The Bedfordshire Waste Reduction in Industry Project

A shanks. first funded project through EB Bedfordshire Ltd

FINAL REPORT

DATE: JUNE 2002

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In particular the following BLSBP members:

Bedfordshire Green Business Network

Amanda Harrison, Mid-Beds District Council

Myles Greenhalgh, Chamber Business

Sarah Williams, Bedfordshire County Council

EXECUTIVE SUMMARY

The Bedfordshire Waste Reduction in Industry Project ended in June 2002 after two highly successful years during which it exceeded expectations of interest, participation and output. It was supported financially by EB Bedfordshire Ltd using £92,000 provided by Shanks through the Landfill Tax Credit Scheme. Oakdene Hollins managed the project within a framework of coordination provided by the Bedfordshire and Luton Sustainable Business Partnership (BLSBP).

The Bedfordshire project was the second of three projects designed to raise the level of industrial participation in waste reduction. Linked projects were run in Aylesbury Vale and Milton Keynes for which separate reports are available.

The reason for the success of this project was primarily due to the high level of awareness and interest in waste reduction amongst manufacturing companies. This was created over several years by a highly active environmental business network in Bedfordshire. The waste reduction in industry project was designed to fit within a framework of other initiatives such as an internet-based waste exchange project and various seminars and events. The network reduced the costs of marketing and promotion and greatly assisted in directing effort to the most appropriate managers and companies.

A database of 101 manufacturing companies were contacted. 38 companies expressed an interest and received an appraisal meeting and 11 companies were selected with whom detailed waste reduction projects were developed. These are shown in this report.

Work with these 11 manufacturing companies produced the following outputs:

Performance Measure	**Output**
Reduction in Discarded Resource	£339,700 per annum
Reduction in Site Emissions	1,100 Tonne per annum
Number of Opportunities Identified	193
Number of Employees trained in waste reduction methods	54
Substitution of materials	2 Tonne per annum

We have given prominence to the value of discarded resource, as it is the difference between this value and the method of accounting in almost all manufacturing companies that lies at the root of poor resource utilisation. When semi finished product is discarded to landfill, the embedded value of resources in the semi-finished product is almost always disregarded by manufacturing companies. Only the purchase price of raw materials and the cost of waste collection and disposal are accounted for.

This waste reduction project was designed to get to the root of waste generation in manufacturing. This often involved changes to measurement techniques, processes and procedures. Companies do not easily accept fundamental changes and it is for this reason that the project manager, Tara Galloway, was appointed from a background in manufacturing in Bedfordshire.

The key learning points from this project for those designing future waste reduction projects aimed at manufacturing projects are:

1. Integrate the project with existing initiatives aimed at industry in the area. This is best achieved through a steering group that involves public sector authorities, agencies and Universities.
2. Requiring an upfront payment to join the project will exacerbate the tendency for companies that least need the project to benefit from it.
3. Offering consultants that are skilled in manufacturing disciplines clearly helps in overcoming the confusion amongst manufacturing companies over terms such as resource utilisation, waste reduction and waste management.
4. Databases of manufacturing companies degrade at a rate of approximately 10% annually. Do not underestimate the time required to identify the right people to contact within companies. Typically, the quality manager is a good route to the production manager.
5. A project of this type will require at least two years to get established and to start producing results. "Word of mouth" recommendations to participate in the project from individuals in one company to others in the region grows in importance over time.
6. Companies that initially reject the offer of a waste reduction project should always be contacted every six to nine months. Changes in business objectives, management or ownership can often alter waste reduction priorities consequently making an activity more appropriate.
7. The Aylesbury Vale, Bedfordshire and Milton Keynes projects all attracted interest from a significant number of companies that least needed assistance. These companies seem to be managed in a way that seeks out even very small improvements in performance and the management appear to welcome external advice and input.
8. If you are seeking a financial payback to your project do not agree to start a project without a clear indication of the involvement of the managing director or finance director.
9. Researching reuse opportunities for several waste materials in other local companies requires considerable resource and time. Many waste materials such as part used rolls, part cut block, and packaging material are rejected by other companies due to the size / shape or output quantity not the raw material. There is clearly an opportunity for an intermediate to take these clean wastes and rework them so as to present them to other companies in a form the can use. This may be an area that the EB Nationwide may consider funding in the future.
10. The single most significant factor affecting resource utilisation was from inventory and the control and management of stock. This factor could result in material damage, obsolescence, excess transportation and handling, increased space requirements, unproductive time, customer service issues, increased overheads as well as concealing other potential improvement opportunities.

1 INTRODUCTION

1.1 THE BEDFORDSHIRE WASTE REDUCTION PROJECT

1.1.1 National Waste Strategy

A Government consultation paper in 1998[1] identified waste minimisation as one of the best ways to reduce the impact of waste on the environment, particularly in the industrial sector due companies becoming increasingly responsible for the waste they produce. The Government's Waste Strategy further supported this in 2000[2] with the industrial sector being identified as one of the key waste producers in the United Kingdom

The documented level of industrial waste has highlighted the growing social, as well as commercial, need for manufacturers, to reduce waste.

1.1.2 Industrial Waste Minimisation

Waste is managed by minimising, reusing, recycling or disposing of it. The greatest environmental and economic benefit is achieved through minimising waste 'at source'. The 'Waste Hierarchy' illustrates the waste management choices, with minimisation the first consideration, and disposal the last.

The waste hierarchy

1. Minimisation
2. Reuse
3. Recycle
4. Disposal

Incorporating a sustainable waste minimisation activity into industry requires accurate measurement, structured implementation, and the results to be both environmentally and commercially beneficial. Previous waste minimisation projects such as; Aire & Calder, Project Catalyst, and The Aylesbury Vale Waste Reduction in Industry Project, demonstrated how improving resource utilisation can satisfy these criteria. The advice and implementation given through the Bedfordshire Project focused on the relationship between waste minimisation, resource utilisation, and cost saving. By identifying the real commercial benefits of minimising waste, the member companies in the project, could justify sustaining waste minimisation as part of their everyday activities.

1.1.3 Aims and Objectives of the Project

The aims and objectives of The Bedfordshire Waste Reduction Project were:

- Elevate the knowledge and understanding of the term waste minimisation to manufacturers in the Bedfordshire area
- Identify realistic and achievable waste minimisation opportunities within individual manufacturing sites
- Provide manufacturers with a pragmatic and structured approach to waste minimisation
- Initiate and progress the physical minimisation of waste through recommendation and implementation

- Provide manufacturers with a sustainable waste minimisation plateau through coaching and training key employees and promoting the internal implementation of recommendations
- Promote other waste minimisation initiatives to encourage adoption of waste minimisation in other areas

The project achieved these objectives by providing three phases of assistance:

1. Promotion and marketing of waste minimisation and the Bedfordshire project to all manufacturers in the county
2. Initial on-site appraisals to all manufacturers responding to the marketing exercises to identify waste minimisation opportunities
3. Manufacturing expertise to assist with selected individual company projects to achieve demonstrable cost / waste savings

The project started in June 2000 and continued through to June 2002.

1.1.4 Project Management

The project was managed and co-ordinated by Oakdene Hollins Ltd, a manufacturing consultancy based in Aylesbury, Buckinghamshire.

Oakdene Hollins Ltd is also the national co-ordinator of the 'Sustainable Technologies Initiative' and 'Waste Minimisation through Recycling, Recovery and Re-use in Industry' for the EPSRC and the DTI.

Oakdene Hollins supplied all of the necessary expertise for the direct consultancy project work and appointed Tara Galloway as project manager. Tara is a qualified Mechanical Engineer with industry based manufacturing expertise in; continuous process improvement, waste minimisation and the automotive industry supply chain.

In addition to the direct consultancy, resource was provided for the administration of the waste minimisation project and specific research activities for waste materials.

1.1.5 The Funding

The project was funded by EB Bedfordshire under the Shanks.first scheme using Landfill Tax Credits. The total project fund was £92,000. This included a £9,506.18 donation from McCormick Plc.

The funds provided for:

- Direct consultancy days for initial appraisals
- Direct consultancy days for individual waste minimisation projects
- Research and management of individual waste minimisation projects
- Project management and administration of the waste minimisation project

2 BEDFORDSHIRE

2.1 THE LOCAL ECONOMY

The county of Bedfordshire has traditionally had a strong manufacturing sector[3]. In the year 2000 the county had 12,295 VAT registered businesses with 1,275, or 10.3% described as being in the manufacturing sector[4].

The county has a number of large companies, one of which is The Vauxhall Motors Group. However in 2001, Vauxhall Motors announced the discontinuation of car manufacture at their Bedfordshire site with the loss of around 2,500 jobs[5]. With a significant number of smaller local manufacturers supplying the Luton based site, the impact on the local economy has been significant. However growth in the aviation sector around Luton airport and the food and packaging sectors in particular, have compensated for this event.

2.2 THE SUPPORTING ORGANISATIONS

"…the absence of a Green Business Network or similar will add considerably to the time required to launch and promote the project…"

Aylesbury Vale Waste Reduction in Industry Project 1998-2001[6]

The Bedfordshire and Luton area has an established and highly active environmental industry support network. Activities include a comprehensive and extensive list of industry forums, seminars, and local events. This thriving network has provided The Bedfordshire Waste Reduction Project with an important link to local industry and a medium to promote waste minimisation to a wider audience.

In recognition of their contribution to The Bedfordshire Waste Reduction Project during its two-year life, we would like to express our appreciation to the Bedfordshire and Luton Sustainable Business Partnership (BLSBP). In particular the following members:

- Bedfordshire County Council
- Chamber Business
- Bedfordshire Green Business Network
- Mid Bedfordshire District Council
- Bedford Borough Council
- Cranfield University

These organisations contributed to the project in the form of: assistance with establishing a database of local manufacturers, advice on those organisations most interested in waste minimisation, and local events in which the Bedfordshire Project could be promoted and discussed.

2.3 PREVIOUS WASTE MINIMISATION PROJECTS

Over the past ten years, there have been many successful waste minimisation projects. The first of these projects was launched in 1992, in Yorkshire, in the river catchments area of Aire and Calder.

2.3.1 The Aire & Calder Project

The Aire and Calder project applied a logical approach to waste minimisation to illustrate both the environment and industry benefits. The funded project worked with eleven companies and resulted in over £3,000,000 of savings per annum (Figure 1). The success of this project helped to promote the need for further waste minimisation projects in the UK.

