Material change for a better environment

**Final Report**

# Opportunities for resource efficiency in the food and drink sector

Site waste prevention reviews Summary Report: FDF members

Material change for a better environment

Food and Drink Federation

Making a real difference

OAKDENE HOLLINS RESEARCH & CONSULTING

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# Executive summary

**Studies have shown that there are significant waste arisings - and subsequent resource efficiency savings opportunities - within the UK food and drink manufacturing sector.**

For example:

- The March 2010 WRAP food baseline study estimated the waste arising from the UK food and drink manufacturers at 5.0 million tonnes with a further 2.2 million tonnes of by-products sent for animal feed; and
- The October 2007 Defra report[1] estimated the no-cost / low-cost resource efficiency savings within the UK food and drink manufacturing sector at 19.3% or £995 million, placing it second (after road freight) in terms of the UK economic sector with the most significant no-cost / low-cost savings opportunities (Appendix 1).

In 2008 the Food and Drink Federation (FDF) and Defra commissioned a survey of all FDF's member production sites (236) to assess packaging and food waste produced from operations, part of work to implement FDF's Five-fold Environmental Ambition to send zero food and packaging waste to landfill from 2015. The report on this work, *Mapping Waste in the Food Industry*[2], revealed that a modest amount of waste was sent directly to landfill– 16.5% of total waste – and that 82% of all waste was recycled or recovered in some way. Mixed waste represented the highest level of waste sent to landfill amounting to 135,000 of the 138,000 tonnes recorded. This work has since been updated and indicates[3] a reduction in the percentage of waste going to landfill (now 9%) with 90.3% recovered or recycled in some manner.

Following the 2008 survey the FDF and WRAP formed a partnership to review the food and packaging waste generated in FDF member companies through a series of site reviews; the partnership being formed due to the synergy between the two organisations' business objectives. This report summarises the findings from these site waste reviews, undertaken between January and September 2009. The 13 sites visited were diverse in nature, falling into the following sub-categories:

- frozen foods;
- tea, coffee and delicatessens;
- prepared sandwiches;
- ready meals;
- sweets and chocolate snacks;
- biscuits and snacks;
- soft drinks;
- ice creams; and
- jams, preserves and desserts.

**Methods**

The method used in the waste reviews consisted of a data collection and analysis stage using site walk-throughs and Pareto analysis, followed by solution development. The site walk-throughs and Pareto Analysis allowed significant opportunities to be identified and quantified, enabling the development of the following focus areas:

- SKU analysis;
- Spillage allowances;
- Raw material packaging; and
- Waste management.

These focus areas applied to all sites visited and as such, allowed for benchmarking and the development of generic solutions that could be applied across a number of manufacturers, enabling more time to be concentrated on tackling site and product specific problems.

[1] *Quantification of the Business Benefits of Resource Efficiency by Oakdene Hollins and Grant Thornton (2007). Defra.*

[2] *Mapping Waste in the Food Industry (2008). Defra and the Food and Drink Federation.*

[3] *Mapping Waste in the Food and Drink Industry (2010). Defra and the Food and Drink Federation*

Site walk-throughs typically started at goods-in, finishing at despatch and waste handling. This meant the entire process was studied, and opportunities that reduced waste and improved efficiency across a number of areas could be identified. Pareto analysis, using the data provided by the companies, proved to be extremely useful in identifying opportunities. In particular, it was important in identifying opportunities that generated the greatest returns to the business.

**Observations and key findings**

In general, the waste reviews highlight the significant progress companies have made on improving their waste management activities and, in particular, diverting waste from landfill. Most companies visited appear to be on course to fulfil their commitment to the FDF's 'Five-Fold Ambition', of sending zero food and packaging waste to landfill from 2015. This is considered by the review team as a positive first step in resource efficiency, breaking what historically would have been regarded as 'business as usual' environmentally negative practice.

Many of the companies observed appear ready to improve their resource efficiency through the implementation of waste reduction or lean production. However, making such improvement requires some major changes to current working practice. For example:

- For many of the companies reviewed, resource efficiency is the responsibility of an individual with insufficient power or organisational support to implement waste reduction or lean production. In the sites that have successfully moved beyond the waste management approach to resource efficiency, the new approach is embedded into the culture and mind-set of the whole organisation (see Appendix 2).
- Successful implementation requires adoption of business level environmental Key Performance Indicators (KPIs) and associated data capturing systems. These will provide the business targets through which to drive the change.

It was not possible to fully quantify the benefits to each company of moving to a more advanced approach to resource efficiency, but the following examples were found where such an approach could be applied:

- ***Lack of contingency planning for rework.*** Current reasons for rework include:
  - The continuous nature of the production lines commonly used in the food manufacturing sector means that the lines cannot be readily switched off when problems arise;
  - A focus on process efficiency rather than production effectiveness, i.e. trying to run every operation at full speed rather than balancing the throughput of each operation to ensure the smooth running of the line; and
  - An acceptance of waste arising from the poor setting up of the line. This can be common on production lines with short production runs where the payback for getting it right is perceived to be insignificant.
- ***Reliance on traditional small sized packaging units for the supply of ingredients***. For example, 25kg bags are still a very common delivery format even for medium volume ingredients, and inbound goods in standard retail size packs - such as standard loaves of bread - are also commonplace.
- ***High use of single-trip packaging***. For example, stretch wrap and corrugated cardboard. This was particularly prevalent on inbound goods.
- ***Lack of quantifying and challenging of absolute raw material wastage.*** A significant level of raw material wastage is currently unchallenged or hidden within waste allowances.

**Key recommendations**

The recommendations made throughout this report to improve prevention of waste within food and drink manufacturing are as follows:

- Integrate resource efficiency across the organisation;
- Develop a set of KPIs to drive improvement;
- Communicate performance to all levels of the organisation to drive resource efficiency improvements;
- Develop contingencies to handle process rework and reintroduce it;
- Challenge the supply of materials to reduce packaging and explore options such as reusable packaging, road tanker deliver and production ready packaging;
- Eliminate waste allowances and focus on absolute raw material wastage; and
- Implement visual waste management to encourage better waste segregation an identify opportunities to divert waste from landfill.

The resource efficiency opportunities, outlined above, can be seen to range from those that are relatively easy to implement as individual improvement projects to those requiring organisation-level cultural change. Encouragingly, from a sector-level perspective, good practice is evident for each of the identified resource efficiency opportunities, demonstrating that solutions exist and that it will be possible to realise the opportunities presented. The key recommendation is, therefore, to investigate how to communicate, and hence encourage the sector-level take up of, current good practice. One suggestion made herein is for the delivery of workshops with representatives of the food and drink industry, focused on the dissemination of different aspects of 'Lean' manufacturing good practice.

Recommended communication topics are:

- Development of a resource efficiency culture;
- Segregation of waste;
- Production-ready packaging; and
- Manufacturing excellence in the food and drink industry.

Observed examples of good practice that could also be implemented are:

- Information boards displayed on the shop floor, including a handwritten message from each member of the senior management team. This includes a review of production output, quality, waste and health and safety, as well as the outcomes from trials and details of forthcoming projects. Each message is updated monthly.
- Environmental KPIs showing output (kilograms of material included within the sold products) versus input (kilograms of purchased materials).
- Review waste management methods and use appropriate labelling e.g. general mixed waste bins listing all the waste streams that should and should not be put in the bin. Spot checks are then undertaken to ensure compliance.
- Rework contingency plans including:
  - Optimisation of the level of line downtime through systematic maintenance and continuous improvement strategies;
  - Good production practices such as line balancing and 'right first time' set up strategies;
  - Having systems in place to accommodate rework where appropriate, e.g. accumulation tables; and
  - Having systems in place to quickly reintroduce rework back onto the line.

**Quantification of savings opportunities**

Table E1 below summarises the aggregated savings opportunities identified at seven sites that provided data for evaluation.

**Table E1:** Summary of food and packaging waste produced and opportunities identified

| Total food and packaging tonnage to market | Total waste generated (tonnes) | Total waste to landfill (tonnes) | Food waste | | | Packaging waste | | |
|---|---|---|---|---|---|---|---|---|
| | | | Waste arising (tonnes) | Waste arising (value) | Achievable food waste reduction (tonnes) | Waste arising (tonnes) | Waste arising (value) | Achievable packaging waste reduction (tonnes) |
| 249,434 | 36,271 | 11,258 | 24,003 | £12,015,847 | 10,811 | 1,245 | £2,074,478 | 175 |

By extrapolating these results, the total achievable savings for all FDF member companies can be calculated, as shown in Table E2 below.

**Table E2:** FDF member savings opportunity

| Resource efficiency opportunity | Total waste arising (tonnes) | 10% savings opportunity (tonnes) | Savings per tonne (value) | 10% savings opportunity (value) |
|---|---|---|---|---|
| **Food waste** | 604,883 | 60,488 | £500 | £30.2 million |
| **Packaging** | 94,900 | 9,490 | £1,666 | £15.8 million |
| **Mixed food and packaging** | 134,819 | 13,482 | £558 | £7.5million |
| **Reused food*** | 506,898 | 50,690 | £430 | £21.8 million |
| **Total** | **1,341,500** | **134,150** | **£561** | **£75.3 million** |

Note*: Assumes the cost differential between the disposal of waste and the reuse of food is £70 and hence the savings per tonne is £500 - £70.

Based on the estimate above that the savings opportunity within the UK food and drink sector is ca.720,000 tonnes and assuming average savings of £561 per tonne (as noted in E2), the value of savings for the whole UK food and drink manufacturing sector is estimated at £404 million.

# Contents

# Glossary

BOM Bill of materials
Defra Department for Environment, Food and Rural Affairs
FDF Food and Drink Federation
KPI Key Performance Indicator
'Lean' Lean Manufacturing: production practice that considers the expenditure of resources for any goal other than the creation of value for the end customer to be wasteful, and thus a target for elimination.
OEE Overall Equipment Effectiveness
PRP Production Ready Packaging
Rework The practice of using previous batches of product in production runs of other products.
RTP Returnable Transit Packaging
5S A workplace organisation methodology that uses a list of five Japanese words which are seiri, seiton, seiso, seiketsu and shitsuke.
SKU Stock keeping unit
SPC Statistical process control
WRAP Waste & Resources Action Programme
ERP An enterprise resource planning (ERP) system is an integrated computer-based application used to manage resources

# Acknowledgements

WRAP is grateful for the opportunity to study the supply chain at each of the 13 sites and appreciates the support and hospitality extended by the businesses and the Food and Drink Federation. In particular, WRAP would like to thank those responsible for the co-ordination of the site visits and provision of the data requested.

# 1.0 Introduction and Background

In October 2007 the Food and Drink Federation (FDF) committed, on behalf of its members, to make a significant contribution to improving the environment by targeting priorities where they can make the biggest difference. Working collectively, their 'Five-Fold Ambition' is to:

- Show leadership nationally and internationally by achieving a 20% absolute reduction in $CO_2$ emissions by 2010 compared to 1990 and aspiring to a 30% reduction by 2020.
- Send zero food and packaging waste to landfill from 2015.
- Make a significant contribution to WRAP's work to achieve an absolute reduction in the level of packaging reaching households by 2010 compared to 2005 and provide more advice to consumers on how best to recycle or reuse packaging.
- Achieve significant reductions in water use and contribute to an industry wide absolute target to reduce water use by 20% by 2020 compared to 2007.
- Embed environmental standards in their transport practices including contracts with hauliers as they fall for renewal to achieve fewer and friendlier food transport miles and contribute to an absolute target for the food chain to reduce its environmental and social impacts by 20% by 2012 compared to 2002.

