Waste prevention reviews in the food and drink sector

A review of 26 site waste prevention reviews undertaken in the food and drink manufacturing sector from 2010 to 2012
WRAP’s vision is a world without waste, where resources are used sustainably.

We work with businesses, individuals, and communities to help them reap the benefits of reducing waste, developing sustainable products and using resources in an efficient way.

Find out more at www.wrap.org.uk
Executive summary

WRAP (The Waste and Resources Action Programme) has been active in supporting Courtauld Commitment signatories and some non-signatory companies in the identification and reduction of waste generated at source since 2008.

This support has been delivered through the activity of waste prevention reviews (WPRs). Initially focused as a mechanism to support companies to identify opportunities where waste arisings could be reduced, the present day WPR model is focussed primarily on the achievement of waste reduction.

The waste hierarchy (Figure 1. The waste hierarchy) is the guiding principle of the WPR process. At the heart of the process model (Figure 3. The WPR methodology) are activities such as visual observation, analysis of company data, engagement of independent industry and internal company expertise, and application of continuous improvement techniques such as Lean manufacturing principles e.g. value stream mapping.

This report provides a summary of 26 WPRs conducted at Courtauld Commitment signatory operations between 2010 and 2012.

Scope

WRAP WPRs were conducted at food & drink manufacturing sites, predominantly in England and Scotland, operated by 14 Courtauld commitment signatories. This represents engagement with 26% of Courtauld signatories, targeting an average of 10% of supply chain waste reported by signatories in 2010 and 2012 reporting periods.

The product sectors WRAP engaged with to conduct the work outlined in this report included bakery, soft and alcoholic drinks, ready meals, fresh produce, dairy, confectionary and internet retail.

All the WPRs were conducted under confidential terms and therefore the details of individual reviews are not divulged in this report. The objectives of this summary are to highlight the general observations made across the organisations, in terms of:

- the quantification of the overall savings opportunities identified (in tonnes, CO₂e and £);
- common themes of waste prevention opportunities identified;
- current good practice observed in waste prevention and waste management; and
- summary of advice / guidance provided to support businesses to prevent waste at source.

Conclusions

The WPRs found that all companies demonstrated good practice in one area or another of waste management relevant to their operation and comparative to their operating sector, where such comparisons could be made. Many companies were found to prioritise diversion of waste from landfill having established suitable end fates for wastes generated. This is reflective of the good progress the Food and Drink industry has made in diversion from landfill.
In respect of waste prevention activity, there was little solid evidence to suggest that focused programmes were in place to directly tackle waste generation at source using the quantity and “true cost” of a waste stream as a driver. In many cases waste reduction was observed to be happening as a consequence of other activity e.g. changes in process or improvements to line efficiency through, as an example, the measurement, and improvement of OEE (operational equipment efficiency).

There was also anecdotal evidence to suggest that there is a “break” between corporate CSR objectives and operational KPIs e.g. staff that can directly influence waste reduction are busy with waste diversion (as their KPI) and are not fully aware of the Courtauld Commitment waste reduction target their company has signed up to.

Quantification of the savings opportunities

Overall, a 19,340 tonne waste reduction opportunity was identified at the 26 sites that undertook WPRs with WRAP. This equates to 0.82% of the overall baseline of 2,349,000 tonnes reported by Courtauld 2 signatories as being generated by UK grocery in 2009. If realised, the reduction opportunities would deliver 16.4% of the overall Courtauld 2 3 year target of a 5% reduction in supply chain waste.

The following table shows the no cost and low cost savings opportunities identified by the WPRs. The analysis shows that in total the waste savings opportunity of over 19,000 tonnes has an associated financial saving of over £13 million and an environmental saving of 58,000 tonnes CO\(_2\)e. Food waste can be seen to be the most significant contributor accounting for 60.8% of the weight based savings, 48.7% of the financial savings, and 87.2% of the environmental savings. The Food and Drink Federation (FDF) reported that in 2009 food waste accounted for 61% of total waste arisings among FDF member companies\(^1\) and hence the 60.8% savings opportunity in the following table is a direct reflection of the composition of the waste being generated.

<table>
<thead>
<tr>
<th>Packaging</th>
<th>Food</th>
<th>Mixed Food &amp; Packaging</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tonnes</td>
<td>£M</td>
<td>tCO(_2)e</td>
<td></td>
</tr>
<tr>
<td>6,736</td>
<td>5.85</td>
<td>7,443</td>
<td></td>
</tr>
<tr>
<td>11,765</td>
<td>6.76</td>
<td>51,315</td>
<td></td>
</tr>
<tr>
<td>840</td>
<td>1.26</td>
<td>85</td>
<td></td>
</tr>
<tr>
<td>19,340</td>
<td>13.87</td>
<td>58,843</td>
<td></td>
</tr>
</tbody>
</table>

