800 585794.

- *Saving Money Through Waste Minimisation: Raw Material Use (GG25)*
- *Saving Money Through Waste Minimisation: Reducing Water Use (GG26)*
- *Saving Money Through Waste Minimisation: Teams and Champions (GG27)*

This systematic approach to waste reduction involves the same basic principles outlined in Section 2. To achieve even greater savings and lasting benefits for your company, these principles have to be applied more thoroughly:

- Step 1 Measuring your wastes and counting their real costs.
- Step 2 Solving problems by a 'cause and effect' method.
- Step 3 Identifying priorities for action.
- Step 4 Implementing change.
- Step 5 Measuring benefits.
- Step 6 Reviewing progress.

For further free help or advice on implementing a waste reduction programme, call the Environmental Helpline on 0800 585794.

The Environmental Helpline can:

- answer your queries about environmental issues, legislation or technology - up to two hours per query;
- tell you about waste minimisation clubs and workshops;
- send you copies of relevant Environmental Technology Best Practice Programme publications, including free Guides and Case Studies on cost-effective ways to reduce waste at source;
- suggest other sources of information;
- arrange for a specialist to contact your company.

For smaller companies, the Helpline offers a **free half-day counselling visit**. For details contact the Environmental Helpline on freephone 0800 585794.

## WASTE REDUCTION PROMPTS

- Product design**
- Design products to minimise waste and assembly costs.
  - Maximise the potential for re-use or recycling of waste material by avoiding adhesives or other contaminants.
- Raw materials selection**
- Discuss with your suppliers how to choose materials to minimise waste or facilitate the re-use or recycling of waste.
  - Are materials used over-specified, eg could a lighter grade of material or packaging be used?
  - Use recycled materials if practicable and if the cost compares favourably with virgin material.
  - Are any potentially hazardous materials used? Could these be substituted to cut costs of handling/storage/disposal?
- Packaging**
- Can packaging be reduced or eliminated? Could the packaging received from suppliers be re-used?
  - Could you use waste from other parts of the business, eg office waste, paper shredding, for infill to packaging?
  - Draw a diagram of the packaging cycle and identify areas for re-usable packaging.
  - Discuss returnability of incoming packaging with your suppliers.
- Process design and operation**
- (a) Part cleaning*
- Enclose all solvent cleaning units.
  - Use refrigerated freeboard on vapour degreasing units.
  - Improve parts draining before and after cleaning.
  - Use mechanical cleaning devices.
  - Use plastic bead blasting.
- (b) Surface finishing*
- Prolong process life by removing contaminants.
  - Redesign parts racks to reduce drag-out.
  - Re-use rinsewater.
  - Install spray or fog nozzle rinse systems.
  - Design and operate all rinse tanks correctly.
  - Install drag-out recovery tanks.
  - Install rinsewater flow control valves.
  - Install drip racks and drain boards.



(c) *Surface coating*

- Use high-volume low-pressure spray guns.
- Use electrostatic spray coating systems.
- Control coating viscosity with heat units.
- Use powder coatings.
- Use high solids coatings.

(d) *Equipment cleaning*

- Use high pressure rinse systems.
- Use mechanical wipers.
- Use a countercurrent rinse sequence.
- Re-use spent rinse water.
- Use 'pigs' to clean lines.
- Use compressed gas to blow out lines.

(e) *Spills/leaks*

- Use bellows-sealed valves.
- Install spill basins or bunds.
- Use seal-less pumps.
- Maximise use of welded pipe joints.
- Install splash guards and drip boards.
- Install overflow control devices.

(f) *Maintenance*

- Purify and re-use coolant on machine tools.
- Rationalise uses of lubricating oils to extend oil change times and cut quantities stored.

**Water use and discharge**

- Evaluate water charges, and sewerage and effluent disposal costs to determine weekly/daily figures.
- Locate and cure any leaks.
- Use manual spray guns to control wash-down use.
- Examine potential for re-use of water, eg wash-downs.
- Can effluent be economically treated on-site to reduce disposal charges? Is there scope for sharing treatment facilities with adjacent businesses?
- Fit an occupancy control if you have urinals flushing round the clock.