Source	*Savings achieved (per annum)*
Water	512,000
Effluent	462,000
Raw materials	1,565,000
Energy	327,000
Others	484,000
TOTAL	**3,350,000**

Figure 1.Savings resulting from the Aire and Calder project as of 31st August 1994[7]

2.3.2 The Aylesbury Vale Waste Reduction Project

In 1998 Oakdene Hollins Ltd received funding of £58,000 from EB Buckinghamshire to provide a waste minimisation project to the Aylesbury Vale area. This project aimed to demonstrate that where a waste reduction project is appropriately designed, manufacturing companies are prepared to make financial payments to extend the life of a project. The project was the initial blueprint of the Bedfordshire Waste Reduction in Industry Project and the subsequent Milton Keynes Project.

The modest project identified and implemented environmental and cost savings (Figure 2) by using a pragmatic and structured approach to waste minimisation. The member companies accepted this approach as it focused on 'at source' waste minimisation in the production area. This approach illustrated the positive impact that waste minimisation can have on industrial competitiveness by improving resource utilisation and reducing cost.

Results from primary output measures for Aylesbury Vale Project	
Output measure	**Unit of measure**
Reduction in discarded resource	£127,000
Employees trained in waste minimisation methods	65
Substitution of materials	£8,000
Reduction in site emissions	37 Tonnes of 377 Tonnes
** Additionally opportunities at individual member companies also positively impacted their process efficiency	

Figure 2.The summary of the primary output measures for the Aylesbury Vale project

The difference in the approach between the Aylesbury Vale project and that of the Bedfordshire project was the initial recruitment and the distribution of manufacturers in the region. Notably, the Aylesbury Vale Project asked first phase members to pay £2,000 at the start of the project. In addition, the distribution of medium sized businesses within the Vale was less extensive than Bedfordshire with only 5 companies having more than 300 employees.

3 METHODOLOGY

3.1 THE PROJECT

The Bedfordshire Waste Reduction in Industry Project was launched in June 2000 and continued through to June 2002. The project aimed to visit 18 manufacturing companies during this time, and carry out individual waste minimisation projects with at least 5 of these. In fact, 38 companies received an initial appraisal visit after expressing interest, and 11 received on-site support to identify and implement savings.

3.1.1 The Project Philosophy

A sample of key learning points from the Aylesbury Vale Waste Reduction in Industry Project, 1998 to 2001, stated:

"…'Waste minimisation' is not a helpful term when marketing the project to manufacturing companies. Manufacturers of all sizes misunderstand it and assume that the very modest cost of waste disposal is all that is being addressed. The use of 'Resource Efficiency' by Envirowise is a more recognisable term for manufacturers…"

"…Subsidies continue to be required to overcome the managerial inertia about 'waste'..."

"…Companies most in need of waste reduction advice are <u>least</u> likely to take up the assistance…"

In addition to the learning points from previous projects, individual business goals continued to change. Business objectives needed to take account of new environmental levies / legislation (i.e. the introduction of the climate change levy in 2001), local economics, national and international pressures, the progressive developments in manufacturing techniques, an increase in the costs of raw materials, rising oil prices, and the relative value of sterling to that of other leading currencies, notably US dollars.

Even with the increased cost in waste disposal many companies still did not distinguish waste to landfill as a critical cost area when evaluating this against the many other business overheads. It was clear from discussions and visits to manufacturers that many organisations used a traditional valuation of the cost of waste by monitoring disposal. As such the true, often substantial, bottom-line savings[8] that can be achieved through waste minimisation needed identifying and clarifying to many businesses.

The diverse range of industry in Bedfordshire made it necessary for the project to appeal to all industry sectors (i.e. automotive, food and drink, aerospace, construction and electronics industry). The project had to promote the generic application of the methodology and the global benefits that could be gained through using a structured approach to waste minimisation. The subsequent numbers and distribution of industry sectors that 'signed up' to the project (Figure 3), demonstrated the universal application and industry acceptance of this approach in the identification of waste minimisation opportunities.

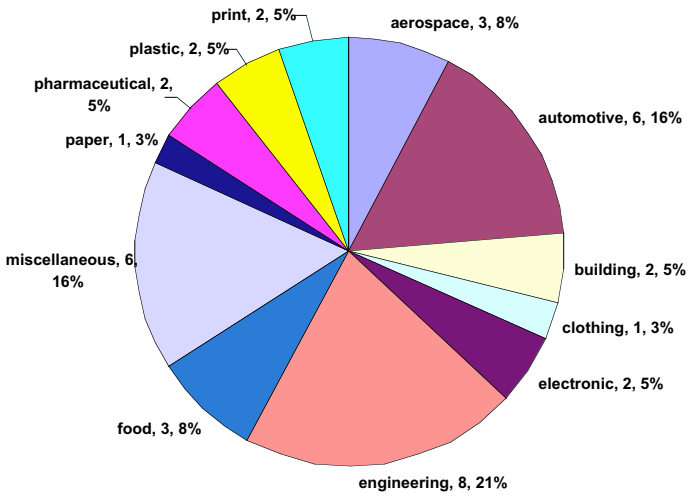

Figure 3.The distribution of companies who received an initial appraisal (e.g. plastics, food, automotive)

An appreciation of these factors was fundamental to the success of the Bedfordshire Project.

The project brought together these points by:

- Integrating with local business networks to ensure accessible information and communication to manufacturers in the county
- Focusing on the terminology "resource utilisation" rather than waste minimisation
- Emphasising that the true cost of waste is not limited to disposal but is the accumulation of cost from material and from the ineffective and unproductive use of the business's energy and resource
- Offering companies up to 30 days on-site expert advice free of charge
- Emphasising that participating companies would be selected
- Demonstrating that the skills and experience of the consultants offered were grounded in manufacturing not environmental disciplines
- Reducing the emphasis during the initial appraisal of the voluntary financial contribution

3.1.2 The Project Management

The recruitment of companies was achieved through general information provided through mailing, local events, and initial appraisals at individual company sites. The appraisals raised the awareness of waste minimisation in the company and for some companies led onto a specific company based waste minimisation project (Figure 4).

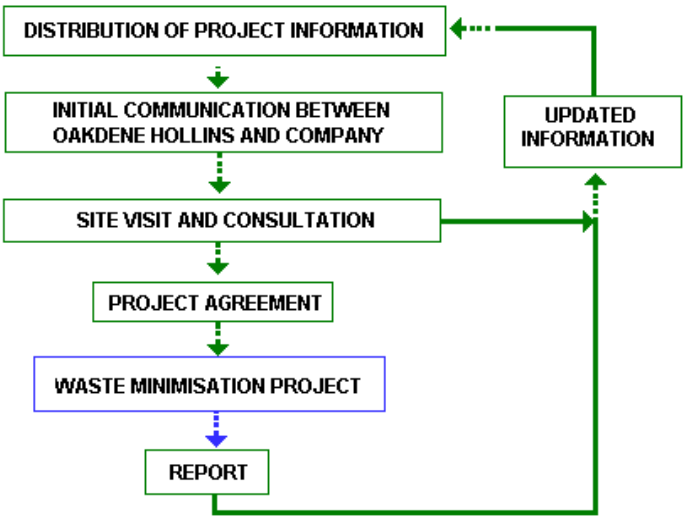

Figure 4. Flowchart for Bedfordshire Project

3.1.2.1 Database

A project database was complied from companies registered on the KBE (Key British Enterprises) database with SIC codes in the manufacturing sector and with greater than 100 employees. A telephone call was made to each of those companies on the database. From this call a number of businesses were removed from the database as they were not eligible for the Bedfordshire Project, i.e. the business did not manufacture in Bedfordshire, the business was moving to a location outside of the county. Other companies were added to this database as marketing information flowed and as local business knowledge and contacts increased. Although directed at manufacturing industries, business's that primarily assembled or distributed product, with a smaller secondary manufacturing units, were not excluded from the project. The final database listed 101 companies.

The mailing information was in the form of an explanatory leaflet, feedback form, and briefing documents. Further to the mailing activities all companies received follow up telephone calls. From these initial activities a shortlist of interested and non-interested businesses was identified. This was time consuming, but the integration and feedback from other local initiatives (Section 2.2) helped to ensure that the right companies and individuals were targeted.

3.1.2.2 The Internet

The increased use of the Internet as a source of information and communication has dramatically changed the way in which today's business gather and use data. This development has had a positive impact on the minimisation of waste material by enabling the communication and distribution of information to often be paperless. In Bedfordshire the internet has also been the communication medium used to establish a local waste exchange service, www.bedfordshire-waste-exchange.co.uk , aimed at matching sources of waste with areas of demand.

The Bedfordshire Waste Reduction Project used the Internet to improve the management and marketing of the project. The Internet sped up the process of communication, improved access to information, and assisted in the promotion of the Bedfordshire Project through websites:

- The Oakdene Hollins Website, www.oakdenehollins.co.uk

- The Envirowise website, www.envirowise.gov.uk
- The Norfolk Waste Management Partnership, www.resource-not-waste.co.uk

3.1.2.3 Working with local business networks

On 8th March 2001, partners from the BLSBP organised The Business Environmental Event (BEE) at The Marston Vale Community Forest Centre. This event provided a selection of environmental workshops, expert speakers, and helpful information to local industries to promote the work and activities available in the region.

The Bedfordshire Waste Reduction in Industry Project was presented to delegates in the Waste Minimisation Workshop as part of the event. The presentation highlighted the principles of waste minimisation, raised awareness of the importance of resource utilisation, the details of the Bedfordshire Project, and demonstrated how the techniques had been put into practice in one local company, Polyformes Ltd. The workshops were very successful with over 30 delegates attending the waste minimisation session.

In addition to the individual events the project was promoted through regular meetings and communication with the BLSBP.

Further literature was available to manufacturers / individuals through the county's libraries and council offices.

3.1.3 Initial Appraisal

After initial information was received through mailing or events, companies were offered an onsite appraisal by one of the manufacturing consultants. The visits typically took the form of an initial meeting with a senior manager / director or management team, and an initial tour of the manufacturing area. The meeting discussed waste minimisation through maximising resource utilisation, current and past company activities, and areas of opportunity. The subsequent manufacturing tour enabled the company and consultants to discuss specific site issues and for the consultants to highlight individual opportunities and to make any initial recommendations.