As part of taking forward the landfill ambition in 2008 the FDF and Defra commissioned [4]a survey of all FDF's member production sites to assess packaging and food waste produced from operations. The report on this work revealed that a modest amount of waste was sent directly to landfill – 16.5% of total waste – and that 82% of all waste was recycled or recovered in some way. Mixed waste represented the highest level of waste sent to landfill amounting to 135,000 of the 138,000 tonnes recorded. This work has since been updated (2010)[5] with a survey of 149 production sites, which showed a reduction to 9% going to landfill and 90.3% recovered or recycled in some manner.

## 1.1 WRAP waste review background

The FDF invited WRAP to conduct waste prevention reviews across member companies to support their 'Five-Fold Ambition' and WRAP's own objectives in support of the Courtauld Commitment.

The key aims of the reviews were to:

- Identify waste streams in packaging, food/product and water usage within the supply chain from goods inwards to despatch to customer;
- Suggest possible solutions to minimise or eliminate waste and encourage diversion from landfill;
- Reduce packaging weight introduced upstream in the supply chain including primary, secondary and tertiary packaging by identifying over-specification;
- Reduce food/product wastage by re-engineering packaging and/or methodologies where appropriate; and
- Identify good practice design/methodologies and/or solutions that could be communicated and utilised across the sector to reduce wastage and promote diversion from landfill.

# 2.0 Method

The reviews have followed a set process as detailed in Figure 1. This report concentrates on activities conducted and outputs concluded to complete the review to the end of Stage 4.

## 2.1 Key focus areas

The waste reviews involved focussing on a number of key areas where it is known that significant resource efficiency opportunities can often be found, as well as calling upon the knowledge of the waste review team to identify the more ad hoc resource efficiency opportunities. The key areas have included:

- Stock Keeping Unit (SKU) analysis;
- spillage allowances;
- raw material packaging; and
- waste management.

[4] *Mapping Waste in the Food Industry (2008). Defra and the Food and Drink Federation*

[5] *Mapping Waste in the Food and Drink Industry (2010). Defra and the Food and Drink Federation*

### *2.1.1 SKU Analysis*

The product range in many food and drink companies can number in the hundreds or thousands of SKUs, driven by customer demands. This places extreme pressure on a company's production system, since many have to accommodate the full product range on no more than 10 production lines. This can lead to high levels of production change-over waste and warehouse waste.

The SKU analysis involves plotting Pareto curves with each SKU shown on the x-axis and their respective sales revenue on the y-axis; an example of this can be seen in Figure 1. The SKUs are listed in order of significance with the SKU generating the highest sales revenue shown first. A cumulative contribution to total sales revenue curve is plotted to show the overall sales profile. From a Pareto perspective, it would be anticipated that 80% of sales would be generated from just 20% of SKUs. This clearly is the hypothetical scenario that can be tested within the waste review when suitable data is provided.

The objective of the analysis is to determine whether there is any scope for product rationalisation. Introducing a formal delisting protocol is one possible opportunity for such rationalisation. Further analysis can be undertaken to determine whether the right products are being produced on the right production lines, i.e. high volume products on the high volume lines.

**Figure 1:** Waste review methodology

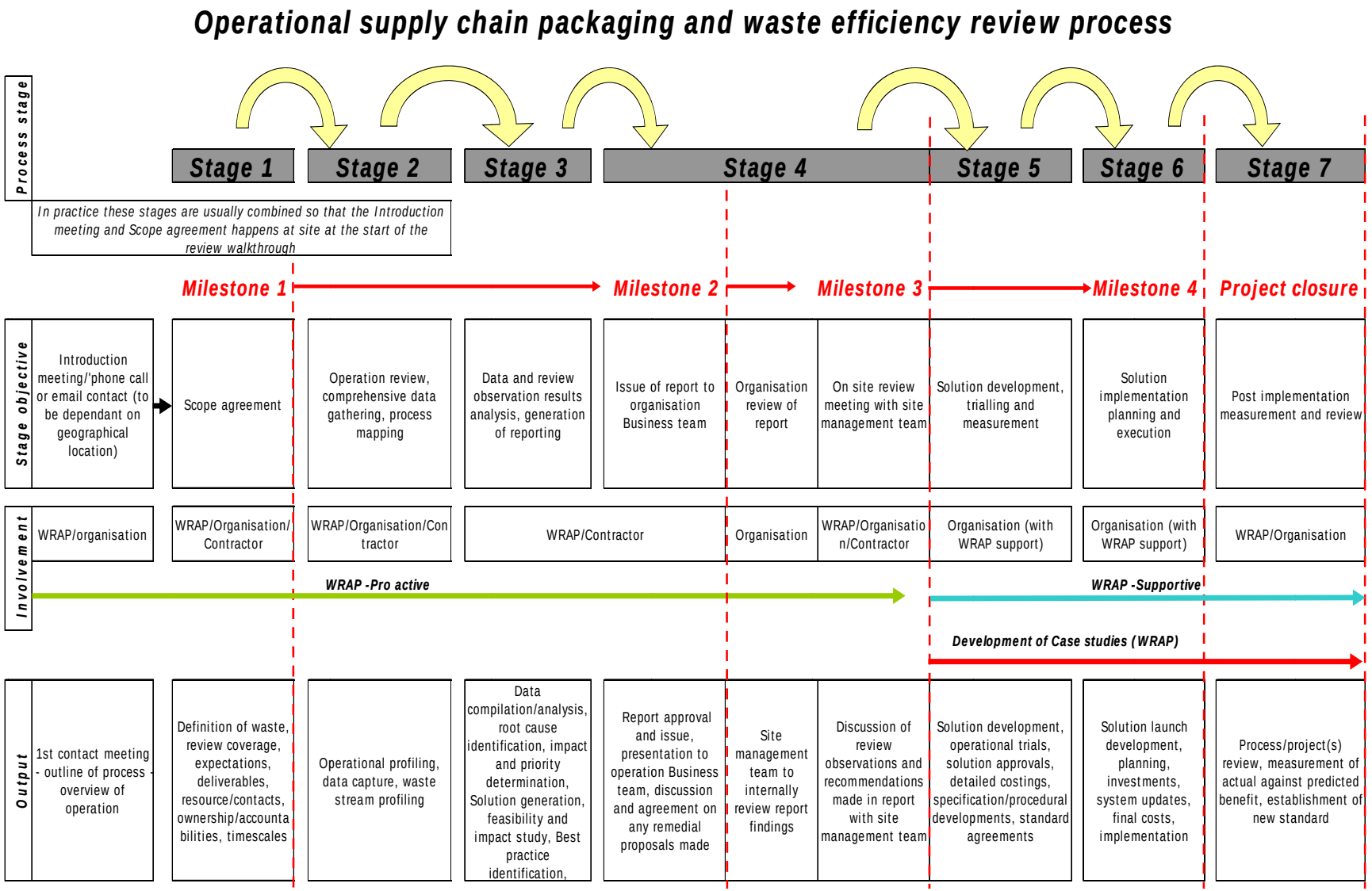
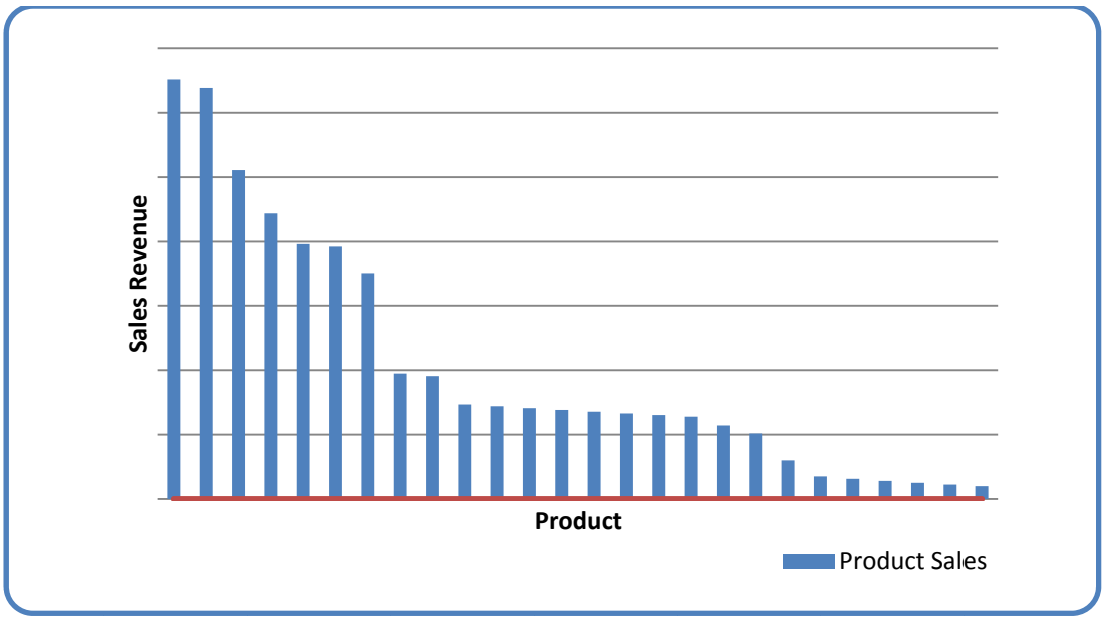


**Figure 1**: SKU analysis

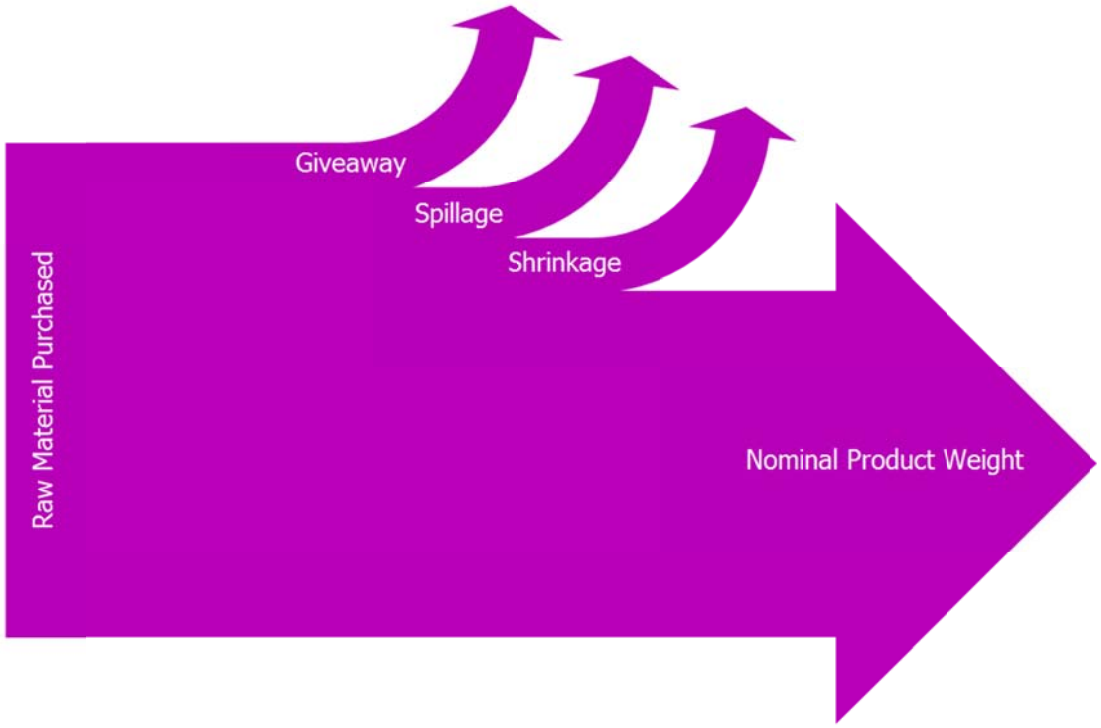



### *2.1.2 Spillage Allowances*

Many companies, not only in the food and drink industry, include a spillage or waste allowance within their bills of materials (BOMs) and within their costing budgets. Since this is accounted for, it often remains unchallenged and considered as an inherent or embedded waste. Variance reports that are reviewed on a daily, weekly or monthly basis focus on the waste arising above the spillage allowance. Since these wastes are not included within the accounting system they are often considered worthy of greater attention.