**Energy management**

- Measure energy used in the manufacturing process.
- What does your energy cost? Check that tariffs are appropriate.
- How much energy are you consuming? How does it vary?
- Measure your performance on a routine basis.
- Survey the heating system to check the efficiency of:
  - boiler;
  - pipe insulation;
  - control system for time/temperatures.



- Are heating methods effective and appropriate?
  - Check lighting systems for:
    - cleanliness (lamps/fittings/roof lights);
    - lights left on unnecessarily;
    - age and condition of lamps;
    - controls (local switches/detectors).
  - Check insulation (walls, roof, windows, doors).
  - Assess energy use in processes together with overall process and waste arisings.
- Waste management**
- Segregate wastes to facilitate recycling or to enable sale of materials that could become another company's raw material.
  - Segregate and re-use or recycle waste solvents.
  - Use filter presses to dewater sludge where metals can be recovered.
- Transport and distribution**
- Control company cars to obtain most economical running costs.
  - Share vehicles.
  - Limit engine size of company vehicles.
  - Maintain vehicles properly.
  - Control your own commercial vehicles.
  - Fit spoilers.
  - Train drivers in economical driving methods.
  - Optimise vehicle routing.
- Support activities**
- Optimise procedures to save paper.
  - Segregate waste paper.
  - Re-use or recycle waste paper.



# INVENTORY MANAGEMENT

Proper control of raw materials, intermediate products, final products and waste streams is an important waste reduction technique. Inadequate inventory control leads to two major sources of waste, out-of-date and no-longer-used raw materials. Inventory controls range from simple changes in ordering procedures to implementing just-in-time manufacturing techniques.

- Can your company reduce waste by tightening up and extending its existing inventory control programmes?

Buying only the amount of raw material needed for a production run or a set period of time is one of the keys to improved inventory control. Excess inventory often has to be disposed of because it goes out-of-date. You should therefore:

- make sure inventory management procedures are applied;
- educate staff in the purchasing department about the problems and costs of disposing of excess materials;
- examine specified expiry dates (especially for stable compounds) to see if they are too short.

The development of review procedures for all purchased materials is another important aspect of inventory control. Your company's standard procedures should require all materials to be approved prior to purchase.

- Check whether a raw material contains any hazardous constituents, and if so, whether suitable non-hazardous substitutes are available.
- Make sure your chemical supplier sends you the relevant Material Safety Data Sheets.

'Just-in-time manufacturing' is the ultimate in inventory control since it eliminates the need for an inventory. Raw materials are moved directly from the receiving dock to the manufacturing area for immediate use. The final product is then shipped out without any intermediate storage. Just-in-time manufacturing is a complex operation and is not applicable to all businesses. However, it can reduce waste significantly.

**WORKSHEET 1**  
**OPPORTUNITIES FOR SAVING MONEY:**  
**MAJOR SOURCES OF WASTE**

<b>NAME:</b>		<b>DATE:</b>	<b>SHEET:    of</b>	
Process or activity	Type of waste	Estimated amount of waste produced week/month/year*	Estimated cost including disposal, raw material purchase costs, utilities, added value/week/month/year*	Current waste reduction activities (if any)
<b>NET ANNUAL COST</b>				

*\*Indicate timescale*

Please photocopy this worksheet.



**WORKSHEET 3**  
**PROCESS AND WASTE FLOWSHEET**  
(See Fig 3 in text) Ref no. ....

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**Input quantities**

**Inputs**

**Waste and quantities/costs**

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**Process name**

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**Process name**

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**Process name**

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**To customer or next flowsheet**

Please photocopy this worksheet.