Realising the savings opportunities

To realise the reduction in tonnes of waste identified and consequential financial savings, the WPRs have highlighted that a number of factors would require change within business operations. These can be categorised as:

- **Improve the utilisation of cross-functional, continuous improvement teams** - waste prevention requires a collaborative approach across all disciplines within the company and the wider supply chain;

- **Increase the application of continuous improvement or Lean manufacturing techniques** - to identify the significant savings opportunities. Examples of tools used in waste prevention good practice include:
  - Root cause analysis;

\(^1\) Mapping Waste in the Food Industry. Produced by Oakdene Hollins for Defra and the Food and Drink Federation (FDF) 2010.
- Pareto analysis;
- The use of problem solving disciplines or methodologies;
- Cross-functional team solution brainstorming;
- Feasibility and impact assessment; and
- Value stream mapping.

**Improve waste measurement** - It is important to quantify the tonnage reduction and savings opportunity so that budgets can be set for the development, planning, and implementation of solutions and to monitor performance to plan, i.e. budgets should be set with respect to the size of the opportunity;

**Improve knowledge sharing** - To maximise the savings generated a roll out plan is recommended: where else can the successful solution(s) be applied within the business?; and

**Improve the establishment of, and regularly check the understanding and compatibility of, CSR objectives on waste prevention with operational activities** - the waste hierarchy would be deemed an essential tool to promote throughout the business along with supportive information of true costs of wastes to the business, company objectives, and strategy to progress up the hierarchy and reduce waste at source. This should be communicated in language that is simplistic for all to understand and relevant to each employee’s sphere of influence. Waste prevention should be the responsibility of all employees similar to quality being the responsibility of all by being incorporated in job descriptions.
Contents

1.0 Background to WRAP waste prevention reviews ................................................. 6
  1.1 Objectives ........................................................................................................ 7
  1.2 WPR Methodology ......................................................................................... 7
2.0 Findings and observations from WPR activity .................................................. 8
  2.1 Quantification of the savings opportunities .................................................... 8
  2.2 General observations from WPR engagements .............................................. 9
     2.2.1 The use of data review tools such as Pareto analysis ............................... 10
     2.2.2 Quantifying the savings opportunity .................................................... 10
     2.2.3 General focus on waste management .................................................... 10
     2.2.4 Identification of common causative factors .......................................... 10
     2.2.5 Good practice ....................................................................................... 10
     2.2.6 Knowledge transfer ............................................................................ 10
     2.2.7 Barriers to realising the savings .......................................................... 10
3.0 Waste prevention interventions ........................................................................ 11
  3.1 Awareness raising ......................................................................................... 12
  3.2 Review of product range .............................................................................. 13
  3.3 Production ready packaging (PRP) ............................................................... 14
  3.4 Raw material yield losses ............................................................................ 15
  3.5 Product yield losses ..................................................................................... 16
  3.6 Overproduction ............................................................................................ 18
  3.7 Expediting .................................................................................................... 18
  3.8 Sale or return ............................................................................................... 19
  3.9 Variety packs ................................................................................................ 19
  3.10 Optimising secondary and tertiary packaging ............................................ 19
     3.10.1 Secondary packaging ........................................................................... 19
     3.10.2 Tertiary packaging ............................................................................... 20
     3.10.3 Recommendations ............................................................................. 20
4.0 Development of environmental KPIs and associated data ............................... 21
5.0 Conclusion, discussion and realising the savings opportunities ....................... 22
  5.1 Conclusion .................................................................................................... 22
  5.2 Discussion ..................................................................................................... 22
  5.3 Realising the savings opportunities ............................................................... 23

Tables

Table 1. A summary of the savings opportunities identified in the 26 WPRs .......... 9
Table 2. Example revenue from waste recovery and waste prevention .......... 12
Table 3. Segregated waste emission impacts (kgCO₂e per tonne of waste treated) .............................................................................................................. 13
Table 4. Examples of Key Performance Indicators ............................................... 22

Figures

Figure 1. The waste hierarchy .............................................................................. 6
Figure 2. A summary of the total waste generated in the UK food and drink supply chain as reported to the Courtauld Commitment .................................................................................. 7
Figure 3. The WPR methodology ...................................................................... 8
Figure 4. A breakdown of the savings opportunity by waste stream ............ 9
Figure 5. The core disciplines required within the cross-functional waste prevention team 11
Figure 6. Example of SKU analysis using Pareto technique.................................................. 14
Figure 7. An example of the scatter diagram used for PRP analysis...................................... 15
Figure 8. The worked example of yield loss variability ......................................................... 18
Figure 9. Challenging material supply ................................................................................ 20
Figure 10. Rogers' adoption / innovation curve ................................................................. 23

Glossary

BoM Bill of materials
Courtauld 2 Phase 2 of the Courtauld Commitment
Defra Department for Environment, Food and Rural Affairs
FDF Food and Drink Federation
KPI Key Performance Indicators
OEE Overall Equipment Effectiveness
OTIF On Time In Full
SKU Stock keeping unit
WRAP Waste & Resources Action Programme
WPR Waste prevention review

