



Energy and Sustainability Topics – Waste minimisation in plastics processing

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Part 1: The business reasons

Waste is estimated to cost UK industry at least £15 billion/year – or some 4.5% of total turnover. In most companies the cost of waste could be reduced by 1% through the implementation of a simple but formal waste minimisation programme. This series is designed to help reduce your waste costs by introducing the tools and techniques of waste minimisation. Effective waste management cuts costs and raises profits. Even when investment is required, the payback period is generally short and the returns can be high.

“Cut waste, and you will boost profit. Money saved from waste minimisation goes straight to the bottom line.”

There are five important reasons for starting a waste minimisation programme are:

1. Waste costs real money

Waste is costing you real money and this is coming directly off your profits. The box below will give an initial estimate of the basic and total cost of waste. At a gross margin of 7%, a reduction in waste costs by 1% is the equivalent of increasing turnover by over 14%. Internal effort spent in waste minimisation can produce benefits equivalent to substantially increased sales.

The potential benefits	
Calculate your potential savings based on raw materials losses:	
Amount of main raw material used last year, e.g., tonnes	A
Amount of product produced last year, e.g., parts	B
Amount of main raw material/unit of product, e.g., polymer/part	C
Quantity of main raw material in parts last year = (B x C)	D
Wasted main raw material = (A – D)	E
Purchase cost of main raw material	F
Cost of wasted raw material = (E x F)	G
The calculations above only show the visible purchase cost of wasted raw material. The true and total cost will also include wasted production costs, labour, storage etc. Consideration of all areas of waste will give a much higher figure. Calculate your potential savings based on a cost reduction of 1% of turnover:	
1% of turnover	£
Profit margin as % of turnover	%
Turnover last year	£
Potential saving = turnover ÷ 100	£

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2. The true costs are hidden

The numbers from the box show that there is a difference between the visible and the true cost of waste. Waste costs are either direct or indirect. Direct costs are visible and include waste collection and disposal costs. The bulk of the waste costs are indirect and hidden. They make up the largest portion of the total waste costs in any business and include:

- Raw material costs.
- Energy consumption.
- Water consumption.
- Effluent generation.
- Packaging.
- Factory & office consumables.
- Wasted time and effort.

These costs are hidden in the accounts and are not shown as separate items, but they exist even for efficient companies. They arise whether you like it or not, and are significant whether you realise it or not. Some companies have found their waste costs were over 20 times higher than they thought and under-estimating such costs is very common.

3. Good investment returns

Cost-effective waste minimisation is a valuable investment that pays dividends for any company. Large savings can be made from small capital spending and money spent on waste minimisation is a sound investment. Waste minimisation has the potential to save a significant amount of money for any manufacturing company.

4. Protecting your image

Customers, employees and investors all have a growing interest in environmental performance, waste minimisation shows how effectively and efficiently you control operations.

Customers are increasingly asking for evidence of good environmental performance. Waste minimisation proves this commitment and is a key part of environmental management. Employees know where materials and resources are being wasted and can see the cost benefits that will make the company more competitive and safeguard their future. For companies involved in waste minimisation, increased employee satisfaction was among the top five benefits of the process.

Investors want the highest possible return on capital and high dividend growth and banks want to see efficient use of borrowed capital. Waste minimisation can help to deliver both of these requirements.

5. The legal requirements

Companies – and key directors and managers – can face stiff penalties for failing to comply with environmental legislation, which gets tougher year by year. Effective waste minimisation helps to prove conformance with existing laws and to save rapid, disruptive and expensive changes to keep within the law in future.

6. The way ahead

The benefits of minimising waste come only from action. To reap the benefits, start to work on your own action plan based on the following:

- Establish a firm Board level commitment for waste minimisation.
- Appoint a part-time waste minimisation 'Champion' to establish the true cost of waste and to motivate the workforce.

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- Produce regular financial one-line reports on the cost of waste collection and disposal and on the total cost of waste
- Inform suppliers of your commitment and guide them to sources of help.