# OPPORTUNITY CHECKLIST

Department	Area	Possible waste	
Incoming materials	Loading docks, pipelines, receiving areas	Packaging/containers	<input type="checkbox"/>
		Off-spec deliveries	<input type="checkbox"/>
		Damaged containers	<input type="checkbox"/>
		Spill residue	<input type="checkbox"/>
		Cleaning rags, etc	<input type="checkbox"/>
		Pallets (non-returnable)	<input type="checkbox"/>
		Gloves, overalls, etc	<input type="checkbox"/>
Storage (raw materials, parts, final products)	Tanks, silos, warehouse, drum storage, yards, storerooms	Tank bottoms	<input type="checkbox"/>
		Off-spec materials	<input type="checkbox"/>
		Excess materials	<input type="checkbox"/>
		Damaged containers	<input type="checkbox"/>
		Empty containers	<input type="checkbox"/>
		Leaks from pumps/valves/pipes	<input type="checkbox"/>
		Out-of-date materials	<input type="checkbox"/>
		No-longer-used materials	<input type="checkbox"/>
		Damaged products	<input type="checkbox"/>
Production	Melting, curing, baking, distilling, washing, coating, forming, machining	Washwater	<input type="checkbox"/>
		Solvents evaporating	<input type="checkbox"/>
		Still bottoms in tanks	<input type="checkbox"/>
		Off-spec product rejects	<input type="checkbox"/>
		Catalysts	<input type="checkbox"/>
		Empty containers	<input type="checkbox"/>
		Sweepings	<input type="checkbox"/>
		Ductwork clearout	<input type="checkbox"/>
		Additives	<input type="checkbox"/>
		Oil	<input type="checkbox"/>
		Process solution dumps	<input type="checkbox"/>
		Rinsewater	<input type="checkbox"/>
		Excess materials	<input type="checkbox"/>
		Filters	<input type="checkbox"/>
		Leaks from tanks/pipes/valves	<input type="checkbox"/>
		Spill residue	<input type="checkbox"/>
		Swarf/off-cuts	<input type="checkbox"/>
Sludge	<input type="checkbox"/>		
Drag-out from baths	<input type="checkbox"/>		
Packaging of dispatched goods	<input type="checkbox"/>		

Please photocopy this checklist.

Support services	Laboratories, maintenance shops, garages, offices	Chemicals	<input type="checkbox"/>
		Samples and containers	<input type="checkbox"/>
		Solvents	<input type="checkbox"/>
		Cleaning agents	<input type="checkbox"/>
		Degreasing sludges	<input type="checkbox"/>
		Sand blasting waste	<input type="checkbox"/>
		Lubricating oils and greases	<input type="checkbox"/>
		Scrap metal	<input type="checkbox"/>
		Caustics	<input type="checkbox"/>
		Filters	<input type="checkbox"/>
		Acids	<input type="checkbox"/>
		Batteries	<input type="checkbox"/>
		Office paper, etc	<input type="checkbox"/>
Energy	Buildings, processes, boiler plant and plant distribution system	High temperatures	<input type="checkbox"/>
		Lights left on	<input type="checkbox"/>
		Taps left running	<input type="checkbox"/>
		Doors left open	<input type="checkbox"/>
		Air leaks from compressor lines	<input type="checkbox"/>
		Heat loss through roof/doors/windows	<input type="checkbox"/>
		Money wasted through buying electricity, gas and water at high tariffs	<input type="checkbox"/>
		Discharge lamps beyond economic life	<input type="checkbox"/>
		Poorly controlled or inefficient heating/hot water systems	<input type="checkbox"/>
		Electric motors over five years old	<input type="checkbox"/>
		Process heat not re-used	<input type="checkbox"/>
		Water	Processes, toilets, kitchens
Underground leaks	<input type="checkbox"/>		
Taps left running	<input type="checkbox"/>		
Wasteful wash-downs	<input type="checkbox"/>		
Other	Consumables	Detergents	<input type="checkbox"/>
		Overalls	<input type="checkbox"/>
		Gloves	<input type="checkbox"/>

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**To customer or**

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Waste and  
quantities/costs

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next flowsheet