Within the waste reviews the lost opportunity costs associated with the spillage allowance are quantified on a per-ingredient basis. The most significant ingredients in terms of cost are then studied to determine where the losses occur. This is presented in a Sankey diagram in Figure 3.

**Figure 3:** Material loss



### 2.1.3 Raw material packaging

Analysis of the raw material packaging often provides considerable opportunities to reduce waste. The site walk-around typically begins in the 'goods-in' area where ingredient and production storage and packaging are observed. Opportunities are estimated to reduce the overall packaging on raw materials, particularly where high volume materials are delivered in small packages, such as 25kg bags. Other areas addressed include where packaging includes unnecessary, additional, layers and cases that are over-specified, e.g. using heavy gauge cardboard where a much lighter gauge would be sufficient. Also identified are opportunities for packaging optimisation, where packaging material could be replaced with another, more easily recycled or reused material.

Combining the observations with the goods received data provided by the manufacturer, as well as using knowledge of typical packaging weights, allows the total amount of packaging to be calculated and potential reduction solutions quantified.

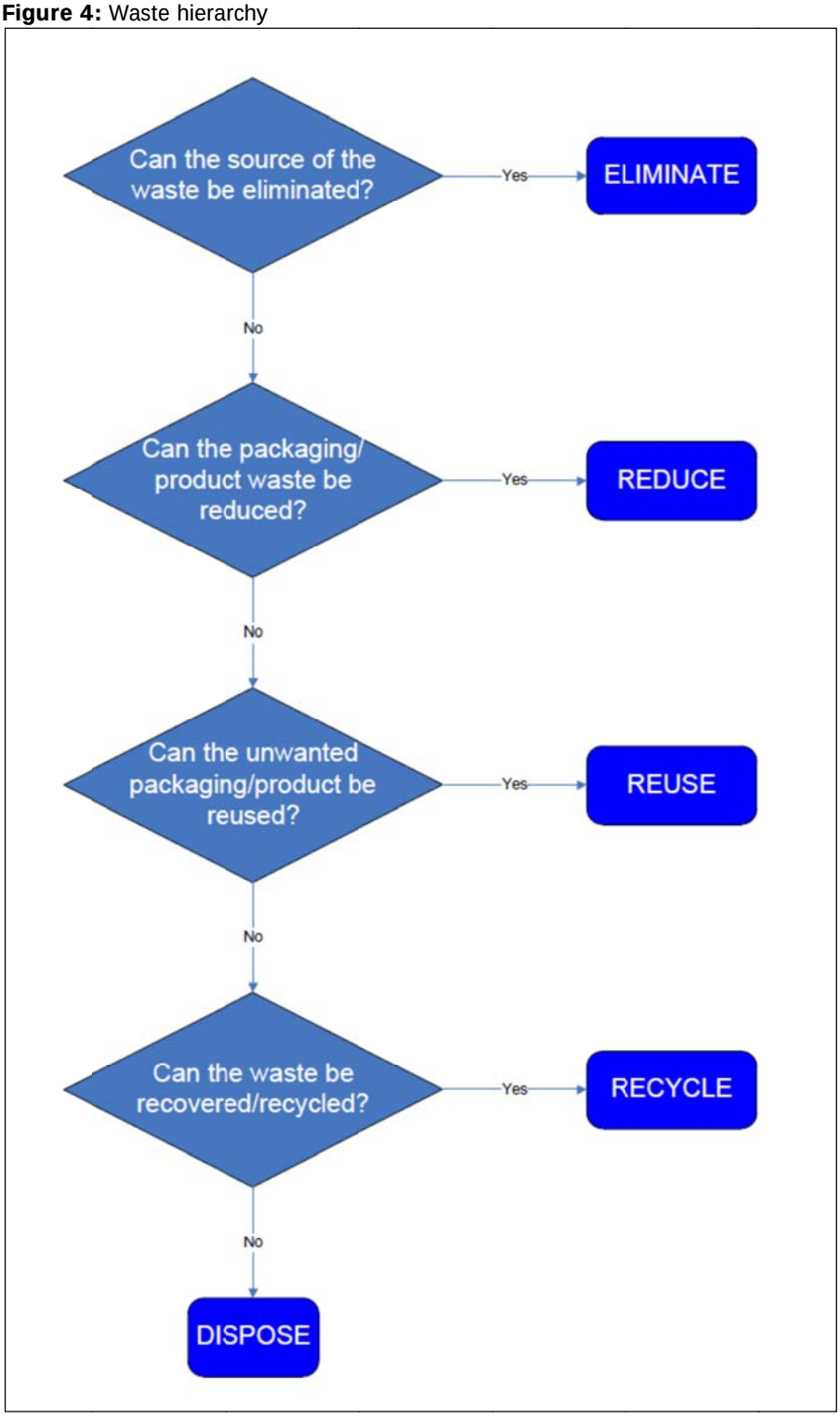
### 2.1.4 Waste management

As part of the site reviews and data analysis, each company's waste management system is evaluated. During the site walk-around the number, type and location of waste/recycling bins is noted as well as any communication or signage. Bin audits are conducted to identify whether bins are being used correctly and waste is properly segregated.

Through the data it is possible to determine each organisation's waste levels, rate of recycling and current and future landfilling costs. These data are then used to quantify recommendations made.

Also examined are disposal methods and whether the organisation is dealing with its waste in the most sustainable way. The waste hierarchy (Figure 4) is used to identify opportunities to eliminate, reduce or reuse waste, as well as ways to generate revenue from the waste stream.

**Figure 4:** Waste hierarchy




## 2.2 Methods review

The methods used to assess the organisations and analyse their data have proved to be robust. In particular, it was clear that analysing ingredients and SKU's using the Pareto approach was robust in identifying areas for focus and improvement.

Inevitably the quality of the data obtained will have a marked impact on the conclusions that can be drawn and the recommendations made. Within this project the quality of the data varied greatly from organisation to organisation. Although the data required for these audits is for the specific purpose of identifying and reducing waste, it is reasonable to expect that all organisations should have these types of data available, as they have committed (through the FDF) to reducing waste.

It was noted that some of the organisations that employed large, expensive and complicated Enterprise Resource Planning (ERP) systems provided worse quality data than others that employed other, more simple, recording methods. This shows that whatever measurement system is used, good application and management is required to ensure effective data management.

## 2.3 Company feedback

All waste reviews were undertaken in strict commercial confidence and feedback received from companies engaged in the site reviews has been positive. One company in the frozen meals sector has published the results of the waste review and how they have acted on the recommendations, reporting a commitment of £630,000 for returnable transit packaging (RTP) to replace cardboard packaging, improved waste segregation, a review of low volume products and improvements in pallet stacking patterns.[6]

[6] *http://www.apetito.co.uk/CMS/files/Sustainability%20Update%20Autumn%202009.pdf*

## 3.0 Observations, key findings and recommendations

**Error! Reference source not found.**Table 1 quantifies the waste arising and the resource efficiency savings opportunities identified across the 13 site reviews. In terms of how the savings could be realised, the waste reviews identified the following approaches:

- Integration of resource efficiency into the organisation, moving beyond waste management;
- Development of environmental Key Performance Indicators (KPIs) and associated data;
- Improved communication of performance to the shop floor;
- Development of contingency planning for rework or machine breakdown;
- Improved line balancing;
- Challenging traditional material supply, including the reliance on small sized packaging units for the supply of ingredients and a heavy use of single-trip packaging;
- Quantifying and challenging absolute raw material wastage; and
- Visual waste management including improved segregation of waste, communication (signage) and discipline.

**Table 1**: Summary of food and packaging waste produced and opportunities identified from the sites providing data for review

| Total food and packaging tonnage to market | Total waste generated (tonnes) | Total waste to landfill (tonnes) | Food waste | | | Packaging waste | | |
|---|---|---|---|---|---|---|---|---|
| | | | Waste arising (tonnes) | Waste arising (value) | Achievable food waste reduction (tonnes) | Waste arising (tonnes) | Waste arising (value) | Achievable packaging waste reduction (tonnes) |
| 249,434 | 36,271 | 11,258 | 24,003 | £12,015,847 | 10,811 | 1,245 | £2,074,478 | 175 |

### 3.1 Integration of resource efficiency into the organisation

Typically, organisations, especially those which focus on such waste management initiatives as diversion of waste from landfill, include resource efficiency under the general classification of environmental management; 10 of the 13 sites visited adopt this approach. Unfortunately, the environmental management role can be detached from mainstream operations and is often delegated to a single person or function with little influence in the organisation. This focus on 'end of pipe' resource efficiency opportunities significantly reduces the level of savings opportunities that can be realised, since the high value savings are generally associated with reductions in raw material usage (ingredients, packaging, etc.). For such raw material savings to be realised, it is important that, at the very least, production management is fully engaged.

Three of the 13 sites visited demonstrated a structured, process-level continuous improvement culture that was firmly embedded into the organisation. The approaches used in these three companies were representative of the 'Lean' production approach. 'Lean' is a tool for competitiveness, capital productivity and customer satisfaction. With well documented financial benefits, it is often driven from senior management and, as a result, 'Lean' becomes very much ingrained into a company's culture and part of everyone's role (see Appendix 2).

Although evidence shows that a 'Lean' focus will generate the greatest improvements in resource efficiency, the environmental management approach can represent a significant first step; realising quick wins that can generate considerable enthusiasm and momentum early on in a resource efficiency campaign, priming the organisation to embrace lean manufacturing or similar continuous improvement initiatives. The focus on diverting waste from landfill is considered a particularly good example, since it involves breaking long term habits and hence changes mind-sets. It has been demonstrated that starting out with smaller quick wins and building up momentum gradually can produce much greater long term results than attempting to change an entire organisation in a short period of time[7].

It was noted that, although significant opportunities for resource efficiency savings were identified at all 13 sites, four companies did not follow the review methodology (shown in Figure 1) beyond Stage 4. Of these four companies, two were regarded as having an embedded culture of continuous improvement. One possible reason for these companies not following all seven stages was that they had internal mechanisms in place to quickly convert the ideas and opportunities identified using the waste review into solutions.

[7] *Collins, Jim (2001). Good to Great. New York: HarperCollins.*

For the other two sites that engaged only up to stage 4 of the review, a possible reason may be time constraints. In many organisations, the environmental management role is combined with that of health and safety and facilities management, and hence there may have been insufficient time to follow all seven stages of the methodology.

It is recommended that manufacturers incorporate resource efficiency into the organisation through company-wide goals set by top level management. Through these goals and by making resource efficiency the responsibility of all departments, and not only that of an 'Environmental Officer', the existing practices will be challenged and a culture of resource efficiency will be fostered.