The appraisals were an essential part of progression onto a specific waste minimisation project as they provided the management team with an opportunity to evaluate and appraise the manufacturing consultant. In all cases, managers were rightly concerned to ensure that the individual consultant would be accepted by the staff in the factory.

On completion of the Bedfordshire Project the names of the 38 companies who received an initial appraisal were given to the BLSBP. This enabled the companies to access other appropriate local environmental initiatives available to them via the BLSBP in the areas in which they were particularly interested.

3.1.4 Specific Waste Minimisation Projects

After an initial appraisal, selected companies were invited to start a specific waste minimisation project to focus on one or more areas of opportunity within their business. The time duration of individual projects varied considerably dependant on the activity undertaken and whether the company went on to implement activities internally or through the Bedfordshire Project.

The selection criteria used were:

1. Evidence of senior management commitment to the project

2. Manufacturing processes with a potential for change and improvement to reduce waste generation
3. Long-term stability of the business, process or management (although this criteria was often difficult to evaluate)

See section 3.2 for a detailed account of the practical approach used to implement the individual waste minimisation projects.

3.2 INDIVIDUAL WASTE MINIMISATION PROJECTS

3.2.1 Resource Effectiveness

"…where natural resources are important inputs to economic activity, improving resource productivity will have a key role in cutting costs, improving overall productivity and reducing waste and pollution…"

Resource Productivity: Making more with less[9]

The waste minimisation methodology used during the Bedfordshire Project used the concept of "resource productivity". The project focused on reducing the resource needed to produce a defined unit of finished goods.

The application of resource productivity requires businesses to consider the resource they are using against their production output. A growing business will typically have a growing resource intake (and potentially produce more waste to landfill). The evaluation of whether the company is less effective can only be measured through calculating the additional resource used against the increase in unit sales and comparing it to the previous productivity results.

3.2.2 Waste Minimisation Techniques

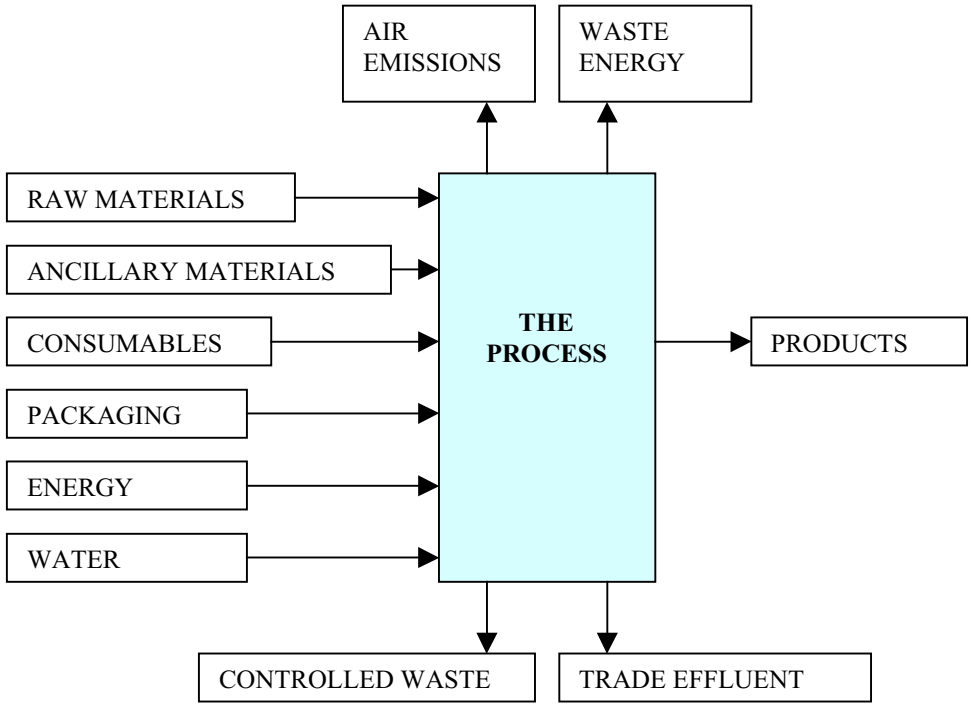

Figure 5.The mass balance of resource

The waste minimisation principles consider the systems evaluated in terms of a mass balance[10] (Figure 5). Everything that goes into the system will equal everything that comes out. Using the principals of mass balance will enable waste to be measured by considering the conversion rate of incoming resource to 'desirable finished goods' out.

The term, 'desirable finished goods' refers to the units of goods produced that are equal to units of market demand required. Any additional goods that are produced may protect the business from supply risk but they are not 'desirable' and do lead to wasted resource. The question is 'What is the optimum rate of conversion within the business?' The desirable rate is 100% but in reality the business must assess what can practically be achieved.

Typically, manufacturers will have limited internal resource to implement opportunities therefore the evaluation and priority of opportunities is critical to maximising the returns. The PDCA continual improvement cycle (Plan Do Check Act or Shewhart cycle) illustrates a systematic process to ensure that all opportunities are; clearly identified and stated, evaluated and prioritised, and priority areas are implemented and actions reviewed. The PDCA cycle (Figure 6) is recognised as a logical approach to improvement and was initially formalised to clarify the approach to industrial improvements in the 1980's by A.W. Shewhart. This approach was adopted initially by the Aylesbury Vale Project to guide the waste minimisation projects and has subsequently been used in the Bedfordshire project.

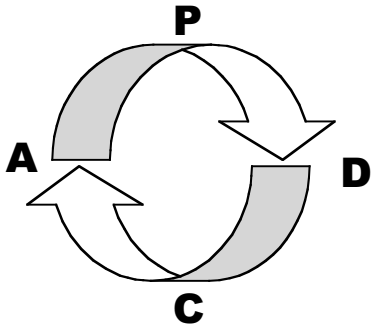

Figure 6.Plan, Do, Check, Act cycle

Both the Environment Agency and Envirowise have expanded upon the application of the PDCA cycle in their approaches to waste minimisation (Figure 7).

PDCA	Environment Agency Approach (1998)	Envirowise Approach (1998)
PLAN	1. Collect data 2. Assess the scope of savings 3. Identify legal obligations 4. Get commitment	1. Give somebody responsibility for waste management 2. Establish the size of the waste problem
DO	5. Individual process mapping 6. Quantity and cost determination 7. True cost of waste 8. Prioritising issues 9. Generating options for improvement	3. Analyse the information 4. Consider the waste minimisation options available 5. Produce an action plan to set targets 6. Implement the action
CHECK	10. Opportunity assessment	7. Review the progress
ACT	11. Project implementation and maintaining momentum	8. Complete the closed loop / continual improvement cycle by returning to step 3

Figure 7.The Environment Agency and Envirowise approaches to waste minimisation

The combination of using the PDCA cycle to guide the phases of an activity and the mass balance principles to identify and measure the wasted resource ensured a holistic approach to the waste minimisation project.

3.2.3 Implementation

In general, the realisation of improvement opportunities is for many organisations the most difficult aspect of any activity. Time restraints, internal resource limitations and expenditure justifications can hinder the momentum of an improvement team.

By identifying and implementing 'quick-fix' opportunities early in the activity can have an overwhelming positive impact on the success of more difficult improvements later in the project. Successful implementation is brought about through 'buy-in' from the team, operators, and management. The benefits of a 'quick-fix' improvement are; the instant payback, the increase in team momentum, and the immediate visual impact. These factors help to get early 'buy-in' into the project.

Setting individual ownership and attaining management support will help with the more difficult implementation activities. In addition, employing an approach of step-by-step goals and individual coaching further assisted this.

3.3 PERFORMANCE INDICATORS

The overall project performance measures are illustrated in Figure 8. The performance indicators for the individual company projects are based on the measures used in the Aylesbury Vale Project (1998-2001). The indicators combine both environmental and core business requirements to enable the results to be of environmental and commercial interest.

OVERALL PROJECT PERFORMANCE INIDCATORS

1. *Number of companies contacted*
2. *Number of companies provided with an appraisal*
3. *Funds paid back into the project by participating companies (£'s)*
4. *Further R&D opportunities created (Number of proposals)*
5. *Months during which project operated (Number of months)*

Individual company project performance indicators

6. *Reduction in discarded resource (£'s)*
7. *Employees trained in waste minimisation methods (Number of individuals)*
8. *Number of opportunities*
9. *Substitution of materials (Tonnes/grams)*
10. *Reduction in site emissions (Tonnes/grams)*
11. *Increase in process performance (Measures specific to individual companies)*

Figure 8.The Bedfordshire Waste Reduction in Industry Project – Project performance indicators

An employee trained in waste minimisation methods included employees who had increased their awareness as result of a waste minimisation activity through to specific classroom based training.

Each waste minimisation project was different in outcome. Only the indicators that were impacted by the project outcome are shown in the 11 individual tables of results within Section 6.

The implementation of waste / cost saving opportunities made during the waste minimisation activity was dependent on the adoption of recommendations by the individual companies. The results of the individual waste minimisation projects are projected for the 2002/3. The projected results are based on opportunities already realised and realistic estimates of the expected benefits that will arise from implementing the key recommendations in full.

3.3.1.1 Discarded Resource

The performance indicator, 'Discarded Resource' represents the net financial value of all the resources embedded in materials at the point at which a company discards them. This value is always higher than the book keeping value ascribed internally. The difference between the book keeping value and that calculated for discarded resource lies at the root of why many companies do not consider waste to be a priority.

Typically, the cost of disposal and the cost of materials is the maximum amount ascribed to discarded materials. It is not feasible to identify a ratio between these costs and the actual value of discarded resource as others have attempted to do. It varies depending upon the type of materials and the extent to which the manufacturing process adds value to these materials. In some cases, manufacturing adds value that is several thousand times the value of the input materials. Where this is the case, the value of the difference between discarded resource and book keeping values for waste is much greater than in simple manufacturing processes.

4 STRATEGIC PROJECT PERFORMANCE

4.1 AWARENESS AND COMPANY PARTICIPATION

The performance of the Bedfordshire Project was very successful, with performance in all areas exceeding initial expectations.

The results from the initial mailing of information and telephone contact with the 101 companies on the database showed a number of various responses (Figure 9).