Acknowledgements

WRAP is grateful for the opportunity to study the supply chain at each of the 26 sites and appreciates the support and hospitality extended by the businesses. 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 Background to WRAP waste prevention reviews

WRAP’s objective for the waste prevention reviews (WPRs) is to use waste prevention expertise to inform and develop best practice at food and drink manufacturing facilities and achieve waste reduction. WRAP’s involvement in WPRs began in 2008 in partnership with the Food and Drink Federation (FDF) supporting their Fivefold ambition in reducing waste to landfill. Subsequent years saw the WPR model develop into a support tool to assist Courtaulds Commitment signatories and non-signatories achieve their targets in waste prevention thereby contributing to the Supply chain waste reduction targets in the Courtaulds Commitment.

Early WPRs of 2008 and 2009 focused heavily on encouraging companies away from a dependency on landfill disposal and divert waste arisings up the waste hierarchy (Figure 1).

Figure 1. The waste hierarchy

WRAP launched Courtaulds 2 in 2010 with a greater emphasis on waste prevention and WRAP commissioned WPRs to assist signatories and their supply chains in meeting the supply chain target of the second phase of the Courtaulds Commitment:

"...to reduce traditional grocery product and packaging waste in the grocery supply chain by 5%",  

2 The Courtaulds Commitment is a voluntary agreement, launched in 2005 and aimed at improving resource efficiency and reducing the carbon and wider environmental impact of the grocery retail sector. The voluntary agreement is run by WRAP in partnership with leading brand owners, retailers, manufacturers and suppliers who have agreed to the targets set by WRAP.

This target includes both solid and liquid wastes and supply chain packaging wastes arising. In addition, it uses 2009 as the baseline and is to be delivered by the end of 2012. Figure 2 shows the status of the supply chain waste target in the second year, with an 8.8% reduction in waste arisings between 2009 (the baseline) and 2011:

**Figure 2.** A summary of the total waste generated in the UK food and drink supply chain as reported to the Courtauld Commitment

![Graph 2: Supply Chain Waste](source: WRAP)

### 1.1 Objectives

The key objectives of the WPR work are:

- to deliver waste prevention reviews across food and drink manufacturing sites, mapping product/food and packaging wastes to inform and develop good practice using the waste hierarchy; and
- to make recommendations regarding food and product waste prevention, recovery and reuse; and/or packaging waste prevention / optimisation (primary, secondary and tertiary).

### 1.2 WPR Methodology

The WPR programme for 2010 to 2012 is based on the continuous improvement methodology outlined in Figure 3. The process is in the two stages;

1. a “diagnostic” phase focused on
the identification of waste arising points;
- quantification of the waste arising point in terms of tonnes and true waste cost to business; and
- Recommendation of focus of waste reduction activity, suggested solutions that could be considered and the development of a waste reduction action plan.

2. W.A.S.T.E. - A problem solving discipline approach, developed by WRAP, focussed on actual reduction or elimination of waste (s) identified in the diagnostic phase by:

- conducting root cause analysis;
- solution generation activity;
- remedial solution trials and verification by measurement; and
- embedding the remedial solution into standard operating procedures.

Such methodologies have proved successful at implementing sustainable remedial solutions to problems (in the scope of the WPRs the problem is defined as tonnes of waste arising and therefore the methodology is focused on waste reduction objectives).

Figure 3. The WPR methodology

2.0 Findings and observations from WPR activity

2.1 Quantification of the savings opportunities

Overall, a savings opportunity of 19,340 tonnes was identified at the 26 sites that undertook WPRs with WRAP. This equates to 0.82% of the overall baseline of 2,349,000 tonnes reported by Courtauld 2 signatories as being generated by the UK food and drink supply chain in 2009. If realised, the reduction opportunities would deliver 16.4% of the overall Courtauld 2 3 year target of a 5% reduction in supply chain waste. This is extremely encouraging since there are over 7,000 businesses (including Courtauld 2 signatories) making up the UK food and drink manufacturing sector so the wider potential for waste reduction is high.

Table 1 shows the no cost, low cost savings opportunities identified by the WPRs. The analysis shows that, from data supplied by the various companies/sites involved, in total the waste savings opportunity of over 19,000 tonnes has an associated financial saving of over £13 million and an environmental saving of 58,000 tonnes CO₂e.
Food waste can be seen to be the most significant contributor accounting for 60.8% of the weight based savings, 48.7% of the financial savings, and 87.2% of the environmental CO₂e savings (note: food waste is also included within the mixed food and packaging and hence this should be considered a minimum estimate). The Food and Drink Federation (FDF) reported that in 2009 food waste accounted for 61% of total waste arisings among FDF member companies and hence the 60.8% savings opportunity in Table 1 corroborates the FDFs analysis.