## 3.2 Development of environmental KPIs and associated data

The waste reviews found a number of companies performing below average in terms of the resource efficiency data being captured or managed. The effective use of data is a fundamental requirement to realising resource efficiency opportunities. The quantification of savings opportunity provides the evidence base for justifying the need for action and the level of resources that should be assigned to the development of a solution; it provides for performance monitoring and process control. Organisations that fail to measure performance have been shown to be unaware of improvement areas and typically believe that they are performing at a higher standard than is actually the case.

A relationship was observed between the establishment of robust KPIs and targets and organisational performance. The two highest performing sites visited had established targets that exceeded the FDF's own commitments, particularly by aiming to eliminate all waste to landfill by 2012 compared with 2015. The KPIs used were clear and easy to understand and posted in prominent locations such as entrances and on large banners so that everybody was aware of them. Although a direct causal link that establishing KPIs leads to good performance has not been identified, it is considered highly probable that measurement helps in identifying areas to improve and that targets give team members an incentive to improve.

The establishment of KPIs also drives the development of an effective data management system. For example, a common KPI for a production process is Overall Equipment Effectiveness (OEE). Establishing OEE as a metric then drives the need for data required for OEE calculation to be recorded, stored and manipulated.

It is important to recognise the need to measure intermediate stages in waste creation. For example, measuring the total amount of waste created on site is good for benchmarking and measuring overall performance but may not be useful in finding specific causes of waste. Recognising the contributors to waste and measuring both the special causes (breakdowns, quality issues, inaccurate forecasting) and inherent causes (poor line set up, ineffective packaging, material shrinkage) is important in realising resource efficiency.

It is recommended that manufacturers develop a robust system of KPIs that measures waste where it is created in order to better identify causes and drive improvement. Some examples of KPIs to use are shown in Table 2.

**Table 2**: Examples of Key Performance Indicators for waste prevention

| Performance Area | Metric |
|---|---|
| **Output** | Kg of good product produced |
| **Quality** | Customer complaints, for example. |
| **Reliability** | Breakdowns |
| | Downtime |
| | Overall Equipment Effectiveness (OEE) |
| **Product Waste** | Rework produced |
| | Rework used |
| | Food waste |
| **Total Waste** | Total produced |
| | Waste to Landfill |
| **Material Variances** | Cardboard waste |
| | Material required vs material used |

## 3.3 Improved communication of performance to the shop floor

From visiting the 13 sites, it is believed that communication of performance to shop floor personnel could be improved. Many of the sites had little or no information or data posted and where sites did make use of line boards, it was felt that some of the information displayed was not useful and detracted from the rest of the board. However, it has been observed that two out of the 13 sites have exceptional communication with shop floor personnel via line boards and posters as well as morning meetings, indicating that some companies are aware of the benefits of good communication.

It is believed that there is a strong correlation between effective communication with shop floor personnel and good organisational performance. This has been observed during the site visits and reinforced through considerable anecdotal evidence from successes in 'Lean' methodologies. Effective communication of performance, targets and goals with shop floor personnel provides them with information to improve their performance and assist in continuous improvement efforts.

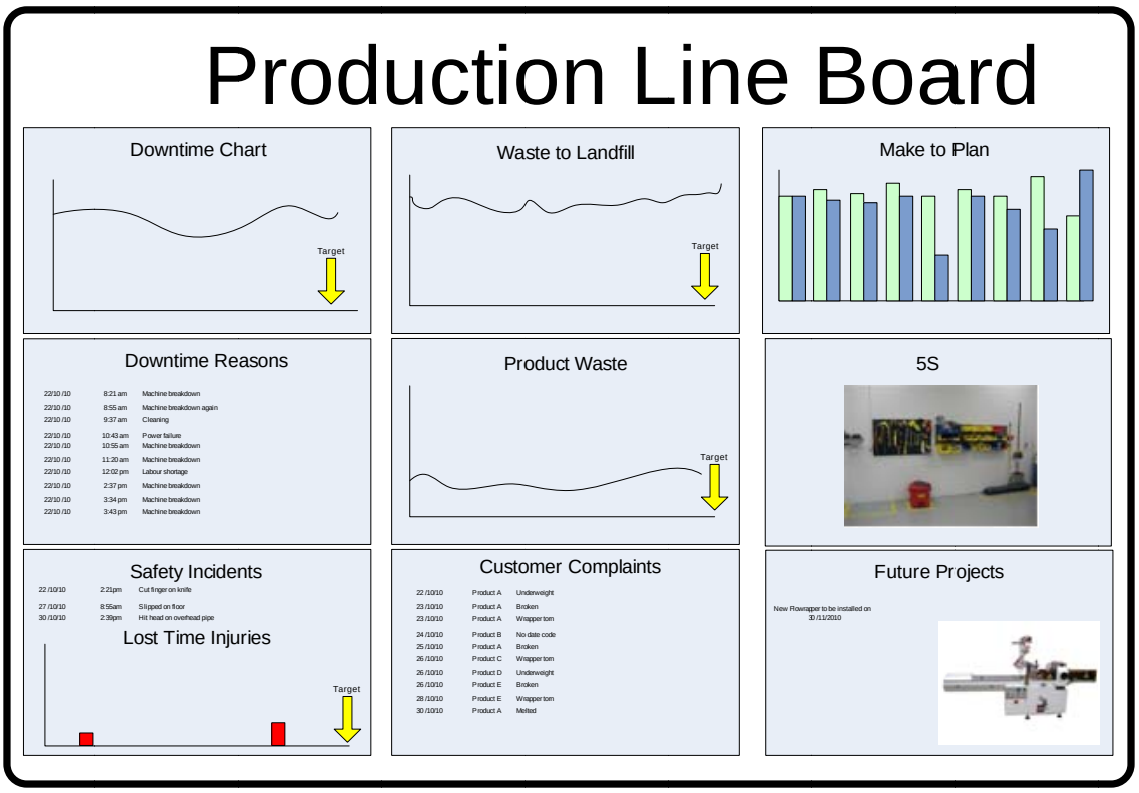
The relevance of data and information communicated to shop floor personnel on line boards is extremely important. At one site, a spread sheet containing a number of pages of data had been posted. It is questioned how relevant this is to shop floor personnel where the messaging on such boards needs to be quick and to the point. The following recommendations were made:

- Install line boards in appropriate locations within the production plant.
- Line boards should cover areas on which shop floor associates can make a direct impact, such as production/downtime, quality, waste, health and safety and 5S[8]. However, it is also recommended that any important news is also posted, particularly engineering changes (new equipment or upgrades), new staff and company level announcements such as new products or acquisitions.
- Display information that is accurate, relevant and up to date and use the boards as the basis for pre-shift meetings.
- Regularly review the boards to identify improvement opportunities.

**Error! Reference source not found.**Figure 5 shows an example of a line board to be displayed on a production line.

[8] *A workplace organization methodology that uses a list of five Japanese words which are seiri, seiton, seiso, seiketsu and shitsuke.*

**Figure 5:** Example of a line board




## 3.4 Development of contingency planning for rework or machine breakdown

A major opportunity identified in many of the organisations centred around rework and particularly attitudes towards rework. Rework is defined as rejected or unfinished product reintroduced into the process (generally at the blending stage) in order to reclaim what would otherwise be waste.

Although reworking the product can divert waste from landfill and improves raw material utilisation, it means that extra energy and labour is required for reprocessing it and results in a reduction in production throughput. It is clear that, due to the nature of food manufacture, some waste/rework is inevitable. However, it is found in some organisations that many people feel rework is a necessary part of the process due to the current recipes requiring a rework component. Thus, in the minds of many operators, reworking is acceptable and necessary with little incentive for minimisation.

However, it was found that a lot of the 'rework' does not end up being utilised. On one occasion it was discovered that although the scrapped product had been placed in bags and labelled 'rework', the facility to rework this product did not yet exist and thus the product was destined to be sent offsite as animal feed. On another occasion a large quantity of 'rework' had been packed into rework bags but been allowed to reach its 'use by' date, requiring it to be discarded.

It is believed the major issue with rework is that it encourages a culture where waste is acceptable and allows waste to be hidden.

Recommendations regarding rework are:

- Identify the root causes of rework: where and why is it generated, and how can it be reduced or eliminated;
- Develop contingency plans to improve the processing of rework;
- Investigate the modification of recipes to include varying degrees of rework so that rework can be driven down and only used when absolutely necessary;
- Change the language used to describe 'rework'. A suggested term is 'Reclaimable Food Waste;
- Revise data systems to capture all waste, and report it as such. Do not allow waste to be 'hidden' as rework.

The continuous nature and size of production lines is a significant factor in the production of food waste. Continuous lines that include a baking stage are particularly problematic and cannot be operated on a stop/start basis. Unplanned machine stoppages results in the backing up of product on the line. This product is often removed from the line and held as rework or scrapped.

Looking at the specific example of biscuit production, should the packaging machine breakdown, it is not feasible to stop the line as all product inside the oven will overcook. The two recommendations to reduce product waste in this instance are: to reduce the cause of downtime through improved preventative maintenance and operator training; and as a contingency, introduce buffers in the form of accumulation tables/conveyors to store product whilst the problem is being addressed. Accumulation conveyors and tables were observed at two of the highest performing sites in the waste reviews and were instrumental in reducing the overall waste.

## 3.5 Improved line balancing

A major point of difference that sets the high performing sites apart from the rest is a smooth, well balanced production system, i.e. all processes within the system running at the same or similar speed. This minimises the impacts associated with bottlenecking and the need for remedial intervention. This may mean that the line does not produce at its peak rate at a given point in time; however, averaged over an eight or 12 hour shift, the overall production will be greater as product has been produced consistently with little downtime or waste. Conversely, some of the sites visited appeared rather chaotic with operators often running from one machine to another to fix problems and address backlogs. Manual packing areas were observed to be the bottlenecks in many of these companies, as operators attempted, often in vain, to keep up with an automated process running at top speed.

It is therefore recommended that manufacturers place emphasis on line balancing in order to smooth operations and reduce downtime. Although slowing down equipment can take considerable discipline, it can improve efficiency and effectiveness overall.

## 3.6 Challenging traditional material supply

How goods are delivered onsite plays an important role in resource efficiency and waste reduction as a considerable amount of waste, at food and drink companies, is due to secondary packaging on incoming goods. Typical of most food and drink manufacturers is a continued reliance on small parcels of materials (food and packaging) supplied in single-use packaging, a prime example being 25kg bags of powdered ingredients. It is not uncommon for some factories to open over 500 x 25kg bags of ingredients per day. Not only does this add a huge amount of complexity to the process, it also creates significant waste, both packaging and food, with food waste typically occurring due to being trapped inside folds in bags, residue in containers and as increased spillage that may occur due to increased handling.

Within the drinks and preserves industries there are examples of glass jars and bottles being delivered on pallets, using cardboard layer pads to separate layers and shrink wrap to keep the bottles from falling. At one drink manufacturing site, use of layer pads results in more than 490 tonnes of cardboard waste every year.

There are many opportunities associated with this reliance on small packs of materials in single-use packaging. Some areas identified where waste could be prevented were:

- Increased waste arising from the need to dispose of secondary packaging; and
- Increased material handling (manual handling) producing waste through the requirement to open and decant every pack.

It is believed that industry reliance on these small packs is mainly for historical reasons and a failure by manufacturing organisations to challenge this traditional supply of goods. In particular, use of the 25kg bag

stems from a time when manufacturing was less automated and ingredients needed to be added by hand. (The 25kg limit is the maximum handling limit for men.) The failure to challenge ingredient supply could be due to a de-coupling of the purchasing and manufacturing departments. Purchasing is often driven by a set of metrics conflicting with production metrics and as a result, ingredients are supplied in a sub-optimal format.
In high performance companies partnerships have been built up with suppliers and systems have been developed to ensure the right products are delivered at the right time in a format that is beneficial to both parties.