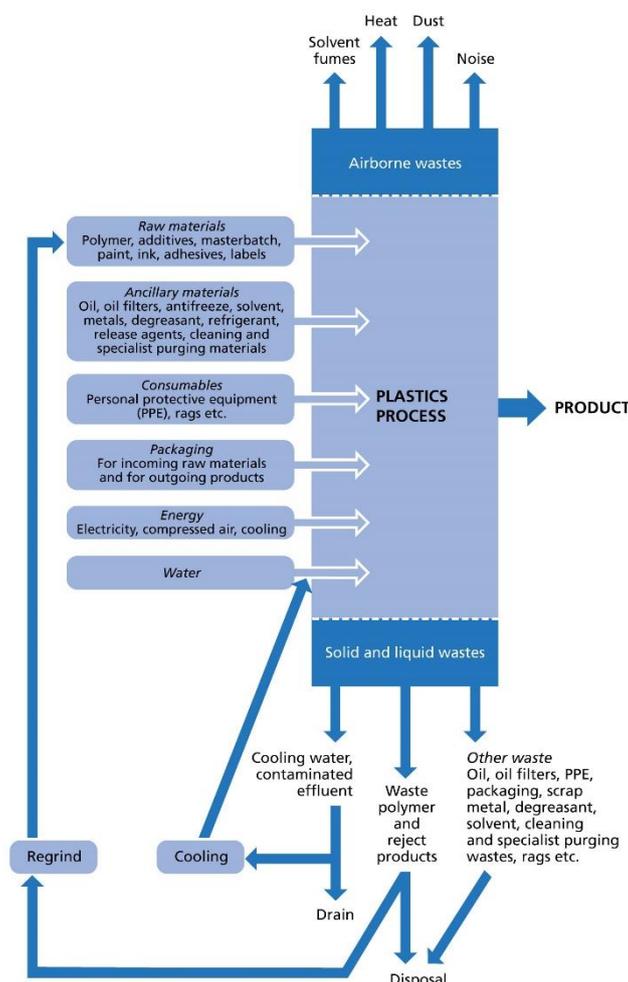
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Part 2: The Waste Walk-Around

Waste is all around your business and some companies put up signs declaring “STOP WASTE”. This is treats us all unfairly because most people would stop waste if only they knew where to look. The signs should really read “FIND WASTE” because only after finding waste can you really start to stop it.

The first step in your waste minimisation programme is to start to find the waste in your business and the best tool for this is to carry out a waste walk-around. The objective is to gain an overview of the processes and to identify some rapid no-cost or low-cost improvements that can be made to save money.

The survey should be carried out as soon as possible – waste is happening now and it is costing you money now. Take an unannounced walk around the site at mid-shift. If there is no night shift it can also be profitable to take a walk around the factory when there is no production being carried out. Always look in your skips - it is an excellent starter for locating waste!



Typical inputs and outputs in plastics processing

1. Simple no-cost and low-cost money saving ideas

Eliminate, reduce, re-use, recycle

The waste 'hierarchy' is most important: first eliminate the source of waste, then reduce the amount, then re-use any waste that does arise, then recycle the waste and only when these have been eliminated should we dispose of the waste.

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- Identify the various waste streams produced on-site. The diagram gives an outline of the typical inputs and outputs during plastics processing as guidance.
- Optimise waste segregation and recycling to minimise the amount of waste requiring disposal.
- Avoid contaminating waste polymer as this lowers its value.
- Estimate the true cost of waste. For example, the cost of waste polymer is not just the disposal cost, but includes the purchase cost of the polymer and the embodied processing costs.

Materials management

- Avoid spills by improving storage and polymer handling techniques.
- Record polymer utilisation wherever possible and track any variations.
- Monitor how much polymer has to be reground and how much is returned from your contract recycler.
- Review product design. Could less polymer be used? Could waste polymer, e.g. in sprues, be reduced? Could a cheaper polymer be used?
- Minimise the need for polymer recovery, regrinding and re-use. Apart from the additional processing, transport and administration costs, converting the recovered polymer into saleable product occupies process time that could be used to make more product.
- Plan production to minimise changeover losses.
- Establish total material loss over a given period. Compare this with the utilisation rate to find the relative importance of process and material handling losses.