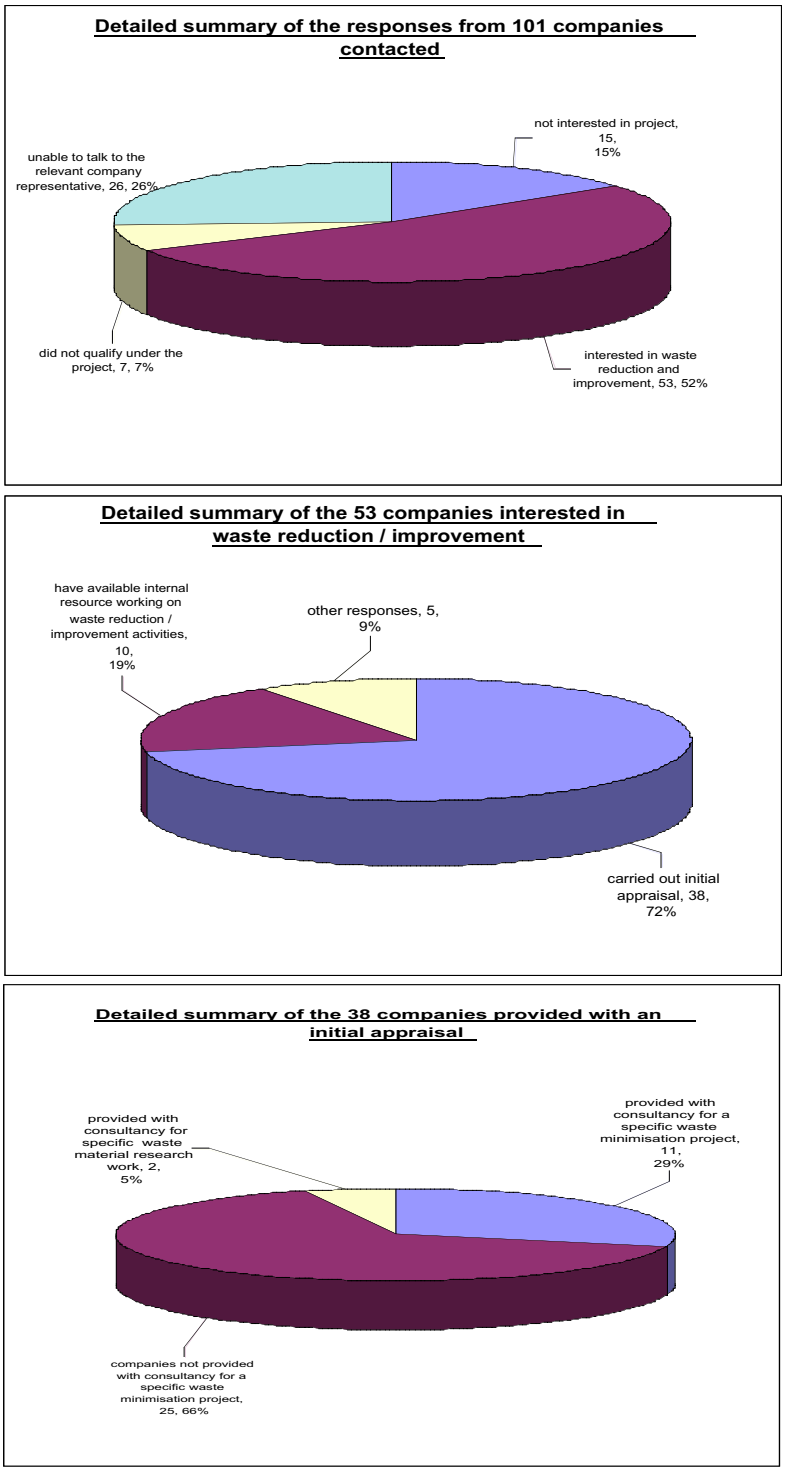

Figure 9.The marketing results of the 101 companies on the database

52% of the 101 manufacturers contacted (companies on the database) were interested in waste minimisation and the improvement process. Out of the 53 companies who expressed an interested in waste minimisation, 72% were provided with an initial on-site appraisal, 19% were either working on or had their own resource to implement waste reduction work internally.

With the help of the successful network of local business support in Bedfordshire many companies were already well informed on environmental issues. This awareness undoubtedly had a positive impact on the numbers of companies taking part in a company visit with an overwhelming 38 of the 101 manufacturers contacted receiving an initial appraisal. From those 38 companies, 11 were provided with consultancy to carry out a specific waste minimisation project and 2 companies were provided with consultancy for waste material research work. However 25 of those companies visited responded in other ways. These ranged from:

- The company was already carrying out significant waste minimisation work. Any additional opportunities identified were discussed in detail during the appraisal so that the company could implement these using their own resource
- Changing company priorities due to issues relating to company ownership or business structure
- The individual contacted changed or left the company
- The company did not meet the selection criteria (Section 3.1.4)

Although initial planning had forecast that the concentration of initial company appraisals in the first phase of the project would be high, it did not anticipate the total project target would be met in the first six months, a total of 21 companies were visited during this period. By the end of 2001 a further 15 companies were visited with one further appraisal made in 2002 (Figure 10).

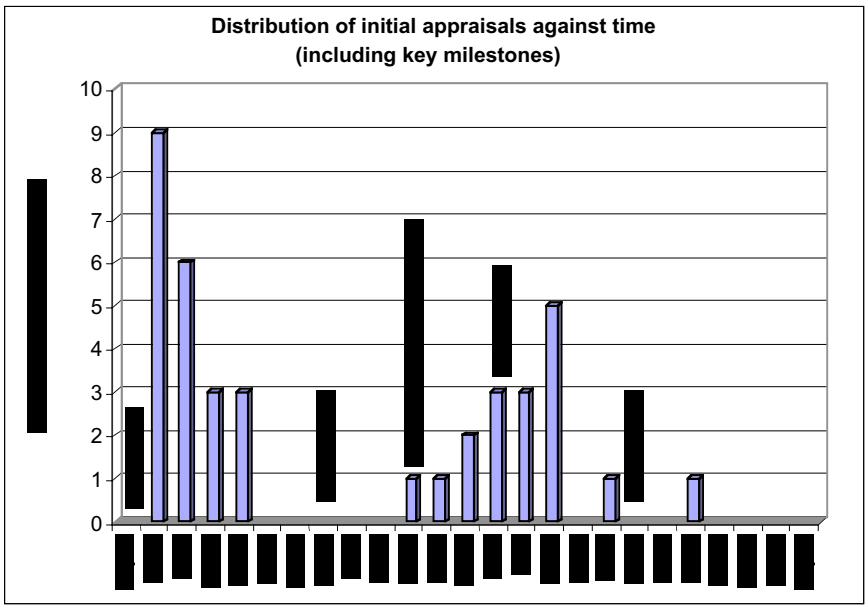

Figure 10.Distribution of initial appraisal visits made from June 2000 to June 2002

The appraisals uncovered that many companies were seriously considering the impact of waste on their business and including waste minimisation as part of their annual objectives.

In the first six months the uptake of company specific waste minimisation projects was slower than expected, with two companies starting onsite work. However, increased marketing focus during 2001 resulted in four companies starting projects. The take-up momentum continued with a final five companies starting projects during 2002. Again this resulted in the project's target of 5 company specific waste minimisation projects being exceeded by an additional 6 projects before 2002.

Out of the 101 companies contacted 15% were not interested in the information regarding the project, although it was unclear if this reflected their interest in waste minimisation.

At 26% of the 101 manufactures we were unable to make one-to-one contact with a relevant person and therefore were unable to get a direct response.

5 SUMMARY OF OVERALL PROJECT PERFORMANCE

SUMMARY OF PROJECT RESULTS

Number of companies contacted	*= 101 manufacturers*
Number of companies provided with an appraisal	*= 38 companies*
Funds paid back into the project by participating companies (£'s)	*= £3,000*
Further R&D opportunities created (Number of proposals)	*= 7 opportunities*
Months during which project operated (Number of months)	*= 25 months*

The overall results from the individual company projects

Reduction in discarded resource (£'s)	*=£339,700 per annum*
Employees trained in waste minimisation methods (Number of individuals)	*= 54*
Number of opportunities	*= 193*
Substitution of materials (Tonnes/grams)	*= 2 Tonne per annum*
Reduction in site emissions (Tonnes/grams)	*= 1,100 Tonnes per annum*
Increase in process performance (Measures specific to individual companies)*	*= see individual company projects*

Figure 11.Overall summary of results from the Bedfordshire Waste Reduction in Industry Project

Figure 11 illustrates the overall results of the Bedfordshire Waste Reduction in Industry Project. A list of the 38 companies visited for an initial appraisal are listed in Appendix A. Full details of the individual project results are highlighted in Section 6 on Company Achievement's.

6 COMPANY ACHIEVEMENT

6.1 ABBEY CORRUGATED LTD, BLUNHAM

Abbey Corrugated Ltd is part of DS Smith (holdings) Plc. They are corrugated sheet manufacturers based in Blunham, supplying product to the packaging converters. Abbey employs over 200 people and has a turnover of around £30 million.

The company's commitment to the environment is demonstrated through their actions and achievements. The company actively take part in local conservation, they are ISO14001 accredited, and for the years 2000 and 2001, have been the winners of the Bedfordshire and Luton Business Excellence Environmental Award.

Approach

To maintain a strong focus on environmental and cost reduction goals Abbey had set up a number of specific teams, one of which was focused on waste minimisation. Although much work was being carried out, Abbey recognised the benefit of having an independent appraisal of their manufacturing systems to explore existing opportunities and highlight new ones.

The project focused on raw material utilisation and guided the members of the internal team through the systematic approach to waste minimisation. The project ran from January to April 2002, inclusive.

The project started with a review of the raw material waste streams through the manufacturing facility. The streams were categorised into three stages, 'prior to production', 'in-production' and 'finished goods'.

The initial review and historical evidence indicated the team should focus their investigation at the raw material waste generated prior to reaching the production line. In addition, there were a number of 'quick-fix' improvements that could be implemented immediately.

The project investigated the supply of goods, the storage of raw material, and the preparation of raw material for production (Figure 12).