### *3.6.1 Reusable packaging*

An obvious answer to reduce waste in the supply chain is to adopt reusable packaging. Returnable transit packaging (RTP) is multi-use packaging, designed to eliminate packaging waste in the supply chain. Examples of RTP are wooden pallets, plastic crates, plastic layer pads and "Pallecon" containers. Another example of reusable packaging could also be plastic cores for film supply that are returned to the supplier for reuse.

Like the traditional supply of ingredients, as described above, the decoupling of production and purchasing could be responsible for this lack of uptake in reusable packaging. Also hindering uptake is the potential risk in adopting new packaging standards when they are not proven in the organisation as well as co-ordinating the reverse logistics to return packaging to the supplier for reuse.

Adopting reusable packaging for ingredients has potential economic benefits for both suppliers and customers in the supply chain. The level of economic payoff is clearly dependent on a variety of variables; however, it is believed that organisations, particularly those that process a significant tonnage of ingredients, could benefit greatly by switching to reusable packaging.

The case for switching items such as film cores from single-use cardboard to multi-use plastic is not as clear cut for food and drink manufacturers. Calculations for one of the companies visited showed that, if it were to push its supplier to provide film on reusable plastic cores, the savings to the organisation (ignoring any savings on packaging that may or may not be passed on by its supplier) would be 35tonnes/year in reduced waste and a small cost saving of approximately £1,400/year in removal costs. Clearly the drive to adopt reusable packaging such as cores, layer pads and pallets should come from suppliers as the savings of the individual manufacturer may not be significant enough to warrant them pushing the issue or taking on the potential risk. Having said that, the FDF's drive to eliminate waste to landfill does provide greater incentive - beyond the financial - for manufacturers to adopt reusable packaging. Considering that reusable packaging such as that mentioned above is being used successfully in some organisations, it is certainly not unreasonable to expect manufacturers to apply some pressure to suppliers to deliver materials in a more sustainable format.

### *3.6.2 Production ready packaging*

Production ready packaging (PRP) is a term that is starting to be used within the food and drink industry[9] with respect to the delivery of materials. It has emerged from the automotive industry[10], particularly the practice of having parts and assemblies supplied in a manner designed to complement the production system. This delivers savings to both the automotive manufacturer and the supplier. Whilst the original intention of this is to create productivity improvements, it also delivers significant reductions in transit packaging waste.

PRP can take many forms and can be described as reusable packaging that is designed to be integrated into the production process to reduce waste (both packaging and food) and improve production efficiency. PRP improves production efficiency by removing a number of steps in the delivery of packaging and ingredients to the process. Some typical examples of PRP are shown in Figure 6.

Figure 7**Error! Reference source not found.** compares the traditional supply of ingredients in single-use packaging with that of PRP. Using simple process diagrams it is clear that with traditional ingredient supply, ingredients in 25kg bags or tubs are delivered to the factory where they are stored in a warehouse. When they are needed they are brought into the factory and decanted into a hopper or stillage. They are then stored until they are required in the process. Switching to PRP, the product is already in its hopper when delivered to the factory. Therefore the product simply needs to be delivered to the factory and connected to the process when required.

[9] *http://www.fdf.org.uk/environment/waste.aspx*

[10] *Toyota Motor (2009), Sustainability Report 2009, available at URL: http://www.toyota.co.jp/en/csr/report/09/download/pdf/sr09_p28_p31.pdf*

The use of PRP was observed in a number of the sites visited, particularly for the high volume ingredients. However, its use in packaging delivery is less common. At one of the ice cream factories, it was observed that sticks were delivered in single-use cardboard boxes that integrated into the production line to act as a hopper, ensuring the sticks stayed in the correct orientation reducing complexity.

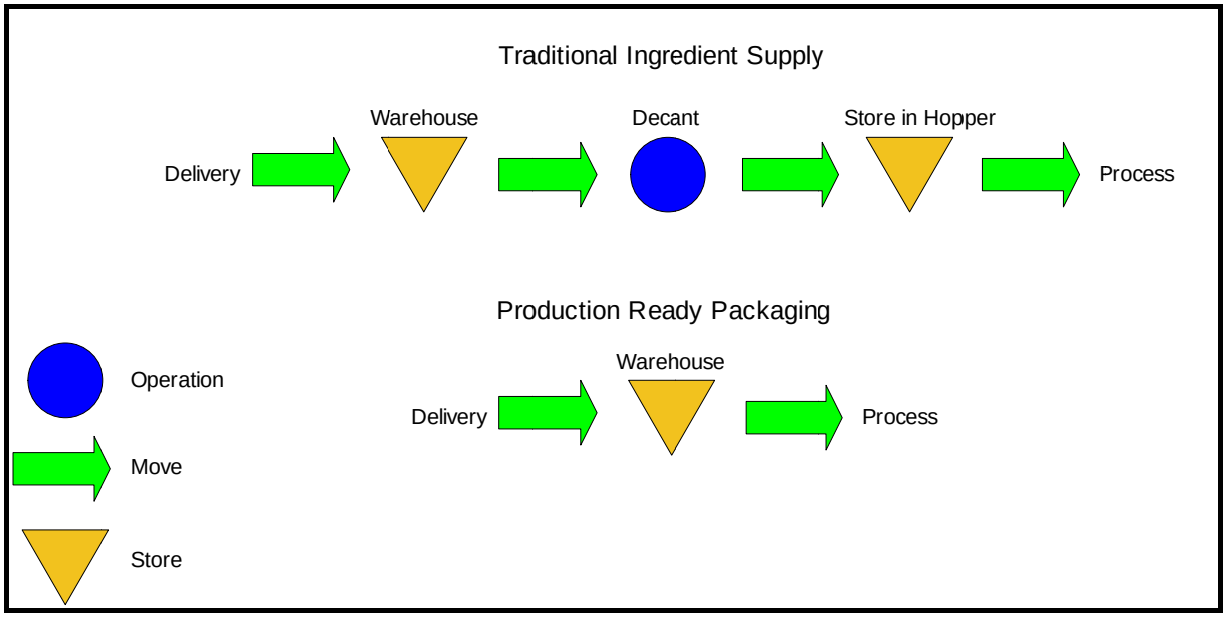
**Figure 6**: Examples of PRP

Intermediate bulk container (IBC)

Custom made removable powder hopper

There is significant scope to roll out PRP to a greater number of sites for a wide variety of ingredients. One suggested approach was to involve multiple customers of a single supplier, a bakery supplying to a number of large sandwich manufacturers for example. As the sandwich manufacturers probably do not gain much strategic advantage through improving bread delivery alone, it may be feasible for the bakery to work with its customers to develop a system that reduces packaging as well as improving efficiency for all parties. Any change to PRP should be investigated and an informed, business decision made.

**Figure 7**: Process simplification from PRP




### *3.6.3 Road tanker delivery*

Road tankers are being used effectively at a number of production sites to receive liquids and powders. They can have considerable benefit over traditional supply as, like PRP, packaging waste is virtually eliminated and complexity can be reduced significantly.

One food manufacturer visited could eliminate the need to open more than 111,000 bags per year by receiving a single dry ingredient by road tanker instead of in 25kg bags. This would reduce complexity not only for the manufacturer but also for the supplier, where filling operations would reduce from 111,000 to 586 per year.

It is clear that road tanker delivery is best suited to large volume ingredients where the benefits are significant. It requires the installation of silos and appropriate conveying/dosing systems that demand capital investment. Moreover, the space efficiency of large silos will typically be much greater than for smaller silos. Despite this, road tanker delivery for smaller volume ingredients may still be a viable option. Compartmentalised tanker trucks allow multiple, small volumes of liquid to be delivered at the same time and small tanks can be installed with varying degrees of pipe work or conveying systems.

### *3.6.4 Packaging over-specification and inconsistency*

From our observations the other area of significance was the excess packaging used to protect packaging materials from the suppliers to the manufacturer or packer filler. In a lot of cases this seemed to be 'historical' or 'standard' practices that have, in some cases, remained unchallenged but nevertheless represented excess materials to be disposed of by the recipient. Examples of this practice included film reel cores, pallet corner protectors, double wall corrugated layer pads, chipboard and MDF pallet top boards, heavy duty pallet polythene shrouds and comparatively high quality corrugated cases containing folding boxboard skillets.

As an example of excess, on one audit it was observed that E flute corrugated display cases are contained in B flute open topped corrugated cases (70 cases per case). The entire pallet containing 50 transit cases also had a polythene top shroud, double wall corrugated layer pads at each pallet layer, corrugated corner protectors at each corner of the pallet and the whole was then stretch-wrapped.

There was also unchallenged inconsistency of method of material protection on the same item type received from different suppliers delivered to the same location. An example of this was the 25kg sugar sacks used at the same location (albeit an ingredient): one supplier delivering in internally coated, 2 ply paper sacks (readily recoverable), whilst another delivered the same product in uncoated 2 ply paper sacks with an integral plastic liner captured between the plys (more difficult to recover). The same inconsistency can be seen for packaging materials: one delivery of corrugated cases was seen using chipboard top boards, another was seen using MDF top boards, others may be seen with corrugated top protection pads, all at the same location.

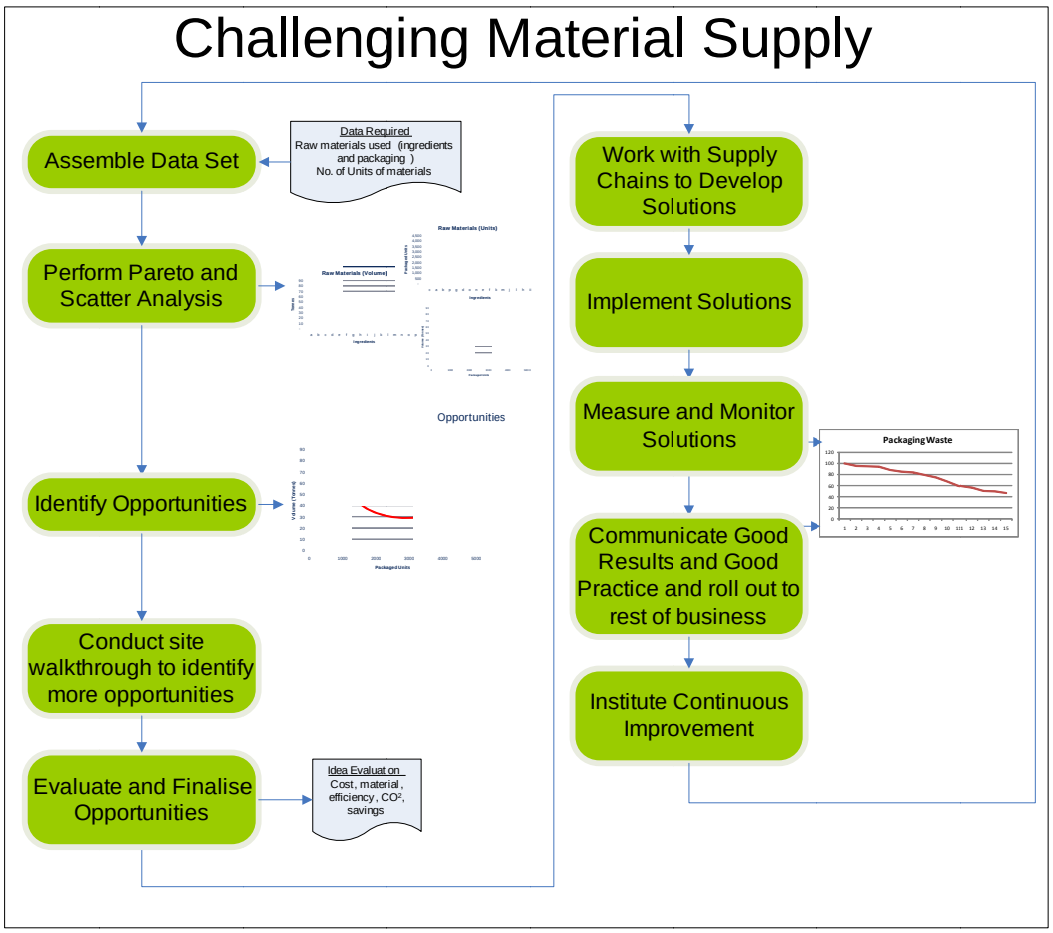
### *3.6.5 Recommendations*

When challenging traditional material supply, the following recommendations are made:

- Use Pareto analysis to look at ingredient supply and identify the major contributors to waste and labour;
- Work with suppliers to get ingredients delivered in more optimal sizes with appropriate packaging that complements production and is either reusable or recyclable; and
- Where appropriate, implement road tanker delivery or production ready packaging.