Packaging

- Re-use any packaging for your products, where appropriate.
- Discuss ways of minimising packaging use with both suppliers and customers.

Water

- Make everyone is aware of water costs.
- Remind everyone to turn off taps.
- Repair all dripping taps as soon as possible.
- Check for leaks in the water system.
- Make sure hot water is not above 60°C.
- Make someone responsible for switching off hot water heaters before holidays.
- Check that your hot water control system is set properly (stop heating one hour before the end of daily work).
- Fit time switches to immersion heaters.
- Fit flush controls to urinal systems in all men's toilets.
- Fit trigger controls to hosepipes.

Utility management

- Implement no-cost and low-cost methods of improving energy efficiency. For example, insulating jackets on heated moulds can reduce energy losses and improve safety. Failure to manage energy is a waste of energy.
- Review hydraulic oil purchase, storage, handling and disposal procedures.
- Consider the benefits to oil lifetime of installing bypass filters in all hydraulic equipment.

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Other measures

- Ensure machines are suitable for the processes being carried out, set-up to obtain optimum polymer and energy consumption, and maintained regularly.
- Ensure employees are trained and understand the effects of their actions. Employees are vital to the success of waste segregation. Employees also need to be made aware that, while regrinding waste polymer saves the company money, it does mean additional costs.

2. Your Action Plan

- Once you are looking for waste, your walk-around should have identified some obvious areas for improvement. You can now make some 'fast starts' to reduce waste in these areas.
- Monitor the amount of polymer used on each machine, how much is reground and how much is sent off-site for reprocessing or final disposal. Monitor utility and packaging usage.
- Find out where and why waste polymer is being generated by your process. Getting it 'Right First Time' is the easiest way of increasing your profits.
- Record your starting position and publicise improvements to both motivate employees and maintain commitment for the initiative from senior management.
- If you don't measure, you can't manage.

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Part 3: Assessing performance

A formal waste minimisation programme can save you up to 1% of turnover (or more than 10% of profit) from effective and low-cost waste minimisation efforts. These gains are substantial and you should be doing something about it?

To find out your current costs and performance, use the tables below to calculate your specific costs. The information you need should be easy to obtain:

- Use accounts records of purchased material and invoices for contract recycling, waste disposal, etc.
- Use production records to find out how much polymer is used, rather than how much is ordered and delivered.
- Use waste transfer notes (a legal requirement) to find out how much solid waste has left the site. You may have to estimate the waste polymer percentage if you do not segregate your wastes.
- Companies or suppliers covered by the packaging waste regulations will already have data on packaging use.

“If you don’t measure it then you can’t manage it.”

1. Polymer use

Identify your three main polymers, group the rest under ‘Others’ and complete the first table:

Polymer use			
Polymer	Amount used (tonnes / year)	Cost (£ / tonne)	Annual cost (£)
1.			
2.			
3.			
Other			
Total polymer use	A	B	C

2. Cost of polymer waste

Complete this table to determine the cost of waste polymer:

Cost of polymer waste			
Polymer Waste Route	Amount (tonnes / year)	Cost (£ / tonne)	Annual cost (£)
1. Waste/rejects reground on site.			

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2. To contract recycler.			
3. Loss in value of polymer sold as scrap.			
4. Sent for final disposal.			
Total polymer waste:	D	E	F

Waste reground on site

The cost of regrinding is about 5% of the polymer cost. This includes rejects, trimmings, etc which are reground. Some of these wastes may not be measured and may be hidden.

Waste reground by contractor

You may use a contractor to regrind. This can be cost-effective, but it is useful to examine the full financial case.

Loss from polymer sold as scrap

Sending polymer for scrap will reduce the value by at least 50%. Any income from scrap represents, at best, a corresponding loss of revenue to the same sum. Fill in the amount received for your scrap as the value lost will be at least this.