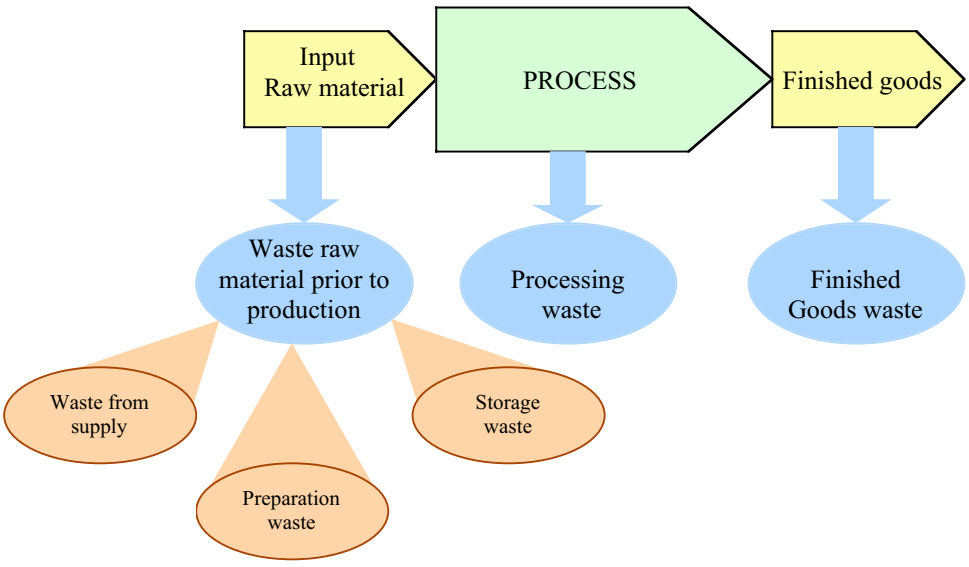

Figure 12.Areas of waste raw material at Abbey Corrugated site

The project highlighted that the majority of the raw material waste resulted from damaged stock and from the current system for managing part rolls of material.

A team made up of the management and operators from Abbey Corrugated and consultants from Oakdene Hollins investigated the reasons for raw material damage by using a system of photographing various types of damage and evaluating the risk of occurrence. During the investigation process a number of 'quick-fix' opportunities were initiated. Two examples of these were the raised guardrail brackets (Figure 13) and overhanging framework in the warehouse. The raised brackets created a risk to the rolls of material when they were lowered to the floor. The overhanging framework increased the potential of marking when rolls were being moved at height. The brackets were modified to eliminate any potential material contact and the overhanging framework was removed.

Figure 13.Raised guard rail brackets caused a significant contact risk to raw material stock

The project guided and coached team members through a number of improvement techniques such as brainstorming, process mapping, and evaluation techniques, to increase and evaluate the ideas generated.

Results

The project went onto identify and implement a number of improvements.

- Increase the raw material waste awareness and the associated costs across the site through presentations and information. This had a positive impact on waste minimisation and generated new opportunities
- Due to the current internal layout and storage in the warehouse conflicting with waste minimisation objectives it was agreed that the warehouse layout needed to be modified. Low cost reengineering of the layout in the warehouse and the optimisation of the stock held would maximise the space and improve access, for the clamp trucks, and to the raw material. This would result in a projected saving of 150 Tonnes of raw material per annum
- The system of managing part rolls of material was necessary but reduced the raw material utilisation. The installation of a modified system of managing and controlling part rolls when returned from line would save a projected 173 Tonnes of raw material per annum
- The preparation process of raw material to the line could vary between operators and therefore a standard preparation process was implemented with the operators to optimise the use of raw material
- It was identified that the quantity of the raw material discarded at the end of a roll could be reduced. Initial trials by a team leader on one line proved to be successful and therefore was implemented onto the other lines

With the implementation of these improvements at little or no cost, Abbey Corrugated had a projected minimisation in site emissions of 820 Tonnes per annum (Figure 14). Improvements already implemented have generated savings of c.395 Tonnes. The value of discarded resource takes into account the savings in raw material plus the costs associated with storing, handling, shredding, baling and transporting the wasted material.

Performance measure	Results
The reduction in discarded resource	£151,000
Reduction in site emissions	820 Tonnes (non-hazardous, solid)
Number of opportunities	23
Employees trained in waste minimisation methods	7

Figure 14.Individual project results from Abbey Corrugated Ltd

6.2 POLYFORMES LTD, LEIGHTON BUZZARD

Polyformes Ltd is a SME based in Leighton Buzzard with turnover of around £3 million. The core business is the manufacture of closed cell polyethylene foam products through varying conversion processes. Polyformes has approximately 50 employees, 30 of which were allocated to the manufacturing departments.

The senior management team (Richard Belger, Paul Henrick, and Ron Garrett) were in full support of implementing waste minimisation in the manufacturing area as this focused activity fitted in with the current business objectives. It was agreed that a survey to identify the key priorities would be beneficial and in response to this the project was split into two phases.

Approach

The first phase of the project provided an overall survey of the opportunities available within the manufacturing area and evaluated these to provide realistic waste and cost benefits. Following these findings a senior management meeting agreed areas to focus a structured implementation phase. It was also agreed that the Production Manager, Dave Evans, would be the overall internal project owner with guidance, training and assistance provided by a consultant funded through the project. The project ran from September 2000 through to September 2001.

The implementation objectives were challenging and focused on wasted resource resulting from currently untapped opportunities. From an initial site survey four key opportunities presented themselves:

- The optimisation of inventory
- The improvement of the tool management system and quick changeover
- The identification of reuse opportunities for waste foam sheet

Several of the employees in the manufacturing area had not carried out improvements using a structured approach and therefore operators were also guided through the improvement methodology during the course of the projects.

The optimisation of inventory

Inventory can effect waste in a number of areas and have a significant impact on 'bottom line' profits. Excess levels of inventory can help to reduce the risk to the customer from business constraints but in doing so can conceal the real manufacturing opportunities.

Excess inventory levels increase the risk of physical waste and ineffective resource use by:

- Increasing material damage, out-of-shelf-life and obsolescence resulting in unnecessary waste to landfill, unforeseeable stock controlling errors, and additional material costs
- Increasing external / internal transport and handling utilising extra LPG and diesel, generating more air pollutants, and increasing overheads
- Increasing the space needed to store material and adding to electricity and heating costs
- Increasing unproductive operator time for managing and moving stock
- Increasing overheads

To ensure that customer satisfaction was maintained throughout, the project focused on inventory optimisation rather than inventory reduction. Focusing only on reduction without considering supply lead times, production lead times, and customer delivery could result in 'stock out', missed deliveries, production planning and scheduling errors, machine downtime, and process inefficiency.

The improvement of the tool management system and quick changeover on CNC machines

The tool management system was a relatively small initial activity that had the benefit of involving wide participation through the company, demonstrating the improvement techniques, providing a number of 'quick-fix' low-cost opportunities, and making very visual improvements. As such this activity was undertaken first to get early 'buy-in' into the project by operators and management.

The tool management system also benefited the changeover of the CNC machines. The CNC operators reviewed their current system of changeover and used the principals of SMED.

The tool management system and CNC changeover reduction activities focused on:

- Reducing the risk of tool damage and obsolescence
- Improving the speed and efficiency of the collection and the return of tools
- Increasing productivity
- Improving the system of control, the maintenance and the housekeeping
- Reducing machine downtime and the extra resource (energy, water, heating) required to make up for lost production time

The identification of reuse opportunities for waste foam sheet

Although the main focus of the project was the minimisation of waste 'at source' it was recognised that there was still a waste output. The bulk of the waste was off-cuts and thin sheets of virgin foam, all of which showed potential reuse opportunities. The Polyethylene foam material was a very bulky, light weight material. The elastic properties made it difficult to compress and the melt temperatures made it more difficult to shred.

Brainstorming ideas for internal and external reuse options identified a number of interesting avenues. Subsequently, local businesses were contacted selected on the basis of their potential

interest in the relevant waste materials. This process was time consuming, involved a large amount of resource and yielded relatively small rewards.

Results

Over the duration of the project 60 opportunities were identified (excluding the numerous small ideas and changes). The following list is a summary of the results of the project:

- Improvement to the stock turnaround of 5% through changes to the purchasing and planning system and increased awareness of the cost of stock. Implementation of all of the identified opportunities projected this to increase by an additional 20%.
- Introduction of performance indicators managed by operators
- Internal floor area saving of 11m_ in critical production areas
- A reduction in discarded resource of around £16,000, a further £26,000 of projected savings through implementation of all recommendations plus additional cost savings from increased resource effectiveness
- Increased knowledge and use of continuous improvement techniques and cross-functional teams in the manufacturing area
- Identification and trials of reuse opportunities for foam waste material with two local industries (BK Engineering Ltd and DT Finishings Ltd) as a substitute for packaging material

The overall projected results from this activity are acknowledged in Figure 15.

Performance measure	Results
The reduction in discarded resource	£42,000
The reduction in site emissions	24 Tonnes or c.240 m^3 per annum* (non-hazardous, solid)
Substitution of material	1 Tonne or c.10 m^3 per annum (non-hazardous, solid) from reuse of waste at local company as substitute packaging material
Number of opportunities	60
Employees trained in waste minimisation methods	10
Increase in process performance	5% *(Increase in stock turn)*
* *Shown also in cubic metres as material is bulky but light weight*	

Figure 15.Individual project results from Polyformes Ltd

6.3 TERINEX LTD, BEDFORD

Terinex Ltd is a Bedford based manufacturing plant producing and distributing various food packaging and ancillary items to the Food and Drinks Industry. The site employs around 90 people and has a turnover of c. £20 million.

Approach

The company started a project in January 2002 which continued until April 2002. Terinex outlined their current manufacturing systems and from this identified the possible areas of waste (Figure 16).