Figure 4 shows a summary of the tonnage based savings shown in Table 1.

### Figure 4. A breakdown of the savings opportunity by waste stream.

2.2 General observations from WPR engagements
The main general observations from the WPRs can be broken down into the following areas:

- the use of data review tools such as Pareto analysis;
- quantifying the savings opportunity;
- general focus on waste management;
- identification of common causative factors;
- good practice;
- knowledge transfer; and
- barriers to realising the savings potential.

---

2.2.1 The use of data review tools such as Pareto analysis
In many of the companies visited the use of Pareto analysis to review their product range or to determine where the significant resource efficiency opportunities exist was a little used or new concept. When employed, this simplistic data analysis approach helped identify new opportunities that the companies had not considered there to be a need to focus on.

2.2.2 Quantifying the savings opportunity
Although many of the opportunities identified by WPRs 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 by the companies in many cases.

2.2.3 General focus on waste management
Much of the resource efficiency work undertaken by companies focuses on diverting waste from landfill and recycling or recovery. Although in many cases this generates cost savings, the WPRs have demonstrated the significantly higher savings opportunities that can be realised through a waste prevention approach.

2.2.4 Identification of common causative factors
A number of the resource efficiency savings opportunities were common across a number of the companies reviewed. These areas include:

- yield losses;
- overuse of retail sized ingredient packs and resource intensive goods in departments;
- contingency planning for rework not fit for purpose;
- communication of system performance not fit for purpose; and
- non-comprehensive data management.

2.2.5 Good practice
The WPRs observed many examples of good practice at businesses engaged. For example, message boards from the senior management team, the use of accumulation tables, tailor made on-line rework integration systems, challenging environmental KPIs and targets and motivated "waste champions". A key challenge to business is how to effectively disseminate these examples of good practice across their operations and promote to the wider sector as a whole.

2.2.6 Knowledge transfer
The WPRs observed that there are, in some cases, several good waste prevention initiatives already in place; however, it was often reported that these activities were or are conducted in isolation and had not been rolled out across other sites within the same company or, in some instances, other production lines at the same site. A consistent recommendation made by the WPR team is that, at the completion of a project, a review be undertaken to establish a roll-out or dissemination plan, since proven interventions can be fast tracked in other areas.

2.2.7 Barriers to realising the savings
The delivery of waste prevention initiatives is significantly different from waste recovery in terms of the staff resources required. Waste recovery is predominantly an ‘end-of-pipe’ activity undertaken by the environmental management, facilities management or hygiene team, with the discipline of waste segregation being the most significant interaction with
production staff. Waste prevention is a cross-functional discipline and Figure 5 shows the main disciplines involved, although it is dependent on the project or opportunity in question.

**Figure 5.** The core disciplines required within the cross-functional waste prevention team

In order for companies to commit such resources to waste prevention, it is important to build up the evidence base by initially focusing on a number of ‘quick win’, low labour-intensive, small scale projects. This will engage staff and develop ownership of the identification of savings opportunities, problem solving, solution development and implementation methodologies used. It is important that time is not wasted on the ‘identification of savings opportunity’ stage, i.e. that a ‘list mentality’ is adopted where too much focus is placed on generating a comprehensive list of opportunities and not enough time is given to realising the savings. The ‘just do it’ approach is a means of minimising the time spent analysing an opportunity and developing the business case for intervention. This is particularly useful in small scale projects. Waste prevention is a continuous improvement exercise and hence further opportunities can be identified during subsequent cycles.

### 3.0 Waste prevention interventions

Waste prevention interventions that are considered the most significant opportunities to realise tonnage savings identified by the WPR teams are:

- awareness raising;
- review of product range;
- production ready packaging;
- raw material yield losses;
- product yield loss;
- overproduction;
- expediting;
- sale or return;
- variety packs; and
- optimising secondary and tertiary packaging.
3.1 Awareness raising
Many companies have embraced the zero waste to landfill philosophy, moving waste up the waste hierarchy from disposal to alternative, higher environmental and economic value recovery options such as recycling and composting. This is considered a commendable first step in the move to viewing waste as a valued resource. Waste prevention represents a significant step further, and for many companies the WPRs identified that this would be a new step change.

The financial savings potential of waste prevention can be significant. Table 2 shows the revenue that can be generated through waste prevention and waste recovery for a number of different materials and packaging formats. Avoidable food waste or co-product is a key material since it can typically account for over 60% of the total waste generated and hence the shift from revenue from recovery of £0 to £50 per tonne to the revenue from waste prevention of £500 to £2,200 per tonne can be significant.