Figure 8 shows a suggested process to follow when challenging material supply.

**Figure 8:** Challenging material supply




## 3.7 Quantifying and challenging absolute raw material wastage

Ingredient shrinkage refers to the ingredient losses during the manufacturing process. Typical examples are spillage, inaccurate dosage (giveaway), spoilage, scrap/reject product and product damage. Clearly there is always going to be some shrinkage inherent in the process and this must be accounted for in the product cost models and bills of material. However, there is a tendency in some companies to 'hide' behind this figure. For example, in one organisation, most ingredients had a 1% 'built-in loss' or shrinkage. In all data on material variances that have been provided, this 1% was included, meaning that the true variance was not stated. By including this 'allowable' loss in all calculations, manufacturing organisations ignore the inherent losses and only focus on the special causes, resulting in an 'acceptance' of waste within the organisation.

Product 'giveaway' was found to be a significant contributor to shrinkage, particularly in the tea and coffee sector. Giveaway is when more than the nominal amount of product is placed into a pack. It has been discovered that, on average, bags of coffee are overfilled by 3.6% (74 tonnes total worth £506,000). From discussions with a leading equipment supplier it has been found that a total giveaway of as little as 1.2% is achievable, meaning a saving of 49.5 tonnes or £338,000.

Recommendations to combat shrinkage are:

- Revise data recording, manipulation and display to better reflect performance and identify where shrinkage is occurring, i.e. measure waste in absolute terms. Pareto analysis has proved to work well in this area;
- Identify the greatest cause of shrinkage and allocate appropriate resources to address the problem; and
- Monitor filling lines and calculate giveaway. Explore opportunities to reduce giveaway.

## 3.8 Visual waste management

Visual management is a lean technique that allows anyone to enter a workplace, with no training, and immediately see and understand how the processes work and if they are under control. An analogy of a visual workplace is a highway where signs show drivers the speed limits, upcoming hazards and what lane to be in to take the correct exit, without them having to know this information beforehand. In the context of waste management, it is a system of signs, coloured bins and visual cues that will allow operators to correctly segregate and dispose of waste. A simple example would be a list on each waste bin indicating the waste streams that should be placed inside it.

Visual management has been shown to have significant benefits at manufacturing sites such as a 15% increase in throughput, and a 70% reduction in materials handling[11] and as such it is strongly recommended that it is applied to waste management in order to yield similar improvements.

### *3.8.1 Segregation of waste: communication (signage) and discipline*

The site visits showed that the companies had made major in-roads in the diversion of waste from landfill. However, it is believed that further improvements could be made regarding waste segregation and maximising the waste being diverted. A major criticism of waste management at many of the sites was the lack of an appropriate system for segregating waste inside the plant. Although most of the sites employed waste contractors that could recycle a variety of waste streams, the allocation of bins within the factory and provision of appropriate signage often meant that waste streams were placed in the incorrect bins and hence material recovery was not maximised.

The two companies performing best in terms of waste segregation used a particularly good method of labelling bins, with signs placed on all bins detailing the permitted waste streams. This showed that the organisation had an in-depth knowledge of its waste streams. More importantly it put the onus on the operator to seek out the correct bin for all wastes: a 'General Waste' label gives the operator an excuse to dispose of all waste in this bin despite the fact that it could be recycled

Generally, it is believed that signage needs to be improved in order to better inform operators about correct disposal means and also to create a linkage between where the waste arises and where it needs to be disposed of. It is also felt that communication of waste metrics could be improved. For some, this requires improved measurement of waste produced as well as the defining and displaying of appropriate metrics and improvement targets. This all forms part of visual management, and as such, it is recommended that companies employ visual waste management to reduce waste to landfill.

### *3.8.2 Implementing visual waste management*

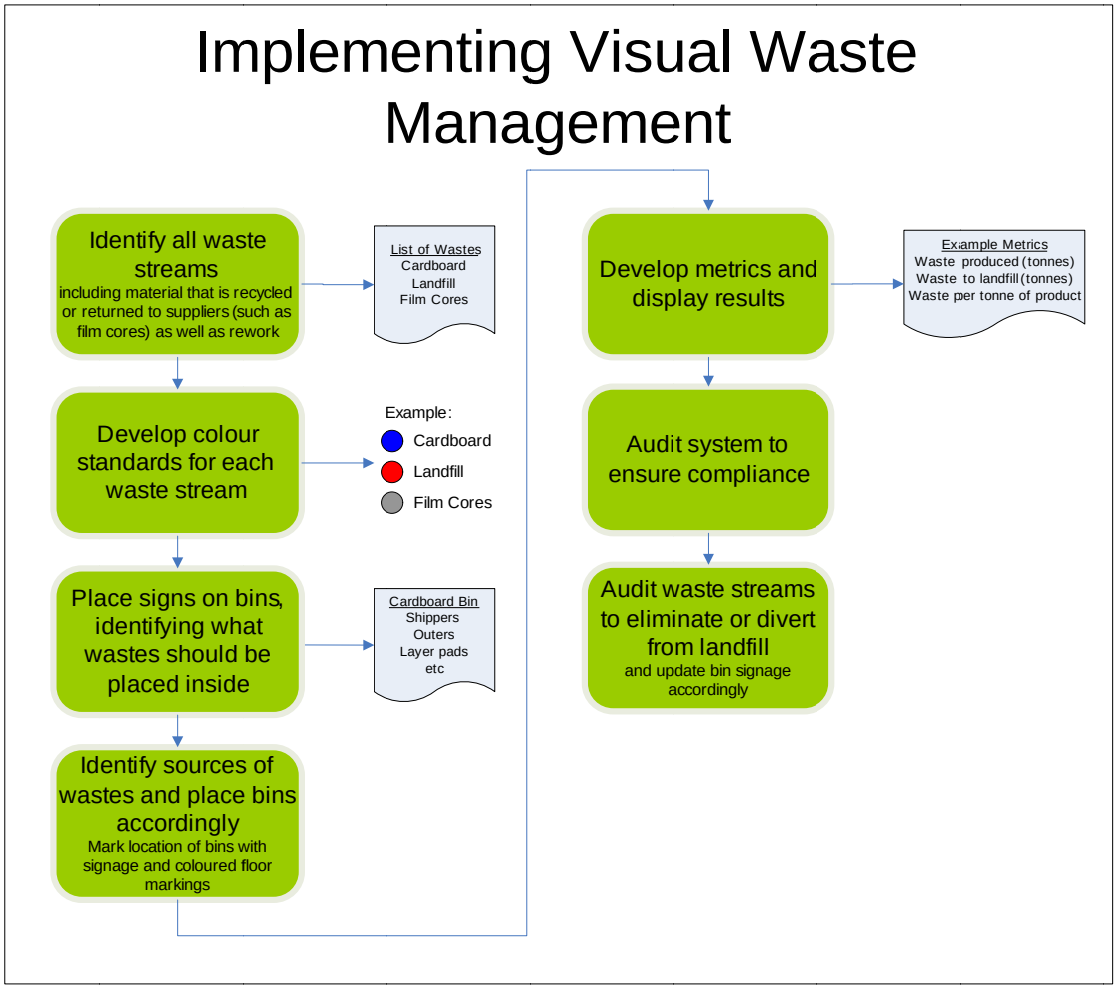
Recommendations aimed at improving visual waste management include the following:

- Identify all waste streams within the organisation. This should also include items that are to be returned to suppliers for reuse such as plastic cores and other packaging components;
- Develop colour standards for different waste streams;
- Purchase coloured bins or mark existing bins with the correct colour;
- Place appropriate signage on all bins (including general mixed waste) to identify the waste streams that are to be placed in these bins. It may be necessary to list some wastes that should not be placed in the bins, for instance cardboard film cores may need to be segregated from the rest of the cardboard. Therefore it would be worthwhile noting on any signage that cardboard cores should not be placed in the cardboard bins. The result should be that for every source of waste within the factory, there will be an appropriate bin and there will be no need to default to 'general mixed waste';
- Identify sources of waste streams in the factory and place bins appropriately. Mark location of bins with visible signage and floor markings;
- Collect data regarding waste production, develop effective metrics (waste produced, waste to landfill, waste per tonne of product) as well as targets and publish all results in prominent locations;
- Regularly audit system to ensure compliance; and
- Regularly audit waste streams with the view to eliminate them or divert from landfill.

This is summarised in Figure 9.

[11] *Galsworth, Visual Workplace, Visual Thinking.Visual-Lean Enterprise Press, 2005*

**Figure 9:** Implementing visual waste management




## 3.9 Summary of recommendations

The recommendations made throughout this report to improve prevention of waste within food and drink manufacturing are as follows:

- Integrate resource efficiency across the organisation;
- Develop a set of KPIs to drive improvement;
- Communicate performance to all levels of the organisation to drive resource efficiency improvements;
- Develop contingencies to handle process rework and reintroduce it;
- Challenge the supply of materials to reduce packaging and explore options such as reusable packaging, road tanker deliver and production ready packaging;
- Eliminate waste allowances and focus on absolute raw material wastage; and
- Implement visual waste management to encourage better waste segregation an identify opportunities to divert waste from landfill.

# 4.0 General conclusions and discussion

## 4.1 General conclusions

The general conclusions from the waste reviews can be broken down into the following five areas:

- The demonstration of the use of such review tools as Pareto analysis;
- The importance of quantifying the savings opportunity;
- Ensuring a general focus on waste management;
- The use of reviews to identify common causative factors; and
- The importance of introducing and highlighting 'good practice'.

### *4.1.1 Demonstration of the use of such review tools as Pareto analysis*

In many of the companies visited the use of Pareto analysis to review their product range and to determine where the significant resource efficiency opportunities exist was a new concept. This approach identified new opportunities that the companies had not considered, thereby identifying areas where waste could be prevented.

### *4.1.2 Quantifying the savings opportunity*

Although many of the opportunities identified were not new (for example, the lost opportunity costs associated with product giveaway) the true value of the savings opportunity was considerably higher than anticipated in many cases, emphasising the importance of quantifying opportunities when communicating across the business.

### *4.1.3 General focus on waste management*

Much of the previous resource efficiency work undertaken by companies focussed on diverting waste from landfill to recycling or recovery. Although in many cases this generates cost savings, the waste reviews have demonstrated the significantly higher savings opportunities that can be realised through a waste reduction approach that focuses on resource efficiency within the supply chain.