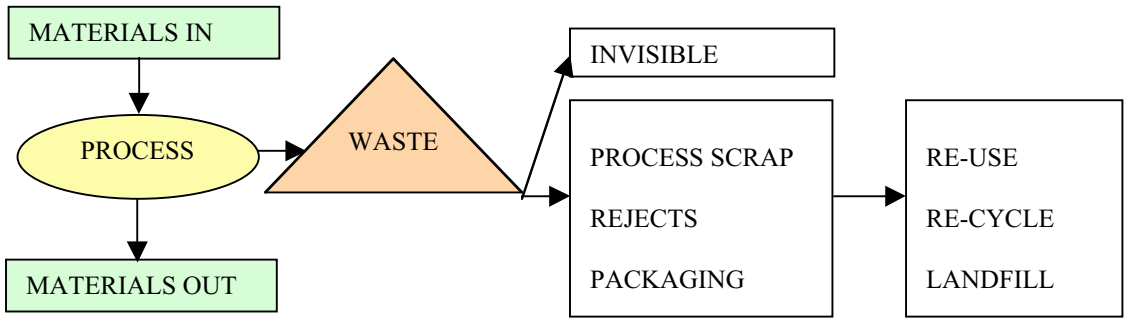

Figure 16.The key aspects to waste as identified by Terinex Ltd

The project focused on the management of incoming materials and the utilisation of these materials in the manufacturing process. The three materials focused upon were:

- Aluminium foil
- Polyester Sheet
- Clingfilm

The principals used to evaluate these materials were illustrated during the project and could then be applied to the other product areas.

Mass balance of raw materials highlighted the real levels of waste. It identified the areas of opportunity including amalgamating the varying operator systems to establish a Best Practise procedure. The project also used Normal Distribution to evaluate the potential 'give-away' from the conversion processes and Control Charts to identify sequential changes through the batches (Figure 17).

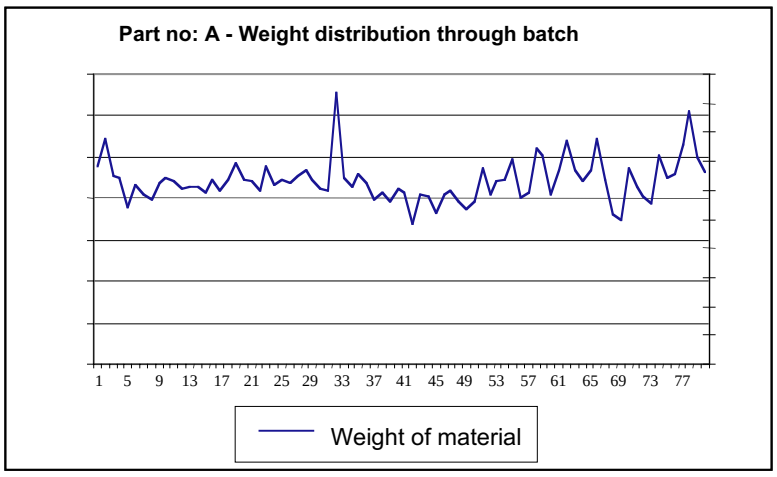

Figure 17.A Control Chart showing the variation of product weight through a batch

Results

The following list summarises some of the key recommendations and improvements made:

- Introduction of automated handling equipment for critical raw materials to reduce outer layer waste caused by transportation and loading of material on machines, and the installation of Best Practise set-up procedures to reduce the outer layer damage to raw material rolls caused when setting up new rolls. The raw material and associated costs of handling, management, baling, and storage will result in a saving c.£23,000
- Development of supplier information regarding material dimensions to enable improved accuracy of yield expectations and production scheduling
- Standardisation of the stock control system between stores and production to help identify the root causes of waste in the future

The overall results of the project are illustrated in Figure 18.

Performance measure	Results
The reduction in discarded resource	£23,000
The reduction in site emissions	10 Tonnes (non-hazardous, solid)
Number of opportunities	8
Employees trained in waste minimisation methods	7
Increase in process performance	3% *(increase in material utilisation in aluminium)*

Figure 18.Individual project results from Terinex Ltd

6.4 DEWHIRST TOILETRIES LTD, SANDY

Dewhirst Toiletries Ltd is based in Sandy, Bedfordshire and employs around 250 people. The company manufactures cosmetics and toiletries for the retail industry.

The management team set the project objective to increase resource utilisation of bulk material. The project extended from September 2001 until January 2002

Approach

The project initially identified the critical bulk streams during the manufacture and evaluated these using the principles of mass balance (Figure 19). The project focused on two critical aspects potentially affecting bulk utilisation, bulk waste streams, and 'give-away' (production wastes resulting from overfill).

The mass balance activity involved evaluating the process from Goods In through to Finished Goods Out using the expertise and knowledge of process operators, supporting staff, and the project consultant. A number of interesting results were identified by evaluating all of the waste streams from the manufacturing activity. Namely, some areas that were initially considered of negligible loss were shown to be a significant cause of physical waste, also some areas previously considered a significant cause of physical waste were shown to be negligible.

The mass balance activity confirmed to the management teams that route causes of waste were not consistently being realised using the current measuring systems and that modification to this system were required.

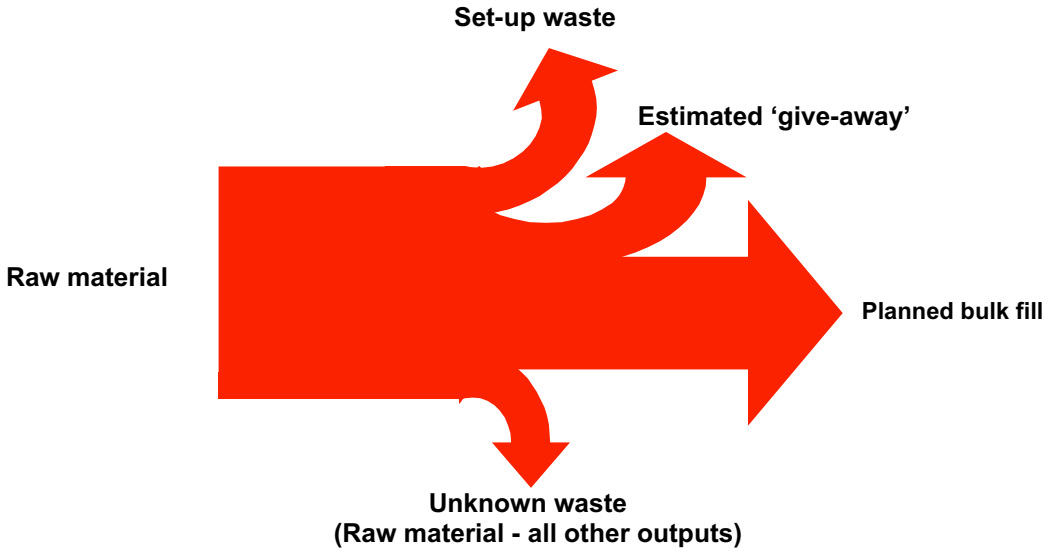

Figure 19.Mass balance diagram from bulk study at Dewhirst Toiletries Ltd

Results

The following is a list of the key recommendations and improvements made:

- The introduction of guidelines on the maximum quantity of product that can be sent to the 'wash out' to eliminate the excess losses of bulk material from washing the used containers
- A 5% increase in material utilisation could be achieved from reducing changeover and set-up waste and optimising the fill weights to minimise product 'give-away' waste
- Modifications made to the system for collecting and recording bulk waste data to clarify the root causes of waste. In addition, the feedback of scrap information was to be carried out on a departmental basis as well as site-wide to show improvement and improve operator input into root cause problem solving (Figure 20)

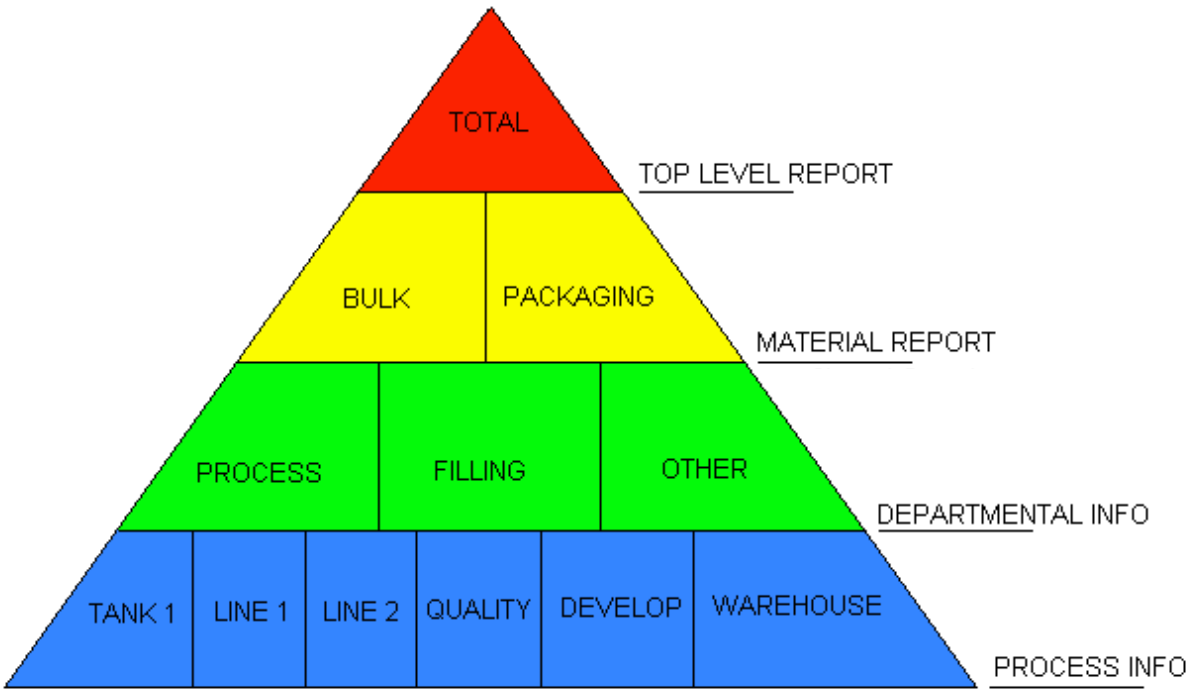

Figure 20.Strategy for the filtering of waste information at Dewhirst Toiletries Ltd

From focusing on the waste measures and going through the improvement steps (Section 3.2.2) the project identified a number issues resulting in data inaccuracy. The improvement of these issues resulted in theoretical financial savings. These theoretical savings are not included in the overall project results in Figure 21.

The overall project results are acknowledged in Figure 21.