<table>
<thead>
<tr>
<th>Material or format</th>
<th>Revenue from recovery (£/tonne)</th>
<th>Revenue from waste prevention (£/tonne)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoidable food waste or co-product</td>
<td>0 to 50</td>
<td>500 to 2,200</td>
</tr>
<tr>
<td>LDPE Shrink and stretch wrap</td>
<td>230 to 440</td>
<td>1,000 to 2,500</td>
</tr>
<tr>
<td>HDPE bottles / drums</td>
<td>120</td>
<td>&lt;2,300</td>
</tr>
<tr>
<td>PET preforms or bottles</td>
<td>65 to 380</td>
<td>775 to 1,600</td>
</tr>
<tr>
<td>Glass bottles</td>
<td>10 to 25</td>
<td>&lt;300</td>
</tr>
<tr>
<td>Bottle caps (PP)</td>
<td>20</td>
<td>2,250</td>
</tr>
<tr>
<td>Card cartons</td>
<td>0 to 120</td>
<td>900 to 1,200</td>
</tr>
<tr>
<td>Card trays</td>
<td>0 to 120</td>
<td>600 to 1,250</td>
</tr>
</tbody>
</table>

Note: the revenues shown do not include the landfill disposal cost savings, which are in the region of £90 to £125 per tonne.

Table 3 shows the estimated environmental impacts from a number of segregated waste streams. In general, the analysis follows that of the waste hierarchy, with waste prevention representing the most significant opportunity from an environmental perspective.
3.2 Review of product range

The product range in many food and drink companies can number in the hundreds or thousands of stock keeping units (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 a limited number of production lines. This can lead to high levels of production change-over with associated downtime, waste and warehouse waste in respect of component complexity.

The objective of the analysis is to determine whether there is any scope for product rationalisation thereby reducing complexity and generating benefit from more efficient resource use and waste reduction. Introducing a formal delisting protocol is one possible approach to be adopted e.g. one in, one out is an effective product range management principle. Further analysis can be undertaken to determine whether the right products are being produced on the right production lines, e.g. high volume products on the high volume lines, etc.

The SKU analysis involves the plotting of 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 6. 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.

**Figure 6. Example of SKU analysis using Pareto technique**

3.3 **Production ready packaging (PRP)**

The WPRs observed the packaging of some of the raw materials to be a significant source of waste, with many ingredients being packed in 25kg bags. The bags are typically slit at point of use, the product decanted and the bag either recycled or, as was more commonly observed by the WPR teams, included in general waste and sent to landfill due to levels of contamination or mixed liner construction.

It is acknowledged that some ingredients must be sourced abroad, but it is suggested that global supply chains have advanced considerably over the last decade and many suppliers can - and do - provide products in alternative formats to the traditional 25kg bag. This is especially the case for the high volume products.

The principle of production ready packaging (PRP) is to work with suppliers to ensure that incoming ingredients are provided in a format that requires minimal material handling prior to production and that results in minimal packaging waste. Matching packaging formats to production volumes is a key part of PRP and, to identify the materials representing the greatest saving opportunity, a scatterplot can be used.

Figure 7 shows an example of the scatterplot with each data point representing an individual stock keeping unit (SKU). The volume of the ingredient used is plotted against the number of packaging units used, thereby highlighting the products that might benefit most from PRP. For example, the data point shown furthest to the right on the plot shows 40 tonnes of product supplied in 4,000 10kg bags. The ring on the plot highlights the SKUs that should be focused on first; namely, those that are high volume that are supplied in small unit quantities.
The potential savings associated with a move to PRP includes:

- reduction in packaging waste: WPRs have indicated that moving to bulk bags could result in a packaging saving of over 60%;
- reduction in residual losses, i.e. products left in the bottom of bags;
- reduction in manual handling;
- reduction in material handling such as waste bags; and
- increased throughput.

3.4 Raw material yield losses

Yield losses in raw materials can vary significantly with the WPRs observing yield losses of up to 25% in some cases. The key embedded causative factors were observed to include:

- **Defective/damaged incoming materials** - The reject rates on incoming goods can be significant, especially on materials that are fragile (poppadoms, crisps, etc.), perishable (fresh fruit and vegetables) or that have tight visual working specifications (wraps, bread, etc). In addition, companies can operate purchasing / procurement policies on a ‘least cost’ basis, which often is to the detriment of quality; hence it is recommended that a ‘full cost’ approach be used. This will take into consideration the impact the quality of the material has on production yield losses.

- **Disparity between production batch sizes and raw material packaging formats** - For example, a raw material used at a rate of 24kg per batch and supplied in 25kg bags will result in 1kg requiring storage and a risk of obsolescence. This is a particular issue for minor ingredients, i.e. those materials used in low volumes. This includes pre-printed packaging.

- **Residue in incoming packaging** - This can be a particular issue for viscous materials such as molasses, or for packaging materials such as 25kg bags.
- **Inaccurate weighing equipment** - In the case of high volume materials such as flour or sugar stored in silos; this can result in significant variance between actual and expected stock levels.

- **Mismanagement of part reels** - This can be a particular issue for shrink-wrap due to the high volumes used in the food sector. Automated splicing technologies have improved significantly in the food sector to overcome this issue; alternatively, larger reel sizes should be considered with improved material handling equipment.