Polymer sent for disposal

This may include items such as purgings which require specialist regrinding, or items which have become contaminated with oil or dust.

If your waste costs are high, then change the disposal route to maximise the value, e.g. use a contract regrinder or regrind in-house rather than selling as scrap.

3. First pass polymer waste

Calculate your first-pass polymer waste rate.

First-pass polymer waste	
$\text{Waste percentage} = \frac{\text{Total polymer waste (D)} \times 100}{\text{Total polymer used (A)}}$	%

Is your site better or worse than the industry average of 10.5%?

This means that industry average first pass polymer utilisation rate was only 89.5%. This may seem acceptable but it is not just the cost of the polymer that is lost or recycled. There will also be associated losses in direct and additional labour, overhead costs such as energy, consumables and the simple costs of recycling. A steady FTY of 90% therefore costs around 1.4% of turnover (equal to nearly 15% of profits) in the short term and in the long-term costs 4% of turnover or nearly 50% of typical profits. First-pass polymer waste has a large and direct impact on profitability!

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4. Cost of general waste disposal

Calculate the cost of general waste from the final part of the table:

Cost of general waste disposal			
General Waste Route	Amount (tonnes / year)	Cost (£ / tonne)	Annual cost (£)
Disposal charges e.g., skip lifts.			
Less income from segregated waste.			
Total general waste (tonnes):	G	H	I

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Part 4: Improving performance

The success of waste minimisation depends on the active support of the Managing Director and other senior managers. Senior management can:

- Demonstrate visible leadership.
- Encourage employee participation.
- Set clear waste minimisation targets.
- Promote a company-wide policy on environmental affairs.

1. Choosing a co-ordinator

A waste minimisation co-ordinator is needed because reducing waste in one area of the business may require action in other areas. The co-ordinator needs three essential qualities:

- Management authority or direct access to senior management.
- Enthusiasm and ability to motivate people.
- A working knowledge of waste management or a willingness to learn.

The waste minimisation co-ordinator is not necessarily a 'full time job and could be the Managing Director, Production or Quality Manager.

The main responsibilities are:

- Co-ordinating waste segregation and measurement.
- Identifying opportunities to prevent waste.
- Locating priority action areas.
- Setting up waste reduction teams.
- Allocating 'ownership of waste'.
- Raising waste reduction awareness.
- Creating monitoring systems for 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 the role is to co-ordinate and facilitate. It will be the waste minimisation team, or teams, who will actually achieve the results.

2. Making 'fast starts'

In order to make 'fast starts' on obvious waste reduction opportunities, the first task is to identify the priority areas for action. Implementing some quick and cheap cost-saving measures will provide evidence of the real benefits to the company of following a systematic approach.

Gather available information

To identify the 'fast starts', you need to obtain information about your site and its activities. Concentrate on collecting information that is easily available.

Key actions

- Walk round and review the site.
- Write down the quantities and direct costs of the 'wastes' that you can see. Identify major sources of waste - such as packaging, lubricants, energy, water and rework.
- Don't worry if information is not available. Make some 'best' estimates or take simple

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measurements to provide approximate information.

- **Tip:** Take photographs of waste and where it is being produced. These will show much waste there is, and help for comparison with future improvements.

Useful further actions

- When estimating costs, remember to go beyond the obvious, e.g., wasted material. Estimate the consequential costs of wasted process time, handling etc.
- Try to identify the main areas and quantities of energy, water and raw materials use. Compare these values with the total use. If there are major discrepancies, try to find out why. The unexplained use of energy, water or raw material may be one of the biggest sources of waste!
- **Tip:** Good communication is essential to success. Involve people in reducing waste and tell them about the successes.

To make sure all the wastes have been identified use a process flowsheet (see Part 5) and go through the process with a key staff.

These actions should help to highlight areas for improvement.

Identifying priorities

Generate some ideas for reducing major wastes to achieve immediate savings. Decide on the priorities to ensure some early successes.