Performance measure	Results
The reduction in discarded resource	£33,000 per annum
The reduction in site emissions	55 Tonnes (Low-hazardous, liquid)
Number of opportunities	8
Employees trained in waste minimisation methods	7
Increase in process performance	5% *(increase in material utilisation)*

Figure 21.Individual project results from Dewhirst Toiletries Ltd

6.5 MEASUREMENT TECHNOLOGY LTD, LUTON

Measurement Technology Ltd (MTL) is a Luton based company with an annual turnover of c.£25 million and employing approximately 350 people. The core production is the manufacture of electronic isolators and barriers, with over 3500 variants.

The company was in the process of planning and implementing a structure for the introduction of 'lean manufacture'. Their commitment to continuous improvement was demonstrated in their realistic approach to 'lean' and the resources provided in the execution of the project.

MTL recognised the link between running a 'lean' and efficient manufacturing facility and the creation of physical waste. The production team, led by the Operations Director, John Arnold, wanted to improve their forecasting and planning system to reduce the level of inventory resulting from excess buffers in incoming raw material and finished goods and subsequently improve resource productivity.

Approach

During March and April 2002, MTL was provided with manufacturing consultancy to focus on the planning and forecasting process to establish if the system could be improved to maintain customer service while reducing inventory stock levels onsite.

As part of the manufacturing area's implementation of 'lean' techniques the company was using Kanban to control their production flow. Kanban principally uses a visual indicator to flag to the upstream production cell that more parts are needed. Parts are then supplied downstream in a set batch size.

The following areas were investigated:

- The forecasting and purchasing system
- The planning and scheduling system
- The effective use of the production Kanban
- The controls in place to manage stock from the Stores to Finished Goods

Results

The project identified both strategic and operational opportunities. The following list is a summary of the recommendations from the project:

- Adjustments to the companies reorder points and buffer levels to eliminate excess stock buffers
- Focus on a number of priority products due to the large number of stock variants to focus resource while gaining maximum payback
- Improved unification of the controlling systems for the incoming goods and outgoing products to maximise of smooth flow of material through the site through a number of system changes
- Extension of the waste minimisation techniques to the other areas of the business

The overall projected results from this activity are acknowledged in Figure 22.

Performance measure	Result
The reduction in discarded resource	£31,500 per annum
The reduction in site emissions	1 tonne per annum (Hazardous, solid)
Number of opportunities	14
Employees trained in waste minimisation methods	2

Figure 22.Individual project results from Measuring Technology Ltd

6.6 PARRIPAK FOODS LTD, CHICKSANDS

Parripak Foods Ltd is a successful growing food processor based in Chicksands, Bedfordshire. The SME buys in vegetables and associated foods, and processes them for use in the 'ready-made meal' industry. Parripak Foods have approximately 200 employees and a current turnover of around £11 million.

During February 2002, a team made up of technical staff from Parripak Foods and the project consultant, investigated the efficiency of the compressed air system onsite. The air system was identified as a potential source of wasted resource. With the future growth in business the company were considering investing in a new compressor unit. The project objectives were to help Parripak determine the most resource efficient and waste-less system for the business or investigate ways of maximising the resource utilisation of the existing system to eliminate the need to invest.

Approach

- Initial meeting with management and technical staff to better understand the issues, the objectives and the background information
- A review of the compressed air distribution network considering layout and line sizes
- Preliminary calculations on the predicted capabilities of the distribution network, considering pressure drops, resilience to peak flows)
- A review of the findings with technical staff at Parripak Foods
- A visual review by 'site-walking' the compressed air network
- Investigation of follow-up issues

Results

The key result from the activity at Parripak Foods was identifying the route to maximising the effectiveness of the current compressor resource. The better understanding of the levels of demand that the current system was capable of coping with enabled a more efficient compressor loading sequence to be chosen. The methodology is robust against future compressed air needs (as per the requirements stated by Parripak Foods at the start of the activity). This confirmed that the capital spend of around £45,000 was not necessary at the current time.

The opportunities to maximise resource utilisation of the current system were:

1. The installation of an intelligent predictive control system to allow the system to have better flexibility to meet manufacturing demand, or
2. The change of the loading sequence on the compressor controller to better meet demand
3. Monitoring and review of compressor sequencing to ensure ongoing best match to demand
4. The upgrading of supply lines and installation of buffer pots to smooth flow variation and potentially lower overall system operating pressure
5. The consideration of changing the current blower in the peeling area to a jet booster

Of these, Option 1 was considered unnecessary given successful implementation of Option 2. Option 4 and 5, if implemented, would yield further efficiency benefits, and potentially enable lowering of system pressure saving £11,000 per annum.

The overall projected results from this activity are acknowledged in Figure 23.

Performance measure	Result
The reduction in discarded resource	£11,000 per annum
Reduction in site emissions	100 Tonnes of CO_2 per annum *(estimated primary carbon saving based on electricity reduction[11])*
Number of opportunities	5 *(2 further project opportunities)*
Employees trained in waste minimisation methods	1

Figure 23.Individual project results from Parripak Foods Ltd

Through investigating the compressed air system at Parripak Foods further opportunities were identified in water distribution, and the chilled water system onsite.

6.7 SCAPA TAPES LTD, DUNSTABLE

Scapa Tapes Ltd is based in Dunstable, and is part of the Scapa Group. The Dunstable site employs around 250 people and manufacture Industrial Tapes primarily for the automotive and medical industries. The Dunstable site is also the main European distribution centre for the Tapes sector of the business.

Approach

The project was focused on a key manufacturing line in the production area. The objective of the activity was to focus on production waste and improving process effectiveness. The main function of the line was the application of the adhesive to a tape medium. The line was a long converting machine and therefore stoppages and quality issues could result in significant product waste. The duration of the project was, October 2000 until May 2001.

The project identified that due to the resulting wastes associated from line stoppages and the corresponding relationship to process effectiveness that the main focus should be on downtime. The project consultant worked with line operators to update and improve the feedback of downtime information to establish priority focus areas using Pareto analysis.

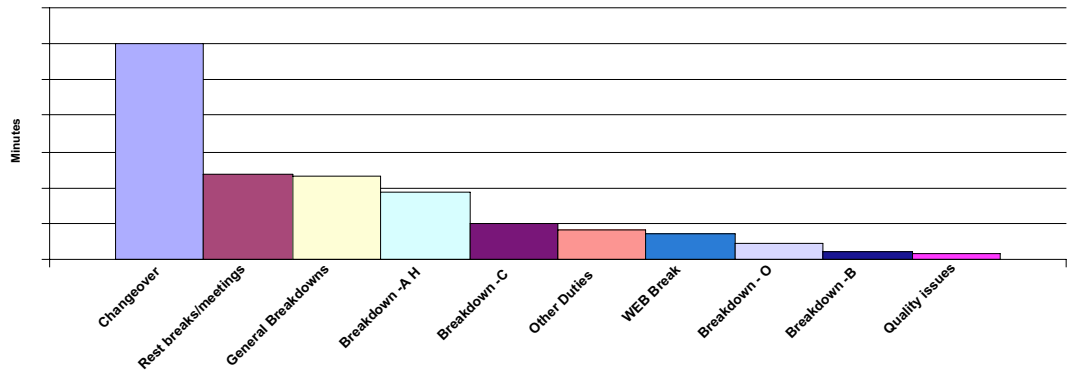

Figure 24.Pareto analysis of downtime on converting line

The Pareto analysis identified that; line changeovers, the scheduling of start-up and shutdown, and resource management, had the greatest impact on downtime (Figure 24).

After identifying priority areas the project worked with support staff, management and line operators to establish solutions and improvements that could be made to reduce downtime and stoppages. The project used SMED principals to reduce changeover downtime and identified system changes to reduce stoppages from scheduling issues.

Results

The following is a list of recommendations and improvements made:

- The implementation of clear, accurate downtime recording on the production by the production operators
- A reduction in resource in the changeover process of £5,000 from implementing the recommendations made
- A reduction in resource of £20,000 by changes to the scheduling of the line
- The identification and implementation of reuse opportunity of c.1 Tonne per annum of waste coated paper by a local manufacturer

Due to changes in internal priorities this project was not fully completed. The details and results shown are based on the information collected up until the project ended in May 2001. The overall results from the project are acknowledged in Figure 25.

Performance measure	Results
The reduction in discarded resource	£25,000 per annum
The reduction in site emissions	1.5 Tonne per annum (hazardous, liquid) Plus, 5 Tonne per annum (low-hazardous, solid)
Substitution of materials	1 Tonne (non-hazardous, solid) from reuse of waste at local company as substitute packaging material
Number of opportunities	23
Employees trained in waste minimisation methods	7
Increase in process performance	6% *(Overall reduction in downtime)*

Figure 25.Individual project results from Scapa Tapes Ltd

6.8 WEBER SBD, FLITWICK

Weber SBD is based in Flitwick. They are one of the UK sites for Weber and Broutin, an international manufacturer of construction mortars. The company designs, develops and manufacture products to meet the needs of the building and civil engineering industries.

Approach

The management felt that the bulk powder line was one of the key contributors to the company's material waste. The project objective was to focus on the process and the controlling systems used in the operation of this line to identify any areas of material loss and identify improvements. The project was carried out from September 2001 to February 2002.

The project evaluated the current systems using input by operators and supporting staff. The information highlighted some issues relating to the current collection and analysis of waste bulk material and identified opportunities to modify and improve the systems.

The project looked at both physical material waste and production waste from 'give-way'. To establish the significance of product 'give-away' the project used Control Charts to monitor and analysis the online performance from the bulking line.

Results

The following is a list of the key recommendations and improvements made:

- Adjustments to the location and design of the ventilation point at the filling heads to reduce the waste caused by extraction of powders at filling
- Smoothing of guide rails on the conveyor system to eliminate the risk of bulk waste resulting from ripped bags
- The introduction of Control Charting to evaluate batch-to-batch information and to help in the optimisation of fill weight
- Increased operator awareness as to the areas of waste and the feedback of improvements
- Introduction of automatic online weighing analysis to compliment the current check weighing facilities
- The reduction in discarded resource from improved efficient use of raw materials by implementing the improvements from the project would be c. £7,000 for 2002/3

The full introduction of the improvements from the project would reduce site emissions by a projected 65 Tonnes.

The overall results of the project are acknowledged in Figure 26.