The special causes of raw material yield losses were observed to include:

- **Delisting** - This can be particularly significant if the retailer only gives very short notice of the intention to delist a product and where the raw materials are unique to that product, e.g. pre-printed labels.

The two key objectives of a waste prevention initiative focused on raw material yield loss are to:

- **Drive down the mean level of yield loss** - This will reduce the overall raw material costs per unit of output, and overhead costs such as waste management costs.

- **Drive down the variability in yield loss** - The causative factors effecting yield loss variability can be associated with the product, shifts, operators, suppliers, seasonality etc. Reducing the inconsistency in yield losses can have a significant impact on inventory, since less raw material will need to be carried on a ‘just in case’ basis, and can improve delivery promise performance indicators, such as On Time In Full (OTIF). In an industry handling perishable ingredients with a short shelf life, this can result in significant savings.

In many operations, yield losses are accounted for by using waste allowances or shrinkage rates. These are incorporated into the budgeted Bill of Materials (BOM) for each product. This approach can result in little attention being given to driving down yield losses, since the losses have been accounted for and are not included in any departmental or company level key performance targets.

A recommendation of the WPRs is that the current accounting systems used be amended to highlight the financial value embedded into the waste allowances. A Pareto Analysis approach can be used to identify the high volume / high value raw materials and products that should form part of the initial focus (i.e. applying the Pareto 80/20 rule to identify the 20% of raw materials or products that account for 80% of the financial value embedded in the waste allowances). This approach enables the value of the opportunity to be quantified and the budget for the development and implementation of solutions to be set.

### 3.5 Product yield losses

Product yield loss typically equates to 1.0% to 1.8% of total production, but product yield losses as high as 6% were identified by the WPR teams. The typical values are dependent on the type of product. For example, a high volume / low product range drinks producer should operate near the 1.0% loss, whereas a low volume / high product range processed food manufacturer is likely to operate nearer the 1.8% losses. **Note: if considering the setting of yield loss targets, it is recommended that consideration be given to other industries. For**
example, a high volume / low product range drinks producer could look to the chemical sector for guidance for good practice and ideas.

Key factors in (embedded) product yield loss include:

- **Start-up / changeover waste** - On average the WPRs found that this accounts for circa 0.7% of product yield loss;
- **Defective products** - Due to the nature of the industry the food sector must operate to tight product specifications;
- **Floor waste** - Ill-fitting or missing guide rails and catch trays can result in high levels of floor waste;
- **Giveaway** - The fear of falling foul of the weights and measures legislation results in many companies running plant with an excessive level of product giveaway. However, this can result in significant financial losses, especially for high value products, such as coffee, spices, etc.
- **QA sampling** - In many cases, this can be regarded as an unavoidable waste but sampling regimes should be challenged on a regular basis;
- **Overproduction** - Due to the level of process variability and the tight demands by customers for guaranteed order completeness, a safety buffer is often included on a ‘just in case’ basis. This is often compounded by the fact the final order confirmation from customers is often well within production order lead times;
- **Sale or return strategies** - Although this strategy can result in higher sales and marginal benefits, it can impact on yield rates, and hence should be regularly monitored. This is discussed below; and
- **No contingency for rework** - This can result in rejected product being classified as waste rather than being reworked. In addition, in cases where good quality product is rejected from the line (for example, flow wrapping issues, collation issues, no label, etc) the manual reintroduction of the rework can have a detrimental impact on the line, i.e. it causes the line to speed up beyond its optimum level.

Key factors in (special) product yield loss include:

- **Production line breakdowns** - Many production processes in the food and drink industry are continuous processes, especially where a baking or cooking process forms part of the line. The use of accumulation tables can provide the necessary buffer. This is particularly useful for the high frequency, short-to-medium-term stoppages, although in some cases where space and capital permits they can be built with the capacity to address long-term stoppages. Vertical accumulation buffers have been developed to be retrofitted on existing production lines where the footprint of the production line is a constraining factor;
- **Promotions** - due to the difficulties in forecasting demand; and
- **New product development** - due to the difficulties in predicting take-up.

Typically, inherent or embedded causative factors of waste accounts for 65% to 90% of total waste and the remainder is waste arising through special causative factors associated with major incidents, such as power cuts or unplanned production stoppages. Waste allowances are typically set above the level of inherent or embedded waste, and hence it is the special causes that trigger an investigation since any losses above the waste allowance have not
been budgeted for and are seen as real losses. The ‘materials variance report’ is the traditional means of flagging up the significant raw material losses in terms of actual versus budgeted losses. Inevitably, focus is placed on those special causes that took the yield losses above the waste allowance threshold. For example, Figure 8 shows a typical profile for yield loss and, if the waste allowance were set at 1.2%, the special causes in weeks 3 to 7 would be the key focus of any investigations.