### *4.1.4 Identification of common causative factors*

A number of the resource efficiency savings opportunities were common across a number of the companies reviewed, including: poor waste segregation, overuse of retail sized ingredient packs and resource intensive goods in departments, poor contingency planning for rework, poor communication of system performance and poor data management.

### *4.1.5 Good practice*

Although much focus has been placed on the savings opportunities, many examples of good practice were evident within the waste reviews. For example, message boards from the senior management team, itemised waste stream listings on general mixed waste bins, the use of accumulation tables and tailor made on-line rework integration systems, challenging environmental KPIs and targets and motivated waste champions were all identified during the reviews. A key challenge, therefore, is how to disseminate these examples of good practice across the whole sector.

## 4.2 Quantification of savings opportunities

Table 3 summarises the savings opportunities identified at the seven sites that provided the necessary data for evaluation.

**Table 3:** Summary of food and packaging waste produced and opportunities identified

| Total food and packaging tonnage to market | Total waste generated (tonnes) | Total waste to landfill (tonnes) | Food waste | | | Packaging waste | | |
|---|---|---|---|---|---|---|---|---|
| | | | Waste arising (tonnes) | Waste arising (value) | Achievable food waste reduction (tonnes) | Waste arising (tonnes) | Waste arising (value) | Achievable packaging waste reduction (tonnes) |
| 249,434 | 36,271 | 11,258 | 24,003 | £12,015,847 | 10,811 | 1,245 | £2,074,478 | 175 |

Key findings include:

- Yield loss in terms of total waste (36,271 tonnes) divided by total tonnage to market (249,434 tonnes) equals 14.5%, i.e. on average 14.5% of food and packaging purchased by each company surveyed ended up as waste within the manufacturing process.
- The total waste to landfill from the sites providing the necessary data equates to 31% of total waste (11,258 tonnes to landfill/36,271tonnes of total waste arising). This is much higher than the findings from the 2010 Defra/FDF report[12], which estimated the waste to landfill from 149 FDF member production sites at 9% of the total waste. However, the difference in the sample size and composition in the two studies is considered to be significant. In particular, it was generally felt that organisations within the current study rightly nominated their worst performing sites for review. In addition, the data from one site reviewed within this study showed that all 5,000 tonnes of waste generated were sent to landfill. NB: This assertion was challenged within the review process. Omitting this site from the analysis results in the average waste to landfill dropping from 31% to 17.25%.
- The overall food waste savings opportunity within the seven sites was estimated at 45%. This again is much higher than the findings from a previous study. The October 2007 Defra report[13] estimated the no-cost / low-cost resource efficiency savings within the UK food and drink manufacturing sector at 19.3%. The sample size and composition was again considered a key factor.
- The 2010 Defra/FDF report estimated that 481,000 tonnes of food and packaging waste were being generated from the 149 production sites surveyed and an additional >300,000 tonnes of materials were being generated as by-product or surplus, most likely for reuse as animal feed. By Combining the by-products/ surplus with the waste generated provides an overall resource efficiency opportunity; applying the 10% reduction to both categories the savings opportunity equates to 78,000 tonnes within the FDF member companies.
- The March 2010 WRAP report estimating the waste arising from the whole food and drink manufacturing sector in the UK at 5.0 million tonnes with a further 2.2 million tonnes of by-products sent for animal feed. The same 10% reduction calculation used above for these figures equates to a resource efficiency opportunity across the UK of ca.720,000 tonnes.
- On average, based on purchasing costs alone, food waste within the seven sites costs companies £500 per tonne (£12,015,847/24,003 tonnes), packaging waste £1,666 per tonne (£2,074,478/1,245 tonnes) and the combined food and packaging waste £558 per tonne ((£12,015,847+£2,074,478)/(24,003+1,245)). The following table shows the results when applying these costs to the findings from the August 2008 Defra/FDF waste survey report. This shows the savings opportunity to equate to £75 million.

[12] *.Mapping Waste in the Food and Drink Industry. (2010). Defra and the Food and Drink Federation*

[13] *Quantification of the Business Benefits of Resource Efficiency by Oakdene Hollins and Grant Thornton. (2007). Defra*

**Table 4:** FDF Member savings opportunity

| Resource efficiency opportunity | Total waste arising (tonnes) | 10% savings opportunity (tonnes) | Savings per tonne (value) | 10% savings opportunity (value) |
|---|---|---|---|---|
| **Food waste** | 604,883 | 60,488 | £500 | £30.2 million |
| **Packaging** | 94,900 | 9,490 | £1,666 | £15.8 million |
| **Mixed food and packaging** | 134,819 | 13,482 | £558 | £7.5million |
| **Reused food*** | 506,898 | 50,690 | £430 | £21.8 million |
| **Total** | **1,341,500** | **134,150** | **£561** | **£75.3 million** |

Note*: Assumes the cost differential between the disposal of waste and the reuse of waste is £70 and hence the savings per tonne is £500 - £70.

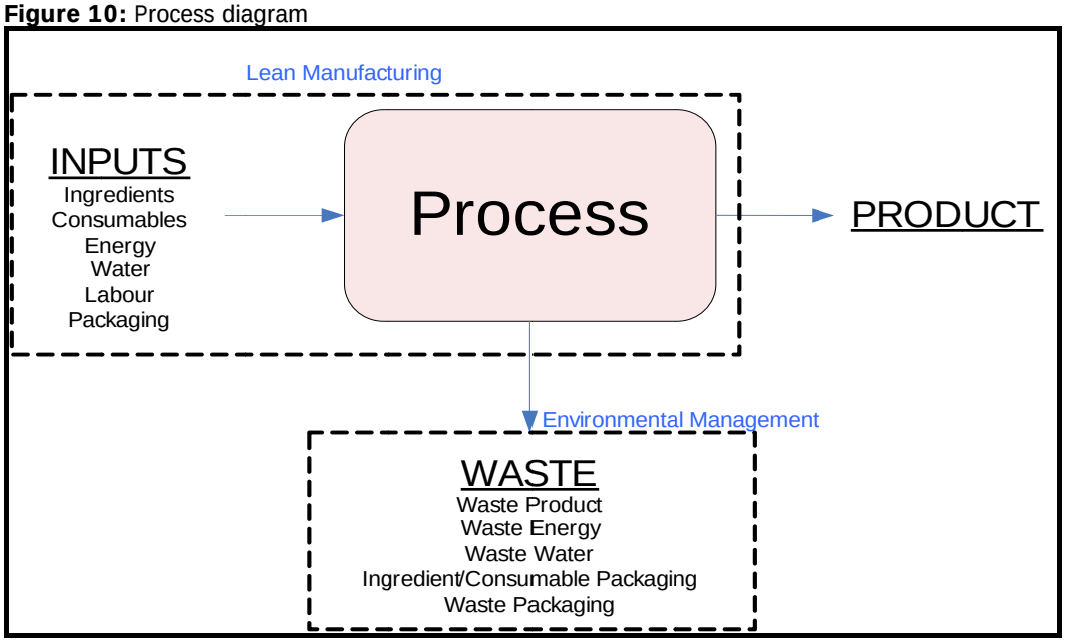
Based on the estimate above that the savings opportunity within the UK food and drink sector is ca.720,000 tonnes and assuming average savings of £561 per tonne (Table 4), the value of savings for the whole UK food and drink manufacturing sector is estimated at £404 million.

## 5.0 Further work

The work that has been completed in the Food and Drink industry, particularly stemming from the FDF's 'Five-Fold Ambition' and the Courtauld Commitment, has generated significant results. The targets that have been set, particularly surrounding the reduction of waste to landfill, primary packaging and $CO_2$, have motivated the food and drink industry to address waste and invest in resource efficiency.

Referring to the process diagram below, the site visits showed that much of the emphasis in resource efficiency has been on environmental/waste management. For many organisations this approach has garnered some significant quick wins; however, despite this approach being the focus, there are still significant improvements to be made in this area and further work is recommended.

**Figure 10:** Process diagram




From the waste reviews, it is believed that the greatest opportunities to reduce waste and improve resource efficiency are through Lean Manufacturing. This is supported by the 2009 WRAP report *Meeting the UK climate change challenge: The contribution of resource efficiency*[14]. Although Lean Manufacturing has existed in various forms for over 100 years, there was an absence of many basic Lean Manufacturing techniques in many of the companies visited.

### 5.1 Resource efficiency through Lean Manufacturing

It is believed that considerable emphasis could be placed upon encouraging the food and drink industry to implement Lean Manufacturing techniques to realise resource efficiency. The two areas, identified in the process diagram above, that should be addressed are: 'the Process' and 'Inputs to the Process'.

WRAP's *Seasonal Confectionery Working Group* has been successful in delivering packaging reduction. It is believed that the success of this group is due to the setting of a high profile target of reducing packaging on Easter eggs by 25% as a minimum and involving a number of key stakeholders in the formulation of a solution[15]. Therefore, it is suggested that further work include the setting of specific targets and involvement of key stakeholders where practical.

### 5.2 Process improvement: Lean workshops and site reviews

The lack of Lean Manufacturing techniques observed in the sites visited highlights a significant opportunity for an assisted program to encourage companies to implement some of the fundamental lean techniques to drive continuous improvement and reduce waste. Given that Lean has been around for so long and most organisations are aware of it, the focus needs to be on demonstrating its benefits and assisting in the roll-out of various Lean

[14] *Meeting the UK climate challenge: The contribution of resource efficiency (2009). WRAP.*

[15] *Reducing Easter Egg Packaging (2011), WRAP*

techniques. It is suggested, therefore, that a series of workshops be carried out with representatives from a number of food and drink companies where a particular area of Lean is covered. The workshop format could include: a brief lecture on the Lean technique (i.e. introduction, Lean techniques, benefits of Lean, and its implementation); and a group discussion to better understand where Lean would be most appropriate for the organisation. Hand-outs would be provided in all workshops to provide greater detail on the Lean technique as well templates and spread sheets to assist in implementation. It would then be expected that attendees return to their business to implement the Lean technique. Assistance by phone or email should be provided after each workshop whilst the technique is being implemented.

Further workshop topics could include:

- introduction to Lean and benefits;
- Key Performance Indicators (KPIs);
- data management;
- communications;
- employee engagement;
- waste allowances; and
- senior level engagement.

At the end of the workshop and site reviews, a number of case studies could be written on best practice implementation of the lean techniques. Coupling these with the workshop hand-outs, templates and spread sheets will create a 'Lean Toolkit' that can be distributed to the entire food and drink industry in the UK.

## 5.3 Inputs to the process: production ready packaging (PRP)

Food and drink manufacturers in the UK produce more than 406,000 tonnes of packaging waste per annum, the majority of which is primary packaging of incoming goods. There is significant opportunity to apply Lean techniques to reduce this.

As discussed, PRP has considerable benefits, including reduced waste and significantly reduced complexity. The recent formation of a Production Ready Packaging Working Group by WRAP is intended to reduce packaging waste from incoming goods through the use of PRP and other improved delivery methods.

Building on the learnings from the Seasonal Confectionery Working Group, a target has been set of 1,000 tonnes reduction in packaging waste by the (up to) five working group member organisations. The working group is holding a series of regular meetings where ideas for PRP can be discussed and solutions to deliver this be developed. In addition, site visits will be conducted where opportunities have been identified and assistance provided to further develop solutions.