Performance measure	Result
The reduction in discarded resource	£7,000 per annum
Reduction in site emissions	65 Tonnes per annum (Low-hazardous, Solid)
Number of opportunities	13
Employees trained in waste minimisation methods	3

Figure 26.Individual project results from Weber SBD Ltd

6.9 CAVENDISH PRINTING INKS LTD, LUTON

Cavendish Printing Inks Ltd is small producer of industrial inks to the printing industry. Their products are used in a variety of applications including; speciality wallpapers, plastics, and packaging materials. The company is an SME based in Luton employing 13 people.

The objective of this project was to identify and recommend opportunities to reduce waste that was generated from the manufacture of the printing inks. This two-day project was carried out during May 2002.

Results

The project identified opportunities in the reduction of incoming material packaging and improvements to raw material utilisation. The key recommendations from the activity were:

Packaging waste minimisation

- Minimisation of secondary packaging of incoming goods through changes in packing specifications (batch sizes, removal of unnecessary protection)
- Raising the awareness of packing 'good practise' when setting or modifying purchasing agreements with suppliers
- Focus on a long-term strategy of moving to a standard finished goods container to minimise waste caused through obsolescence or repackaging of inks for different customers

Improved utilisation of 'hazardous' raw materials

- Modification in the design of mixing drum covers to minimise solvent escape during the mixing process
- Consideration of 'conical' bottomed IBC's to improve yield on liquid constituents

The overall projected results from this activity are acknowledged in Figure 27. The management at Cavendish Inks have started a programme of reviews with current suppliers to minimise incoming packaging waste.

Performance measure	Result
The reduction in discarded resource	£2,200 per annum
The reduction in site emissions	5 Tonne (Low-hazardous, solid)
Number of opportunities	16
Employees trained in waste minimisation methods	5

Figure 27.Individual project results for Cavendish Printing Inks Ltd

6.10 RKB ABSOLUTE PRECISION LTD, SANDY

RKB Absolute Precision Ltd is a 'one-shop' aluminium-casting producer supplying predominantly to the telecommunications, defence and hi-tech electronic industries. The manufacturing facility is located in Sandy, Bedfordshire.

The objective of the project was to examine the current systems of manufacture and to identify waste minimisation opportunities. The project was carried out during September and October 2001.

Results

Managing spent silica and green sand waste

- Silica sand was a significant input resource and cost in the casting process and the project identified a number of options to manage the waste. Green sand was being reused internally but there was some inherent loss through the process. Both materials had opportunities for waste minimisation, in particular:

- Modifications to the mould production area to minimise waste from sand falling to the floor
- Eliminating the need for 'just-in-case' sand casts
- Optimising the sizes of the casting boxes to minimise the sand needed to make the cast
- Installation of an internal sand reclaim unit
- Reuse of spent sand to other industries, e.g. fine aggregates

These improvements would result in a 5% reduction in green sand waste

Reducing the utilisation of auxiliary resources

- Eliminate compressed air and CO_2 leaks and install a regular leak detection system
- Monitoring of key resources against sales output to ensure the resources are being used effectively
- Reuse of coolant by extracting it from aluminium swarf using a centrifugal spinner (also potentially increasing the resale cost of the aluminium waste)

The overall projected results from this activity are acknowledged in Figure 28.

Performance measure	Result
Reduction in site emissions	12 Tonnes per annum (non-hazardous, solid)
Number of opportunities	13
Employees trained in waste minimisation methods	3
The reduction in discarded resource	negligible

Figure 28.Individual project results for RKB Absolute Precision Ltd

6.11 DANFOSS RANDALL LTD, BEDFORD

Danfoss Randall Ltd is a heating control manufacturer based in Bedford. The Bedford site has a turnover of c. £23 million and employs approximately 250 people.

The investigation was focused on the areas of:

- Energy efficiency
- Wasted production resource
- A review of individual processes

Approach

The project assessed the performance of manufacturing cells, material flow through the site, resource utilisation and, controlling systems.

Danfoss were changing the layout of their production area. The advantages of changing to a system of group layout / manufacturing cells over the traditional process layout, are:

- Increased throughput and hence improved customer response time. Reduced production lead-times and in turn reduced customer order lead-times due to the minimisation of material movement and other “non value added” tasks

- Reduced inventory (raw material, WIP and finished stock). The aim is to get the material in, processed and out in the minimum time
- Reduced "just in case" production, i.e. run sizes are based on one-piece flow and hence can be tailored to customer orders rather than economic batch sizes
- Improved bottleneck management via increased operator flexibility
- Improved customer service

All of these factors reduce the risk of production waste and cost.

Results

Lighting is one of the significant consumers of electricity and it is recommended that the high efficiency lighting installed in half the factory be extended to the rest of the factory. All the lighting in the warehouse appeared to be switched on first thing in the morning and off last thing at night. This appeared to be irrespective of whether anybody was actually working in the area. A "switch-off" policy was required. Also, there were other areas of the factory where energy consumption needed to be monitored. The implementation of these improvements could reduce energy by 10%.

A key recommendation was to continue the improvement of the manufacturing cells by getting down to one-piece-flow. The benefits of moving to one-piece flow would be to enable the company to more closely tailor the production of goods to demand and customer requirements.

A 10% reduction in inventory could be achieved through addressing the seasonal nature of the demand by flexible working practices and other stock management improvements. This would reduce the risk of obsolescence, damage and loss.

Prior to the start of the project Danfoss had successfully identified and implemented opportunities to reduce packaging waste with their suppliers. Danfoss started this process with intra-group vendors in the supply chain as these opportunities could be managed more easily. Some minor recommendations were made to further improve packaging waste reduction e.g. the relocation of cardboard collection points to aid the recycling process. It is estimated that the above changes could reduce the solid site emissions by one Tonne per annum.

The overall projected results from this activity are acknowledged in Figure 29.

Performance measure	Result
The reduction in discarded resource	£14,000 per annum
Reduction in site emissions	1 Tonne per annum *(Hazardous, solid)*
Number of opportunities	10
Employees trained in waste minimisation methods	2
Increase in process performance	10%

Figure 29.Individual project result for Danfoss Randall Ltd

CONCLUSIONS

- The importance of local and national business organisations in promotion and implementation of waste minimisation projects is critical to early recruitment. The successful network of local business support in Bedfordshire undoubtedly was a significant factor in the high percentage of companies partaking in a company an in awareness visit. This factor was also further evident from the keen interest of local manufacturers in developing systems for waste minimisation in a difficult economic climate
- Initial appraisals were an essential part of any ongoing project as they provided the management team with a personal understanding with the project consultant. The result of this was companies benefited from rapid project momentum and improved understanding by the consultant of the processes
- The identification and implementation of 'quick-fix' opportunities early in a waste minimisation activity can have an overwhelming positive impact on the success of more difficult improvements later in the project. Successful implementation is brought about through 'buy-in' from the team, operators, and management. The benefits of a 'quick-fix' improvement are; the instant payback, the increase in team momentum, and the immediate visual impact, all helping early, fast 'buy-in'
- Even with the increased awareness of waste minimisation it was still evident that manufacturers still misunderstood the terminology and in many cases still considered this to be a waste management issue. Initial appraisals enabled the explanation of the holistic approach to waste minimisation 'at source' and often increased the interest of management.
- To disregard any idea as not fitting the acceptable criteria of 'waste minimisation' de-motivates employees and results in difficulties in sustaining a positive cultural change and attitude to improvement. Ideas breeds ideas.
- Through ensuring that the project eliminated the worries of immeasurable financial risk to the business, the Bedfordshire project was successful in engaging SME's of less than 50 employees in phase one projects. In addition the value and implementation of waste minimisation was quickly realised and valued.
- The effect of business objectives and pressures on project acceptance and successful implementation is critical. The rapidly changing face of manufacturing results in many companies changing strategic direction at short notice. These strategic changes could and in some cases did impact the projects as they changed the focus of available resource. Although recommendations were accepted as helpful the realisation of these opportunities were often moved into the future
- The Environment Agency's approach (1998) stresses the importance of clear, accurate measurement data to enable the correct conclusions to be made. A considerable quantity of the time and resource allocated to a project was taken in ensuring the accuracy of data.
- The project identified inventory and the control and management of stock as the most significant factor affecting resource utilisation. This factor could result in material damage, obsolescence, excess transportation and handling, increased space requirements, unproductive time, customer service issues, increased overheads as well as concealing other potential improvement opportunities.

SUMMARY OF PROJECT RESULTS

Number of companies contacted	*= 101 manufacturers*
Number of companies provided with an appraisal	*= 38 companies*
Funds paid back into the project by participating companies (£'s)	*= £3,000*
Further R&D opportunities created (Number of proposals)	*= 7 opportunities*
Months during which project operated (Number of months)	*= 25 months*

The overall results from the individual company projects

Reduction in discarded resource (£'s)	*=£339,700 per annum*
Employees trained in waste minimisation methods (Number of individuals)	*= 54*
Number of opportunities	*= 193*
Substitution of materials (Tonnes/grams)	*= 2 Tonne per annum*
Reduction in site emissions (Tonnes/grams)	*= 1,100 Tonnes per annum*
Increase in process performance (Measures specific to individual companies)*	*= see individual company projects*

APPENDIX A

Companies visited between June 2000 – June 2002
ABB Kent Meters Ltd
Abbey Corrugated Ltd
ACO Technologies plc
Aerospace Composite Technologies Ltd
BK Engineering Ltd
BE Aerospace UK Ltd
Binney & Smith (Europe) Ltd
BOSS Manufacturing Ltd
Cardale Engineering Co. Ltd
Cavendish Printing Inks Ltd
Comau Estil
Danfoss Randall Ltd
Daray Lighting Ltd
Dewhirst Toiletries Ltd
FAI Automotive plc
Gossard Ltd
Grundfos Pumps Ltd
Honeywell
Kensal Ltd
Measurement Technology Ltd
Milcutt Engineering Ltd
Parripak Foods Ltd
Plysu Brands Ltd
Polestar Specialist Colour Ltd
Polyformes Ltd
RKB Precision Products Ltd
Saxon Valley Foods
Scapa Tapes UK Ltd
SKF (UK) Ltd
Stanbridge Precision Turned Parts Ltd
Terinex
Transfixt Ltd
Unistrut Ltd
The Wallis Laboratory Ltd
Watkiss Automation Ltd
Weber SBD
Walk Off Mats International
York House (Meat Products) Ltd

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