**Figure 8.** The worked example of yield loss variability

![Graph showing yield loss variability](image)

3.6 Overproduction
Overproduction can be considered an effect of the high levels of process variability and the delivery promise demands being placed by customers, i.e. to ensure customer orders are fulfilled, a safety buffer is placed on each order, the bakers dozen being a case in point. Tackling yield losses, discussed above, can have a significant impact on this “just in case” overproduction.

3.7 Expediting
Expediting is the process where customer orders bypass the conventional planning and scheduling processes and are fast tracked through the system. It can be caused in two ways;

- due to the unpredictability of demand for some products or poor planning, customers can place orders with very short lead times.
- there is a shortfall in an order requiring an additional "top up" order to be undertaken.

Such orders are force-fitted into the production schedules often causing extreme disruption in the form of extensive clean down and changeover of production lines.

To reduce the level of customer-related expediting, it is necessary to work with the customers to identify the root causes. In some cases this can simply be an awareness raising exercise to highlight to the customer the impact such short term ordering can have on
overall production performance. Quantifying the level of disruption caused can also inform the decision on whether to accept the order or the value placed on the order.

For order fulfilment shortfalls, improving the consistency of production through the reduction in yield losses will have a significant impact. Additionally, rather than penalising suppliers for order shortfalls some companies have set tolerance bands on orders to take into consideration the difficulty in meeting exact order quantities.

3.8 Sale or return
In many sectors within the food and drink industry a sale or return system is used with the justification being made on a marginal costing basis. Reviews of credit notes showed that sale or return systems can account for as much as 1.1% of the product yield losses.

A review of the sale or return process is recommended to identify the true cost of operating this service. If it is deemed cost effective then a customer monitoring system should be set up to identify those that continually over order. Working with the customers, more accurate order placement systems can be developed to minimise over-ordering.

3.9 Variety packs
Variety packs can represent an issue for food manufacturing companies since production lines are not geared to produce the full pack variety at the same time. In many cases the systems used to overcome this can be regarded as short-term fixes; they can be extremely labour intensive, including the need to rip open and repack, and can result in high volumes of wasted packaging. Due to the increased popularity of variety packs it is recommended that a detailed value stream mapping exercise be undertaken to identify the areas of opportunity in terms of a longer term solution.

3.10 Optimising secondary and tertiary packaging

3.10.1 Secondary packaging
In most food and drink companies corrugated, shrink-wrap and stretch wrap, are the three key packaging materials accounting for over 80% of total secondary and tertiary packaging. A technical assessment of the packaging can result in down-gauging or size reduction.

In the case of corrugated, material substitution is a potential alternative with returnable systems such as returnable transit packaging and reusable layer pads being replacement options. The environmental and economic viability of these alternative systems should be considered carefully since it is dependent on:

- **Trip rates** - The more complex the supply chain the more likely that the trip rates will be low;
- **The cleaning regime** that will be put in place to ensure the packaging does not represent a hygiene / contamination risk; and
- **The number of packaging units required in the system to prevent stock outs** - This can be a particular problem during peak trading, e.g. at Christmas.

Inconsistent application of stretch wrap during the application process was identified by the WPR teams as a significant waste prevention opportunity since it results in more stretch
wrap than needed being applied and also reduces the stability of the load (see WRAP report). This can be particularly evident on manually stretch wrapped products but equally, due to the quantities being used, this can be a problem on badly set or maintained automated systems.

3.10.2 Tertiary packaging
Many of the raw materials for the food and drink industry are imported. To maximise the utilisation of the shipping containers, many companies have moved over to using slip sheets instead of pallets. The key benefit of the switch to slip sheets is the increase in shipping volume per shipment of at least 5% per load\(^5\). An additional benefit is the impact this has on the wood waste being generated since many of the imported pallets are single trip.

3.10.3 Recommendations
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 optimal sizes with appropriate packaging that complements production and is either reusable or recyclable.
- Where appropriate, implement road tanker delivery or production ready packaging.

Figure 9 shows a suggested process to follow when challenging material supply.

---

\(^5\) [http://www.astronslipsheet.com/pallet-handling.html](http://www.astronslipsheet.com/pallet-handling.html)
4.0 Development of environmental KPIs and associated data

The WPRs concluded that a number of companies were not effectively capturing or utilising captured data on waste arising. The effective use of data is a fundamental requirement to realising waste prevention opportunities. The quantification of the 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 found by the WPR teams to be unaware of improvement areas and typically believe that they are performing at a higher standard than they actually are.

WPRs recommended that a strategic approach to waste prevention be adopted, starting with measures to quantify how much waste is being generated by each operation and classifying each waste in terms of whether it is avoidable or unavoidable. Once quantified, the main causes and savings opportunity can be identified, tackling the top losses in turn e.g. determined by Pareto analysis. Some companies operate a ‘top loss meeting’ which is a means of focusing on the most significant opportunities.