- Find the major sources of waste.
- Identify the priority areas. These may be the largest quantities, e.g., effluents or solid waste to landfill or the highest net costs, e.g., disposal costs, energy consumption, raw material wastage.
- Talk to the staff involved in the activity producing the waste to understand why it is produced. Is it because no-one had seriously considered there was a problem or because it is an established practice may no longer be relevant?
- Use a waste reduction team or other staff to come up with ideas for preventing major wastes. Simply asking staff for ideas can often be very useful. Informal 'brainstorming' sessions are the best way of generating ideas. Estimate the savings you will achieve from the best ideas.
- Focus on a few major areas with the largest financial savings and where there are practical ideas for making changes.

In one day, you should be able to identify potential actions to make 'fast start' savings and put them in order of priority.

Making the first savings

To make your first savings:

- Make an action plan.
- Agree who is going to do what and by when.
- Involve the 'front line' staff controlling operations that produce waste to define aims and priorities, as well as to allocate responsibility.
- Set the plan in motion, and review progress against the plan's aims.
- **Tip:** Simple ideas are often most effective.

Measuring savings

To demonstrate savings, it is necessary to measure:

- Waste production, e.g., skips per month.
- Raw material use, e.g., orders per month

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- Utility use, e.g., what was the last bill?

As part of the action plan, make sure that simple measuring systems are in place. These should be both cost-effective and appropriate. Decide on the measurement level necessary to check progress, and include regular checks in the plan. Use simple information gathering methods such as:

- Stock control information.
- Installed meters for energy and water.
- Separating different types of important solid waste to measure waste simply by weight or volume.
- Counting waste containers - helpful for less important wastes, but 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 these measurements for reference.

Achieving more savings

Progress reviews will provide evidence that waste reduction is worth the commitment and effort.

- Tip: Take some more photographs to record any visible changes.

Use this evidence to convince management and employees that a waste reduction programme is profitable and extend the operations.

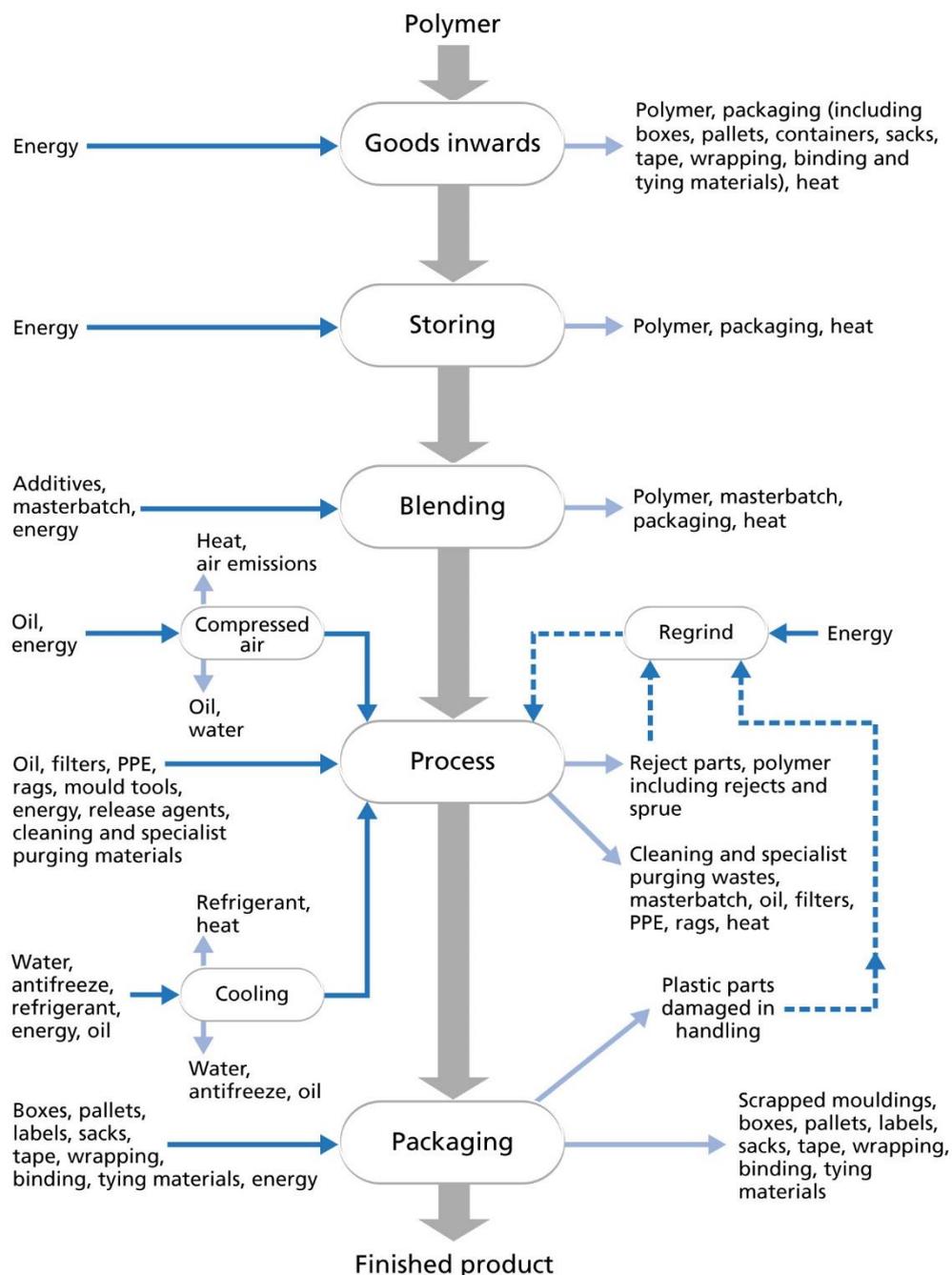
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Part 5: Waste minimisation tools