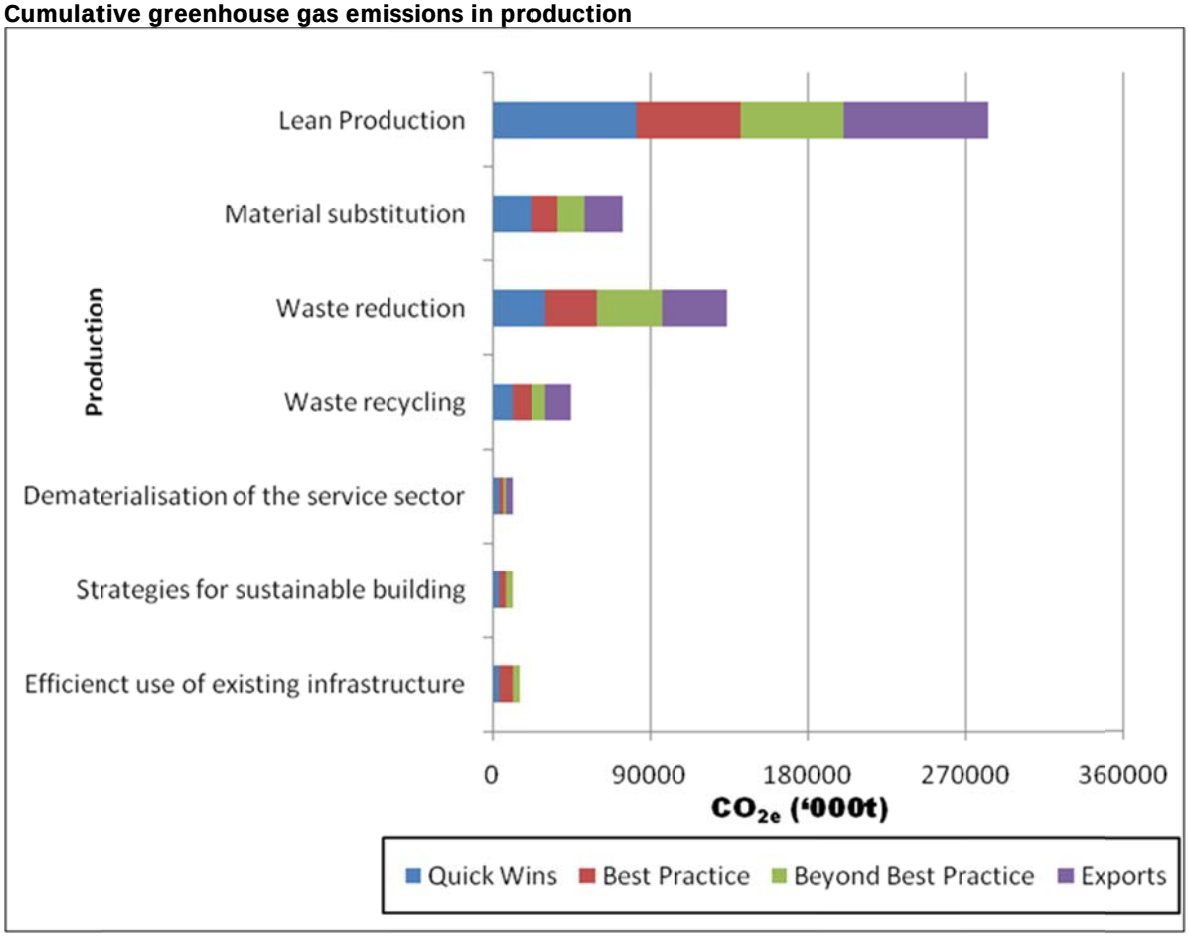
The output of this project is targeted to be the 1,000 tonnes reduction in packaging waste as well as a number of case studies on examples of best practice identified. These case studies could then be used to demonstrate the benefits of PRP to other food and drink companies.

# Appendix 1: Waste management verses waste reduction

Many of the companies visited focus their efforts on diverting waste from landfill, seeking alternative disposal methods instead of trying to prevent or reduce the creation of the waste. An example of this was a manufacturer that sought out an alternative waste management company that had the capability to recycle rather than landfill its plastic bags. Clearly this is a substantial improvement on landfilling; however, far greater savings (both financial and environmental) might be achieved by eliminating this stream completely through the use of reusable packaging or by seeking more sustainable packaging.

Resource efficiency is a term that has become popular due to an anticipated scarcity of resources and environmental concerns. As such, when trying to improve resource efficiency the focus has traditionally been on environmental management. Although this approach has produced considerable gains, particularly as quick wins with payback within one year, recent studies - have shown that the majority of resource efficiency gains in production will be obtained through Lean Production techniques[16].

**Cumulative greenhouse gas emissions in production**



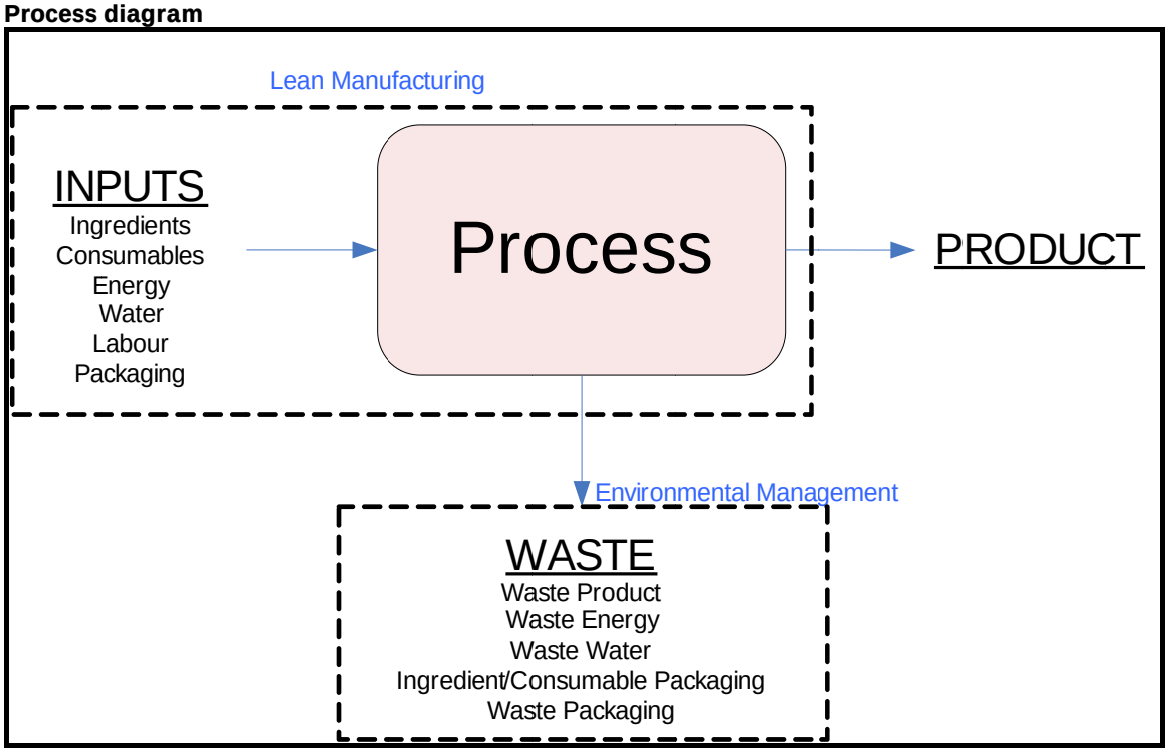

*Source: Meeting the UK climate change challenge: The contribution of resource efficiency, WRAP 2009.*

Traditionally, environmental management and Lean have been viewed as separate functions within organisations. Although it is recognised that each can contribute to the other's success (e.g. Lean Manufacturing can reduce scrap and therefore total waste), the two are typically performed by different company departments, often with quite a different approach.

[16] *Meeting the UK climate change challenge: The contribution of resource efficiency (2009), WRAP*

Experience shows that environmental management generally takes on a waste management approach, often concerned with the treatment and effective disposal of waste (materials, packaging and water) and dealing with the problem after it occurs. Lean, by its very definition, focuses on cost reduction by improving the inputs to the process and the process itself. This is demonstrated in the following diagram:

**Process diagram**




The drivers for Lean Manufacturing and environment management impact significantly on their implementation in an organisation. As Lean is seen as a tool for competitiveness, capital productivity and customer satisfaction, with well documented financial benefits, it is often driven by senior management. Typically, the benefits from environmental management have been much smaller than for Lean and, as such, the drivers for environmental management are generally linked to government legislation and public relations/marketing opportunities rather than a genuine source of competitive advantage. As a result, we see that Lean is very much ingrained into a company's culture and part of everyone's role, whereas environmental management is often delegated to a single person or function with considerably less influence in the organisation.

It is questioned whether organisations should drive resource efficiency through a Lean focus or an environmental focus. Both approaches will potentially yield environmental and efficiency improvements, meanwhile better waste segregation stemming from environmental management at a manufacturing company could provide useful information to reduce material waste. It is particularly interesting to observe how Lean Production's "Seven Deadly Wastes" have direct environmental impact.

It is acknowledged that the environmental management approach is a simpler method than the Lean approach and requires less of a commitment from the company; however, it is also believed that the returns from environmental management are smaller. The opportunity for $CO_2e$ savings arising from Lean production is much greater than the environmental management approach (targeting waste)[17]. It could also be argued that many of the gains of the environmental management approach have already been realised, as they have been particularly driven by legislative measures (such as Landfill Tax) and the potential market opportunities.

Although Lean produces considerable environmental gains, there are environmental areas (blind spots) that are not covered under Lean and will be missed if a purely Lean approach is taken. In particular, there is no incentive under Lean to switch from hazardous to non-hazardous substances or chemicals. There is also no incentive to reduce life-cycle impacts, in particular the extraction of raw materials and the disposal of production waste. However, it is believed that government policy, voluntary targets and agreements and market forces should encourage organisations to address these blind spots.

[17] *Meeting the UK climate change challenge: The contribution of resource efficiency (2009), WRAP.*

**Environmental impact of 'Lean': the seven deadly wastes**

| Lean Waste Type | Environmental Impacts |
|---|---|
| **Overproduction**<br>Manufacturing items for which there are no orders | • More raw materials and energy consumed in making the unnecessary products<br>• Extra products may spoil or become obsolete requiring disposal<br>• Extra hazardous materials used result in extra emissions, waste disposal, worker exposure, etc. |
| **Inventory**<br>Excess raw material, work-in-process, or finished goods | • More packaging to store work-in-process (WIP)<br>• Waste from deterioration or damage to stored WIP<br>• More materials needed to replace damaged WIP<br>• More energy used to heat, cool, and light inventory space |
| **Defects**<br>Production of off-specification products that result in rework and/or defective materials | • Raw materials and energy consumed in making defective products<br>• Defective components require recycling or disposal<br>• More space required for rework and repair, increasing energy use for heating, cooling, and lighting |
| **Transportation**<br>Excess transport of WIP or products<br><br>**Motion**<br>Human movements that are unnecessary or straining | • More energy use for transport<br>• Emissions from transport<br>• More space required for WIP movement, increasing lighting, heating, and cooling demand and energy use<br>• More packaging required to protect components during movement<br>• Damage and spills during transport<br>• Transportation of hazardous materials requires special packaging to prevent risk during accidents |
| **Over processing**<br>Process steps that are not required to produce the product | • More parts and raw materials consumed per unit of production<br>• Unnecessary processing increases wastes, energy use, and emissions |
| **Waiting**<br>Delays associated with stock-outs, equipment downtime, capacity bottlenecks | • Potential material spoilage or component damage causing waste<br>• Wasted energy from heating, cooling, and lighting during production downtime |

Source: *www.epa.gov//lean* Accessed 02/02/2010

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