WPRs observed a relationship between the establishment of robust KPIs and targets and organisational performance. The KPIs used in good performing sites are clear and easy to understand, and posted in prominent locations such as entrances and on large banners so that everybody is aware of them. Measurement helps in identifying areas to improve and targets give team members an incentive to improve and provide a focus.

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 (raw material variability, 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 the base data required to generate the KPIs are shown in Table 4. Careful consideration must be given to the KPIs to be used since they shape the whole strategic focus of the company. For example, a revenue target on the waste produced can encourage - rather than discourage - the generation of high value wastes.
Table 4. Examples of Key Performance Indicators

<table>
<thead>
<tr>
<th>Performance area</th>
<th>Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Output</strong></td>
<td>Kgs of good product produced</td>
</tr>
<tr>
<td><strong>Quality</strong></td>
<td>Customer complaints etc</td>
</tr>
<tr>
<td><strong>Reliability</strong></td>
<td>Breakdowns</td>
</tr>
<tr>
<td></td>
<td>Downtime</td>
</tr>
<tr>
<td></td>
<td>Overall Equipment Effectiveness (OEE)</td>
</tr>
<tr>
<td><strong>Product waste</strong></td>
<td>Rework produced</td>
</tr>
<tr>
<td></td>
<td>Rework used</td>
</tr>
<tr>
<td></td>
<td>Food waste</td>
</tr>
<tr>
<td><strong>Total waste</strong></td>
<td>Total produced</td>
</tr>
<tr>
<td></td>
<td>Waste to Landfill</td>
</tr>
<tr>
<td><strong>Material variances</strong></td>
<td>Cardboard waste</td>
</tr>
<tr>
<td></td>
<td>Material required vs material used</td>
</tr>
</tbody>
</table>

5.0 Conclusion, discussion and realising the savings opportunities

5.1 Conclusion
The WPRs found that all companies demonstrated good practice in one area or another of waste management relevant to their operation and comparative to their operating sector where comparisons could be made. Many companies were found to put priority to diversion of waste from landfill having established suitable end fates for wastes generated. This is reflective of the good progress the Food and Drink industry has made in diversion from landfill.

In respect of waste prevention activity, there was little solid evidence to suggest that focused programmes were in place to directly tackle waste generation at source using the quantity and true cost of a waste stream as a driver. In many cases waste reduction was observed to be happening as a consequence of other activity e.g. changes in process or improvements to line efficiency through, as an example, the measurement, and improvement of OEE (operational equipment efficiency).

There was also anecdotal evidence to suggest that there is a “break” between corporate CSR objectives and operational KPIs i.e. staff that can directly influence waste reduction are busy with waste diversion (as their KPI) and are not fully aware of the Courtauld Commitment waste reduction target their company has signed up to.

5.2 Discussion
It is suggested that the relatively low savings levels (11,000 tonnes) realised in the first year of Courtauld 2 is representative of the take up rate of new technologies or initiatives. Many of the sites where WPRs have been undertaken since 2008 can be regarded as among the 'innovators' within the sector and hence are the first within the sector to embrace change and take up such initiatives as waste prevention. Figure 10 shows a model developed by Everett Rogers in 1962 that shows that the 'innovators' typically only account for circa 2.5% of the sector and hence the adoption rate is slow at this stage. Conversely, once through this phase the next two phases (early adopters and early majority) account for 47.5% of the sector.
5.3 Realising the savings opportunities
To realise the reduction in tonnes of waste identified and consequential financial savings, the WPRs have highlighted that a number of factors would require change within business operations. These can be categorised as:

- **Improve the utilisation of cross-functional, continuous improvement teams** - Waste prevention requires a collaborative approach across all disciplines within the company and the wider supply chain;

- **Increase the application of continuous improvement or Lean manufacturing tools** - to identify the significant savings opportunities. Examples of tools used in waste prevention good practice include:
  - Root cause analysis;
  - Pareto analysis;
  - The use of problem solving disciplines or methodologies;
  - Cross-functional team solution brainstorming;
  - Feasibility and impact assessment; and
  - Value stream mapping.

- **Improve waste measurement and use associated with KPIs** - It is important to quantify the tonnage reduction and savings opportunity so that budgets can be set regarding the development, planning, and implementation of solutions and to monitor performance to plan, i.e. budgets should be set with respect to the size of the opportunity;

- **Improve knowledge sharing** - To maximise the savings generated, a roll out plan is recommended: where else can the successful solution(s) be applied within the business?; and

- **Improve the establishment and regularly check the understanding and compatibility of CSR objectives on waste prevention with operational activities** – the waste hierarchy would be deemed an essential tool to promote...
throughout the business along with supportive information of true costs of wastes to the business, company objectives, and strategy to progress up the hierarchy and reduce waste at source. This should be communicated in language that is simplistic for all to understand and relevant to each employee’s sphere of influence. Waste prevention should be the responsibility of all employees similar to quality being the responsibility of all by being incorporated in job descriptions.