The key tools in waste minimisation are the 'waste tracking model' and the 'cause and effect diagram'. These help to find both 'fast starts' and to develop a systematic approach for long-term savings.

1. The waste tracking model

To manage waste effectively and to pinpoint where savings can be made, all the different wastes produced by a company (and the stage at which they are produced) needs to be identified. The tool used for this is the 'waste tracking model'. A general 'waste tracking model' for plastics processing is shown below:



General waste tracking model for plastics processing

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Each process step both adds value and incurs a cost from the labour, materials and utilities used in the process step.

- **Tip:** The true cost of waste includes the cost of wasted resources and rejects at each stage in the process. The cost of rejects includes the value added to the material by the time it is rejected and this increases through the process.

Waste tracking to identify costs

Consider your production operation as a series of processes. Each process has its own inputs, outputs and waste. Using the example, you can make a waste tracking model for your complete process. Once you have this global view of the process, create an 'opportunity sheet' for each step of the process. This sheet places amounts and costs on the wastes for each step. Add up the total costs to give the overall cost of waste to your business.

- **Tip:** If the information you need is not available, either make a 'best' guess or carry out some simple measurements and decide whether improved information collection is justified.

You should now have a good picture of the 'cost of waste' to the business. Combine the details from the waste tracking model to see if there are discrepancies in overall values, i.e., between identified and total actual water use, and raw material and energy consumption.

- **Tip:** Dig deeper if there are major discrepancies. They may be a major cost and a major savings opportunity!

2. The 'cause and effect' diagram

'Cause and effect' diagrams are a standard tool for quality improvement and will be familiar to many people. They are used to identify opportunities for eliminating waste in each process step and are useful when you need to identify possible causes of a problem in a structured manner. For each effect there are likely to be several causes.

In manufacturing, the key causes are:

- People.
- Methods.
- Materials.
- Machinery.

Remember to look for ways to cure the cause (or causes) of the problem and not just the symptoms.

- **Tip:** Ask the people who work on the process to suggest reasons (without blame) for the problem.
- **Tip** - List their suggestions against each cause (they know the process better than you!
- **Tip** - Involve everyone in the development of solutions.
- **Tip** - Implement no-cost measures as soon as possible.